OMPT practice worksheets

The OMPT is the online mathematics placement test set by more than forty European universities. These are practice sheets for **every level from OMPT-A to OMPT-G** — one sheet per chapter of each syllabus — **21 sheets, 630 questions**, every one with a full worked answer and the common mistakes named. Free to print.

The seven levels are different SUBJECT LISTS, not seven difficulties of the same paper: OMPT-B adds trigonometry and integration to OMPT-A, while OMPT-E drops the calculus entirely and adds statistics, probability and counting. Practising the wrong one is wasted work, so start from the level your programme names.

You choose how long each sheet is. Every sheet carries 30 questions and a control at the top sets it to 10, 20 or all of them — for a five-minute drill or a full period. The answers follow your choice, and it is remembered across the sheets.

The OMPT is open-answer: you type the answer rather than choosing one. So instead of explaining wrong options, each answer names the mistakes students actually make and shows the value each one leads to — if your answer matches one of them, you can see immediately where it went wrong.

Download all 21 sheets (PDF)

OMPT-A

Numbers, algebra, linear formulas, systems, quadratics, functions, exponentials and logarithms, differentiation. Typically set for economics, business and the social sciences.

270 questions across 9 sheets

1. Exact fraction arithmetic

Adding, subtracting, multiplying and dividing fractions without a calculator, leaving every answer exact.
30 questions

2. Algebraic fractions

Simplifying and combining fractions whose numerators and denominators are expressions.
30 questions

3. Straight lines

4. Systems of two equations

The gradient of the line through two points, and the equation that follows from it.

Solving two linear equations in two unknowns.

5. Quadratics

Solving quadratic equations by factorisation, by formula, and finding turning points.
30 questions

6. Functions

Asymptotes, composites, and equations with the unknown underneath.
30 questions

7. Logarithms

Combining logarithms into one, and solving logarithmic and exponential equations.
30 questions

8. Differentiation

The product, quotient and chain rules, and finding stationary points.
30 questions

OMPT-A mixed paper

Every OMPT-A topic together.
30 questions

OMPT-B

Everything in OMPT-A, plus trigonometry and integration. Typically set for engineering, computer science, natural sciences and mathematics.

330 questions across 11 sheets

1. Exact fraction arithmetic

Adding, subtracting, multiplying and dividing fractions without a calculator, leaving every answer exact.
30 questions

2. Algebraic fractions

Simplifying and combining fractions whose numerators and denominators are expressions.
30 questions

3. Straight lines

The gradient of the line through two points, and the equation that follows from it.
30 questions

4. Systems of two equations

Solving two linear equations in two unknowns.
30 questions

5. Quadratics

Solving quadratic equations by factorisation, by formula, and finding turning points.

6. Functions

Asymptotes, composites, and equations with the unknown underneath.

30 questions

30 questions

7. Logarithms

Combining logarithms into one, and solving logarithmic and exponential equations.

30 questions

8. Differentiation

The product, quotient and chain rules, and finding stationary points.

30 questions

9. Trigonometry

Exact values, identities and trigonometric equations.

30 questions

10. Integration

Antiderivatives and definite integrals.

30 questions

OMPT-B mixed paper

Every OMPT-B topic together.

30 questions

OMPT-C

Numbers, algebra, linear formulas and basic geometry. No quadratics, no functions and no calculus — the shortest of the seven. Typically set for general admission where a basic numeracy standard is required.

150 questions across 5 sheets

1. Exact fraction arithmetic

Adding, subtracting, multiplying and dividing fractions without a calculator, leaving every answer exact.

30 questions

2. Algebraic fractions

Simplifying and combining fractions whose numerators and denominators are expressions.

30 questions

3. Straight lines

The gradient of the line through two points, and the equation that follows from it.

30 questions

13. Geometry

Angles, triangles, polygons, circles, Pythagoras and distances.

30 questions

OMPT-C mixed paper

Every OMPT-C topic together.

30 questions

OMPT-D

Everything in OMPT-B, plus geometry. The most demanding of the seven: 21 questions in 180 minutes. Typically set for advanced engineering, physics, pure mathematics and theoretical computer science.

360 questions across 12 sheets

1. Exact fraction arithmetic

Adding, subtracting, multiplying and dividing fractions without a calculator, leaving every answer exact.

30 questions

2. Algebraic fractions

Simplifying and combining fractions whose numerators and denominators are expressions.

30 questions

3. Straight lines

The gradient of the line through two points, and the equation that follows from it.

30 questions

4. Systems of two equations

Solving two linear equations in two unknowns.

30 questions

5. Quadratics

Solving quadratic equations by factorisation, by formula, and finding turning points.

30 questions

6. Functions

Asymptotes, composites, and equations with the unknown underneath.

30 questions

7. Logarithms

Combining logarithms into one, and solving logarithmic and exponential equations.

30 questions

8. Differentiation

The product, quotient and chain rules, and finding stationary points.

30 questions

9. Trigonometry

Exact values, identities and trigonometric equations.

30 questions

10. Integration

Antiderivatives and definite integrals.

30 questions

13. Geometry

Angles, triangles, polygons, circles, Pythagoras and distances.

30 questions

OMPT-D mixed paper

Every OMPT-D topic together.

30 questions

OMPT-E

OMPT-A without the calculus, plus descriptive statistics, probability, combinatorics and distributions. Typically set for statistics, econometrics, data programmes and psychology.

300 questions across 10 sheets

1. Exact fraction arithmetic

Adding, subtracting, multiplying and dividing fractions without a calculator, leaving every answer exact.
30 questions

2. Algebraic fractions

Simplifying and combining fractions whose numerators and denominators are expressions.
30 questions

3. Straight lines

The gradient of the line through two points, and the equation that follows from it.
30 questions

4. Systems of two equations

Solving two linear equations in two unknowns.
30 questions

5. Quadratics

Solving quadratic equations by factorisation, by formula, and finding turning points.
30 questions

6. Functions

Asymptotes, composites, and equations with the unknown underneath.
30 questions

7. Logarithms

Combining logarithms into one, and solving logarithmic and exponential equations.
30 questions

11. Descriptive statistics

Mean, median and the spread of a data set.
30 questions

12. Probability and counting

Sample spaces, permutations, combinations and binomial probabilities.
30 questions

OMPT-E mixed paper

Every OMPT-E topic together.
30 questions

OMPT-F

Algebra, linear formulas, quadratics, functions, logarithms and differentiation. No numbers chapter and no systems chapter. Typically set for biology, earth sciences and the other natural sciences.

210 questions across 7 sheets

2. Algebraic fractions

Simplifying and combining fractions whose numerators and denominators are expressions.

30 questions

3. Straight lines

The gradient of the line through two points, and the equation that follows from it.

30 questions

5. Quadratics

Solving quadratic equations by factorisation, by formula, and finding turning points.

30 questions

6. Functions

Asymptotes, composites, and equations with the unknown underneath.

30 questions

7. Logarithms

Combining logarithms into one, and solving logarithmic and exponential equations.

30 questions

8. Differentiation

The product, quotient and chain rules, and finding stationary points.

30 questions

OMPT-F mixed paper

Every OMPT-F topic together.

30 questions

OMPT-G

Linear formulas through logarithms, plus sequences and series, trigonometry and geometry. Typically set for stem programmes that also test physics and chemistry.

270 questions across 9 sheets

Not here: OMPT-G also has a physics module and a chemistry module, 4 topics each. Those are not mathematics and are not on this site — the sheets below cover its nine mathematics chapters.

3. Straight lines

The gradient of the line through two points, and the equation that follows from it.

30 questions

4. Systems of two equations

Solving two linear equations in two unknowns.

30 questions

5. Quadratics

6. Functions

Solving quadratic equations by factorisation, by formula, and finding turning points.

Asymptotes, composites, and equations with the unknown underneath.

7. Logarithms

Combining logarithms into one, and solving logarithmic and exponential equations.

30 questions

9. Trigonometry

Exact values, identities and trigonometric equations.

30 questions

13. Geometry

Angles, triangles, polygons, circles, Pythagoras and distances.

30 questions

14. Sequences and series

Arithmetic and geometric sequences, and the sum of a series.

30 questions

OMPT-G mixed paper

Every OMPT-G topic together.

30 questions

Which OMPT are you sitting?

OMPT is not one test. There are seven, and they differ in SYLLABUS as well as in difficulty, so practising the wrong one is wasted work. Your university names the level it wants and sets its own pass mark — check your programme page before you start.

Test	What it covers	On this site
OMPT-A	Numbers, algebra, linear formulas, systems, quadratics, functions, exponentials and logarithms, differentiation.	9 sheets, 270 questions
OMPT-B	Everything in OMPT-A, plus trigonometry and integration.	11 sheets, 330 questions
OMPT-C	Numbers, algebra, linear formulas and basic geometry. No quadratics, no functions and no calculus — the shortest of the seven.	5 sheets, 150 questions
OMPT-D	Everything in OMPT-B, plus geometry. The most demanding of the seven: 21 questions in 180 minutes.	12 sheets, 360 questions
OMPT-E	OMPT-A without the calculus, plus descriptive statistics, probability, combinatorics and distributions.	10 sheets, 300 questions
OMPT-F	Algebra, linear formulas, quadratics, functions, logarithms and differentiation. No numbers chapter and	7 sheets, 210 questions

Test	What it covers	On this site
	no systems chapter.	
OMPT-G	Linear formulas through logarithms, plus sequences and series, trigonometry and geometry. Its physics and chemistry modules are not here.	9 sheets, 270 questions

Every answer on these pages was re-derived by an independent method before the page was built. Nothing here is published on the strength of the code that produced it.

1. Exact fraction arithmetic

Adding, subtracting, multiplying and dividing fractions without a calculator, leaving every answer exact. Set for OMPT-A, OMPT-B, OMPT-C, OMPT-D and OMPT-E.

Questions

1

Calculate and give your answer as a fraction in lowest terms: $\frac{8}{5} + \frac{1}{6}$

Answer: ____________________

2

Calculate exactly, without a calculator: $\left(\frac{9}{16}\right)^{-\frac{3}{2}}$

Answer: ____________________

3

Solve and give the LARGER solution: $|4x - 6| = 7$

Answer: ____________________

4

Calculate exactly, as a fraction in lowest terms: $\frac{1}{11} + \frac{8}{9} \times \frac{6}{11}$

Answer: ____________________

5

Calculate and give your answer as a fraction in lowest terms: $\frac{7}{12} - \frac{7}{5}$

Answer: ______________________

6

Calculate exactly, without a calculator: $\left(\frac{64}{27}\right)^{-\frac{2}{3}}$

Answer: ______________________

7

Solve and give the LARGER solution: $|5x + 2| = 9$

Answer: ______________________

8

Calculate exactly, as a fraction in lowest terms: $\frac{9}{5} + \frac{9}{5} \times \frac{5}{2}$

Answer: ______________________

9

Calculate and give your answer as a fraction in lowest terms: $\frac{1}{10} - \frac{8}{3}$

Answer: ______________________

10

Calculate exactly, without a calculator: $\left(\frac{25}{4}\right)^{-\frac{3}{2}}$

Answer: ______________________

11

Solve and give the LARGER solution: $|5x + 2| = 11$

Answer: ______________________

12

Calculate exactly, as a fraction in lowest terms: $\frac{7}{8} + \frac{1}{7} \times \frac{1}{7}$

Answer: ______________________

13

Calculate and give your answer as a fraction in lowest terms: $\frac{1}{3} + \frac{7}{8}$

Answer: ______________________

14

Calculate exactly, without a calculator: $\left(\frac{1}{8}\right)^{-\frac{2}{3}}$

Answer: ______________________

15

Solve and give the LARGER solution: $|6x - 8| = 15$

Answer: ____________________

16

Calculate exactly, as a fraction in lowest terms: $\frac{3}{8} + \frac{6}{11} \times \frac{1}{2}$

Answer: ____________________

17

Calculate and give your answer as a fraction in lowest terms: $\frac{7}{4} + \frac{7}{5}$

Answer: ____________________

18

Calculate exactly, without a calculator: $\left(\frac{8}{125}\right)^{-\frac{2}{3}}$

Answer: ____________________

19

Solve and give the LARGER solution: $|4x + 2| = 4$

Answer: ____________________

20

Calculate exactly, as a fraction in lowest terms: $\frac{3}{5} + \frac{1}{8} \times \frac{5}{9}$

Answer: ______________________

21

Calculate and give your answer as a fraction in lowest terms: $\frac{7}{8} - \frac{3}{10}$

Answer: ______________________

22

Calculate exactly, without a calculator: $\left(\frac{9}{100}\right)^{-\frac{3}{2}}$

Answer: ______________________

23

Solve and give the LARGER solution: $|5x + 4| = 2$

Answer: ______________________

24

Calculate exactly, as a fraction in lowest terms: $\frac{8}{5} + \frac{4}{11} \times \frac{6}{11}$

Answer: ______________________

25

Calculate and give your answer as a fraction in lowest terms: $\frac{1}{10} - \frac{5}{11}$

Answer: ____________________

26

Calculate exactly, without a calculator: $\left(\frac{4}{9}\right)^{-\frac{3}{2}}$

Answer: ____________________

27

Solve and give the LARGER solution: $|4x + 7| = 9$

Answer: ____________________

28

Calculate exactly, as a fraction in lowest terms: $\frac{6}{7} + \frac{8}{11} \times \frac{1}{2}$

Answer: ____________________

29

Calculate and give your answer as a fraction in lowest terms: $\frac{3}{11} - \frac{7}{5}$

Answer: ____________________

30

Calculate exactly, without a calculator: $\left(\frac{27}{125}\right)^{-\frac{2}{3}}$

Answer: ______________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: $\frac{53}{30}$

Write both over the common denominator 30, combine the numerators, then cancel: $\frac{53}{30}$
.

Common mistakes, and the answer each one gives:

- Added (or subtracted) numerators and denominators separately → $\frac{9}{11}$

2

Answer: $\frac{64}{27}$

A negative exponent turns the fraction over, and the fraction $\frac{3}{2}$ means the square root raised to the power 3: $\left(\frac{16}{9}\right)^{3/2} = \frac{64}{27}$.

Common mistakes, and the answer each one gives:

- Ignored the minus sign, so the fraction was never turned over → $\frac{27}{64}$
- Took the root but never applied the power → $\frac{4}{3}$
- Turned the fraction over and stopped there → $\frac{16}{9}$

3

Answer: $\frac{13}{4}$

The bars mean the inside is 7 away from zero in EITHER direction, so there are two equations: $4x - 6 = 7$ and $4x - 6 = -7$. They give $\frac{13}{4}$ and $-\frac{1}{4}$; the larger is $\frac{13}{4}$.

Common mistakes, and the answer each one gives:

- Gave the smaller of the two solutions → $-\frac{1}{4}$
- Solved the positive branch, then negated the answer instead of solving the second branch → $-\frac{13}{4}$

4

Answer: $\frac{19}{33}$

Multiplication comes before addition, so work out $\dfrac{8}{9} \times \dfrac{6}{11} = \frac{16}{33}$ first, then add $\dfrac{1}{11}$: $\frac{19}{33}$.

Common mistakes, and the answer each one gives:

- Worked strictly left to right, adding before multiplying → $\frac{194}{363}$

5

Answer: $-\frac{49}{60}$

Write both over the common denominator 60, combine the numerators, then cancel: $-\frac{49}{60}$.

Common mistakes, and the answer each one gives:

- Added (or subtracted) numerators and denominators separately → 0

6

Answer: $\frac{9}{16}$

A negative exponent turns the fraction over, and the fraction $\frac{2}{3}$ means the cube root raised to the power 2: $\left(\dfrac{27}{64}\right)^{2/3} = \frac{9}{16}$.

Common mistakes, and the answer each one gives:

- Ignored the minus sign, so the fraction was never turned over → $\frac{16}{9}$
- Took the root but never applied the power → $\frac{3}{4}$
- Turned the fraction over and stopped there → $\frac{27}{64}$

7

Answer: $\frac{7}{5}$

The bars mean the inside is 9 away from zero in EITHER direction, so there are two equations: $5x + 2 = 9$ and $5x + 2 = -9$. They give $\frac{7}{5}$ and $-\frac{11}{5}$; the larger is $\frac{7}{5}$.

Common mistakes, and the answer each one gives:

- Gave the smaller of the two solutions → $-\frac{11}{5}$
- Solved the positive branch, then negated the answer instead of solving the second branch → $-\frac{7}{5}$

8

Answer: $\frac{63}{10}$

Multiplication comes before addition, so work out $\dfrac{9}{5} \times \dfrac{5}{2} = \frac{9}{2}$ first, then add $\dfrac{9}{5}$: $\frac{63}{10}$.

Common mistakes, and the answer each one gives:

- Worked strictly left to right, adding before multiplying → 9

9

Answer: $-\frac{77}{30}$

Write both over the common denominator 30, combine the numerators, then cancel: $-\frac{77}{30}$.

Common mistakes, and the answer each one gives:

- Added (or subtracted) numerators and denominators separately → -1

10

Answer: $\frac{8}{125}$

A negative exponent turns the fraction over, and the fraction $\frac{3}{2}$ means the square root raised to the power 3: $\left(\frac{4}{25}\right)^{3/2} = \frac{8}{125}$.

Common mistakes, and the answer each one gives:

- Ignored the minus sign, so the fraction was never turned over → $\frac{125}{8}$
- Took the root but never applied the power → $\frac{2}{5}$
- Turned the fraction over and stopped there → $\frac{4}{25}$

11

Answer: $\frac{9}{5}$

The bars mean the inside is 11 away from zero in EITHER direction, so there are two equations: $5x + 2 = 11$ and $5x + 2 = -11$. They give $\frac{9}{5}$ and $-\frac{13}{5}$; the larger is $\frac{9}{5}$.

Common mistakes, and the answer each one gives:

- Gave the smaller of the two solutions → $-\frac{13}{5}$
- Solved the positive branch, then negated the answer instead of solving the second branch → $-\frac{9}{5}$

12

Answer: $\frac{351}{392}$

Multiplication comes before addition, so work out $\dfrac{1}{7} \times \dfrac{1}{7} = \frac{1}{49}$ first, then add $\dfrac{7}{8}$: $\frac{351}{392}$.

Common mistakes, and the answer each one gives:

- Worked strictly left to right, adding before multiplying → $\frac{57}{392}$

13

Answer: $\frac{29}{24}$

Write both over the common denominator 24, combine the numerators, then cancel: $\frac{29}{24}$
.

Common mistakes, and the answer each one gives:

- Added (or subtracted) numerators and denominators separately → $\frac{8}{11}$

14

Answer: 4

A negative exponent turns the fraction over, and the fraction $\frac{2}{3}$ means the cube root raised to the power 2: $\left(\dfrac{8}{1}\right)^{2/3} = 4$.

Common mistakes, and the answer each one gives:

- Ignored the minus sign, so the fraction was never turned over → $\frac{1}{4}$
- Took the root but never applied the power → 2
- Turned the fraction over and stopped there → 8

15

Answer: $\frac{23}{6}$

The bars mean the inside is 15 away from zero in EITHER direction, so there are two equations: $6x - 8 = 15$ and $6x - 8 = -15$. They give $\frac{23}{6}$ and $-\frac{7}{6}$; the larger is $\frac{23}{6}$.

Common mistakes, and the answer each one gives:

- Gave the smaller of the two solutions → $-\frac{7}{6}$
- Solved the positive branch, then negated the answer instead of solving the second branch → $-\frac{23}{6}$

16

Answer: $\frac{57}{88}$

Multiplication comes before addition, so work out $\dfrac{6}{11} \times \dfrac{1}{2} = \frac{3}{11}$ first, then add $\dfrac{3}{8}$: $\frac{57}{88}$.

Common mistakes, and the answer each one gives:

- Worked strictly left to right, adding before multiplying → $\frac{81}{176}$

17

Answer: $\frac{63}{20}$

Write both over the common denominator 20, combine the numerators, then cancel: $\frac{63}{20}$
.

Common mistakes, and the answer each one gives:

- Added (or subtracted) numerators and denominators separately → $\frac{14}{9}$

18

Answer: $\frac{25}{4}$

A negative exponent turns the fraction over, and the fraction $\frac{2}{3}$ means the cube root raised to the power 2: $\left(\frac{125}{8}\right)^{2/3} = \frac{25}{4}$.

Common mistakes, and the answer each one gives:

- Ignored the minus sign, so the fraction was never turned over → $\frac{4}{25}$
- Took the root but never applied the power → $\frac{5}{2}$
- Turned the fraction over and stopped there → $\frac{125}{8}$

19

Answer: $\frac{1}{2}$

The bars mean the inside is 4 away from zero in EITHER direction, so there are two equations: $4x + 2 = 4$ and $4x + 2 = -4$. They give $\frac{1}{2}$ and $-\frac{3}{2}$; the larger is $\frac{1}{2}$.

Common mistakes, and the answer each one gives:

- Gave the smaller of the two solutions → $-\frac{3}{2}$
- Solved the positive branch, then negated the answer instead of solving the second branch → $-\frac{1}{2}$

20

Answer: $\frac{241}{360}$

Multiplication comes before addition, so work out $\frac{1}{8} \times \frac{5}{9} = \frac{5}{72}$ first, then add $\frac{3}{5}$: $\frac{241}{360}$.

Common mistakes, and the answer each one gives:

- Worked strictly left to right, adding before multiplying → $\frac{29}{72}$

21

Answer: $\frac{23}{40}$

Write both over the common denominator 40, combine the numerators, then cancel: $\frac{23}{40}$
.

Common mistakes, and the answer each one gives:

- Added (or subtracted) numerators and denominators separately → -2

22

Answer: $\frac{1000}{27}$

A negative exponent turns the fraction over, and the fraction $\frac{3}{2}$ means the square root raised to the power 3: $\left(\frac{100}{9}\right)^{3/2} = \frac{1000}{27}$.

Common mistakes, and the answer each one gives:

- Ignored the minus sign, so the fraction was never turned over → $\frac{27}{1000}$
- Took the root but never applied the power → $\frac{10}{3}$
- Turned the fraction over and stopped there → $\frac{100}{9}$

23

Answer: $-\frac{2}{5}$

The bars mean the inside is 2 away from zero in EITHER direction, so there are two equations: $5x + 4 = 2$ and $5x + 4 = -2$. They give $-\frac{2}{5}$ and $-\frac{6}{5}$; the larger is $-\frac{2}{5}$.

Common mistakes, and the answer each one gives:

- Gave the smaller of the two solutions → $-\frac{6}{5}$
- Solved the positive branch, then negated the answer instead of solving the second branch → $\frac{2}{5}$

24

Answer: $\frac{1088}{605}$

Multiplication comes before addition, so work out $\dfrac{4}{11} \times \dfrac{6}{11} = \frac{24}{121}$ first, then add $\dfrac{8}{5}$: $\frac{1088}{605}$.

Common mistakes, and the answer each one gives:

- Worked strictly left to right, adding before multiplying → $\frac{648}{605}$

25

Answer: $-\frac{39}{110}$

Write both over the common denominator 110, combine the numerators, then cancel: $-\frac{39}{110}$.

Common mistakes, and the answer each one gives:

- Added (or subtracted) numerators and denominators separately → 4

26

Answer: $\frac{27}{8}$

A negative exponent turns the fraction over, and the fraction $\frac{3}{2}$ means the square root raised to the power 3: $\left(\dfrac{9}{4}\right)^{3/2} = \frac{27}{8}$.

Common mistakes, and the answer each one gives:

- Ignored the minus sign, so the fraction was never turned over → $\frac{8}{27}$
- Took the root but never applied the power → $\frac{3}{2}$
- Turned the fraction over and stopped there → $\frac{9}{4}$

27

Answer: $\frac{1}{2}$

The bars mean the inside is 9 away from zero in EITHER direction, so there are two equations: $4x + 7 = 9$ and $4x + 7 = -9$. They give $\frac{1}{2}$ and -4; the larger is $\frac{1}{2}$.

Common mistakes, and the answer each one gives:

- Gave the smaller of the two solutions → -4
- Solved the positive branch, then negated the answer instead of solving the second branch → $-\frac{1}{2}$

28

Answer: $\frac{94}{77}$

Multiplication comes before addition, so work out $\dfrac{8}{11} \times \dfrac{1}{2} = \frac{4}{11}$ first, then add $\dfrac{6}{7}$: $\frac{94}{77}$.

Common mistakes, and the answer each one gives:

- Worked strictly left to right, adding before multiplying → $\frac{61}{77}$

29

Answer: $-\frac{62}{55}$

Write both over the common denominator 55, combine the numerators, then cancel: $-\frac{62}{55}$.

Common mistakes, and the answer each one gives:

- Added (or subtracted) numerators and denominators separately → $-\frac{2}{3}$

30

Answer: $\frac{25}{9}$

A negative exponent turns the fraction over, and the fraction $\frac{2}{3}$ means the cube root raised to the power 2: $\left(\frac{125}{27}\right)^{2/3} = \frac{25}{9}$.

Common mistakes, and the answer each one gives:

- Ignored the minus sign, so the fraction was never turned over → $\frac{9}{25}$
- Took the root but never applied the power → $\frac{5}{3}$
- Turned the fraction over and stopped there → $\frac{125}{27}$

2. Algebraic fractions

Simplifying and combining fractions whose numerators and denominators are expressions. Set for OMPT-A, OMPT-B, OMPT-C, OMPT-D, OMPT-E and OMPT-F.

Questions

1

Write as a single fraction and simplify: $\frac{4}{x+6} + \frac{8}{x+3}$

Answer: ____________________

2

Expand and simplify: $(6x+6)(6x-6)$

Answer: ____________________

3

Factorise fully: $x^2 + 7x + 12$

Answer: ____________________

4

Simplify to a single power of x: $\frac{x^8 \cdot x^6}{x^5}$

Answer: ____________________

5

Simplify fully: $\dfrac{x-5}{x-1} \div \dfrac{x+4}{x-1}$

Answer: ______________________

6

Write as a single fraction and simplify: $\dfrac{2}{x+5} + \dfrac{3}{x+2}$

Answer: ______________________

7

Expand and simplify: $(4x-6)^2$

Answer: ______________________

8

Factorise fully: $x^2 - 4x - 12$

Answer: ______________________

9

Simplify to a single power of x: $\dfrac{x^4 \cdot x^3}{x^4}$

Answer: ______________________

10

Simplify fully: $\dfrac{x+6}{x+5} \div \dfrac{x+7}{x+5}$

Answer: ______________________________

11

Write as a single fraction and simplify: $\dfrac{5}{x+2} + \dfrac{2}{x+3}$

Answer: ______________________________

12

Expand and simplify: $(6x-7)^2$

Answer: ______________________________

13

Factorise fully: $x^2 + 4x - 45$

Answer: ______________________________

14

Simplify to a single power of x: $\dfrac{x^6 \cdot x^5}{x^4}$

Answer: ______________________________

15

Simplify fully: $\frac{x+3}{x+7} \div \frac{x}{x+7}$

Answer: ____________________

16

Write as a single fraction and simplify: $\frac{8}{x+4} + \frac{3}{x+1}$

Answer: ____________________

17

Expand and simplify: $(1x+9)(1x-9)$

Answer: ____________________

18

Factorise fully: $x^2 + 10x + 24$

Answer: ____________________

19

Simplify to a single power of x: $\frac{x^3 \cdot x^4}{x^2}$

Answer: ____________________

20

Simplify fully: $\frac{x}{x-7} \div \frac{x+3}{x-7}$

Answer: ____________________

21

Write as a single fraction and simplify: $\frac{3}{x+1} + \frac{5}{x+4}$

Answer: ____________________

22

Expand and simplify: $(2x+2)(2x-2)$

Answer: ____________________

23

Factorise fully: $x^2 - 5x - 6$

Answer: ____________________

24

Simplify to a single power of x: $\frac{x^5 \cdot x^8}{x^6}$

Answer: ____________________

25

Simplify fully: $\dfrac{x-2}{x-4} \div \dfrac{x-7}{x-4}$

Answer: ______________________________

26

Write as a single fraction and simplify: $\dfrac{9}{x+5} + \dfrac{2}{x+1}$

Answer: ______________________________

27

Expand and simplify: $(4x+4)(4x-4)$

Answer: ______________________________

28

Factorise fully: $x^2 + 10x + 16$

Answer: ______________________________

29

Simplify to a single power of x: $\dfrac{x^7 \cdot x^6}{x^5}$

Answer: ______________________________

30

Simplify fully: $\dfrac{x-1}{x+1} \div \dfrac{x-5}{x+1}$

Answer: ______________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: $\frac{12(x+5)}{(x+3)(x+6)}$

The common denominator is $(x+6)(x+3)$. $\frac{4(x+3)+8(x+6)}{(x+6)(x+3)} = \frac{12(x+5)}{(x+3)(x+6)}$.

Common mistakes, and the answer each one gives:

- Added numerators and denominators separately → $\frac{12}{2x+9}$
- Used $(x+6+3)$ as the common denominator → $\frac{12}{x+9}$

2

Answer: $36x^2 - 36$

$(p \pm q)^2 = p^2 \pm 2pq + q^2$ and $(p+q)(p-q) = p^2 - q^2$. Here that gives $36x^2 - 36$.

Common mistakes, and the answer each one gives:

- Kept a middle term; in this product the two cancel → $36x^2 + 72x - 36$
- Added the squares instead of subtracting → $36x^2 + 36$
- Squared only the first term → $36x^2 - 6$

3

Answer: $(x+3)\,(x+4)$

Find two numbers whose PRODUCT is 12 and whose SUM is -7: they are -3 and -4. So the factorisation is $(x+3)\,(x+4)$.

Common mistakes, and the answer each one gives:

- Used the numbers with their signs unchanged in the brackets → $x^2 - 7x + 12$
- Matched the sum to the constant and the product to the middle term → $x^2 + 6x - 7$

4

Answer: x^9

Multiplying adds the exponents and dividing subtracts them: $8+6-5=9$, so the answer is x^9.

Common mistakes, and the answer each one gives:

- Multiplied the exponents instead of adding them → x^{43}
- Divided the exponents instead of subtracting → $x^{\frac{14}{5}}$

5

Answer: $\frac{x-5}{x+4}$

Dividing by a fraction is multiplying by its reciprocal: $\dfrac{x-5}{x-1} \times \dfrac{x-1}{x+4}$. The $x-1$ then cancels, leaving $\frac{x-5}{x+4}$.

Common mistakes, and the answer each one gives:

- Multiplied straight across without flipping the second fraction → $\frac{x^2-x-20}{x^2-2x+1}$
- Flipped the FIRST fraction instead of the second → $\frac{x^2-2x+1}{x^2-x-20}$

6

Answer: $\frac{5x+19}{(x+2)(x+5)}$

The common denominator is $(x+5)(x+2)$. $\dfrac{2(x+2)+3(x+5)}{(x+5)(x+2)} = \frac{5x+19}{(x+2)(x+5)}$.

Common mistakes, and the answer each one gives:

- Added numerators and denominators separately → $\frac{5}{2x+7}$
- Used $(x+5+2)$ as the common denominator → $\frac{5}{x+7}$

7

Answer: $16x^2 - 48x + 36$

$(p \pm q)^2 = p^2 \pm 2pq + q^2$ and $(p + q)(p - q) = p^2 - q^2$. Here that gives $16x^2 - 48x + 36$.

Common mistakes, and the answer each one gives:

- Squared each term and left out the middle term → $16x^2 + 36$
- Gave the middle term the wrong sign → $16x^2 + 48x + 36$
- Doubled the whole bracket instead of squaring it → $8x - 12$

8

Answer: $(x - 6)\,(x + 2)$

Find two numbers whose PRODUCT is -12 and whose SUM is 4: they are -2 and 6. So the factorisation is $(x - 6)\,(x + 2)$.

Common mistakes, and the answer each one gives:

- Used the numbers with their signs unchanged in the brackets → $x^2 + 4x - 12$
- Matched the sum to the constant and the product to the middle term → $x^2 - 5x + 4$

9

Answer: x^3

Multiplying adds the exponents and dividing subtracts them: $4 + 3 - 4 = 3$, so the answer is x^3.

Common mistakes, and the answer each one gives:

- Multiplied the exponents instead of adding them → x^8
- Divided the exponents instead of subtracting → $x^{\frac{7}{4}}$

10

Answer: $\frac{x+6}{x+7}$

Dividing by a fraction is multiplying by its reciprocal: $\dfrac{x+6}{x+5} \times \dfrac{x+5}{x+7}$. The $x+5$ then cancels, leaving $\frac{x+6}{x+7}$.

Common mistakes, and the answer each one gives:

- Multiplied straight across without flipping the second fraction → $\frac{x^2+13x+42}{x^2+10x+25}$
- Flipped the FIRST fraction instead of the second → $\frac{x^2+10x+25}{x^2+13x+42}$

11

Answer: $\frac{7x+19}{(x+2)(x+3)}$

The common denominator is $(x+2)(x+3)$. $\dfrac{5(x+3)+2(x+2)}{(x+2)(x+3)} = \frac{7x+19}{(x+2)(x+3)}$.

Common mistakes, and the answer each one gives:

- Added numerators and denominators separately → $\frac{7}{2x+5}$
- Used $(x+2+3)$ as the common denominator → $\frac{7}{x+5}$

12

Answer: $36x^2 - 84x + 49$

$(p \pm q)^2 = p^2 \pm 2pq + q^2$ and $(p+q)(p-q) = p^2 - q^2$. Here that gives $36x^2 - 84x + 49$.

Common mistakes, and the answer each one gives:

- Squared each term and left out the middle term → $36x^2 + 49$
- Gave the middle term the wrong sign → $36x^2 + 84x + 49$
- Doubled the whole bracket instead of squaring it → $12x - 14$

13

Answer: $(x-5)\,(x+9)$

Find two numbers whose PRODUCT is -45 and whose SUM is -4: they are -9 and 5. So the factorisation is $(x-5)\,(x+9)$.

Common mistakes, and the answer each one gives:

- Used the numbers with their signs unchanged in the brackets → $x^2-4x-45$
- Matched the sum to the constant and the product to the middle term → x^2+3x-4

14

Answer: x^7

Multiplying adds the exponents and dividing subtracts them: $6+5-4=7$, so the answer is x^7.

Common mistakes, and the answer each one gives:

- Multiplied the exponents instead of adding them → x^{26}
- Divided the exponents instead of subtracting → $x^{\frac{11}{4}}$

15

Answer: $\frac{x+3}{x}$

Dividing by a fraction is multiplying by its reciprocal: $\dfrac{x+3}{x+7}\times\dfrac{x+7}{x}$. The $x+7$ then cancels, leaving $\frac{x+3}{x}$.

Common mistakes, and the answer each one gives:

- Multiplied straight across without flipping the second fraction → $\frac{x^2+3x}{x^2+14x+49}$
- Flipped the FIRST fraction instead of the second → $\frac{x^2+14x+49}{x^2+3x}$

16

Answer: $\frac{11x+20}{(x+1)(x+4)}$

The common denominator is $(x+4)(x+1)$. $\dfrac{8(x+1)+3(x+4)}{(x+4)(x+1)} = \frac{11x+20}{(x+1)(x+4)}$.

Common mistakes, and the answer each one gives:

- Added numerators and denominators separately → $\frac{11}{2x+5}$
- Used $(x+4+1)$ as the common denominator → $\frac{11}{x+5}$

17

Answer: $x^2 - 81$

$(p \pm q)^2 = p^2 \pm 2pq + q^2$ and $(p+q)(p-q) = p^2 - q^2$. Here that gives $x^2 - 81$.

Common mistakes, and the answer each one gives:

- Kept a middle term; in this product the two cancel → $x^2 + 18x - 81$
- Added the squares instead of subtracting → $x^2 + 81$
- Squared only the first term → $x^2 - 9$

18

Answer: $(x+4)\,(x+6)$

Find two numbers whose PRODUCT is 24 and whose SUM is -10: they are -4 and -6. So the factorisation is $(x+4)\,(x+6)$.

Common mistakes, and the answer each one gives:

- Used the numbers with their signs unchanged in the brackets → $x^2 - 10x + 24$
- Matched the sum to the constant and the product to the middle term → $x^2 + 9x - 10$

19

Answer: x^5

Multiplying adds the exponents and dividing subtracts them: $3+4-2=5$, so the answer is x^5.

Common mistakes, and the answer each one gives:

- Multiplied the exponents instead of adding them → x^{10}
- Divided the exponents instead of subtracting → $x^{\frac{7}{2}}$

20

Answer: $\frac{x}{x+3}$

Dividing by a fraction is multiplying by its reciprocal: $\dfrac{x}{x-7} \times \dfrac{x-7}{x+3}$. The $x-7$ then cancels, leaving $\frac{x}{x+3}$.

Common mistakes, and the answer each one gives:

- Multiplied straight across without flipping the second fraction → $\frac{x^2+3x}{x^2-14x+49}$
- Flipped the FIRST fraction instead of the second → $\frac{x^2-14x+49}{x^2+3x}$

21

Answer: $\frac{8x+17}{(x+1)(x+4)}$

The common denominator is $(x+1)(x+4)$. $\dfrac{3(x+4)+5(x+1)}{(x+1)(x+4)} = \frac{8x+17}{(x+1)(x+4)}$.

Common mistakes, and the answer each one gives:

- Added numerators and denominators separately → $\frac{8}{2x+5}$
- Used $(x+1+4)$ as the common denominator → $\frac{8}{x+5}$

22

Answer: $4x^2 - 4$

$(p \pm q)^2 = p^2 \pm 2pq + q^2$ and $(p+q)(p-q) = p^2 - q^2$. Here that gives $4x^2 - 4$.

Common mistakes, and the answer each one gives:

- Kept a middle term; in this product the two cancel → $4x^2 + 8x - 4$
- Added the squares instead of subtracting → $4x^2 + 4$
- Squared only the first term → $4x^2 - 2$

23

Answer: $(x-6)(x+1)$

Find two numbers whose PRODUCT is -6 and whose SUM is 5: they are -1 and 6. So the factorisation is $(x-6)(x+1)$.

Common mistakes, and the answer each one gives:

- Used the numbers with their signs unchanged in the brackets → $x^2 + 5x - 6$
- Matched the sum to the constant and the product to the middle term → $x^2 - 6x + 5$

24

Answer: x^7

Multiplying adds the exponents and dividing subtracts them: $5 + 8 - 6 = 7$, so the answer is x^7.

Common mistakes, and the answer each one gives:

- Multiplied the exponents instead of adding them → x^{34}
- Divided the exponents instead of subtracting → $x^{\frac{13}{6}}$

25

Answer: $\frac{x-2}{x-7}$

Dividing by a fraction is multiplying by its reciprocal: $\dfrac{x-2}{x-4} \times \dfrac{x-4}{x-7}$. The $x-4$ then cancels, leaving $\frac{x-2}{x-7}$.

Common mistakes, and the answer each one gives:

- Multiplied straight across without flipping the second fraction → $\frac{x^2-9x+14}{x^2-8x+16}$
- Flipped the FIRST fraction instead of the second → $\frac{x^2-8x+16}{x^2-9x+14}$

26

Answer: $\frac{11x+19}{(x+1)(x+5)}$

The common denominator is $(x+5)(x+1)$. $\dfrac{9(x+1)+2(x+5)}{(x+5)(x+1)} = \frac{11x+19}{(x+1)(x+5)}$.

Common mistakes, and the answer each one gives:

- Added numerators and denominators separately → $\frac{11}{2x+6}$
- Used $(x+5+1)$ as the common denominator → $\frac{11}{x+6}$

27

Answer: $16x^2-16$

$(p \pm q)^2 = p^2 \pm 2pq + q^2$ and $(p+q)(p-q) = p^2 - q^2$. Here that gives $16x^2-16$.

Common mistakes, and the answer each one gives:

- Kept a middle term; in this product the two cancel → $16x^2+32x-16$
- Added the squares instead of subtracting → $16x^2+16$
- Squared only the first term → $16x^2-4$

28

Answer: $(x+2)\,(x+8)$

Find two numbers whose PRODUCT is 16 and whose SUM is -10: they are -8 and -2. So the factorisation is $(x+2)\,(x+8)$.

Common mistakes, and the answer each one gives:

- Used the numbers with their signs unchanged in the brackets → $x^2 - 10x + 16$
- Matched the sum to the constant and the product to the middle term → $x^2 + 9x - 10$

29

Answer: x^8

Multiplying adds the exponents and dividing subtracts them: $7 + 6 - 5 = 8$, so the answer is x^8.

Common mistakes, and the answer each one gives:

- Multiplied the exponents instead of adding them → x^{37}
- Divided the exponents instead of subtracting → $x^{\frac{13}{5}}$

30

Answer: $\frac{x-1}{x-5}$

Dividing by a fraction is multiplying by its reciprocal: $\dfrac{x-1}{x+1} \times \dfrac{x+1}{x-5}$. The $x+1$ then cancels, leaving $\frac{x-1}{x-5}$.

Common mistakes, and the answer each one gives:

- Multiplied straight across without flipping the second fraction → $\frac{x^2-6x+5}{x^2+2x+1}$
- Flipped the FIRST fraction instead of the second → $\frac{x^2+2x+1}{x^2-6x+5}$

3. Straight lines

The gradient of the line through two points, and the equation that follows from it. Set for OMPT-A, OMPT-B, OMPT-C, OMPT-D, OMPT-E, OMPT-F and OMPT-G.

Questions

1

Give the gradient of the line through $A(7;\ -2)$ and $B(11;\ -4)$.

Answer: ____________________

2

Solve for x: $5\left(x-2\right)=2x-7$

Answer: ____________________

3

Solve for x: $\dfrac{x+5}{5}=\dfrac{x+4}{6}$

Answer: ____________________

4

Give the gradient of the line through $A(8;\ 4)$ and $B(6;\ 7)$.

Answer: ____________________

5

Solve for x: $6\left(x+8\right)=5x+3$

Answer: ______________________

6

Solve for x: $\dfrac{x-6}{4}=\dfrac{x-3}{6}$

Answer: ______________________

7

Give the gradient of the line through $A(7;\ -1)$ and $B(6;\ 2)$.

Answer: ______________________

8

Solve for x: $2\left(x+5\right)=6x+9$

Answer: ______________________

9

Solve for x: $\dfrac{x-7}{2}=\dfrac{x+3}{6}$

Answer: ______________________

10

Give the gradient of the line through $A(-8;\ -6)$ and $B(-12;\ -5)$.

Answer: ____________________

11

Solve for x: $7\left(x-4\right)=4x-5$

Answer: ____________________

12

Solve for x: $\dfrac{x+3}{2}=\dfrac{x+5}{4}$

Answer: ____________________

13

Give the gradient of the line through $A(2;\ 7)$ and $B(-1;\ -2)$.

Answer: ____________________

14

Solve for x: $3\left(x-5\right)=5x+6$

Answer: ____________________

15

Solve for x: $\dfrac{x+4}{5}=\dfrac{x-6}{2}$

Answer: ______________________

16

Give the gradient of the line through $A(-5;\ -2)$ and $B(-3;\ -9)$.

Answer: ______________________

17

Solve for x: $5\left(x-5\right)=6x-3$

Answer: ______________________

18

Solve for x: $\dfrac{x+4}{3}=\dfrac{x-9}{6}$

Answer: ______________________

19

Give the gradient of the line through $A(-5;\ 2)$ and $B(-2;\ 0)$.

Answer: ______________________

20

Solve for x: $5\left(x-5\right)=6x-4$

Answer: ____________________

21

Solve for x: $\dfrac{x-5}{3}=\dfrac{x-1}{2}$

Answer: ____________________

22

Give the gradient of the line through $A(-1;\ -5)$ and $B(0;\ -7)$.

Answer: ____________________

23

Solve for x: $7\left(x+6\right)=6x-4$

Answer: ____________________

24

Solve for x: $\dfrac{x+9}{2}=\dfrac{x-4}{6}$

Answer: ____________________

25

Give the gradient of the line through $A(5;\ 2)$ and $B(6;\ -6)$.

Answer: ____________________

26

Solve for x: $5\left(x+8\right)=3x+2$

Answer: ____________________

27

Solve for x: $\dfrac{x+9}{6}=\dfrac{x-4}{5}$

Answer: ____________________

28

Give the gradient of the line through $A(-4;\ 2)$ and $B(-7;\ 7)$.

Answer: ____________________

29

Solve for x: $2\left(x-5\right)=6x-8$

Answer: ____________________

30

Solve for x: $\dfrac{x-9}{4} = \dfrac{x-3}{3}$

Answer: ____________________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: $-\frac{1}{2}$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-4 - (-2)}{11 - (7)} = -\tfrac{1}{2}.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → -2
- Subtracted the coordinates in opposite orders → $\frac{1}{2}$

2

Answer: 1

Expand the bracket: $5x - 10 = 2x - 7$. Collect the x terms on one side and the numbers on the other, then divide: $x = 1$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → $-\frac{5}{3}$
- Moved a term across without changing its sign → 8

3

Answer: -10

Cross-multiply to clear both denominators: $6\left(x + 5\right) = 5\left(x + 4\right)$. Expand, collect the x terms and divide: $x = -10$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → -26
- Added the fractions instead of cross-multiplying → $-\frac{50}{11}$

4

Answer: $-\frac{3}{2}$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - (4)}{6 - (8)} = -\frac{3}{2}.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $-\frac{2}{3}$
- Subtracted the coordinates in opposite orders → $\frac{3}{2}$

5

Answer: -45

Expand the bracket: $6x + 48 = 5x + 3$. Collect the x terms on one side and the numbers on the other, then divide: $x = -45$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → -5
- Moved a term across without changing its sign → -54

6

Answer: 12

Cross-multiply to clear both denominators: $6\left(x - 6\right) = 4\left(x - 3\right)$. Expand, collect the x terms and divide: $x = 12$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → $\frac{33}{2}$
- Added the fractions instead of cross-multiplying → $\frac{24}{5}$

7

Answer: -3

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{2 - (-1)}{6 - (7)} = -3.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $-\frac{1}{3}$
- Subtracted the coordinates in opposite orders → 3

8

Answer: $\frac{1}{4}$

Expand the bracket: $2x + 10 = 6x + 9$. Collect the x terms on one side and the numbers on the other, then divide: $x = \frac{1}{4}$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → -1
- Moved a term across without changing its sign → 7

9

Answer: 12

Cross-multiply to clear both denominators: $6\left(x - 7\right) = 2\left(x + 3\right)$. Expand, collect the x terms and divide: $x = 12$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → $\frac{45}{4}$
- Added the fractions instead of cross-multiplying → $\frac{9}{2}$

10

Answer: $-\frac{1}{4}$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-5 - (-6)}{-12 - (-8)} = -\tfrac{1}{4}.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → -4
- Subtracted the coordinates in opposite orders → $\frac{1}{4}$

11

Answer: $\frac{23}{3}$

Expand the bracket: $7x - 28 = 4x - 5$. Collect the x terms on one side and the numbers on the other, then divide: $x = \frac{23}{3}$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → $-\frac{1}{3}$
- Moved a term across without changing its sign → $\frac{38}{3}$

12

Answer: -1

Cross-multiply to clear both denominators: $4\left(x+3\right) = 2\left(x+5\right)$. Expand, collect the x terms and divide: $x = -1$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → $-\frac{7}{2}$
- Added the fractions instead of cross-multiplying → $-\frac{11}{3}$

13

Answer: 3

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-2-(7)}{-1-(2)} = 3.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $\frac{1}{3}$
- Subtracted the coordinates in opposite orders → -3

14

Answer: $-\frac{21}{2}$

Expand the bracket: $3x - 15 = 5x + 6$. Collect the x terms on one side and the numbers on the other, then divide: $x = -\frac{21}{2}$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → $-\frac{11}{2}$
- Moved a term across without changing its sign → $-\frac{3}{2}$

15

Answer: $\frac{38}{3}$

Cross-multiply to clear both denominators: $2\left(x+4\right) = 5\left(x-6\right)$. Expand, collect the x terms and divide: $x = \frac{38}{3}$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → $\frac{14}{3}$
- Added the fractions instead of cross-multiplying → $\frac{22}{7}$

16

Answer: $-\frac{7}{2}$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-9 - (-2)}{-3 - (-5)} = -\tfrac{7}{2}.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $-\frac{2}{7}$
- Subtracted the coordinates in opposite orders → $\frac{7}{2}$

17

Answer: -22

Expand the bracket: $5x - 25 = 6x - 3$. Collect the x terms on one side and the numbers on the other, then divide: $x = -22$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → -2
- Moved a term across without changing its sign → -31

18

Answer: -17

Cross-multiply to clear both denominators: $6\,(x + 4) = 3\,(x - 9)$. Expand, collect the x terms and divide: $x = -17$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → -11
- Added the fractions instead of cross-multiplying → $\frac{1}{3}$

19

Answer: $-\frac{2}{3}$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - (2)}{-2 - (-5)} = -\tfrac{2}{3}.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $-\frac{3}{2}$
- Subtracted the coordinates in opposite orders → $\frac{2}{3}$

20

Answer: -21

Expand the bracket: $5x - 25 = 6x - 4$. Collect the x terms on one side and the numbers on the other, then divide: $x = -21$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → -1
- Moved a term across without changing its sign → -33

21

Answer: -7

Cross-multiply to clear both denominators: $2\left(x - 5\right) = 3\left(x - 1\right)$. Expand, collect the x terms and divide: $x = -7$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → -9
- Added the fractions instead of cross-multiplying → $\frac{13}{5}$

22

Answer: -2

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-7 - (-5)}{0 - (-1)} = -2.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $-\frac{1}{2}$
- Subtracted the coordinates in opposite orders → 2

23

Answer: -46

Expand the bracket: $7x + 42 = 6x - 4$. Collect the x terms on one side and the numbers on the other, then divide: $x = -46$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → -10
- Moved a term across without changing its sign → -34

24

Answer: $-\frac{31}{2}$

Cross-multiply to clear both denominators: $6\left(x + 9\right) = 2\left(x - 4\right)$. Expand, collect the x terms and divide: $x = -\frac{31}{2}$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → $-\frac{29}{2}$
- Added the fractions instead of cross-multiplying → $-\frac{23}{4}$

25

Answer: -8

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-6-(2)}{6-(5)} = -8.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $-\frac{1}{8}$
- Subtracted the coordinates in opposite orders → 8

26

Answer: -19

Expand the bracket: $5x + 40 = 3x + 2$. Collect the x terms on one side and the numbers on the other, then divide: $x = -19$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → -3
- Moved a term across without changing its sign → -22

27

Answer: 69

Cross-multiply to clear both denominators: $5\left(x+9\right) = 6\left(x-4\right)$. Expand, collect the x terms and divide: $x = 69$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → 49
- Added the fractions instead of cross-multiplying → $-\frac{21}{11}$

28

Answer: $-\frac{5}{3}$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7 - (2)}{-7 - (-4)} = -\tfrac{5}{3}.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $-\frac{3}{5}$
- Subtracted the coordinates in opposite orders → $\frac{5}{3}$

29

Answer: $-\frac{1}{2}$

Expand the bracket: $2x - 10 = 6x - 8$. Collect the x terms on one side and the numbers on the other, then divide: $x = -\frac{1}{2}$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → $\frac{3}{4}$
- Moved a term across without changing its sign → $-\frac{13}{2}$

30

Answer: -15

Cross-multiply to clear both denominators: $3\left(x - 9\right) = 4\left(x - 3\right)$. Expand, collect the x terms and divide: $x = -15$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → -24
- Added the fractions instead of cross-multiplying → $\frac{39}{7}$

4. Systems of two equations

Solving two linear equations in two unknowns. Set for OMPT-A, OMPT-B, OMPT-D, OMPT-E and OMPT-G.

Questions

1

Solve the system and give the value of x: $4x + 2y = 20$ and $x - 4y = -22$

Answer: ______________________

2

Solve the system and give the value of x: $y = 2 - 2x$ and $2x + 2y = 2$

Answer: ______________________

3

Solve the system and give the value of x: $6x + 3y = 18$ and $2x - 2y = -12$

Answer: ______________________

4

Solve the system and give the value of x: $y = 3x + 12$ and $x + 5y = -4$

Answer: ______________________

5

Solve the system and give the value of x: $x + 6y = -41$ and $3x - 5y = 38$

Answer: ____________________

6

Solve the system and give the value of x: $y = 2x + 10$ and $4x + 3y = -10$

Answer: ____________________

7

Solve the system and give the value of x: $6x + 4y = 2$ and $3x - 6y = -15$

Answer: ____________________

8

Solve the system and give the value of x: $y = 2x + 2$ and $4x + 3y = -4$

Answer: ____________________

9

Solve the system and give the value of x: $5x + 1y = 25$ and $5x - 1y = 15$

Answer: ____________________

10

Solve the system and give the value of x: $y = 2x + 4$ and $2x + 3y = -28$

Answer: ____________________

11

Solve the system and give the value of x: $x + 4y = 1$ and $x - 5y = 1$

Answer: ____________________

12

Solve the system and give the value of x: $y = -3x - 14$ and $3x + 2y = -13$

Answer: ____________________

13

Solve the system and give the value of x: $5x + 4y = -13$ and $6x - 3y = -39$

Answer: ____________________

14

Solve the system and give the value of x: $y = x + 1$ and $2x + 3y = 3$

Answer: ____________________

15

Solve the system and give the value of x: $4x + 4y = -12$ and $4x - 1y = -12$

Answer: ____________________

16

Solve the system and give the value of x: $y = 4x - 3$ and $5x + 4y = 30$

Answer: ____________________

17

Solve the system and give the value of x: $3x + 3y = -6$ and $2x - 4y = 38$

Answer: ____________________

18

Solve the system and give the value of x: $y = 3x + 6$ and $3x + 5y = 12$

Answer: ____________________

19

Solve the system and give the value of x: $5x + 2y = -12$ and $6x - 5y = -7$

Answer: ____________________

20

Solve the system and give the value of x: $y = 9 - 4x$ and $2x + y = 7$

Answer: ______________________

21

Solve the system and give the value of x: $x + 4y = 6$ and $6x - 6y = -24$

Answer: ______________________

22

Solve the system and give the value of x: $y = -4x - 6$ and $5x + 3y = -18$

Answer: ______________________

23

Solve the system and give the value of x: $3x + 6y = -45$ and $6x - 3y = 0$

Answer: ______________________

24

Solve the system and give the value of x: $y = -3x$ and $5x + 3y = 8$

Answer: ______________________

25

Solve the system and give the value of x: $2x + 2y = 6$ and $5x - 2y = -13$

Answer: ______________________

26

Solve the system and give the value of x: $y = 19 - 4x$ and $4x + 2y = 14$

Answer: ______________________

27

Solve the system and give the value of x: $4x + 3y = 12$ and $5x - 6y = 54$

Answer: ______________________

28

Solve the system and give the value of x: $y = 2x + 8$ and $5x + 5y = -50$

Answer: ______________________

29

Solve the system and give the value of x: $6x + 6y = 12$ and $3x - 6y = 33$

Answer: ______________________

30

Solve the system and give the value of x: $y = 8 - 2x$ and $5x + 3y = 21$

Answer: ____________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: 2

Eliminate y by scaling and adding, or substitute. The solution is $x = 2$, $y = 6$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → 6

2

Answer: 1

The first equation already gives y, so put it straight into the second: $2x + 2\left(2 - 2x\right) = 2$. That leaves one unknown, and $x = 1$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → 0
- Substituted into the equation it came from, which says nothing → 3

3

Answer: 0

Eliminate y by scaling and adding, or substitute. The solution is $x = 0$, $y = 6$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → 6

4

Answer: -4

The first equation already gives y, so put it straight into the second: $1x + 5\left(3x + 12\right) = -4$. That leaves one unknown, and $x = -4$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → 0
- Substituted into the equation it came from, which says nothing → 1

5

Answer: 1

Eliminate y by scaling and adding, or substitute. The solution is $x = 1$, $y = -7$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → -7

6

Answer: -4

The first equation already gives y, so put it straight into the second: $4x + 3\left(2x + 10\right) = -10$. That leaves one unknown, and $x = -4$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → 2
- Substituted into the equation it came from, which says nothing → -1

7

Answer: -1

Eliminate y by scaling and adding, or substitute. The solution is $x = -1$, $y = 2$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → 2

8

Answer: -1

The first equation already gives y, so put it straight into the second: $4x + 3\left(2x + 2\right) = -4$. That leaves one unknown, and $x = -1$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → 0
- Substituted into the equation it came from, which says nothing → 2

9

Answer: 4

Eliminate y by scaling and adding, or substitute. The solution is $x = 4$, $y = 5$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → 5

10

Answer: -5

The first equation already gives y, so put it straight into the second: $2x + 3\left(2x+4\right) = -28$. That leaves one unknown, and $x = -5$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → -6
- Substituted into the equation it came from, which says nothing → -2

11

Answer: 1

Eliminate y by scaling and adding, or substitute. The solution is $x = 1$, $y = 0$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → 0

12

Answer: -5

The first equation already gives y, so put it straight into the second: $3x + 2\left(-3x-14\right) = -13$. That leaves one unknown, and $x = -5$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → 1
- Substituted into the equation it came from, which says nothing → -3

13

Answer: -5

Eliminate y by scaling and adding, or substitute. The solution is $x = -5$, $y = 3$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → 3

14

Answer: 0

The first equation already gives y, so put it straight into the second: $2x + 3\left(x+1\right) = 3$. That leaves one unknown, and $x = 0$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → 1
- Substituted into the equation it came from, which says nothing → 3

15

Answer: -3

Eliminate y by scaling and adding, or substitute. The solution is $x = -3$, $y = 0$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → 0

16

Answer: 2

The first equation already gives y, so put it straight into the second: $5x + 4\left(4x - 3\right) = 30$. That leaves one unknown, and $x = 2$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → 5
- Substituted into the equation it came from, which says nothing → 6

17

Answer: 5

Eliminate y by scaling and adding, or substitute. The solution is $x = 5$, $y = -7$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → -7

18

Answer: -1

The first equation already gives y, so put it straight into the second: $3x + 5\left(3x + 6\right) = 12$. That leaves one unknown, and $x = -1$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → 3
- Substituted into the equation it came from, which says nothing → 4

19

Answer: -2

Eliminate y by scaling and adding, or substitute. The solution is $x = -2$, $y = -1$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → -1

20

Answer: 1

The first equation already gives y, so put it straight into the second: $2x + 1\,(9 - 4x) = 7$. That leaves one unknown, and $x = 1$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → 5
- Substituted into the equation it came from, which says nothing → 2

21

Answer: -2

Eliminate y by scaling and adding, or substitute. The solution is $x = -2$, $y = 2$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → 2

22

Answer: 0

The first equation already gives y, so put it straight into the second: $5x + 3\left(-4x - 6\right) = -18$. That leaves one unknown, and $x = 0$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → -6
- Substituted into the equation it came from, which says nothing → 3

23

Answer: -3

Eliminate y by scaling and adding, or substitute. The solution is $x = -3$, $y = -6$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → -6

24

Answer: -2

The first equation already gives y, so put it straight into the second: $5x + 3\left(-3x\right) = 8$. That leaves one unknown, and $x = -2$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → 6
- Substituted into the equation it came from, which says nothing → 1

25

Answer: -1

Eliminate y by scaling and adding, or substitute. The solution is $x = -1$, $y = 4$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → 4

26

Answer: 6

The first equation already gives y, so put it straight into the second: $4x + 2\left(19 - 4x\right) = 14$. That leaves one unknown, and $x = 6$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → -5
- Substituted into the equation it came from, which says nothing → 8

27

Answer: 6

Eliminate y by scaling and adding, or substitute. The solution is $x = 6$, $y = -4$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → -4

28

Answer: -6

The first equation already gives y, so put it straight into the second: $5x + 5\left(2x+8\right) = -50$. That leaves one unknown, and $x = -6$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → -4
- Substituted into the equation it came from, which says nothing → -1

29

Answer: 5

Eliminate y by scaling and adding, or substitute. The solution is $x = 5$, $y = -3$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → -3

30

Answer: 3

The first equation already gives y, so put it straight into the second: $5x + 3\left(8-2x\right) = 21$. That leaves one unknown, and $x = 3$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → 2
- Substituted into the equation it came from, which says nothing → 6

5. Quadratics

Solving quadratic equations by factorisation, by formula, and finding turning points. Set for OMPT-A, OMPT-B, OMPT-D, OMPT-E, OMPT-F and OMPT-G.

Questions

1

Solve $x^2 + 10x + 24 = 0$ and give the LARGER root.

Answer: ______________________

2

Solve exactly and give the LARGER solution: $2x^2 - 7x + 4 = 0$

Answer: ______________________

3

The parabola $f(x) = -x^2 - 8x - 12$ has a maximum. At what value of x does it occur?

Answer: ______________________

4

A parabola and a line meet where $x^2 + 2x = 4x + 8$. Give the LARGER of the two x-coordinates.

Answer: ______________________

5

Solve $x^2 + 3x - 4 = 0$ and give the LARGER root.

Answer: ______________________

6

Solve exactly and give the LARGER solution: $2x^2 - 4x - 5 = 0$

Answer: ______________________

7

The parabola $f(x) = -4x^2 - 8x - 9$ has a maximum. At what value of x does it occur?

Answer: ______________________

8

A parabola and a line meet where $x^2 + 6x + 18 = -4x - 6$. Give the LARGER of the two x-coordinates.

Answer: ______________________

9

Solve $x^2 + 13x + 42 = 0$ and give the LARGER root.

Answer: ______________________

10

Solve exactly and give the LARGER solution: $x^2 + 6x + 7 = 0$

Answer: ____________________

11

The parabola $f(x) = -x^2 + 8x - 16$ has a maximum. At what value of x does it occur?

Answer: ____________________

12

A parabola and a line meet where $x^2 - 2x - 17 = -3x - 5$. Give the LARGER of the two x-coordinates.

Answer: ____________________

13

Solve $x^2 + 16x + 63 = 0$ and give the LARGER root.

Answer: ____________________

14

Solve exactly and give the LARGER solution: $x^2 - 5x + 5 = 0$

Answer: ____________________

15

The parabola $f(x) = -4x^2 - 8x - 3$ has a maximum. At what value of x does it occur?

Answer: ______________________

16

A parabola and a line meet where $x^2 - 8x - 8 = -5x - 4$. Give the LARGER of the two x-coordinates.

Answer: ______________________

17

Solve $x^2 + 12x + 35 = 0$ and give the LARGER root.

Answer: ______________________

18

Solve exactly and give the LARGER solution: $x^2 + 7x + 3 = 0$

Answer: ______________________

19

The parabola $f(x) = -4x^2 - 24x - 42$ has a maximum. At what value of x does it occur?

Answer: ______________________

20

A parabola and a line meet where $x^2 - 3x - 32 = -x - 8$. Give the LARGER of the two x-coordinates.

Answer: ______________________

21

Solve $x^2 - 14x + 45 = 0$ and give the LARGER root.

Answer: ______________________

22

Solve exactly and give the LARGER solution: $2x^2 + 5x - 8 = 0$

Answer: ______________________

23

The parabola $f(x) = -4x^2 - 8x - 2$ has a maximum. At what value of x does it occur?

Answer: ______________________

24

A parabola and a line meet where $x^2 - 6x - 2 = -5x - 2$. Give the LARGER of the two x-coordinates.

Answer: ______________________

25

Solve $x^2 + 4x - 45 = 0$ and give the LARGER root.

Answer: ____________________

26

Solve exactly and give the LARGER solution: $x^2 + 4x - 6 = 0$

Answer: ____________________

27

The parabola $f(x) = -3x^2 - 18x - 24$ has a maximum. At what value of x does it occur?

Answer: ____________________

28

A parabola and a line meet where $x^2 + 5x - 15 = -9$. Give the LARGER of the two x-coordinates.

Answer: ____________________

29

Solve $x^2 + 7x = 0$ and give the LARGER root.

Answer: ____________________

30

Solve exactly and give the LARGER solution: $2x^2 - x - 2 = 0$

Answer: ______________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: -4

$(x+4)(x+6)=0$, so $x=-6$ or $x=-4$. The larger is -4.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -6
- Read the roots off with the signs unchanged → 6

2

Answer: $\frac{\sqrt{17}}{4}+\frac{7}{4}$

The discriminant is $b^2-4ac=17$, which is positive but not a perfect square, so the roots are irrational and the formula is needed: $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$. The larger root is $\frac{\sqrt{17}}{4}+\frac{7}{4}$.

Common mistakes, and the answer each one gives:

- Used $+b$ in the numerator instead of $-b$ → $-\frac{7}{4}+\frac{\sqrt{17}}{4}$
- Divided by a instead of $2a$ → $\frac{\sqrt{17}}{2}+\frac{7}{2}$
- Gave the smaller root → $\frac{7}{4}-\frac{\sqrt{17}}{4}$

3

Answer: -4

The turning point of $ax^2 + bx + c$ sits at $x = -\frac{b}{2a}$. Here $a = -1$ and $b = -8$, so $x = -\frac{-8}{2(-1)} = -4$. (Completing the square gives $-1\left(x+4\right)^2 + 4$, which shows the same thing.)

Common mistakes, and the answer each one gives:

- Used $\frac{b}{2a}$ without the minus sign → 4
- Gave the MAXIMUM VALUE instead of where it happens → 4

4

Answer: 4

Where the graphs meet, the two expressions are equal. Bring everything to one side: $x^2 - 2x - 8 = 0$, which factorises as $\left(x-4\right)\left(x+2\right)$. The roots are -2 and 4.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -2
- Read the roots straight off the brackets with the signs unchanged → 2

5

Answer: 1

$\left(x-1\right)\left(x+4\right) = 0$, so $x = 1$ or $x = -4$. The larger is 1.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -4
- Read the roots off with the signs unchanged → 4

6

Answer: $1+\frac{\sqrt{14}}{2}$

The discriminant is $b^2-4ac=56$, which is positive but not a perfect square, so the roots are irrational and the formula is needed: $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$. The larger root is $1+\frac{\sqrt{14}}{2}$.

Common mistakes, and the answer each one gives:

- Used $+b$ in the numerator instead of $-b$ → $-1+\frac{\sqrt{14}}{2}$
- Divided by a instead of $2a$ → $2+\sqrt{14}$
- Gave the smaller root → $1-\frac{\sqrt{14}}{2}$

7

Answer: -1

The turning point of ax^2+bx+c sits at $x=-\dfrac{b}{2a}$. Here $a=-4$ and $b=-8$, so $x=-\dfrac{-8}{2(-4)}=-1$. (Completing the square gives $-4\left(x+1\right)^2-5$, which shows the same thing.)

Common mistakes, and the answer each one gives:

- Used $\dfrac{b}{2a}$ without the minus sign → 1
- Gave the MAXIMUM VALUE instead of where it happens → -5

8

Answer: -4

Where the graphs meet, the two expressions are equal. Bring everything to one side: $x^2+10x+24=0$, which factorises as $\left(x+4\right)\left(x+6\right)$. The roots are -6 and -4.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -6
- Read the roots straight off the brackets with the signs unchanged → 6

9

Answer: -6

$(x+6)(x+7)=0$, so $x=-7$ or $x=-6$. The larger is -6.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -7
- Read the roots off with the signs unchanged → 7

10

Answer: $-3+\sqrt{2}$

The discriminant is $b^2-4ac=8$, which is positive but not a perfect square, so the roots are irrational and the formula is needed: $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$. The larger root is $-3+\sqrt{2}$.

Common mistakes, and the answer each one gives:

- Used $+b$ in the numerator instead of $-b$ → $\sqrt{2}+3$
- Divided by a instead of $2a$ → $-6+2\sqrt{2}$
- Gave the smaller root → $-3-\sqrt{2}$

11

Answer: 4

The turning point of ax^2+bx+c sits at $x=-\dfrac{b}{2a}$. Here $a=-1$ and $b=8$, so $x=-\dfrac{8}{2(-1)}=4$. (Completing the square gives $-1\left(x-4\right)^2$, which shows the same thing.)

Common mistakes, and the answer each one gives:

- Used $\dfrac{b}{2a}$ without the minus sign → -4
- Gave the MAXIMUM VALUE instead of where it happens → 0

12

Answer: 3

Where the graphs meet, the two expressions are equal. Bring everything to one side: $x^2 + x - 12 = 0$, which factorises as $(x-3)(x+4)$. The roots are -4 and 3.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -4
- Read the roots straight off the brackets with the signs unchanged → 4

13

Answer: -7

$(x+7)(x+9) = 0$, so $x = -7$ or $x = -9$. The larger is -7.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -9
- Read the roots off with the signs unchanged → 9

14

Answer: $\frac{\sqrt{5}}{2} + \frac{5}{2}$

The discriminant is $b^2 - 4ac = 5$, which is positive but not a perfect square, so the roots are irrational and the formula is needed: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. The larger root is $\frac{\sqrt{5}}{2} + \frac{5}{2}$.

Common mistakes, and the answer each one gives:

- Used $+b$ in the numerator instead of $-b$ → $-\frac{5}{2} + \frac{\sqrt{5}}{2}$
- Divided by a instead of $2a$ → $\sqrt{5} + 5$
- Gave the smaller root → $\frac{5}{2} - \frac{\sqrt{5}}{2}$

15

Answer: -1

The turning point of $ax^2 + bx + c$ sits at $x = -\dfrac{b}{2a}$. Here $a = -4$ and $b = -8$, so $x = -\dfrac{-8}{2(-4)} = -1$. (Completing the square gives $-4\left(x+1\right)^2 + 1$, which shows the same thing.)

Common mistakes, and the answer each one gives:

- Used $\dfrac{b}{2a}$ without the minus sign → 1
- Gave the MAXIMUM VALUE instead of where it happens → 1

16

Answer: 4

Where the graphs meet, the two expressions are equal. Bring everything to one side: $x^2 - 3x - 4 = 0$, which factorises as $\left(x-4\right)\left(x+1\right)$. The roots are -1 and 4.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -1
- Read the roots straight off the brackets with the signs unchanged → 1

17

Answer: -5

$\left(x+5\right)\left(x+7\right) = 0$, so $x = -5$ or $x = -7$. The larger is -5.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -7
- Read the roots off with the signs unchanged → 7

18

Answer: $-\frac{7}{2}+\frac{\sqrt{37}}{2}$

The discriminant is $b^2-4ac=37$, which is positive but not a perfect square, so the roots are irrational and the formula is needed: $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$. The larger root is $-\frac{7}{2}+\frac{\sqrt{37}}{2}$.

Common mistakes, and the answer each one gives:

- Used $+b$ in the numerator instead of $-b$ → $\frac{\sqrt{37}}{2}+\frac{7}{2}$
- Divided by a instead of $2a$ → $-7+\sqrt{37}$
- Gave the smaller root → $-\frac{7}{2}-\frac{\sqrt{37}}{2}$

19

Answer: -3

The turning point of ax^2+bx+c sits at $x=-\dfrac{b}{2a}$. Here $a=-4$ and $b=-24$, so $x=-\dfrac{-24}{2(-4)}=-3$. (Completing the square gives $-4\left(x+3\right)^2-6$, which shows the same thing.)

Common mistakes, and the answer each one gives:

- Used $\dfrac{b}{2a}$ without the minus sign → 3
- Gave the MAXIMUM VALUE instead of where it happens → -6

20

Answer: 6

Where the graphs meet, the two expressions are equal. Bring everything to one side: $x^2-2x-24=0$, which factorises as $\left(x-6\right)\left(x+4\right)$. The roots are -4 and 6.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -4
- Read the roots straight off the brackets with the signs unchanged → 4

21

Answer: 9

$(x-9)(x-5)=0$, so $x=5$ or $x=9$. The larger is 9.

Common mistakes, and the answer each one gives:

- Gave the smaller root → 5
- Read the roots off with the signs unchanged → -5

22

Answer: $-\frac{5}{4}+\frac{\sqrt{89}}{4}$

The discriminant is $b^2-4ac=89$, which is positive but not a perfect square, so the roots are irrational and the formula is needed: $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$. The larger root is $-\frac{5}{4}+\frac{\sqrt{89}}{4}$.

Common mistakes, and the answer each one gives:

- Used $+b$ in the numerator instead of $-b$ → $\frac{5}{4}+\frac{\sqrt{89}}{4}$
- Divided by a instead of $2a$ → $-\frac{5}{2}+\frac{\sqrt{89}}{2}$
- Gave the smaller root → $-\frac{\sqrt{89}}{4}-\frac{5}{4}$

23

Answer: -1

The turning point of ax^2+bx+c sits at $x=-\dfrac{b}{2a}$. Here $a=-4$ and $b=-8$, so $x=-\dfrac{-8}{2(-4)}=-1$. (Completing the square gives $-4\left(x+1\right)^2+2$, which shows the same thing.)

Common mistakes, and the answer each one gives:

- Used $\dfrac{b}{2a}$ without the minus sign → 1
- Gave the MAXIMUM VALUE instead of where it happens → 2

24

Answer: 1

Where the graphs meet, the two expressions are equal. Bring everything to one side: $x^2 - x = 0$, which factorises as $x\left(x - 1\right)$. The roots are 0 and 1.

Common mistakes, and the answer each one gives:

- Gave the smaller root → 0
- Read the roots straight off the brackets with the signs unchanged → 0

25

Answer: 5

$\left(x - 5\right)\left(x + 9\right) = 0$, so $x = -9$ or $x = 5$. The larger is 5.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -9
- Read the roots off with the signs unchanged → 9

26

Answer: $-2 + \sqrt{10}$

The discriminant is $b^2 - 4ac = 40$, which is positive but not a perfect square, so the roots are irrational and the formula is needed: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. The larger root is $-2 + \sqrt{10}$.

Common mistakes, and the answer each one gives:

- Used $+b$ in the numerator instead of $-b$ → $2 + \sqrt{10}$
- Divided by a instead of $2a$ → $-4 + 2\sqrt{10}$
- Gave the smaller root → $-\sqrt{10} - 2$

27

Answer: -3

The turning point of $ax^2 + bx + c$ sits at $x = -\dfrac{b}{2a}$. Here $a = -3$ and $b = -18$, so $x = -\dfrac{-18}{2(-3)} = -3$. (Completing the square gives $-3\left(x+3\right)^2 + 3$, which shows the same thing.)

Common mistakes, and the answer each one gives:

- Used $\dfrac{b}{2a}$ without the minus sign → 3
- Gave the MAXIMUM VALUE instead of where it happens → 3

28

Answer: 1

Where the graphs meet, the two expressions are equal. Bring everything to one side: $x^2 + 5x - 6 = 0$, which factorises as $\left(x-1\right)\left(x+6\right)$. The roots are -6 and 1.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -6
- Read the roots straight off the brackets with the signs unchanged → 6

29

Answer: 0

$x\left(x+7\right) = 0$, so $x = 0$ or $x = -7$. The larger is 0.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -7
- Read the roots off with the signs unchanged → 7

30

Answer: $\frac{1}{4} + \frac{\sqrt{17}}{4}$

The discriminant is $b^2 - 4ac = 17$, which is positive but not a perfect square, so the roots are irrational and the formula is needed: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. The larger root is $\frac{1}{4} + \frac{\sqrt{17}}{4}$.

Common mistakes, and the answer each one gives:

- Used $+b$ in the numerator instead of $-b$ → $-\frac{1}{4} + \frac{\sqrt{17}}{4}$
- Divided by a instead of $2a$ → $\frac{1}{2} + \frac{\sqrt{17}}{2}$
- Gave the smaller root → $\frac{1}{4} - \frac{\sqrt{17}}{4}$

6. Functions

Asymptotes, composites, and equations with the unknown underneath. Set for OMPT-A, OMPT-B, OMPT-D, OMPT-E, OMPT-F and OMPT-G.

Questions

1

Give the equation of the VERTICAL asymptote of $f(x) = \dfrac{2x+5}{2x+8}$

Answer: ______________________

2

Simplify fully: $\dfrac{x^2 - x - 12}{x^2 + 11x + 24}$

Answer: ______________________

3

Expand and simplify: $4\left(3x-1\right)^2 + 4$

Answer: ______________________

4

Solve for x: $\dfrac{2x+1}{x+1} = 5$

Answer: ______________________

5

Solve for x: $(x+2)^3 = -1$

Answer: ____________________

6

Give the equation of the VERTICAL asymptote of $f(x) = \dfrac{2-2x}{2x+3}$

Answer: ____________________

7

Simplify fully: $\dfrac{x^2+10x+21}{x^2+11x+28}$

Answer: ____________________

8

Expand and simplify: $4\left(5x-1\right)^2 - 2$

Answer: ____________________

9

Solve for x: $\dfrac{5x}{x-3} = 2$

Answer: ____________________

10

Solve for x: $(x-3)^3 = -64$

Answer: ____________________

11

Give the equation of the VERTICAL asymptote of $f(x) = \dfrac{6-2x}{x+6}$

Answer: ____________________

12

Simplify fully: $\dfrac{x^2+4x-12}{x^2+10x+24}$

Answer: ____________________

13

Expand and simplify: $4(5x-1)^2 - 4$

Answer: ____________________

14

Solve for x: $\dfrac{6x-8}{x} = 3$

Answer: ____________________

15

Solve for x: $(x+3)^3 = -64$

Answer: ________________

16

Give the equation of the VERTICAL asymptote of $f(x) = \dfrac{3x+7}{2x+3}$

Answer: ________________

17

Simplify fully: $\dfrac{x^2+3x}{x^2+5x}$

Answer: ________________

18

Expand and simplify: $5\left(5x-4\right)^2 - 8$

Answer: ________________

19

Solve for x: $\dfrac{2x-7}{x+2} = 5$

Answer: ________________

20

Solve for x: $(x-5)^3 = -8$

Answer: ____________________

21

Give the equation of the VERTICAL asymptote of $f(x) = \dfrac{1-x}{x+2}$

Answer: ____________________

22

Simplify fully: $\dfrac{x^2+9x+20}{x^2+2x-15}$

Answer: ____________________

23

Expand and simplify: $5\left(2x+5\right)^2+7$

Answer: ____________________

24

Solve for x: $\dfrac{6x-8}{x-5} = 2$

Answer: ____________________

25

Solve for x: $(x+6)^3 = -27$

Answer: ____________________

26

Give the equation of the VERTICAL asymptote of $f(x) = \dfrac{8-x}{2x+6}$

Answer: ____________________

27

Simplify fully: $\dfrac{x^2-9x+14}{x^2-12x+35}$

Answer: ____________________

28

Expand and simplify: $5\left(5x-1\right)^2-1$

Answer: ____________________

29

Solve for x: $\dfrac{4x-6}{x+7} = 6$

Answer: ____________________

30

Solve for x: $(x-5)^3=-64$

Answer: ______________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: -4

The vertical asymptote sits where the denominator is zero: $2x + 8 = 0$, so $x = -4$. (The horizontal one is $y = 1$, the ratio of the leading coefficients.)

Common mistakes, and the answer each one gives:

- Set the NUMERATOR to zero (that gives the x-intercept) → $-\frac{5}{2}$
- Gave the horizontal asymptote instead → 1
- Forgot the sign when solving → 4

2

Answer: $\frac{x-4}{x+8}$

Factorise both: $\dfrac{(x-4)(x+3)}{(x+3)(x+8)}$. The factor $x+3$ is common to both and cancels, leaving $\frac{x-4}{x+8}$.

Common mistakes, and the answer each one gives:

- Cancelled the x^2 terms, which are terms and not factors → $\frac{-x-12}{11x+24}$
- Cancelled the wrong bracket → $\frac{x+3}{x+8}$

3

Answer: $36x^2 - 24x + 8$

Square the bracket FIRST, then multiply by 4, then add the constant — the order matters. $(3x-1)^2 = 9x^2 - 6x + 1$, and the whole thing comes to $36x^2 - 24x + 8$.

Common mistakes, and the answer each one gives:

- Multiplied the bracket by the outside number before squaring → $144x^2 - 96x + 20$
- Squared each term inside the bracket separately → $36x^2 + 8$

4

Answer: $-\frac{4}{3}$

Multiply both sides by $x+1$: $2x+1=5\left(x+1\right)$. Expand, collect and divide: $x=-\frac{4}{3}$. (Check it is not $x=-1$, which the original forbids.)

Common mistakes, and the answer each one gives:

- Multiplied only the numerator by the right-hand side → 2
- Set the denominator to zero, which is the EXCLUDED value → -1

5

Answer: -3

A cube is undone by a cube root, and unlike a square root it keeps the sign: $\sqrt[3]{-1}=-1$. So $x+2=-1$ and $x=-3$.

Common mistakes, and the answer each one gives:

- Divided by 3 instead of taking the cube root → $-\frac{7}{3}$
- Took the cube root but lost the sign → -1

6

Answer: $-\frac{3}{2}$

The vertical asymptote sits where the denominator is zero: $2x+3=0$, so $x=-\frac{3}{2}$. (The horizontal one is $y=-1$, the ratio of the leading coefficients.)

Common mistakes, and the answer each one gives:

- Set the NUMERATOR to zero (that gives the x-intercept) → 1
- Gave the horizontal asymptote instead → -1
- Forgot the sign when solving → $\frac{3}{2}$

7

Answer: $\frac{x+3}{x+4}$

Factorise both: $\dfrac{(x+3)(x+7)}{(x+4)(x+7)}$. The factor $x+7$ is common to both and cancels, leaving $\frac{x+3}{x+4}$.

Common mistakes, and the answer each one gives:

- Cancelled the x^2 terms, which are terms and not factors → $\frac{10x+21}{11x+28}$
- Cancelled the wrong bracket → $\frac{x+7}{x+4}$

8

Answer: $100x^2 - 40x + 2$

Square the bracket FIRST, then multiply by 4, then add the constant — the order matters. $(5x-1)^2 = 25x^2 - 10x + 1$, and the whole thing comes to $100x^2 - 40x + 2$.

Common mistakes, and the answer each one gives:

- Multiplied the bracket by the outside number before squaring → $400x^2 - 160x + 14$
- Squared each term inside the bracket separately → $100x^2 + 2$

9

Answer: -2

Multiply both sides by $x-3$: $5x = 2(x-3)$. Expand, collect and divide: $x = -2$. (Check it is not $x = 3$, which the original forbids.)

Common mistakes, and the answer each one gives:

- Multiplied only the numerator by the right-hand side → $\frac{2}{5}$
- Set the denominator to zero, which is the EXCLUDED value → 3

10

Answer: -1

A cube is undone by a cube root, and unlike a square root it keeps the sign: $\sqrt[3]{-64} = -4$. So $x - 3 = -4$ and $x = -1$.

Common mistakes, and the answer each one gives:

- Divided by 3 instead of taking the cube root → $-\frac{55}{3}$
- Took the cube root but lost the sign → 7

11

Answer: -6

The vertical asymptote sits where the denominator is zero: $x + 6 = 0$, so $x = -6$. (The horizontal one is $y = -2$, the ratio of the leading coefficients.)

Common mistakes, and the answer each one gives:

- Set the NUMERATOR to zero (that gives the x-intercept) → 3
- Gave the horizontal asymptote instead → -2
- Forgot the sign when solving → 6

12

Answer: $\frac{x-2}{x+4}$

Factorise both: $\dfrac{(x-2)(x+6)}{(x+4)(x+6)}$. The factor $x + 6$ is common to both and cancels, leaving $\frac{x-2}{x+4}$.

Common mistakes, and the answer each one gives:

- Cancelled the x^2 terms, which are terms and not factors → $\frac{2x-6}{5x+12}$
- Cancelled the wrong bracket → $\frac{x+6}{x+4}$

13

Answer: $100x^2 - 40x$

Square the bracket FIRST, then multiply by 4, then add the constant — the order matters. $(5x-1)^2 = 25x^2 - 10x + 1$, and the whole thing comes to $100x^2 - 40x$.

Common mistakes, and the answer each one gives:

- Multiplied the bracket by the outside number before squaring → $400x^2 - 160x + 12$
- Squared each term inside the bracket separately → $100x^2$

14

Answer: $\frac{8}{3}$

Multiply both sides by x: $6x - 8 = 3\,(x)$. Expand, collect and divide: $x = \frac{8}{3}$. (Check it is not $x = 0$, which the original forbids.)

Common mistakes, and the answer each one gives:

- Multiplied only the numerator by the right-hand side → $\frac{11}{6}$
- Set the denominator to zero, which is the EXCLUDED value → 0

15

Answer: -7

A cube is undone by a cube root, and unlike a square root it keeps the sign: $\sqrt[3]{-64} = -4$. So $x + 3 = -4$ and $x = -7$.

Common mistakes, and the answer each one gives:

- Divided by 3 instead of taking the cube root → $-\frac{73}{3}$
- Took the cube root but lost the sign → 1

16

Answer: $-\frac{3}{2}$

The vertical asymptote sits where the denominator is zero: $2x+3=0$, so $x=-\frac{3}{2}$. (The horizontal one is $y=\frac{3}{2}$, the ratio of the leading coefficients.)

Common mistakes, and the answer each one gives:

- Set the NUMERATOR to zero (that gives the x-intercept) → $-\frac{7}{3}$
- Gave the horizontal asymptote instead → $\frac{3}{2}$
- Forgot the sign when solving → $\frac{3}{2}$

17

Answer: $\frac{x+3}{x+5}$

Factorise both: $\dfrac{x\left(x+3\right)}{x\left(x+5\right)}$. The factor x is common to both and cancels, leaving $\frac{x+3}{x+5}$.

Common mistakes, and the answer each one gives:

- Cancelled the x^2 terms, which are terms and not factors → $\frac{3}{5}$
- Cancelled the wrong bracket → $\frac{x}{x+5}$

18

Answer: $125x^2-200x+72$

Square the bracket FIRST, then multiply by 5, then add the constant — the order matters. $\left(5x-4\right)^2=25x^2-40x+16$, and the whole thing comes to $125x^2-200x+72$.

Common mistakes, and the answer each one gives:

- Multiplied the bracket by the outside number before squaring → $625x^2-1000x+392$
- Squared each term inside the bracket separately → $125x^2+72$

19

Answer: $-\frac{17}{3}$

Multiply both sides by $x+2$: $2x-7=5\left(x+2\right)$. Expand, collect and divide: $x=-\frac{17}{3}$. (Check it is not $x=-2$, which the original forbids.)

Common mistakes, and the answer each one gives:

- Multiplied only the numerator by the right-hand side → 6
- Set the denominator to zero, which is the EXCLUDED value → -2

20

Answer: 3

A cube is undone by a cube root, and unlike a square root it keeps the sign: $\sqrt[3]{-8}=-2$. So $x-5=-2$ and $x=3$.

Common mistakes, and the answer each one gives:

- Divided by 3 instead of taking the cube root → $\frac{7}{3}$
- Took the cube root but lost the sign → 7

21

Answer: -2

The vertical asymptote sits where the denominator is zero: $x+2=0$, so $x=-2$. (The horizontal one is $y=-1$, the ratio of the leading coefficients.)

Common mistakes, and the answer each one gives:

- Set the NUMERATOR to zero (that gives the x-intercept) → 1
- Gave the horizontal asymptote instead → -1
- Forgot the sign when solving → 2

22

Answer: $\frac{x+4}{x-3}$

Factorise both: $\dfrac{(x+4)(x+5)}{(x-3)(x+5)}$. The factor $x+5$ is common to both and cancels, leaving $\frac{x+4}{x-3}$.

Common mistakes, and the answer each one gives:

- Cancelled the x^2 terms, which are terms and not factors → $\frac{9x+20}{2x-15}$
- Cancelled the wrong bracket → $\frac{x+5}{x-3}$

23

Answer: $20x^2 + 100x + 132$

Square the bracket FIRST, then multiply by 5, then add the constant — the order matters. $(2x+5)^2 = 4x^2 + 20x + 25$, and the whole thing comes to $20x^2 + 100x + 132$.

Common mistakes, and the answer each one gives:

- Multiplied the bracket by the outside number before squaring → $100x^2 + 500x + 632$
- Squared each term inside the bracket separately → $20x^2 + 132$

24

Answer: $-\frac{1}{2}$

Multiply both sides by $x-5$: $6x-8 = 2(x-5)$. Expand, collect and divide: $x = -\frac{1}{2}$. (Check it is not $x = 5$, which the original forbids.)

Common mistakes, and the answer each one gives:

- Multiplied only the numerator by the right-hand side → $\frac{5}{3}$
- Set the denominator to zero, which is the EXCLUDED value → 5

25

Answer: -9

A cube is undone by a cube root, and unlike a square root it keeps the sign: $\sqrt[3]{-27} = -3$. So $x + 6 = -3$ and $x = -9$.

Common mistakes, and the answer each one gives:

- Divided by 3 instead of taking the cube root → -15
- Took the cube root but lost the sign → -3

26

Answer: -3

The vertical asymptote sits where the denominator is zero: $2x + 6 = 0$, so $x = -3$. (The horizontal one is $y = -\frac{1}{2}$, the ratio of the leading coefficients.)

Common mistakes, and the answer each one gives:

- Set the NUMERATOR to zero (that gives the x-intercept) → 8
- Gave the horizontal asymptote instead → $-\frac{1}{2}$
- Forgot the sign when solving → 3

27

Answer: $\frac{x-2}{x-5}$

Factorise both: $\dfrac{(x-7)\,(x-2)}{(x-7)\,(x-5)}$. The factor $x - 7$ is common to both and cancels, leaving $\frac{x-2}{x-5}$.

Common mistakes, and the answer each one gives:

- Cancelled the x^2 terms, which are terms and not factors → $\frac{9x-14}{12x-35}$
- Cancelled the wrong bracket → $\frac{x-7}{x-5}$

28

Answer: $125x^2 - 50x + 4$

Square the bracket FIRST, then multiply by 5, then add the constant — the order matters. $(5x - 1)^2 = 25x^2 - 10x + 1$, and the whole thing comes to $125x^2 - 50x + 4$.

Common mistakes, and the answer each one gives:

- Multiplied the bracket by the outside number before squaring → $625x^2 - 250x + 24$
- Squared each term inside the bracket separately → $125x^2 + 4$

29

Answer: -24

Multiply both sides by $x + 7$: $4x - 6 = 6\,(x + 7)$. Expand, collect and divide: $x = -24$. (Check it is not $x = -7$, which the original forbids.)

Common mistakes, and the answer each one gives:

- Multiplied only the numerator by the right-hand side → 3
- Set the denominator to zero, which is the EXCLUDED value → -7

30

Answer: 1

A cube is undone by a cube root, and unlike a square root it keeps the sign: $\sqrt[3]{-64} = -4$. So $x - 5 = -4$ and $x = 1$.

Common mistakes, and the answer each one gives:

- Divided by 3 instead of taking the cube root → $-\frac{49}{3}$
- Took the cube root but lost the sign → 9

7. Logarithms

Combining logarithms into one, and solving logarithmic and exponential equations. Set for OMPT-A, OMPT-B, OMPT-D, OMPT-E, OMPT-F and OMPT-G.

Questions

1

Write as a single logarithm: $3\log_3(x) + \log_3(4)$. Give only the ARGUMENT of the resulting logarithm.

Answer: ____________________

2

Solve for x: $\log_5(x+4) = \log_5(7)$

Answer: ____________________

3

Solve for x: $3^{3x+6} = 243$

Answer: ____________________

4

Evaluate exactly: $\log_9(81)$

Answer: ____________________

5

Write as a single logarithm: $2\log_5(x) + \log_5(5)$. Give only the ARGUMENT of the resulting logarithm.

Answer: ______________________

6

Solve for x: $\log_2(x+1) = \log_2(9)$

Answer: ______________________

7

Solve for x: $2^{4x-1} = 4$

Answer: ______________________

8

Evaluate exactly: $\log_{25}(125)$

Answer: ______________________

9

Write as a single logarithm: $4\log_7(x) + \log_7(6)$. Give only the ARGUMENT of the resulting logarithm.

Answer: ______________________

10

Solve for x: $\log_5(x+7) = \log_5(14)$

Answer: ____________________

11

Solve for x: $2^{2x-3} = 32$

Answer: ____________________

12

Evaluate exactly: $\log_4(32)$

Answer: ____________________

13

Write as a single logarithm: $5\log_7(x) + \log_7(6)$. Give only the ARGUMENT of the resulting logarithm.

Answer: ____________________

14

Solve for x: $\log_2(x+8) = \log_2(13)$

Answer: ____________________

15

Solve for x: $5^{2x+2} = 25$

Answer: ______________________

16

Evaluate exactly: $\log_8(32)$

Answer: ______________________

17

Write as a single logarithm: $6\log_3(x) + \log_3(2)$. Give only the ARGUMENT of the resulting logarithm.

Answer: ______________________

18

Solve for x: $\log_5(x+4) = \log_5(8)$

Answer: ______________________

19

Solve for x: $3^{2x-4} = 81$

Answer: ______________________

20

Evaluate exactly: $\log_{25}(15625)$

Answer: ______________________

21

Write as a single logarithm: $4\log_3(x) + \log_3(7)$. Give only the ARGUMENT of the resulting logarithm.

Answer: ______________________

22

Solve for x: $\log_5(x+2) = \log_5(13)$

Answer: ______________________

23

Solve for x: $2^{4x-1} = 32$

Answer: ______________________

24

Evaluate exactly: $\log_{125}(625)$

Answer: ______________________

25

Write as a single logarithm: $2\log_{10}(x)+\log_{10}(6)$. Give only the ARGUMENT of the resulting logarithm.

Answer: ____________________

26

Solve for x: $\log_2(x+4)=\log_2(14)$

Answer: ____________________

27

Solve for x: $2^{3x-1}=8$

Answer: ____________________

28

Evaluate exactly: $\log_{27}(81)$

Answer: ____________________

29

Write as a single logarithm: $6\log_6(x)+\log_6(7)$. Give only the ARGUMENT of the resulting logarithm.

Answer: ____________________

30

Solve for x: $\log_3(x+4) = \log_3(10)$

Answer: ______________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: $4x^3$

The power rule turns $3\log_3(x)$ into $\log_3(x^3)$, and the product rule combines the two into $\log_3(4x^3)$.

Common mistakes, and the answer each one gives:

- Added the arguments instead of multiplying them → $x^3 + 4$
- Multiplied by the power instead of raising to it → $12x$

2

Answer: 3

Equal logarithms with the same base have equal arguments, so $x + 4 = 7$ and $x = 3$. Check the domain: $x + 4 > 0$ holds.

Common mistakes, and the answer each one gives:

- Subtracted the shift from the wrong side → 11
- Treated the log as a multiplier and divided → $\frac{7}{4}$

3

Answer: $-\frac{1}{3}$

Write the right-hand side as a power of 3: $243 = 3^5$. With the same base on both sides the exponents must be equal, so $3x + 6 = 5$ and $x = -\frac{1}{3}$.

Common mistakes, and the answer each one gives:

- Set the exponent equal to 243 instead of to 5 → 79
- Forgot to move the constant in the exponent across → $\frac{5}{3}$

4

Answer: 2

Write both numbers as powers of 3: $9 = 3^2$ and $81 = 3^4$. Then $\log_9 81 = \dfrac{4}{2} = 2$, because the base has to be raised to that power to reach the argument.

Common mistakes, and the answer each one gives:

- Divided the two numbers → 9
- Turned the fraction of exponents upside down → $\frac{1}{2}$

5

Answer: $5x^2$

The power rule turns $2\log_5(x)$ into $\log_5(x^2)$, and the product rule combines the two into $\log_5(5x^2)$.

Common mistakes, and the answer each one gives:

- Added the arguments instead of multiplying them → $x^2 + 5$
- Multiplied by the power instead of raising to it → $10x$

6

Answer: 8

Equal logarithms with the same base have equal arguments, so $x + 1 = 9$ and $x = 8$. Check the domain: $x + 1 > 0$ holds.

Common mistakes, and the answer each one gives:

- Subtracted the shift from the wrong side → 10
- Treated the log as a multiplier and divided → 9

7

Answer: $\frac{3}{4}$

Write the right-hand side as a power of 2: $4 = 2^2$. With the same base on both sides the exponents must be equal, so $4x - 1 = 2$ and $x = \frac{3}{4}$.

Common mistakes, and the answer each one gives:

- Set the exponent equal to 4 instead of to 2 → $\frac{5}{4}$
- Forgot to move the constant in the exponent across → $\frac{1}{2}$

8

Answer: $\frac{3}{2}$

Write both numbers as powers of 5: $25 = 5^2$ and $125 = 5^3$. Then $\log_{25} 125 = \dfrac{3}{2} = \frac{3}{2}$, because the base has to be raised to that power to reach the argument.

Common mistakes, and the answer each one gives:

- Divided the two numbers → 5
- Turned the fraction of exponents upside down → $\frac{2}{3}$

9

Answer: $6x^4$

The power rule turns $4\log_7(x)$ into $\log_7(x^4)$, and the product rule combines the two into $\log_7(6x^4)$.

Common mistakes, and the answer each one gives:

- Added the arguments instead of multiplying them → $x^4 + 6$
- Multiplied by the power instead of raising to it → $24x$

10

Answer: 7

Equal logarithms with the same base have equal arguments, so $x + 7 = 14$ and $x = 7$. Check the domain: $x + 7 > 0$ holds.

Common mistakes, and the answer each one gives:

- Subtracted the shift from the wrong side → 21
- Treated the log as a multiplier and divided → 2

11

Answer: 4

Write the right-hand side as a power of 2: $32 = 2^5$. With the same base on both sides the exponents must be equal, so $2x - 3 = 5$ and $x = 4$.

Common mistakes, and the answer each one gives:

- Set the exponent equal to 32 instead of to 5 → $\frac{35}{2}$
- Forgot to move the constant in the exponent across → $\frac{5}{2}$

12

Answer: $\frac{5}{2}$

Write both numbers as powers of 2: $4 = 2^2$ and $32 = 2^5$. Then $\log_4 32 = \dfrac{5}{2} = \frac{5}{2}$, because the base has to be raised to that power to reach the argument.

Common mistakes, and the answer each one gives:

- Divided the two numbers → 8
- Turned the fraction of exponents upside down → $\frac{2}{5}$

13

Answer: $6x^5$

The power rule turns $5\log_7(x)$ into $\log_7(x^5)$, and the product rule combines the two into $\log_7(6x^5)$.

Common mistakes, and the answer each one gives:

- Added the arguments instead of multiplying them → x^5+6
- Multiplied by the power instead of raising to it → $30x$

14

Answer: 5

Equal logarithms with the same base have equal arguments, so $x+8=13$ and $x=5$. Check the domain: $x+8>0$ holds.

Common mistakes, and the answer each one gives:

- Subtracted the shift from the wrong side → 21
- Treated the log as a multiplier and divided → $\frac{13}{8}$

15

Answer: 0

Write the right-hand side as a power of 5: $25=5^2$. With the same base on both sides the exponents must be equal, so $2x+2=2$ and $x=0$.

Common mistakes, and the answer each one gives:

- Set the exponent equal to 25 instead of to 2 → $\frac{23}{2}$
- Forgot to move the constant in the exponent across → 1

16

Answer: $\frac{5}{3}$

Write both numbers as powers of 2: $8 = 2^3$ and $32 = 2^5$. Then $\log_8 32 = \dfrac{5}{3} = \frac{5}{3}$, because the base has to be raised to that power to reach the argument.

Common mistakes, and the answer each one gives:

- Divided the two numbers → 4
- Turned the fraction of exponents upside down → $\frac{3}{5}$

17

Answer: $2x^6$

The power rule turns $6\log_3(x)$ into $\log_3(x^6)$, and the product rule combines the two into $\log_3(2x^6)$.

Common mistakes, and the answer each one gives:

- Added the arguments instead of multiplying them → $x^6 + 2$
- Multiplied by the power instead of raising to it → $12x$

18

Answer: 4

Equal logarithms with the same base have equal arguments, so $x + 4 = 8$ and $x = 4$. Check the domain: $x + 4 > 0$ holds.

Common mistakes, and the answer each one gives:

- Subtracted the shift from the wrong side → 12
- Treated the log as a multiplier and divided → 2

19

Answer: 4

Write the right-hand side as a power of 3: $81 = 3^4$. With the same base on both sides the exponents must be equal, so $2x - 4 = 4$ and $x = 4$.

Common mistakes, and the answer each one gives:

- Set the exponent equal to 81 instead of to 4 → $\frac{85}{2}$
- Forgot to move the constant in the exponent across → 2

20

Answer: 3

Write both numbers as powers of 5: $25 = 5^2$ and $15625 = 5^6$. Then $\log_{25} 15625 = \dfrac{6}{2} = 3$, because the base has to be raised to that power to reach the argument.

Common mistakes, and the answer each one gives:

- Divided the two numbers → 625
- Turned the fraction of exponents upside down → $\frac{1}{3}$

21

Answer: $7x^4$

The power rule turns $4\log_3(x)$ into $\log_3(x^4)$, and the product rule combines the two into $\log_3(7x^4)$.

Common mistakes, and the answer each one gives:

- Added the arguments instead of multiplying them → $x^4 + 7$
- Multiplied by the power instead of raising to it → $28x$

22

Answer: 11

Equal logarithms with the same base have equal arguments, so $x + 2 = 13$ and $x = 11$. Check the domain: $x + 2 > 0$ holds.

Common mistakes, and the answer each one gives:

- Subtracted the shift from the wrong side → 15
- Treated the log as a multiplier and divided → $\frac{13}{2}$

23

Answer: $\frac{3}{2}$

Write the right-hand side as a power of 2: $32 = 2^5$. With the same base on both sides the exponents must be equal, so $4x - 1 = 5$ and $x = \frac{3}{2}$.

Common mistakes, and the answer each one gives:

- Set the exponent equal to 32 instead of to 5 → $\frac{33}{4}$
- Forgot to move the constant in the exponent across → $\frac{5}{4}$

24

Answer: $\frac{4}{3}$

Write both numbers as powers of 5: $125 = 5^3$ and $625 = 5^4$. Then $\log_{125} 625 = \dfrac{4}{3} = \frac{4}{3}$, because the base has to be raised to that power to reach the argument.

Common mistakes, and the answer each one gives:

- Divided the two numbers → 5
- Turned the fraction of exponents upside down → $\frac{3}{4}$

25

Answer: $6x^2$

The power rule turns $2\log_{10}(x)$ into $\log_{10}(x^2)$, and the product rule combines the two into $\log_{10}(6x^2)$.

Common mistakes, and the answer each one gives:

- Added the arguments instead of multiplying them → $x^2 + 6$
- Multiplied by the power instead of raising to it → $12x$

26

Answer: 10

Equal logarithms with the same base have equal arguments, so $x + 4 = 14$ and $x = 10$. Check the domain: $x + 4 > 0$ holds.

Common mistakes, and the answer each one gives:

- Subtracted the shift from the wrong side → 18
- Treated the log as a multiplier and divided → $\frac{7}{2}$

27

Answer: $\frac{4}{3}$

Write the right-hand side as a power of 2: $8 = 2^3$. With the same base on both sides the exponents must be equal, so $3x - 1 = 3$ and $x = \frac{4}{3}$.

Common mistakes, and the answer each one gives:

- Set the exponent equal to 8 instead of to 3 → 3
- Forgot to move the constant in the exponent across → 1

28

Answer: $\frac{4}{3}$

Write both numbers as powers of 3: $27 = 3^3$ and $81 = 3^4$. Then $\log_{27} 81 = \dfrac{4}{3} = \frac{4}{3}$, because the base has to be raised to that power to reach the argument.

Common mistakes, and the answer each one gives:

- Divided the two numbers → 3
- Turned the fraction of exponents upside down → $\frac{3}{4}$

29

Answer: $7x^6$

The power rule turns $6\log_6(x)$ into $\log_6(x^6)$, and the product rule combines the two into $\log_6(7x^6)$.

Common mistakes, and the answer each one gives:

- Added the arguments instead of multiplying them → $x^6 + 7$
- Multiplied by the power instead of raising to it → $42x$

30

Answer: 6

Equal logarithms with the same base have equal arguments, so $x + 4 = 10$ and $x = 6$. Check the domain: $x + 4 > 0$ holds.

Common mistakes, and the answer each one gives:

- Subtracted the shift from the wrong side → 14
- Treated the log as a multiplier and divided → $\frac{5}{2}$

8. Differentiation

The product, quotient and chain rules, and finding stationary points. Set for OMPT-A, OMPT-B, OMPT-D and OMPT-F.

Questions

1

Differentiate: $f(x) = \left(12x^2 + 1\right)^5$

Answer: ______________________

2

$f(x) = 2x^3 + 3x^2 - 12x$. Give the x-coordinate of the local MAXIMUM.

Answer: ______________________

3

Differentiate with respect to x: $f(x) = \dfrac{x-2}{x^2+7}$

Answer: ______________________

4

Differentiate with respect to x: $f(x) = \left(3x^2 + 1\right)^3$

Answer: ______________________

5

Differentiate: $f(x) = x^6 e^{12x}$

Answer: ____________________

6

$f(x) = 4x^3 + 18x^2 - 120x$. Give the x-coordinate of the local MAXIMUM.

Answer: ____________________

7

Differentiate with respect to x: $f(x) = \dfrac{3x - 2}{x^2 + 9}$

Answer: ____________________

8

Differentiate with respect to x: $f(x) = \left(4x^2 + 8\right)^4$

Answer: ____________________

9

Differentiate: $f(x) = \frac{x^5}{x+8}$

Answer: ____________________

10

$f(x) = 3x^3 - 18x^2 - 45x$. Give the x-coordinate of the local MAXIMUM.

Answer: ____________________

11

Differentiate with respect to x: $f(x) = \dfrac{4x+6}{x^2+6}$

Answer: ____________________

12

Differentiate with respect to x: $f(x) = \left(x^2 - 8\right)^4$

Answer: ____________________

13

Differentiate: $f(x) = \left(8x^2 + 1\right)^2$

Answer: ____________________

14

$f(x) = 3x^3 - \frac{9x^2}{2} - 108x$. Give the x-coordinate of the local MAXIMUM.

Answer: ____________________

15

Differentiate with respect to x: $f(x) = \dfrac{6x+3}{x^2+7}$

Answer: ______________________

16

Differentiate with respect to x: $f(x) = \left(5x^2+6\right)^3$

Answer: ______________________

17

Differentiate: $f(x) = \left(4x^2+1\right)^2$

Answer: ______________________

18

$f(x) = 4x^3 - 12x^2 - 180x$. Give the x-coordinate of the local MAXIMUM.

Answer: ______________________

19

Differentiate with respect to x: $f(x) = \dfrac{x-9}{x^2+6}$

Answer: ______________________

20

Differentiate with respect to x: $f(x) = \left(2x^2 - 4\right)^5$

Answer: ____________________

21

Differentiate: $f(x) = \frac{x^2}{x+6}$

Answer: ____________________

22

$f(x) = 2x^3 - 6x^2 - 144x$. Give the x-coordinate of the local MAXIMUM.

Answer: ____________________

23

Differentiate with respect to x: $f(x) = \dfrac{3x - 6}{x^2 + 7}$

Answer: ____________________

24

Differentiate with respect to x: $f(x) = \left(2x^2 - 5\right)^3$

Answer: ____________________

25

Differentiate: $f(x) = x^5 e^{10x}$

Answer: ______________________

26

$f(x) = x^3 + 6x^2 - 63x$. Give the x-coordinate of the local MAXIMUM.

Answer: ______________________

27

Differentiate with respect to x: $f(x) = \dfrac{2x}{x^2 + 2}$

Answer: ______________________

28

Differentiate with respect to x: $f(x) = \left(x^2\right)^4$

Answer: ______________________

29

Differentiate: $f(x) = \frac{x^2}{x+9}$

Answer: ______________________

30

$f(x) = 4x^3 - 12x$. Give the x-coordinate of the local MAXIMUM.

Answer: ____________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: $120x\left(12x^2+1\right)^4$

Outer power 5, inner $12x^2+1$, so $f' = 5(12x^2+1)^4 \cdot 24x$. This gives $f'(x) = 120x\left(12x^2+1\right)^4$.

Common mistakes, and the answer each one gives:

- Differentiated each part separately and combined them → $5\left(12x^2+1\right)^4$

2

Answer: -2

$f'(x) = 6x^2+6x-12 = 0$ at $x=-2$ and $x=1$. $f''(x) = 12x+6$, and $f''(-2) = -18 < 0$, so $x=-2$ is the maximum.

Common mistakes, and the answer each one gives:

- Gave the local MINIMUM instead → 1
- Gave the y-value rather than the x-coordinate → 20
- Solved f(x) = 0 instead of f'(x) = 0 → 0

3

Answer: $\frac{-x^2+4x+7}{x^4+14x^2+49}$

The quotient rule is $\dfrac{u'v-uv'}{v^2}$ — and the ORDER of the two products matters, unlike the product rule. With $u=x-2$ and $v=x^2+7$: $u'=1$ and $v'=2x$, giving $\frac{-x^2+4x+7}{x^4+14x^2+49}$.

Common mistakes, and the answer each one gives:

- Wrote $uv'-u'v$ in the numerator, the two products swapped → $\frac{x^2-4x-7}{x^4+14x^2+49}$
- Differentiated top and bottom separately → $\frac{1}{2x}$

4

Answer: $162x^5 + 108x^3 + 18x$

Differentiate the outside, keeping the inside as it is, then multiply by the derivative of the inside: $3\left(3x^2+1\right)^2 \times 6x$, which expands to $162x^5 + 108x^3 + 18x$.

Common mistakes, and the answer each one gives:

- Forgot to multiply by the derivative of the inside → $27x^4 + 18x^2 + 3$
- Differentiated the inside and raised THAT to the power → $216x^3$

5

Answer: $x^5\left(12x+6\right)e^{12x}$

$u = x^6$, $v = e^{12x}$, so $f' = u'v + uv'$. This gives $f'(x) = x^5\left(12x+6\right)e^{12x}$.

Common mistakes, and the answer each one gives:

- Differentiated each part separately and combined them → $72x^5e^{12x}$

6

Answer: -5

$f'(x) = 12x^2 + 36x - 120 = 0$ at $x = -5$ and $x = 2$. $f''(x) = 24x + 36$, and $f''(-5) = -84 < 0$, so $x = -5$ is the maximum.

Common mistakes, and the answer each one gives:

- Gave the local MINIMUM instead → 2
- Gave the y-value rather than the x-coordinate → 550
- Solved f(x) = 0 instead of f'(x) = 0 → 0

7

Answer: $\frac{-3x^2+4x+27}{x^4+18x^2+81}$

The quotient rule is $\dfrac{u'v-uv'}{v^2}$ — and the ORDER of the two products matters, unlike the product rule. With $u=3x-2$ and $v=x^2+9$: $u'=3$ and $v'=2x$, giving $\frac{-3x^2+4x+27}{x^4+18x^2+81}$.

Common mistakes, and the answer each one gives:

- Wrote $uv'-u'v$ in the numerator, the two products swapped → $\frac{3x^2-4x-27}{x^4+18x^2+81}$
- Differentiated top and bottom separately → $\frac{3}{2x}$

8

Answer: $2048x^7+12288x^5+24576x^3+16384x$

Differentiate the outside, keeping the inside as it is, then multiply by the derivative of the inside: $4\left(4x^2+8\right)^3\times 8x$, which expands to $2048x^7+12288x^5+24576x^3+16384x$.

Common mistakes, and the answer each one gives:

- Forgot to multiply by the derivative of the inside → $256x^6+1536x^4+3072x^2+2048$
- Differentiated the inside and raised THAT to the power → $4096x^4$

9

Answer: $\frac{4x^4(x+10)}{x^2+16x+64}$

$u=x^5$, $v=x+8$, so $f'=\dfrac{u'v-uv'}{v^2}$. This gives $f'(x)=\frac{4x^4(x+10)}{x^2+16x+64}$.

Common mistakes, and the answer each one gives:

- Differentiated each part separately and combined them → $5x^4$

10

Answer: -1

$f'(x) = 9x^2 - 36x - 45 = 0$ at $x = -1$ and $x = 5$. $f''(x) = 18x - 36$, and $f''(-1) = -54 < 0$, so $x = -1$ is the maximum.

Common mistakes, and the answer each one gives:

- Gave the local MINIMUM instead → 5
- Gave the y-value rather than the x-coordinate → 24
- Solved f(x) = 0 instead of f'(x) = 0 → 0

11

Answer: $\frac{-4x^2-12x+24}{x^4+12x^2+36}$

The quotient rule is $\dfrac{u'v - uv'}{v^2}$ — and the ORDER of the two products matters, unlike the product rule. With $u = 4x + 6$ and $v = x^2 + 6$: $u' = 4$ and $v' = 2x$, giving $\frac{-4x^2-12x+24}{x^4+12x^2+36}$.

Common mistakes, and the answer each one gives:

- Wrote $uv' - u'v$ in the numerator, the two products swapped → $\frac{4x^2+12x-24}{x^4+12x^2+36}$
- Differentiated top and bottom separately → $\frac{2}{x}$

12

Answer: $8x^7 - 192x^5 + 1536x^3 - 4096x$

Differentiate the outside, keeping the inside as it is, then multiply by the derivative of the inside: $4\left(x^2 - 8\right)^3 \times 2x$, which expands to $8x^7 - 192x^5 + 1536x^3 - 4096x$.

Common mistakes, and the answer each one gives:

- Forgot to multiply by the derivative of the inside → $4x^6 - 96x^4 + 768x^2 - 2048$
- Differentiated the inside and raised THAT to the power → $16x^4$

13

Answer: $256x^3 + 32x$

Outer power 2, inner $8x^2 + 1$, so $f' = 2(8x^2 + 1)^1 \cdot 16x$. This gives $f'(x) = 256x^3 + 32x$.

Common mistakes, and the answer each one gives:

- Differentiated each part separately and combined them → $16x^2 + 2$

14

Answer: -3

$f'(x) = 9x^2 - 9x - 108 = 0$ at $x = -3$ and $x = 4$. $f''(x) = 18x - 9$, and $f''(-3) = -63 < 0$, so $x = -3$ is the maximum.

Common mistakes, and the answer each one gives:

- Gave the local MINIMUM instead → 4
- Gave the y-value rather than the x-coordinate → $\frac{405}{2}$
- Solved f(x) = 0 instead of f'(x) = 0 → 0

15

Answer: $\frac{-6x^2-6x+42}{x^4+14x^2+49}$

The quotient rule is $\dfrac{u'v - uv'}{v^2}$ — and the ORDER of the two products matters, unlike the product rule. With $u = 6x + 3$ and $v = x^2 + 7$: $u' = 6$ and $v' = 2x$, giving $\frac{-6x^2-6x+42}{x^4+14x^2+49}$.

Common mistakes, and the answer each one gives:

- Wrote $uv' - u'v$ in the numerator, the two products swapped → $\frac{6x^2+6x-42}{x^4+14x^2+49}$
- Differentiated top and bottom separately → $\frac{3}{x}$

16

Answer: $750x^5 + 1800x^3 + 1080x$

Differentiate the outside, keeping the inside as it is, then multiply by the derivative of the inside: $3\left(5x^2+6\right)^2 \times 10x$, which expands to $750x^5 + 1800x^3 + 1080x$.

Common mistakes, and the answer each one gives:

- Forgot to multiply by the derivative of the inside → $75x^4 + 180x^2 + 108$
- Differentiated the inside and raised THAT to the power → $1000x^3$

17

Answer: $64x^3 + 16x$

Outer power 2, inner $4x^2+1$, so $f' = 2(4x^2+1)^1 \cdot 8x$. This gives $f'(x) = 64x^3 + 16x$.

Common mistakes, and the answer each one gives:

- Differentiated each part separately and combined them → $8x^2 + 2$

18

Answer: -3

$f'(x) = 12x^2 - 24x - 180 = 0$ at $x = -3$ and $x = 5$. $f''(x) = 24x - 24$, and $f''(-3) = -96 < 0$, so $x = -3$ is the maximum.

Common mistakes, and the answer each one gives:

- Gave the local MINIMUM instead → 5
- Gave the y-value rather than the x-coordinate → 324
- Solved f(x) = 0 instead of f'(x) = 0 → 0

19

Answer: $\frac{-x^2+18x+6}{x^4+12x^2+36}$

The quotient rule is $\dfrac{u'v - uv'}{v^2}$ — and the ORDER of the two products matters, unlike the product rule. With $u = x - 9$ and $v = x^2 + 6$: $u' = 1$ and $v' = 2x$, giving $\frac{-x^2+18x+6}{x^4+12x^2+36}$.

Common mistakes, and the answer each one gives:

- Wrote $uv' - u'v$ in the numerator, the two products swapped → $\frac{x^2-18x-6}{x^4+12x^2+36}$
- Differentiated top and bottom separately → $\frac{1}{2x}$

20

Answer: $320x^9 - 2560x^7 + 7680x^5 - 10240x^3 + 5120x$

Differentiate the outside, keeping the inside as it is, then multiply by the derivative of the inside: $5\left(2x^2-4\right)^4 \times 4x$, which expands to $320x^9 - 2560x^7 + 7680x^5 - 10240x^3 + 5120x$.

Common mistakes, and the answer each one gives:

- Forgot to multiply by the derivative of the inside → $80x^8 - 640x^6 + 1920x^4 - 2560x^2 + 1280$
- Differentiated the inside and raised THAT to the power → $1024x^5$

21

Answer: $\frac{x(x+12)}{x^2+12x+36}$

$u = x^2$, $v = x + 6$, so $f' = \dfrac{u'v - uv'}{v^2}$. This gives $f'(x) = \frac{x(x+12)}{x^2+12x+36}$.

Common mistakes, and the answer each one gives:

- Differentiated each part separately and combined them → $2x$

22

Answer: -4

$f'(x) = 6x^2 - 12x - 144 = 0$ at $x = -4$ and $x = 6$. $f''(x) = 12x - 12$, and $f''(-4) = -60 < 0$, so $x = -4$ is the maximum.

Common mistakes, and the answer each one gives:

- Gave the local MINIMUM instead → 6
- Gave the y-value rather than the x-coordinate → 352
- Solved f(x) = 0 instead of f'(x) = 0 → 0

23

Answer: $\frac{-3x^2+12x+21}{x^4+14x^2+49}$

The quotient rule is $\dfrac{u'v - uv'}{v^2}$ — and the ORDER of the two products matters, unlike the product rule. With $u = 3x - 6$ and $v = x^2 + 7$: $u' = 3$ and $v' = 2x$, giving $\frac{-3x^2+12x+21}{x^4+14x^2+49}$.

Common mistakes, and the answer each one gives:

- Wrote $uv' - u'v$ in the numerator, the two products swapped → $\frac{3x^2-12x-21}{x^4+14x^2+49}$
- Differentiated top and bottom separately → $\frac{3}{2x}$

24

Answer: $48x^5 - 240x^3 + 300x$

Differentiate the outside, keeping the inside as it is, then multiply by the derivative of the inside: $3\left(2x^2 - 5\right)^2 \times 4x$, which expands to $48x^5 - 240x^3 + 300x$.

Common mistakes, and the answer each one gives:

- Forgot to multiply by the derivative of the inside → $12x^4 - 60x^2 + 75$
- Differentiated the inside and raised THAT to the power → $64x^3$

25

Answer: $x^4\left(10x+5\right)e^{10x}$

$u = x^5$, $v = e^{10x}$, so $f' = u'v + uv'$. This gives $f'(x) = x^4\left(10x+5\right)e^{10x}$.

Common mistakes, and the answer each one gives:

- Differentiated each part separately and combined them → $50x^4e^{10x}$

26

Answer: -7

$f'(x) = 3x^2 + 12x - 63 = 0$ at $x = -7$ and $x = 3$. $f''(x) = 6x + 12$, and $f''(-7) = -30 < 0$, so $x = -7$ is the maximum.

Common mistakes, and the answer each one gives:

- Gave the local MINIMUM instead → 3
- Gave the y-value rather than the x-coordinate → 392
- Solved f(x) = 0 instead of f'(x) = 0 → 0

27

Answer: $\frac{4-2x^2}{x^4+4x^2+4}$

The quotient rule is $\dfrac{u'v - uv'}{v^2}$ — and the ORDER of the two products matters, unlike the product rule. With $u = 2x$ and $v = x^2 + 2$: $u' = 2$ and $v' = 2x$, giving $\frac{4-2x^2}{x^4+4x^2+4}$.

Common mistakes, and the answer each one gives:

- Wrote $uv' - u'v$ in the numerator, the two products swapped → $\frac{2x^2-4}{x^4+4x^2+4}$
- Differentiated top and bottom separately → $\frac{1}{x}$

28

Answer: $8x^7$

Differentiate the outside, keeping the inside as it is, then multiply by the derivative of the inside: $4\left(x^2\right)^3 \times 2x$, which expands to $8x^7$.

Common mistakes, and the answer each one gives:

- Forgot to multiply by the derivative of the inside → $4x^6$
- Differentiated the inside and raised THAT to the power → $16x^4$

29

Answer: $\frac{x(x+18)}{x^2+18x+81}$

$u = x^2$, $v = x + 9$, so $f' = \dfrac{u'v - uv'}{v^2}$. This gives $f'(x) = \frac{x(x+18)}{x^2+18x+81}$.

Common mistakes, and the answer each one gives:

- Differentiated each part separately and combined them → $2x$

30

Answer: -1

$f'(x) = 12x^2 - 12 = 0$ at $x = -1$ and $x = 1$. $f''(x) = 24x$, and $f''(-1) = -24 < 0$, so $x = -1$ is the maximum.

Common mistakes, and the answer each one gives:

- Gave the local MINIMUM instead → 1
- Gave the y-value rather than the x-coordinate → 8
- Solved f(x) = 0 instead of f'(x) = 0 → 0

9. Trigonometry

Exact values, identities and trigonometric equations. Set for OMPT-B, OMPT-D and OMPT-G.

Questions

1

Give the exact value: $\sin\left(\frac{3\pi}{4}\right)$

Answer: ____________________

2

Give the SMALLEST NON-NEGATIVE solution: $3\cos(x) = \frac{3\sqrt{2}}{2}$

Answer: ____________________

3

Simplify as far as possible: $9\tan(x)\cos(x)$

Answer: ____________________

4

Give the exact value: $\cos\left(\frac{\pi}{3}\right)$

Answer: ____________________

5

Give the SMALLEST NON-NEGATIVE solution: $4\sin(x) = 2\sqrt{2}$

Answer: ______________________

6

Simplify as far as possible: $5\tan(x)\cos(x)$

Answer: ______________________

7

Give the exact value: $\cos\left(\frac{3\pi}{4}\right)$

Answer: ______________________

8

Give the SMALLEST NON-NEGATIVE solution: $2\sin(x) = 1$

Answer: ______________________

9

Simplify as far as possible: $6\sin^2(x) + 6\cos^2(x)$

Answer: ______________________

10

Give the exact value: $\cos\left(\frac{\pi}{6}\right)$

Answer: ____________________

11

Give the SMALLEST NON-NEGATIVE solution: $2\sin(x) = \sqrt{2}$

Answer: ____________________

12

Simplify as far as possible: $3\tan(x)\cos(x)$

Answer: ____________________

13

Give the exact value: $\sin\left(\frac{5\pi}{6}\right)$

Answer: ____________________

14

Give the SMALLEST NON-NEGATIVE solution: $7\sin(x) = \frac{7\sqrt{3}}{2}$

Answer: ____________________

15

Simplify as far as possible: $9\sin^2(x) + 9\cos^2(x)$

Answer: ______________________

16

Give the exact value: $\sin(\pi)$

Answer: ______________________

17

Give the SMALLEST NON-NEGATIVE solution: $9\sin(x) = \frac{9\sqrt{2}}{2}$

Answer: ______________________

18

Simplify as far as possible: $4\sin^2(x) + 4\cos^2(x)$

Answer: ______________________

19

Give the exact value: $\sin\left(\frac{\pi}{3}\right)$

Answer: ______________________

20

Give the SMALLEST NON-NEGATIVE solution: $6\cos(x) = 3$

Answer: ______________________

21

Simplify as far as possible: $7\tan(x)\cos(x)$

Answer: ______________________

22

Give the exact value: $\cos\left(\frac{\pi}{2}\right)$

Answer: ______________________

23

Give the SMALLEST NON-NEGATIVE solution: $5\cos(x) = \frac{5\sqrt{2}}{2}$

Answer: ______________________

24

Simplify as far as possible: $8\tan(x)\cos(x)$

Answer: ______________________

25

Give the exact value: $\cos\left(\frac{5\pi}{6}\right)$

Answer: ____________________

26

Give the SMALLEST NON-NEGATIVE solution: $8\cos(x) = 4\sqrt{2}$

Answer: ____________________

27

Simplify as far as possible: $7\sin^2(x) + 7\cos^2(x)$

Answer: ____________________

28

Give the exact value: $\cos(\pi)$

Answer: ____________________

29

Give the SMALLEST NON-NEGATIVE solution: $8\sin(x) = 4$

Answer: ____________________

30

Simplify as far as possible: $5\sin^2(x)+5\cos^2(x)$

Answer: ______________________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: $\frac{\sqrt{2}}{2}$

$\frac{3\pi}{4}$ is a special angle, so the value is exact rather than a decimal. Read it off the unit circle: $\sin\left(\frac{3\pi}{4}\right) = \frac{\sqrt{2}}{2}$.

Common mistakes, and the answer each one gives:

- Gave the cosine instead → $-\frac{\sqrt{2}}{2}$
- Worked in degrees, reading the number as an angle in degrees → $\sin\left(\frac{\pi}{240}\right)$

2

Answer: $\frac{\pi}{4}$

Divide by 3 first: $\cos(x) = \frac{\sqrt{2}}{2}$. That is a special value, and the smallest angle at or above zero with it is $\frac{\pi}{4}$. (Others follow every 2π, and there is a second one inside the first turn unless the value is 1.)

Common mistakes, and the answer each one gives:

- Gave the other solution inside the first turn, which is larger → $\frac{7\pi}{4}$
- Forgot to divide by the coefficient before taking the inverse → 0

3

Answer: $9\sin(x)$

Use $\sin^2(x) + \cos^2(x) = 1$ and $\tan(x) = \dfrac{\sin(x)}{\cos(x)}$. Here that reduces the expression to $9\sin(x)$.

Common mistakes, and the answer each one gives:

- Cancelled to the cosine rather than the sine → $9\cos(x)$
- Left the tangent untouched → $9\tan(x)$

4

Answer: $\frac{1}{2}$

$\frac{\pi}{3}$ is a special angle, so the value is exact rather than a decimal. Read it off the unit circle: $\cos\left(\frac{\pi}{3}\right) = \frac{1}{2}$.

Common mistakes, and the answer each one gives:

- Gave the sine instead → $\frac{\sqrt{3}}{2}$
- Worked in degrees, reading the number as an angle in degrees → $\cos\left(\frac{\pi}{540}\right)$

5

Answer: $\frac{\pi}{4}$

Divide by 4 first: $\sin(x) = \frac{\sqrt{2}}{2}$. That is a special value, and the smallest angle at or above zero with it is $\frac{\pi}{4}$. (Others follow every 2π, and there is a second one inside the first turn unless the value is 1.)

Common mistakes, and the answer each one gives:

- Gave the other solution inside the first turn, which is larger → $\frac{3\pi}{4}$
- Forgot to divide by the coefficient before taking the inverse → $\frac{\pi}{2}$

6

Answer: $5\sin\left(x\right)$

Use $\sin^2(x)+\cos^2(x)=1$ and $\tan(x)=\dfrac{\sin(x)}{\cos(x)}$. Here that reduces the expression to $5\sin\left(x\right)$.

Common mistakes, and the answer each one gives:

- Cancelled to the cosine rather than the sine → $5\cos\left(x\right)$
- Left the tangent untouched → $5\tan\left(x\right)$

7

Answer: $-\frac{\sqrt{2}}{2}$

$\frac{3\pi}{4}$ is a special angle, so the value is exact rather than a decimal. Read it off the unit circle: $\cos\left(\frac{3\pi}{4}\right)=-\frac{\sqrt{2}}{2}$.

Common mistakes, and the answer each one gives:

- Gave the sine instead → $\frac{\sqrt{2}}{2}$
- Worked in degrees, reading the number as an angle in degrees → $\cos\left(\frac{\pi}{240}\right)$

8

Answer: $\frac{\pi}{6}$

Divide by 2 first: $\sin(x)=\frac{1}{2}$. That is a special value, and the smallest angle at or above zero with it is $\frac{\pi}{6}$. (Others follow every 2π, and there is a second one inside the first turn unless the value is 1.)

Common mistakes, and the answer each one gives:

- Gave the other solution inside the first turn, which is larger → $\frac{5\pi}{6}$
- Forgot to divide by the coefficient before taking the inverse → $\frac{\pi}{2}$

9

Answer: 6

Use $\sin^2(x) + \cos^2(x) = 1$ and $\tan(x) = \dfrac{\sin(x)}{\cos(x)}$. Here that reduces the expression to 6.

Common mistakes, and the answer each one gives:

- Added the arguments instead of using the identity → 12
- Treated $\sin^2 + \cos^2$ as 0 → 0

10

Answer: $\frac{\sqrt{3}}{2}$

$\frac{\pi}{6}$ is a special angle, so the value is exact rather than a decimal. Read it off the unit circle: $\cos\left(\frac{\pi}{6}\right) = \frac{\sqrt{3}}{2}$.

Common mistakes, and the answer each one gives:

- Gave the sine instead → $\frac{1}{2}$
- Worked in degrees, reading the number as an angle in degrees → $\cos\left(\frac{\pi}{1080}\right)$

11

Answer: $\frac{\pi}{4}$

Divide by 2 first: $\sin(x) = \frac{\sqrt{2}}{2}$. That is a special value, and the smallest angle at or above zero with it is $\frac{\pi}{4}$. (Others follow every 2π, and there is a second one inside the first turn unless the value is 1.)

Common mistakes, and the answer each one gives:

- Gave the other solution inside the first turn, which is larger → $\frac{3\pi}{4}$
- Forgot to divide by the coefficient before taking the inverse → $\frac{\pi}{2}$

12

Answer: $3\sin(x)$

Use $\sin^2(x) + \cos^2(x) = 1$ and $\tan(x) = \dfrac{\sin(x)}{\cos(x)}$. Here that reduces the expression to $3\sin(x)$.

Common mistakes, and the answer each one gives:

- Cancelled to the cosine rather than the sine → $3\cos(x)$
- Left the tangent untouched → $3\tan(x)$

13

Answer: $\frac{1}{2}$

$\frac{5\pi}{6}$ is a special angle, so the value is exact rather than a decimal. Read it off the unit circle: $\sin\left(\frac{5\pi}{6}\right) = \frac{1}{2}$.

Common mistakes, and the answer each one gives:

- Gave the cosine instead → $-\frac{\sqrt{3}}{2}$
- Worked in degrees, reading the number as an angle in degrees → $\sin\left(\frac{\pi}{216}\right)$

14

Answer: $\frac{\pi}{3}$

Divide by 7 first: $\sin(x) = \frac{\sqrt{3}}{2}$. That is a special value, and the smallest angle at or above zero with it is $\frac{\pi}{3}$. (Others follow every 2π, and there is a second one inside the first turn unless the value is 1.)

Common mistakes, and the answer each one gives:

- Gave the other solution inside the first turn, which is larger → $\frac{2\pi}{3}$
- Forgot to divide by the coefficient before taking the inverse → $\frac{\pi}{2}$

15

Answer: 9

Use $\sin^2(x) + \cos^2(x) = 1$ and $\tan(x) = \dfrac{\sin(x)}{\cos(x)}$. Here that reduces the expression to 9.

Common mistakes, and the answer each one gives:

- Added the arguments instead of using the identity → 18
- Treated $\sin^2 + \cos^2$ as 0 → 0

16

Answer: 0

π is a special angle, so the value is exact rather than a decimal. Read it off the unit circle: $\sin(\pi) = 0$.

Common mistakes, and the answer each one gives:

- Gave the cosine instead → -1
- Worked in degrees, reading the number as an angle in degrees → $\sin\left(\frac{\pi}{180}\right)$

17

Answer: $\frac{\pi}{4}$

Divide by 9 first: $\sin(x) = \frac{\sqrt{2}}{2}$. That is a special value, and the smallest angle at or above zero with it is $\frac{\pi}{4}$. (Others follow every 2π, and there is a second one inside the first turn unless the value is 1.)

Common mistakes, and the answer each one gives:

- Gave the other solution inside the first turn, which is larger → $\frac{3\pi}{4}$
- Forgot to divide by the coefficient before taking the inverse → $\frac{\pi}{2}$

18

Answer: 4

Use $\sin^2(x) + \cos^2(x) = 1$ and $\tan(x) = \dfrac{\sin(x)}{\cos(x)}$. Here that reduces the expression to 4.

Common mistakes, and the answer each one gives:

- Added the arguments instead of using the identity → 8
- Treated $\sin^2 + \cos^2$ as 0 → 0

19

Answer: $\frac{\sqrt{3}}{2}$

$\frac{\pi}{3}$ is a special angle, so the value is exact rather than a decimal. Read it off the unit circle: $\sin\left(\frac{\pi}{3}\right) = \frac{\sqrt{3}}{2}$.

Common mistakes, and the answer each one gives:

- Gave the cosine instead → $\frac{1}{2}$
- Worked in degrees, reading the number as an angle in degrees → $\sin\left(\frac{\pi}{540}\right)$

20

Answer: $\frac{\pi}{3}$

Divide by 6 first: $\cos(x) = \frac{1}{2}$. That is a special value, and the smallest angle at or above zero with it is $\frac{\pi}{3}$. (Others follow every 2π, and there is a second one inside the first turn unless the value is 1.)

Common mistakes, and the answer each one gives:

- Gave the other solution inside the first turn, which is larger → $\frac{5\pi}{3}$
- Forgot to divide by the coefficient before taking the inverse → 0

21

Answer: $7\sin(x)$

Use $\sin^2(x)+\cos^2(x)=1$ and $\tan(x)=\dfrac{\sin(x)}{\cos(x)}$. Here that reduces the expression to $7\sin(x)$.

Common mistakes, and the answer each one gives:

- Cancelled to the cosine rather than the sine → $7\cos(x)$
- Left the tangent untouched → $7\tan(x)$

22

Answer: 0

$\frac{\pi}{2}$ is a special angle, so the value is exact rather than a decimal. Read it off the unit circle: $\cos\left(\frac{\pi}{2}\right)=0$.

Common mistakes, and the answer each one gives:

- Gave the sine instead → 1
- Worked in degrees, reading the number as an angle in degrees → $\cos\left(\frac{\pi}{360}\right)$

23

Answer: $\frac{\pi}{4}$

Divide by 5 first: $\cos(x)=\frac{\sqrt{2}}{2}$. That is a special value, and the smallest angle at or above zero with it is $\frac{\pi}{4}$. (Others follow every 2π, and there is a second one inside the first turn unless the value is 1.)

Common mistakes, and the answer each one gives:

- Gave the other solution inside the first turn, which is larger → $\frac{7\pi}{4}$
- Forgot to divide by the coefficient before taking the inverse → 0

24

Answer: $8\sin(x)$

Use $\sin^2(x)+\cos^2(x)=1$ and $\tan(x)=\dfrac{\sin(x)}{\cos(x)}$. Here that reduces the expression to $8\sin(x)$.

Common mistakes, and the answer each one gives:

- Cancelled to the cosine rather than the sine → $8\cos(x)$
- Left the tangent untouched → $8\tan(x)$

25

Answer: $-\frac{\sqrt{3}}{2}$

$\frac{5\pi}{6}$ is a special angle, so the value is exact rather than a decimal. Read it off the unit circle: $\cos\left(\frac{5\pi}{6}\right)=-\frac{\sqrt{3}}{2}$.

Common mistakes, and the answer each one gives:

- Gave the sine instead → $\frac{1}{2}$
- Worked in degrees, reading the number as an angle in degrees → $\cos\left(\frac{\pi}{216}\right)$

26

Answer: $\frac{\pi}{4}$

Divide by 8 first: $\cos(x)=\frac{\sqrt{2}}{2}$. That is a special value, and the smallest angle at or above zero with it is $\frac{\pi}{4}$. (Others follow every 2π, and there is a second one inside the first turn unless the value is 1.)

Common mistakes, and the answer each one gives:

- Gave the other solution inside the first turn, which is larger → $\frac{7\pi}{4}$
- Forgot to divide by the coefficient before taking the inverse → 0

27

Answer: 7

Use $\sin^2(x) + \cos^2(x) = 1$ and $\tan(x) = \dfrac{\sin(x)}{\cos(x)}$. Here that reduces the expression to 7.

Common mistakes, and the answer each one gives:

- Added the arguments instead of using the identity → 14
- Treated $\sin^2 + \cos^2$ as 0 → 0

28

Answer: -1

π is a special angle, so the value is exact rather than a decimal. Read it off the unit circle: $\cos(\pi) = -1$.

Common mistakes, and the answer each one gives:

- Gave the sine instead → 0
- Worked in degrees, reading the number as an angle in degrees → $\cos\left(\frac{\pi}{180}\right)$

29

Answer: $\frac{\pi}{6}$

Divide by 8 first: $\sin(x) = \frac{1}{2}$. That is a special value, and the smallest angle at or above zero with it is $\frac{\pi}{6}$. (Others follow every 2π, and there is a second one inside the first turn unless the value is 1.)

Common mistakes, and the answer each one gives:

- Gave the other solution inside the first turn, which is larger → $\frac{5\pi}{6}$
- Forgot to divide by the coefficient before taking the inverse → $\frac{\pi}{2}$

30

Answer: 5

Use $\sin^2(x) + \cos^2(x) = 1$ and $\tan(x) = \dfrac{\sin(x)}{\cos(x)}$. Here that reduces the expression to 5.

Common mistakes, and the answer each one gives:

- Added the arguments instead of using the identity → 10
- Treated $\sin^2 + \cos^2$ as 0 → 0

10. Integration

Antiderivatives and definite integrals. Set for OMPT-B and OMPT-D.

Questions

1

Find the antiderivative of $f(x) = 2x^4 + 3$ that passes through the origin.

Answer: ______________________

2

Evaluate exactly: $\int_2^6 2x^2 \, dx$

Answer: ______________________

3

Find the antiderivative of $f(x) = 3x^4$ that passes through the origin.

Answer: ______________________

4

Evaluate exactly: $\int_1^3 x \, dx$

Answer: ______________________

5

Find the antiderivative of $f(x) = 2x^4 + 1$ that passes through the origin.

Answer: ______________________

6

Evaluate exactly: $\int_2^4 5x^3\,dx$

Answer: ______________________

7

Find the antiderivative of $f(x) = 4x^5 + 5$ that passes through the origin.

Answer: ______________________

8

Evaluate exactly: $\int_3^4 4x^3\,dx$

Answer: ______________________

9

Find the antiderivative of $f(x) = 5x^5 - 3$ that passes through the origin.

Answer: ______________________

10

Evaluate exactly: $\int_{0}^{3} 5x \, dx$

Answer: ____________________

11

Find the antiderivative of $f(x) = 3x^5 - 7$ that passes through the origin.

Answer: ____________________

12

Evaluate exactly: $\int_{3}^{7} 3x^2 \, dx$

Answer: ____________________

13

Find the antiderivative of $f(x) = x^2 - 7$ that passes through the origin.

Answer: ____________________

14

Evaluate exactly: $\int_{0}^{2} x^3 \, dx$

Answer: ____________________

15

Find the antiderivative of $f(x) = 3x^4 + 1$ that passes through the origin.

Answer: ____________________

16

Evaluate exactly: $\int_0^1 4x^2 \, dx$

Answer: ____________________

17

Find the antiderivative of $f(x) = 6x^2 + 7$ that passes through the origin.

Answer: ____________________

18

Evaluate exactly: $\int_2^4 5x \, dx$

Answer: ____________________

19

Find the antiderivative of $f(x) = 4x^2 - 5$ that passes through the origin.

Answer: ____________________

20

Evaluate exactly: $\int_0^3 2x^3\,dx$

Answer: ______________________

21

Find the antiderivative of $f(x) = 4x^4 - 8$ that passes through the origin.

Answer: ______________________

22

Evaluate exactly: $\int_1^2 5x^3\,dx$

Answer: ______________________

23

Find the antiderivative of $f(x) = 2x^4 - 2$ that passes through the origin.

Answer: ______________________

24

Evaluate exactly: $\int_3^7 4x\,dx$

Answer: ______________________

25

Find the antiderivative of $f(x) = 2x^2$ that passes through the origin.

Answer: ____________________

26

Evaluate exactly: $\int_1^4 5x^3\,dx$

Answer: ____________________

27

Find the antiderivative of $f(x) = 6x^4 + 8$ that passes through the origin.

Answer: ____________________

28

Evaluate exactly: $\int_0^3 3x^3\,dx$

Answer: ____________________

29

Find the antiderivative of $f(x) = x^5 + 1$ that passes through the origin.

Answer: ____________________

30

Evaluate exactly: $\int_{2}^{5} x\,dx$

Answer: ______________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: $\frac{2x^5}{5} + 3x$

Raise each exponent by one and divide by the new exponent: $\dfrac{2x^5}{5} + 3x + C$. Passing through the origin makes $C = 0$, so the answer is $\frac{2x^5}{5} + 3x$.

Common mistakes, and the answer each one gives:

- Differentiated instead of integrating → $8x^3$
- Raised the exponent but did not divide by the new one → $2x^5 + 3x$

2

Answer: $\frac{416}{3}$

Integrate first: $\int 2x^2\,dx = \frac{2x^3}{3}$. Then substitute the upper limit and subtract the lower: $\left[\frac{2x^3}{3}\right]_2^6 = 144 - \frac{16}{3} = \frac{416}{3}$.

Common mistakes, and the answer each one gives:

- Subtracted the wrong way round → $-\frac{416}{3}$
- Substituted the limits into the ORIGINAL function, not its integral → 64

3

Answer: $\frac{3x^5}{5}$

Raise each exponent by one and divide by the new exponent: $\dfrac{3x^5}{5} + C$. Passing through the origin makes $C = 0$, so the answer is $\frac{3x^5}{5}$.

Common mistakes, and the answer each one gives:

- Differentiated instead of integrating → $12x^3$
- Raised the exponent but did not divide by the new one → $3x^5$

4

Answer: 4

Integrate first: $\int x\,dx = \frac{x^2}{2}$. Then substitute the upper limit and subtract the lower: $\left[\frac{x^2}{2}\right]_1^3 = \frac{9}{2} - \frac{1}{2} = 4.$

Common mistakes, and the answer each one gives:

- Subtracted the wrong way round → -4
- Substituted the limits into the ORIGINAL function, not its integral → 2

5

Answer: $\frac{2x^5}{5} + x$

Raise each exponent by one and divide by the new exponent: $\dfrac{2x^5}{5} + x + C$. Passing through the origin makes $C = 0$, so the answer is $\frac{2x^5}{5} + x$.

Common mistakes, and the answer each one gives:

- Differentiated instead of integrating → $8x^3$
- Raised the exponent but did not divide by the new one → $2x^5 + x$

6

Answer: 300

Integrate first: $\int 5x^3\,dx = \frac{5x^4}{4}$. Then substitute the upper limit and subtract the lower: $\left[\frac{5x^4}{4}\right]_2^4 = 320 - 20 = 300.$

Common mistakes, and the answer each one gives:

- Subtracted the wrong way round → -300
- Substituted the limits into the ORIGINAL function, not its integral → 280

7

Answer: $\frac{2x^6}{3} + 5x$

Raise each exponent by one and divide by the new exponent: $\dfrac{4x^6}{6} + 5x + C$. Passing through the origin makes $C = 0$, so the answer is $\frac{2x^6}{3} + 5x$.

Common mistakes, and the answer each one gives:

- Differentiated instead of integrating → $20x^4$
- Raised the exponent but did not divide by the new one → $4x^6 + 5x$

8

Answer: 175

Integrate first: $\int 4x^3\,dx = x^4$. Then substitute the upper limit and subtract the lower: $\left[x^4\right]_3^4 = 256 - 81 = 175$.

Common mistakes, and the answer each one gives:

- Subtracted the wrong way round → -175
- Substituted the limits into the ORIGINAL function, not its integral → 148

9

Answer: $\frac{5x^6}{6} - 3x$

Raise each exponent by one and divide by the new exponent: $\dfrac{5x^6}{6} - 3x + C$. Passing through the origin makes $C = 0$, so the answer is $\frac{5x^6}{6} - 3x$.

Common mistakes, and the answer each one gives:

- Differentiated instead of integrating → $25x^4$
- Raised the exponent but did not divide by the new one → $5x^6 - 3x$

10

Answer: $\frac{45}{2}$

Integrate first: $\int 5x\,dx = \frac{5x^2}{2}$. Then substitute the upper limit and subtract the lower: $\left[\frac{5x^2}{2}\right]_0^3 = \frac{45}{2} - 0 = \frac{45}{2}$.

Common mistakes, and the answer each one gives:

- Subtracted the wrong way round → $-\frac{45}{2}$
- Substituted the limits into the ORIGINAL function, not its integral → 15

11

Answer: $\frac{x^6}{2} - 7x$

Raise each exponent by one and divide by the new exponent: $\dfrac{3x^6}{6} - 7x + C$. Passing through the origin makes $C = 0$, so the answer is $\frac{x^6}{2} - 7x$.

Common mistakes, and the answer each one gives:

- Differentiated instead of integrating → $15x^4$
- Raised the exponent but did not divide by the new one → $3x^6 - 7x$

12

Answer: 316

Integrate first: $\int 3x^2\,dx = x^3$. Then substitute the upper limit and subtract the lower: $\left[x^3\right]_3^7 = 343 - 27 = 316$.

Common mistakes, and the answer each one gives:

- Subtracted the wrong way round → -316
- Substituted the limits into the ORIGINAL function, not its integral → 120

13

Answer: $\frac{x^3}{3} - 7x$

Raise each exponent by one and divide by the new exponent: $\dfrac{1x^3}{3} - 7x + C$. Passing through the origin makes $C = 0$, so the answer is $\frac{x^3}{3} - 7x$.

Common mistakes, and the answer each one gives:

- Differentiated instead of integrating → $2x$
- Raised the exponent but did not divide by the new one → $x^3 - 7x$

14

Answer: 4

Integrate first: $\int x^3\,dx = \frac{x^4}{4}$. Then substitute the upper limit and subtract the lower: $\left[\frac{x^4}{4}\right]_0^2 = 4 - 0 = 4$.

Common mistakes, and the answer each one gives:

- Subtracted the wrong way round → -4
- Substituted the limits into the ORIGINAL function, not its integral → 8

15

Answer: $\frac{3x^5}{5} + x$

Raise each exponent by one and divide by the new exponent: $\dfrac{3x^5}{5} + x + C$. Passing through the origin makes $C = 0$, so the answer is $\frac{3x^5}{5} + x$.

Common mistakes, and the answer each one gives:

- Differentiated instead of integrating → $12x^3$
- Raised the exponent but did not divide by the new one → $3x^5 + x$

16

Answer: $\frac{4}{3}$

Integrate first: $\int 4x^2\,dx = \frac{4x^3}{3}$. Then substitute the upper limit and subtract the lower: $\left[\frac{4x^3}{3}\right]_0^1 = \frac{4}{3} - 0 = \frac{4}{3}$.

Common mistakes, and the answer each one gives:

- Subtracted the wrong way round → $-\frac{4}{3}$
- Substituted the limits into the ORIGINAL function, not its integral → 4

17

Answer: $2x^3 + 7x$

Raise each exponent by one and divide by the new exponent: $\dfrac{6x^3}{3} + 7x + C$. Passing through the origin makes $C = 0$, so the answer is $2x^3 + 7x$.

Common mistakes, and the answer each one gives:

- Differentiated instead of integrating → $12x$
- Raised the exponent but did not divide by the new one → $6x^3 + 7x$

18

Answer: 30

Integrate first: $\int 5x\,dx = \frac{5x^2}{2}$. Then substitute the upper limit and subtract the lower: $\left[\frac{5x^2}{2}\right]_2^4 = 40 - 10 = 30$.

Common mistakes, and the answer each one gives:

- Subtracted the wrong way round → -30
- Substituted the limits into the ORIGINAL function, not its integral → 10

19

Answer: $\frac{4x^3}{3} - 5x$

Raise each exponent by one and divide by the new exponent: $\dfrac{4x^3}{3} - 5x + C$. Passing through the origin makes $C = 0$, so the answer is $\frac{4x^3}{3} - 5x$.

Common mistakes, and the answer each one gives:

- Differentiated instead of integrating → $8x$
- Raised the exponent but did not divide by the new one → $4x^3 - 5x$

20

Answer: $\frac{81}{2}$

Integrate first: $\int 2x^3\,dx = \frac{x^4}{2}$. Then substitute the upper limit and subtract the lower: $\left[\frac{x^4}{2}\right]_0^3 = \frac{81}{2} - 0 = \frac{81}{2}$.

Common mistakes, and the answer each one gives:

- Subtracted the wrong way round → $-\frac{81}{2}$
- Substituted the limits into the ORIGINAL function, not its integral → 54

21

Answer: $\frac{4x^5}{5} - 8x$

Raise each exponent by one and divide by the new exponent: $\dfrac{4x^5}{5} - 8x + C$. Passing through the origin makes $C = 0$, so the answer is $\frac{4x^5}{5} - 8x$.

Common mistakes, and the answer each one gives:

- Differentiated instead of integrating → $16x^3$
- Raised the exponent but did not divide by the new one → $4x^5 - 8x$

22

Answer: $\frac{75}{4}$

Integrate first: $\int 5x^3\,dx = \frac{5x^4}{4}$. Then substitute the upper limit and subtract the lower: $\left[\frac{5x^4}{4}\right]_1^2 = 20 - \frac{5}{4} = \frac{75}{4}$.

Common mistakes, and the answer each one gives:

- Subtracted the wrong way round → $-\frac{75}{4}$
- Substituted the limits into the ORIGINAL function, not its integral → 35

23

Answer: $\frac{2x^5}{5} - 2x$

Raise each exponent by one and divide by the new exponent: $$\frac{2x^5}{5} - 2x + C$$. Passing through the origin makes $C = 0$, so the answer is $\frac{2x^5}{5} - 2x$.

Common mistakes, and the answer each one gives:

- Differentiated instead of integrating → $8x^3$
- Raised the exponent but did not divide by the new one → $2x^5 - 2x$

24

Answer: 80

Integrate first: $\int 4x\,dx = 2x^2$. Then substitute the upper limit and subtract the lower: $\left[2x^2\right]_3^7 = 98 - 18 = 80$.

Common mistakes, and the answer each one gives:

- Subtracted the wrong way round → -80
- Substituted the limits into the ORIGINAL function, not its integral → 16

25

Answer: $\frac{2x^3}{3}$

Raise each exponent by one and divide by the new exponent: $\dfrac{2x^3}{3} + C$. Passing through the origin makes $C = 0$, so the answer is $\frac{2x^3}{3}$.

Common mistakes, and the answer each one gives:

- Differentiated instead of integrating → $4x$
- Raised the exponent but did not divide by the new one → $2x^3$

26

Answer: $\frac{1275}{4}$

Integrate first: $\int 5x^3\,dx = \frac{5x^4}{4}$. Then substitute the upper limit and subtract the lower: $\left[\frac{5x^4}{4}\right]_1^4 = 320 - \frac{5}{4} = \frac{1275}{4}$.

Common mistakes, and the answer each one gives:

- Subtracted the wrong way round → $-\frac{1275}{4}$
- Substituted the limits into the ORIGINAL function, not its integral → 315

27

Answer: $\frac{6x^5}{5} + 8x$

Raise each exponent by one and divide by the new exponent: $\dfrac{6x^5}{5} + 8x + C$. Passing through the origin makes $C = 0$, so the answer is $\frac{6x^5}{5} + 8x$.

Common mistakes, and the answer each one gives:

- Differentiated instead of integrating → $24x^3$
- Raised the exponent but did not divide by the new one → $6x^5 + 8x$

28

Answer: $\frac{243}{4}$

Integrate first: $\int 3x^3\,dx = \frac{3x^4}{4}$. Then substitute the upper limit and subtract the lower: $\left[\frac{3x^4}{4}\right]_0^3 = \frac{243}{4} - 0 = \frac{243}{4}$.

Common mistakes, and the answer each one gives:

- Subtracted the wrong way round → $-\frac{243}{4}$
- Substituted the limits into the ORIGINAL function, not its integral → 81

29

Answer: $\frac{x^6}{6} + x$

Raise each exponent by one and divide by the new exponent: $\dfrac{1x^6}{6} + x + C$. Passing through the origin makes $C = 0$, so the answer is $\frac{x^6}{6} + x$.

Common mistakes, and the answer each one gives:

- Differentiated instead of integrating → $5x^4$
- Raised the exponent but did not divide by the new one → $x^6 + x$

30

Answer: $\frac{21}{2}$

Integrate first: $\int x\,dx = \frac{x^2}{2}$. Then substitute the upper limit and subtract the lower: $\left[\frac{x^2}{2}\right]_2^5 = \frac{25}{2} - 2 = \frac{21}{2}$.

Common mistakes, and the answer each one gives:

- Subtracted the wrong way round → $-\frac{21}{2}$
- Substituted the limits into the ORIGINAL function, not its integral → 3

11. Descriptive statistics

Mean, median and the spread of a data set. Set for OMPT-E.

Questions

1

For the data set $2, 16, 8, 28, 23, 17$, give the exact MEDIAN.

Answer: ____________________

2

For the data set $22, 16, 26, 5, 4$, give the exact VARIANCE.

Answer: ____________________

3

For the data set $11, 13, 30, 10, 1, 16, 18$, give the exact MEAN.

Answer: ____________________

4

For the data set $16, 21, 11, 28, 24$, give the exact VARIANCE.

Answer: ____________________

5

For the data set $11, 16, 7, 12, 13, 11$, give the exact MEAN.

Answer: ______________________

6

For the data set $18, 25, 17, 18, 29$, give the exact VARIANCE.

Answer: ______________________

7

For the data set $5, 28, 30, 28, 29$, give the exact MEDIAN.

Answer: ______________________

8

For the data set $21, 6, 8, 21, 26$, give the exact RANGE.

Answer: ______________________

9

For the data set $24, 7, 19, 11, 26, 19, 12$, give the exact MEAN.

Answer: ______________________

10

For the data set $27, 23, 10, 24, 14$, give the exact VARIANCE.

Answer: ______________________

11

For the data set $26, 7, 17, 16, 14, 24$, give the exact MEDIAN.

Answer: ______________________

12

For the data set $2, 5, 28, 12, 16$, give the exact VARIANCE.

Answer: ______________________

13

For the data set $18, 21, 20, 4, 18$, give the exact MEDIAN.

Answer: ______________________

14

For the data set $18, 28, 20, 19, 5$, give the exact VARIANCE.

Answer: ______________________

15

For the data set $10, 2, 24, 19, 29, 28$, give the exact MEAN.

Answer: ______________________

16

For the data set $23, 13, 26, 15, 10$, give the exact RANGE.

Answer: ______________________

17

For the data set $21, 2, 9, 12, 25, 14$, give the exact MEAN.

Answer: ______________________

18

For the data set $4, 17, 15, 1, 9$, give the exact RANGE.

Answer: ______________________

19

For the data set $18, 16, 5, 10, 9, 23$, give the exact MEAN.

Answer: ______________________

20

For the data set $27, 1, 1, 8, 2$, give the exact VARIANCE.

Answer: ______________________

21

For the data set $8, 7, 2, 4, 1, 18, 10$, give the exact MEAN.

Answer: ______________________

22

For the data set $23, 24, 14, 7, 25$, give the exact VARIANCE.

Answer: ______________________

23

For the data set $29, 11, 14, 27, 1, 12$, give the exact MEDIAN.

Answer: ______________________

24

For the data set $4, 14, 9, 4, 27$, give the exact RANGE.

Answer: ______________________

25

For the data set $24, 4, 6, 4, 11, 7, 16$, give the exact MEDIAN.

Answer: ______________________________

26

For the data set $27, 4, 9, 8, 2$, give the exact VARIANCE.

Answer: ______________________________

27

For the data set $2, 3, 18, 22, 14, 24$, give the exact MEDIAN.

Answer: ______________________________

28

For the data set $1, 27, 11, 11, 4$, give the exact RANGE.

Answer: ______________________________

29

For the data set $8, 4, 29, 2, 1, 10$, give the exact MEAN.

Answer: ______________________________

30

For the data set $16, 3, 28, 26, 26$, give the exact VARIANCE.

Answer: ______________________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: $\frac{33}{2}$

Put the values in order first — $2, 8, 16, 17, 23, 28$ — then take the middle one: $\frac{33}{2}$.

Common mistakes, and the answer each one gives:

- Gave the mean instead of the median → $\frac{47}{3}$
- Took the middle of the list AS WRITTEN, without sorting it first → 28

2

Answer: $\frac{1956}{25}$

The mean is $\frac{73}{5}$. Square each value's distance from it, add those up and divide by 5: $\frac{1956}{25}$.

Common mistakes, and the answer each one gives:

- Gave the range instead of the variance → 22
- Added the distances from the mean without squaring them → $\frac{202}{25}$

3

Answer: $\frac{99}{7}$

The mean is the total divided by how many there are: $\dfrac{99}{7} = \frac{99}{7}$.

Common mistakes, and the answer each one gives:

- Gave the median instead of the mean → 13
- Took the middle of the list AS WRITTEN, without sorting it first → 10

4

Answer: $\frac{178}{5}$

The mean is 20. Square each value's distance from it, add those up and divide by 5: $\frac{178}{5}$.

Common mistakes, and the answer each one gives:

- Gave the range instead of the variance → 17
- Added the distances from the mean without squaring them → $\frac{26}{5}$

5

Answer: $\frac{35}{3}$

The mean is the total divided by how many there are: $\dfrac{70}{6} = \frac{35}{3}$.

Common mistakes, and the answer each one gives:

- Gave the median instead of the mean → $\frac{23}{2}$
- Took the middle of the list AS WRITTEN, without sorting it first → 12

6

Answer: $\frac{566}{25}$

The mean is $\frac{107}{5}$. Square each value's distance from it, add those up and divide by 5: $\frac{566}{25}$.

Common mistakes, and the answer each one gives:

- Gave the range instead of the variance → 12
- Added the distances from the mean without squaring them → $\frac{112}{25}$

7

Answer: 28

Put the values in order first — $5, 28, 28, 29, 30$ — then take the middle one: 28.

Common mistakes, and the answer each one gives:

- Gave the mean instead of the median → 24
- Took the middle of the list AS WRITTEN, without sorting it first → 30

8

Answer: 20

The range is the largest value minus the smallest: $26 - 6 = 20$.

Common mistakes, and the answer each one gives:

- Gave the variance instead of the range → $\frac{1566}{25}$
- Added the distances from the mean without squaring them → $\frac{188}{25}$

9

Answer: $\frac{118}{7}$

The mean is the total divided by how many there are: $\dfrac{118}{7} = \frac{118}{7}$.

Common mistakes, and the answer each one gives:

- Gave the median instead of the mean → 19
- Took the middle of the list AS WRITTEN, without sorting it first → 11

10

Answer: $\frac{1046}{25}$

The mean is $\frac{98}{5}$. Square each value's distance from it, add those up and divide by 5: $\frac{1046}{25}$.

Common mistakes, and the answer each one gives:

- Gave the range instead of the variance → 17
- Added the distances from the mean without squaring them → $\frac{152}{25}$

11

Answer: $\frac{33}{2}$

Put the values in order first — $7, 14, 16, 17, 24, 26$ — then take the middle one: $\frac{33}{2}$.

Common mistakes, and the answer each one gives:

- Gave the mean instead of the median → $\frac{52}{3}$
- Took the middle of the list AS WRITTEN, without sorting it first → 16

12

Answer: $\frac{2096}{25}$

The mean is $\frac{63}{5}$. Square each value's distance from it, add those up and divide by 5: $\frac{2096}{25}$.

Common mistakes, and the answer each one gives:

- Gave the range instead of the variance → 26
- Added the distances from the mean without squaring them → $\frac{188}{25}$

13

Answer: 18

Put the values in order first — $4, 18, 18, 20, 21$ — then take the middle one: 18.

Common mistakes, and the answer each one gives:

- Gave the mean instead of the median → $\frac{81}{5}$
- Took the middle of the list AS WRITTEN, without sorting it first → 20

14

Answer: $\frac{274}{5}$

The mean is 18. Square each value's distance from it, add those up and divide by 5: $\frac{274}{5}$.

Common mistakes, and the answer each one gives:

- Gave the range instead of the variance → 23
- Added the distances from the mean without squaring them → $\frac{26}{5}$

15

Answer: $\frac{56}{3}$

The mean is the total divided by how many there are: $\dfrac{112}{6} = \frac{56}{3}$.

Common mistakes, and the answer each one gives:

- Gave the median instead of the mean → $\frac{43}{2}$
- Took the middle of the list AS WRITTEN, without sorting it first → 19

16

Answer: 16

The range is the largest value minus the smallest: $26 - 10 = 16$.

Common mistakes, and the answer each one gives:

- Gave the variance instead of the range → $\frac{926}{25}$
- Added the distances from the mean without squaring them → $\frac{142}{25}$

17

Answer: $\frac{83}{6}$

The mean is the total divided by how many there are: $\dfrac{83}{6} = \frac{83}{6}$.

Common mistakes, and the answer each one gives:

- Gave the median instead of the mean → 13
- Took the middle of the list AS WRITTEN, without sorting it first → 12

18

Answer: 16

The range is the largest value minus the smallest: $17 - 1 = 16$.

Common mistakes, and the answer each one gives:

- Gave the variance instead of the range → $\frac{944}{25}$
- Added the distances from the mean without squaring them → $\frac{136}{25}$

19

Answer: $\frac{27}{2}$

The mean is the total divided by how many there are: $\dfrac{81}{6} = \frac{27}{2}$.

Common mistakes, and the answer each one gives:

- Gave the median instead of the mean → 13
- Took the middle of the list AS WRITTEN, without sorting it first → 10

20

Answer: $\frac{2474}{25}$

The mean is $\frac{39}{5}$. Square each value's distance from it, add those up and divide by 5: $\frac{2474}{25}$.

Common mistakes, and the answer each one gives:

- Gave the range instead of the variance → 26
- Added the distances from the mean without squaring them → $\frac{194}{25}$

21

Answer: $\frac{50}{7}$

The mean is the total divided by how many there are: $\dfrac{50}{7} = \frac{50}{7}$.

Common mistakes, and the answer each one gives:

- Gave the median instead of the mean → 7
- Took the middle of the list AS WRITTEN, without sorting it first → 4

22

Answer: $\frac{1226}{25}$

The mean is $\frac{93}{5}$. Square each value's distance from it, add those up and divide by 5: $\frac{1226}{25}$.

Common mistakes, and the answer each one gives:

- Gave the range instead of the variance → 18
- Added the distances from the mean without squaring them → $\frac{162}{25}$

23

Answer: 13

Put the values in order first — $1, 11, 12, 14, 27, 29$ — then take the middle one: 13.

Common mistakes, and the answer each one gives:

- Gave the mean instead of the median → $\frac{47}{3}$
- Took the middle of the list AS WRITTEN, without sorting it first → 27

24

Answer: 23

The range is the largest value minus the smallest: $27 - 4 = 23$.

Common mistakes, and the answer each one gives:

- Gave the variance instead of the range → $\frac{1826}{25}$
- Added the distances from the mean without squaring them → $\frac{178}{25}$

25

Answer: 7

Put the values in order first — $4, 4, 6, 7, 11, 16, 24$ — then take the middle one: 7.

Common mistakes, and the answer each one gives:

- Gave the mean instead of the median → $\frac{72}{7}$
- Took the middle of the list AS WRITTEN, without sorting it first → 4

26

Answer: $\frac{394}{5}$

The mean is 10. Square each value's distance from it, add those up and divide by 5: $\frac{394}{5}$.

Common mistakes, and the answer each one gives:

- Gave the range instead of the variance → 25
- Added the distances from the mean without squaring them → $\frac{34}{5}$

27

Answer: 16

Put the values in order first — $2, 3, 14, 18, 22, 24$ — then take the middle one: 16.

Common mistakes, and the answer each one gives:

- Gave the mean instead of the median → $\frac{83}{6}$
- Took the middle of the list AS WRITTEN, without sorting it first → 22

28

Answer: 26

The range is the largest value minus the smallest: $27 - 1 = 26$.

Common mistakes, and the answer each one gives:

- Gave the variance instead of the range → $\frac{2024}{25}$
- Added the distances from the mean without squaring them → $\frac{166}{25}$

29

Answer: 9

The mean is the total divided by how many there are: $\dfrac{54}{6} = 9$.

Common mistakes, and the answer each one gives:

- Gave the median instead of the mean → 6
- Took the middle of the list AS WRITTEN, without sorting it first → 2

30

Answer: $\frac{2204}{25}$

The mean is $\frac{99}{5}$. Square each value's distance from it, add those up and divide by 5: $\frac{2204}{25}$.

Common mistakes, and the answer each one gives:

- Gave the range instead of the variance → 25
- Added the distances from the mean without squaring them → $\frac{206}{25}$

12. Probability and counting

Sample spaces, permutations, combinations and binomial probabilities. Set for OMPT-E.

Questions

1

In how many different ORDERS can 4 of 8 distinct books be placed on a shelf?

Answer: ______________________

2

A committee of 4 people is chosen from 8 candidates. How many different committees are possible?

Answer: ______________________

3

Two fair 6-sided dice are rolled. What is the probability that their total is exactly 5?

Answer: ______________________

4

A fair coin is tossed 3 times. What is the probability of exactly 1 heads?

Answer: ______________________

5

In how many different ORDERS can 3 of 8 distinct books be placed on a shelf?

Answer: ______________________

6

A committee of 2 people is chosen from 10 candidates. How many different committees are possible?

Answer: ______________________

7

Two fair 6-sided dice are rolled. What is the probability that their total is at least 7?

Answer: ______________________

8

A fair coin is tossed 5 times. What is the probability of exactly 3 heads?

Answer: ______________________

9

In how many different ORDERS can 2 of 8 distinct books be placed on a shelf?

Answer: ______________________

10

A committee of 2 people is chosen from 6 candidates. How many different committees are possible?

Answer: ______________________

11

Two fair 6-sided dice are rolled. What is the probability that their total is exactly 8?

Answer: ______________________

12

A fair coin is tossed 5 times. What is the probability of exactly 2 heads?

Answer: ______________________

13

In how many different ORDERS can 2 of 6 distinct books be placed on a shelf?

Answer: ______________________

14

A committee of 3 people is chosen from 6 candidates. How many different committees are possible?

Answer: ______________________

15

Two fair 6-sided dice are rolled. What is the probability that their total is exactly 10?

Answer: ____________________

16

A fair coin is tossed 6 times. What is the probability of exactly 3 heads?

Answer: ____________________

17

In how many different ORDERS can 3 of 7 distinct books be placed on a shelf?

Answer: ____________________

18

A committee of 4 people is chosen from 7 candidates. How many different committees are possible?

Answer: ____________________

19

Two fair 6-sided dice are rolled. What is the probability that their total is at least 8?

Answer: ____________________

20

A fair coin is tossed 6 times. What is the probability of exactly 2 heads?

Answer: ______________________

21

In how many different ORDERS can 3 of 9 distinct books be placed on a shelf?

Answer: ______________________

22

A committee of 4 people is chosen from 9 candidates. How many different committees are possible?

Answer: ______________________

23

Two fair 6-sided dice are rolled. What is the probability that their total is at least 9?

Answer: ______________________

24

A fair coin is tossed 6 times. What is the probability of exactly 1 heads?

Answer: ______________________

25

In how many different ORDERS can 2 of 9 distinct books be placed on a shelf?

Answer: ____________________

26

A committee of 3 people is chosen from 10 candidates. How many different committees are possible?

Answer: ____________________

27

Two fair 6-sided dice are rolled. What is the probability that their total is at least 5?

Answer: ____________________

28

A fair coin is tossed 5 times. What is the probability of exactly 1 heads?

Answer: ____________________

29

In how many different ORDERS can 2 of 7 distinct books be placed on a shelf?

Answer: ____________________

30

A committee of 4 people is chosen from 6 candidates. How many different committees are possible?

Answer: ____________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: 1680

The first place has 8 candidates, the next 7, and so on for 4 places: $\dfrac{8!}{(8-4)!} = 1680.$

Common mistakes, and the answer each one gives:

- Used combinations, which ignore the order → 70
- Arranged all of them rather than only the chosen ones → 40320

2

Answer: 70

A committee is a SET, so order does not matter: $\binom{8}{4} = \dfrac{8!}{4!\,(8-4)!} = 70.$

Common mistakes, and the answer each one gives:

- Counted the orders as different, which a committee does not → 1680
- Multiplied the two numbers → 32

3

Answer: $\frac{1}{9}$

There are $6 \times 6 = 36$ equally likely outcomes. Counting the ones whose total is exactly 5 gives 4, so the probability is $\dfrac{4}{36} = \frac{1}{9}.$

Common mistakes, and the answer each one gives:

- Counted the 11 possible TOTALS as equally likely → $\frac{4}{11}$
- Used 12 outcomes, one per face of each die → $\frac{1}{3}$

4

Answer: $\frac{3}{8}$

Each of the $2^3 = 8$ sequences is equally likely, and $\binom{3}{1} = 3$ of them have exactly 1 heads. So the probability is $\frac{3}{8}$.

Common mistakes, and the answer each one gives:

- Divided the count of heads by the number of tosses → $\frac{1}{3}$
- Used $2n$ outcomes instead of 2^n → $\frac{1}{2}$

5

Answer: 336

The first place has 8 candidates, the next 7, and so on for 3 places: $\dfrac{8!}{(8-3)!} = 336$.

Common mistakes, and the answer each one gives:

- Used combinations, which ignore the order → 56
- Arranged all of them rather than only the chosen ones → 40320

6

Answer: 45

A committee is a SET, so order does not matter: $\binom{10}{2} = \dfrac{10!}{2!\,(10-2)!} = 45$.

Common mistakes, and the answer each one gives:

- Counted the orders as different, which a committee does not → 90
- Multiplied the two numbers → 20

7

Answer: $\frac{7}{12}$

There are $6 \times 6 = 36$ equally likely outcomes. Counting the ones whose total is at least 7 gives 21, so the probability is $\dfrac{21}{36} = \frac{7}{12}$.

Common mistakes, and the answer each one gives:

- Counted the 11 possible TOTALS as equally likely → 1
- Used 12 outcomes, one per face of each die → $\frac{7}{4}$

8

Answer: $\frac{5}{16}$

Each of the $2^5 = 32$ sequences is equally likely, and $\binom{5}{3} = 10$ of them have exactly 3 heads. So the probability is $\frac{5}{16}$.

Common mistakes, and the answer each one gives:

- Divided the count of heads by the number of tosses → $\frac{3}{5}$
- Used $2n$ outcomes instead of 2^n → 1

9

Answer: 56

The first place has 8 candidates, the next 7, and so on for 2 places: $\dfrac{8!}{(8-2)!} = 56$.

Common mistakes, and the answer each one gives:

- Used combinations, which ignore the order → 28
- Arranged all of them rather than only the chosen ones → 40320

10

Answer: 15

A committee is a SET, so order does not matter: $\binom{6}{2} = \dfrac{6!}{2!\,(6-2)!} = 15.$

Common mistakes, and the answer each one gives:

- Counted the orders as different, which a committee does not → 30
- Multiplied the two numbers → 12

11

Answer: $\frac{5}{36}$

There are $6 \times 6 = 36$ equally likely outcomes. Counting the ones whose total is exactly 8 gives 5, so the probability is $\dfrac{5}{36} = \frac{5}{36}$.

Common mistakes, and the answer each one gives:

- Counted the 11 possible TOTALS as equally likely → $\frac{5}{11}$
- Used 12 outcomes, one per face of each die → $\frac{5}{12}$

12

Answer: $\frac{5}{16}$

Each of the $2^5 = 32$ sequences is equally likely, and $\binom{5}{2} = 10$ of them have exactly 2 heads. So the probability is $\frac{5}{16}$.

Common mistakes, and the answer each one gives:

- Divided the count of heads by the number of tosses → $\frac{2}{5}$
- Used $2n$ outcomes instead of 2^n → 1

13

Answer: 30

The first place has 6 candidates, the next 5, and so on for 2 places: $\dfrac{6!}{(6-2)!} = 30$.

Common mistakes, and the answer each one gives:

- Used combinations, which ignore the order → 15
- Arranged all of them rather than only the chosen ones → 720

14

Answer: 20

A committee is a SET, so order does not matter: $\binom{6}{3} = \dfrac{6!}{3!\,(6-3)!} = 20$.

Common mistakes, and the answer each one gives:

- Counted the orders as different, which a committee does not → 120
- Multiplied the two numbers → 18

15

Answer: $\frac{1}{12}$

There are $6 \times 6 = 36$ equally likely outcomes. Counting the ones whose total is exactly 10 gives 3, so the probability is $\dfrac{3}{36} = \frac{1}{12}$.

Common mistakes, and the answer each one gives:

- Counted the 11 possible TOTALS as equally likely → $\frac{3}{11}$
- Used 12 outcomes, one per face of each die → $\frac{1}{4}$

16

Answer: $\frac{5}{16}$

Each of the $2^6 = 64$ sequences is equally likely, and $\binom{6}{3} = 20$ of them have exactly 3 heads. So the probability is $\frac{5}{16}$.

Common mistakes, and the answer each one gives:

- Divided the count of heads by the number of tosses → $\frac{1}{2}$
- Used $2n$ outcomes instead of 2^n → $\frac{5}{3}$

17

Answer: 210

The first place has 7 candidates, the next 6, and so on for 3 places: $\dfrac{7!}{(7-3)!} = 210$.

Common mistakes, and the answer each one gives:

- Used combinations, which ignore the order → 35
- Arranged all of them rather than only the chosen ones → 5040

18

Answer: 35

A committee is a SET, so order does not matter: $\binom{7}{4} = \dfrac{7!}{4!\,(7-4)!} = 35$.

Common mistakes, and the answer each one gives:

- Counted the orders as different, which a committee does not → 840
- Multiplied the two numbers → 28

19

Answer: $\frac{5}{12}$

There are $6 \times 6 = 36$ equally likely outcomes. Counting the ones whose total is at least 8 gives 15, so the probability is $\dfrac{15}{36} = \frac{5}{12}$.

Common mistakes, and the answer each one gives:

- Counted the 11 possible TOTALS as equally likely → 1
- Used 12 outcomes, one per face of each die → $\frac{5}{4}$

20

Answer: $\frac{15}{64}$

Each of the $2^6 = 64$ sequences is equally likely, and $\binom{6}{2} = 15$ of them have exactly 2 heads. So the probability is $\frac{15}{64}$.

Common mistakes, and the answer each one gives:

- Divided the count of heads by the number of tosses → $\frac{1}{3}$
- Used $2n$ outcomes instead of 2^n → $\frac{5}{4}$

21

Answer: 504

The first place has 9 candidates, the next 8, and so on for 3 places: $\dfrac{9!}{(9-3)!} = 504$.

Common mistakes, and the answer each one gives:

- Used combinations, which ignore the order → 84
- Arranged all of them rather than only the chosen ones → 362880

22

Answer: 126

A committee is a SET, so order does not matter: $\binom{9}{4} = \dfrac{9!}{4!\,(9-4)!} = 126.$

Common mistakes, and the answer each one gives:

- Counted the orders as different, which a committee does not → 3024
- Multiplied the two numbers → 36

23

Answer: $\frac{5}{18}$

There are $6 \times 6 = 36$ equally likely outcomes. Counting the ones whose total is at least 9 gives 10, so the probability is $\dfrac{10}{36} = \frac{5}{18}$.

Common mistakes, and the answer each one gives:

- Counted the 11 possible TOTALS as equally likely → $\frac{10}{11}$
- Used 12 outcomes, one per face of each die → $\frac{5}{6}$

24

Answer: $\frac{3}{32}$

Each of the $2^6 = 64$ sequences is equally likely, and $\binom{6}{1} = 6$ of them have exactly 1 heads. So the probability is $\frac{3}{32}$.

Common mistakes, and the answer each one gives:

- Divided the count of heads by the number of tosses → $\frac{1}{6}$
- Used $2n$ outcomes instead of 2^n → $\frac{1}{2}$

25

Answer: 72

The first place has 9 candidates, the next 8, and so on for 2 places: $\dfrac{9!}{(9-2)!} = 72.$

Common mistakes, and the answer each one gives:

- Used combinations, which ignore the order → 36
- Arranged all of them rather than only the chosen ones → 362880

26

Answer: 120

A committee is a SET, so order does not matter: $\binom{10}{3} = \dfrac{10!}{3!\,(10-3)!} = 120.$

Common mistakes, and the answer each one gives:

- Counted the orders as different, which a committee does not → 720
- Multiplied the two numbers → 30

27

Answer: $\frac{5}{6}$

There are $6 \times 6 = 36$ equally likely outcomes. Counting the ones whose total is at least 5 gives 30, so the probability is $\dfrac{30}{36} = \frac{5}{6}$.

Common mistakes, and the answer each one gives:

- Counted the 11 possible TOTALS as equally likely → 1
- Used 12 outcomes, one per face of each die → $\frac{5}{2}$

28

Answer: $\frac{5}{32}$

Each of the $2^5 = 32$ sequences is equally likely, and $\binom{5}{1} = 5$ of them have exactly 1 heads. So the probability is $\frac{5}{32}$.

Common mistakes, and the answer each one gives:

- Divided the count of heads by the number of tosses → $\frac{1}{5}$
- Used $2n$ outcomes instead of 2^n → $\frac{1}{2}$

29

Answer: 42

The first place has 7 candidates, the next 6, and so on for 2 places: $\dfrac{7!}{(7-2)!} = 42$.

Common mistakes, and the answer each one gives:

- Used combinations, which ignore the order → 21
- Arranged all of them rather than only the chosen ones → 5040

30

Answer: 15

A committee is a SET, so order does not matter: $\binom{6}{4} = \dfrac{6!}{4!\,(6-4)!} = 15$.

Common mistakes, and the answer each one gives:

- Counted the orders as different, which a committee does not → 360
- Multiplied the two numbers → 24

13. Geometry

Angles, triangles, polygons, circles, Pythagoras and distances. Set for OMPT-C, OMPT-D and OMPT-G.

Questions

1

A right-angled triangle has a hypotenuse of 26 and one leg of 10. How long is the other leg?

Answer: ____________________

2

Two angles of a triangle are 31° and 110°. How many degrees is the third?

Answer: ____________________

3

What is the sum of the interior angles of a polygon with 7 sides, in degrees?

Answer: ____________________

4

A circle has a radius of 8. What is its circumference? Leave your answer in terms of π.

Answer: ____________________

5

How far apart are the points $(-6, -2)$ and $(2, 13)$?

Answer: ______________________

6

A right-angled triangle has a hypotenuse of 25 and one leg of 7. How long is the other leg?

Answer: ______________________

7

Two angles of a triangle are 76° and 66°. How many degrees is the third?

Answer: ______________________

8

What is the sum of the interior angles of a polygon with 9 sides, in degrees?

Answer: ______________________

9

A circle has a radius of 9. What is its circumference? Leave your answer in terms of π.

Answer: ______________________

10

How far apart are the points $(7, -6)$ and $(15, 9)$?

Answer: ______________________

11

A right-angled triangle has a hypotenuse of 10 and one leg of 6. How long is the other leg?

Answer: ______________________

12

Two angles of a triangle are 20° and 75°. How many degrees is the third?

Answer: ______________________

13

What is the sum of the interior angles of a polygon with 16 sides, in degrees?

Answer: ______________________

14

A circle has a radius of 10. What is its circumference? Leave your answer in terms of π.

Answer: ______________________

15

How far apart are the points $(7, -8)$ and $(27, 13)$?

Answer: ______________________

16

A right-angled triangle has legs of length 10 and 24. How long is its hypotenuse?

Answer: ______________________

17

Two angles of a triangle are 23° and 113°. How many degrees is the third?

Answer: ______________________

18

What is the sum of the interior angles of a polygon with 12 sides, in degrees?

Answer: ______________________

19

A circle has a radius of 13. What is its area? Leave your answer in terms of π.

Answer: ______________________

20

How far apart are the points $(8, -4)$ and $(18, 20)$?

Answer: ______________________

21

A right-angled triangle has legs of length 3 and 4. How long is its hypotenuse?

Answer: ______________________

22

Two angles of a triangle are 27° and 76°. How many degrees is the third?

Answer: ______________________

23

What is the sum of the interior angles of a polygon with 8 sides, in degrees?

Answer: ______________________

24

A circle has a radius of 6. What is its circumference? Leave your answer in terms of π.

Answer: ______________________

25

How far apart are the points $(-7, 4)$ and $(-4, 8)$?

Answer: ______________________

26

A right-angled triangle has legs of length 20 and 21. How long is its hypotenuse?

Answer: ______________________

27

Two angles of a triangle are 44° and 69°. How many degrees is the third?

Answer: ______________________

28

What is the sum of the interior angles of a polygon with 18 sides, in degrees?

Answer: ______________________

29

A circle has a radius of 6. What is its area? Leave your answer in terms of π.

Answer: ______________________

30

How far apart are the points $(-7, -5)$ and $(-4, -1)$?

Answer: ______________________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: 24

Rearrange Pythagoras: the missing leg squared is $26^2 - 10^2 = 576$, so the leg is $\sqrt{576} = 24$.

Common mistakes, and the answer each one gives:

- Subtracted the lengths instead of their squares → 16
- Added the squares, which is the rule for the HYPOTENUSE → $2\sqrt{194}$

2

Answer: 39

The three angles of any triangle add to 180°, so the third is $180 - 31 - 110 = 39$.

Common mistakes, and the answer each one gives:

- Used 360°, which is the angles round a POINT → 219
- Subtracted only one of the two given angles → 149

3

Answer: 900

A polygon with 7 sides splits into 5 triangles from one corner, and each triangle contributes 180°: $(7-2) \times 180 = 900$.

Common mistakes, and the answer each one gives:

- Multiplied the number of sides by 180 without subtracting 2 → 1260
- Gave the EXTERIOR angle sum, which is 360 for every polygon → 360

4

Answer: 16π

Circumference $= 2\pi r = 2 \times \pi \times 8 = 16\pi$.

Common mistakes, and the answer each one gives:

- Used the area formula πr^2 → 64π
- Used the diameter as the radius → 32π

5

Answer: 17

The horizontal gap is 8 and the vertical gap is 15, so Pythagoras gives $\sqrt{8^2 + 15^2} = \sqrt{289} = 17$.

Common mistakes, and the answer each one gives:

- Added the two gaps instead of using Pythagoras → 23
- Forgot the square root → 289

6

Answer: 24

Rearrange Pythagoras: the missing leg squared is $25^2 - 7^2 = 576$, so the leg is $\sqrt{576} = 24$.

Common mistakes, and the answer each one gives:

- Subtracted the lengths instead of their squares → 18
- Added the squares, which is the rule for the HYPOTENUSE → $\sqrt{674}$

7

Answer: 38

The three angles of any triangle add to $180°$, so the third is $180 - 76 - 66 = 38$.

Common mistakes, and the answer each one gives:

- Used $360°$, which is the angles round a POINT → 218
- Subtracted only one of the two given angles → 104

8

Answer: 1260

A polygon with 9 sides splits into 7 triangles from one corner, and each triangle contributes $180°$: $(9-2) \times 180 = 1260$.

Common mistakes, and the answer each one gives:

- Multiplied the number of sides by 180 without subtracting 2 → 1620
- Gave the EXTERIOR angle sum, which is 360 for every polygon → 360

9

Answer: 18π

Circumference $= 2\pi r = 2 \times \pi \times 9 = 18\pi$.

Common mistakes, and the answer each one gives:

- Used the area formula πr^2 → 81π
- Used the diameter as the radius → 36π

10

Answer: 17

The horizontal gap is 8 and the vertical gap is 15, so Pythagoras gives $\sqrt{8^2 + 15^2} = \sqrt{289} = 17$.

Common mistakes, and the answer each one gives:

- Added the two gaps instead of using Pythagoras → 23
- Forgot the square root → 289

11

Answer: 8

Rearrange Pythagoras: the missing leg squared is $10^2 - 6^2 = 64$, so the leg is $\sqrt{64} = 8$.

Common mistakes, and the answer each one gives:

- Subtracted the lengths instead of their squares → 4
- Added the squares, which is the rule for the HYPOTENUSE → $2\sqrt{34}$

12

Answer: 85

The three angles of any triangle add to 180°, so the third is $180 - 20 - 75 = 85$.

Common mistakes, and the answer each one gives:

- Used 360°, which is the angles round a POINT → 265
- Subtracted only one of the two given angles → 160

13

Answer: 2520

A polygon with 16 sides splits into 14 triangles from one corner, and each triangle contributes 180°: $(16-2)\times 180 = 2520$.

Common mistakes, and the answer each one gives:

- Multiplied the number of sides by 180 without subtracting 2 → 2880
- Gave the EXTERIOR angle sum, which is 360 for every polygon → 360

14

Answer: 20π

Circumference $= 2\pi r = 2\times\pi\times 10 = 20\pi$.

Common mistakes, and the answer each one gives:

- Used the area formula πr^2 → 100π
- Used the diameter as the radius → 40π

15

Answer: 29

The horizontal gap is 20 and the vertical gap is 21, so Pythagoras gives $\sqrt{20^2+21^2} = \sqrt{841} = 29$.

Common mistakes, and the answer each one gives:

- Added the two gaps instead of using Pythagoras → 41
- Forgot the square root → 841

16

Answer: 26

Pythagoras: the square on the hypotenuse equals the sum of the squares on the legs. $10^2 + 24^2 = 676$, and $\sqrt{676} = 26$.

Common mistakes, and the answer each one gives:

- Added the legs instead of their squares → 34
- Subtracted the squares, which finds a LEG not the hypotenuse → $2\sqrt{119}$

17

Answer: 44

The three angles of any triangle add to 180°, so the third is $180 - 23 - 113 = 44$.

Common mistakes, and the answer each one gives:

- Used 360°, which is the angles round a POINT → 224
- Subtracted only one of the two given angles → 157

18

Answer: 1800

A polygon with 12 sides splits into 10 triangles from one corner, and each triangle contributes 180°: $(12 - 2) \times 180 = 1800$.

Common mistakes, and the answer each one gives:

- Multiplied the number of sides by 180 without subtracting 2 → 2160
- Gave the EXTERIOR angle sum, which is 360 for every polygon → 360

19

Answer: 169π

Area $= \pi r^2 = \pi \times 13^2 = 169\pi$.

Common mistakes, and the answer each one gives:

- Used the circumference formula $2\pi r$ → 26π
- Doubled the radius instead of squaring it → 26π

20

Answer: 26

The horizontal gap is 10 and the vertical gap is 24, so Pythagoras gives $\sqrt{10^2 + 24^2} = \sqrt{676} = 26$.

Common mistakes, and the answer each one gives:

- Added the two gaps instead of using Pythagoras → 34
- Forgot the square root → 676

21

Answer: 5

Pythagoras: the square on the hypotenuse equals the sum of the squares on the legs. $3^2 + 4^2 = 25$, and $\sqrt{25} = 5$.

Common mistakes, and the answer each one gives:

- Added the legs instead of their squares → 7
- Subtracted the squares, which finds a LEG not the hypotenuse → $\sqrt{7}$

22

Answer: 77

The three angles of any triangle add to 180°, so the third is $180 - 27 - 76 = 77$.

Common mistakes, and the answer each one gives:

- Used 360°, which is the angles round a POINT → 257
- Subtracted only one of the two given angles → 153

23

Answer: 1080

A polygon with 8 sides splits into 6 triangles from one corner, and each triangle contributes 180°: $(8 - 2) \times 180 = 1080$.

Common mistakes, and the answer each one gives:

- Multiplied the number of sides by 180 without subtracting 2 → 1440
- Gave the EXTERIOR angle sum, which is 360 for every polygon → 360

24

Answer: 12π

Circumference $= 2\pi r = 2 \times \pi \times 6 = 12\pi$.

Common mistakes, and the answer each one gives:

- Used the area formula πr^2 → 36π
- Used the diameter as the radius → 24π

25

Answer: 5

The horizontal gap is 3 and the vertical gap is 4, so Pythagoras gives $\sqrt{3^2 + 4^2} = \sqrt{25} = 5$.

Common mistakes, and the answer each one gives:

- Added the two gaps instead of using Pythagoras → 7
- Forgot the square root → 25

26

Answer: 29

Pythagoras: the square on the hypotenuse equals the sum of the squares on the legs. $20^2 + 21^2 = 841$, and $\sqrt{841} = 29$.

Common mistakes, and the answer each one gives:

- Added the legs instead of their squares → 41
- Subtracted the squares, which finds a LEG not the hypotenuse → $\sqrt{41}$

27

Answer: 67

The three angles of any triangle add to 180°, so the third is $180 - 44 - 69 = 67$.

Common mistakes, and the answer each one gives:

- Used 360°, which is the angles round a POINT → 247
- Subtracted only one of the two given angles → 136

28

Answer: 2880

A polygon with 18 sides splits into 16 triangles from one corner, and each triangle contributes 180°: $(18-2)\times 180 = 2880$.

Common mistakes, and the answer each one gives:

- Multiplied the number of sides by 180 without subtracting 2 → 3240
- Gave the EXTERIOR angle sum, which is 360 for every polygon → 360

29

Answer: 36π

Area $= \pi r^2 = \pi \times 6^2 = 36\pi$.

Common mistakes, and the answer each one gives:

- Used the circumference formula $2\pi r$ → 12π
- Doubled the radius instead of squaring it → 12π

30

Answer: 5

The horizontal gap is 3 and the vertical gap is 4, so Pythagoras gives $\sqrt{3^2+4^2} = \sqrt{25} = 5$.

Common mistakes, and the answer each one gives:

- Added the two gaps instead of using Pythagoras → 7
- Forgot the square root → 25

14. Sequences and series

Arithmetic and geometric sequences, and the sum of a series. Set for OMPT-G.

Questions

1

An arithmetic sequence starts at 11 and goes up by -9 each time. What is its 7th term?

Answer: ______________________

2

A geometric sequence starts at 1 and each term is $\frac{1}{2}$ times the one before. What is its 6th term?

Answer: ______________________

3

An arithmetic sequence starts at 10 and goes up by 9 each time. What is the sum of its first 7 terms?

Answer: ______________________

4

An arithmetic sequence starts at -11 and goes up by 8 each time. What is its 10th term?

Answer: ______________________

5

A geometric sequence starts at 9 and each term is 2 times the one before. What is its 5th term?

Answer: ____________________

6

An arithmetic sequence starts at -1 and goes up by 5 each time. What is the sum of its first 6 terms?

Answer: ____________________

7

An arithmetic sequence starts at 2 and goes up by 9 each time. What is its 11th term?

Answer: ____________________

8

A geometric sequence starts at 1 and each term is 3 times the one before. What is its 4th term?

Answer: ____________________

9

An arithmetic sequence starts at 2 and goes up by 5 each time. What is the sum of its first 19 terms?

Answer: ____________________

10

An arithmetic sequence starts at -3 and goes up by 4 each time. What is its 9th term?

Answer: ______________________

11

A geometric sequence starts at 6 and each term is 3 times the one before. What is its 7th term?

Answer: ______________________

12

An arithmetic sequence starts at 7 and goes up by 5 each time. What is the sum of its first 11 terms?

Answer: ______________________

13

An arithmetic sequence starts at 10 and goes up by 3 each time. What is its 30th term?

Answer: ______________________

14

A geometric sequence starts at 8 and each term is -2 times the one before. What is its 6th term?

Answer: ______________________

15

An arithmetic sequence starts at 4 and goes up by 5 each time. What is the sum of its first 14 terms?

Answer: ____________________

16

An arithmetic sequence starts at 7 and goes up by -8 each time. What is its 16th term?

Answer: ____________________

17

A geometric sequence starts at 8 and each term is 2 times the one before. What is its 4th term?

Answer: ____________________

18

An arithmetic sequence starts at 6 and goes up by 9 each time. What is the sum of its first 12 terms?

Answer: ____________________

19

An arithmetic sequence starts at -4 and goes up by -7 each time. What is its 23th term?

Answer: ____________________

20

A geometric sequence starts at 6 and each term is 2 times the one before. What is its 4th term?

Answer: ____________________

21

An arithmetic sequence starts at 0 and goes up by 9 each time. What is the sum of its first 15 terms?

Answer: ____________________

22

An arithmetic sequence starts at -3 and goes up by 3 each time. What is its 16th term?

Answer: ____________________

23

A geometric sequence starts at 3 and each term is $\frac{1}{2}$ times the one before. What is its 7th term?

Answer: ____________________

24

An arithmetic sequence starts at -10 and goes up by 8 each time. What is the sum of its first 13 terms?

Answer: ____________________

25

An arithmetic sequence starts at 2 and goes up by 6 each time. What is its 27th term?

Answer: ____________________

26

A geometric sequence starts at 6 and each term is 3 times the one before. What is its 8th term?

Answer: ____________________

27

An arithmetic sequence starts at -4 and goes up by 5 each time. What is the sum of its first 13 terms?

Answer: ____________________

28

An arithmetic sequence starts at -1 and goes up by 7 each time. What is its 14th term?

Answer: ____________________

29

A geometric sequence starts at 4 and each term is 3 times the one before. What is its 6th term?

Answer: ____________________

30

An arithmetic sequence starts at 12 and goes up by 7 each time. What is the sum of its first 18 terms?

Answer: ______________________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: -43

The nth term is $a + (n-1)d$ — the step is taken 6 times, not 7: $11 + 6 \times -9 = -43$.

Common mistakes, and the answer each one gives:

- Used $a + nd$, taking the step one time too many → -52
- Multiplied the first term by the step → -99

2

Answer: $\frac{1}{32}$

The nth term is ar^{n-1}, so the ratio is applied 5 times: $1 \times \left(\frac{1}{2}\right)^5 = \frac{1}{32}$.

Common mistakes, and the answer each one gives:

- Used ar^n, applying the ratio one time too many → $\frac{1}{64}$
- Added the ratio each time instead of multiplying → $\frac{7}{2}$

3

Answer: 259

The last term is $10 + 6 \times 9 = 64$, and a sum of an arithmetic sequence is the number of terms times the average of the first and last: $7 \times \dfrac{10 + 64}{2} = 259$.

Common mistakes, and the answer each one gives:

- Multiplied the number of terms by the LAST term rather than the average → 448
- Multiplied the number of terms by the FIRST term → 70

4

Answer: 61

The nth term is $a+(n-1)d$ — the step is taken 9 times, not 10: $-11+9\times 8=61$.

Common mistakes, and the answer each one gives:

- Used $a+nd$, taking the step one time too many → 69
- Multiplied the first term by the step → -88

5

Answer: 144

The nth term is ar^{n-1}, so the ratio is applied 4 times: $9\times(2)^4=144$.

Common mistakes, and the answer each one gives:

- Used ar^n, applying the ratio one time too many → 288
- Added the ratio each time instead of multiplying → 17

6

Answer: 69

The last term is $-1+5\times 5=24$, and a sum of an arithmetic sequence is the number of terms times the average of the first and last: $6\times\dfrac{-1+24}{2}=69$.

Common mistakes, and the answer each one gives:

- Multiplied the number of terms by the LAST term rather than the average → 144
- Multiplied the number of terms by the FIRST term → -6

7

Answer: 92

The nth term is $a + (n - 1)d$ — the step is taken 10 times, not 11: $2 + 10 \times 9 = 92$.

Common mistakes, and the answer each one gives:

- Used $a + nd$, taking the step one time too many → 101
- Multiplied the first term by the step → 18

8

Answer: 27

The nth term is ar^{n-1}, so the ratio is applied 3 times: $1 \times (3)^3 = 27$.

Common mistakes, and the answer each one gives:

- Used ar^n, applying the ratio one time too many → 81
- Added the ratio each time instead of multiplying → 10

9

Answer: 893

The last term is $2 + 18 \times 5 = 92$, and a sum of an arithmetic sequence is the number of terms times the average of the first and last: $19 \times \dfrac{2 + 92}{2} = 893$.

Common mistakes, and the answer each one gives:

- Multiplied the number of terms by the LAST term rather than the average → 1748
- Multiplied the number of terms by the FIRST term → 38

10

Answer: 29

The nth term is $a + (n-1)d$ — the step is taken 8 times, not 9: $-3 + 8 \times 4 = 29$.

Common mistakes, and the answer each one gives:

- Used $a + nd$, taking the step one time too many → 33
- Multiplied the first term by the step → -12

11

Answer: 4374

The nth term is ar^{n-1}, so the ratio is applied 6 times: $6 \times (3)^6 = 4374$.

Common mistakes, and the answer each one gives:

- Used ar^n, applying the ratio one time too many → 13122
- Added the ratio each time instead of multiplying → 24

12

Answer: 352

The last term is $7 + 10 \times 5 = 57$, and a sum of an arithmetic sequence is the number of terms times the average of the first and last: $11 \times \dfrac{7+57}{2} = 352$.

Common mistakes, and the answer each one gives:

- Multiplied the number of terms by the LAST term rather than the average → 627
- Multiplied the number of terms by the FIRST term → 77

13

Answer: 97

The nth term is $a+(n-1)d$ — the step is taken 29 times, not 30: $10+29\times3=97$.

Common mistakes, and the answer each one gives:

- Used $a+nd$, taking the step one time too many → 100
- Multiplied the first term by the step → 30

14

Answer: -256

The nth term is ar^{n-1}, so the ratio is applied 5 times: $8\times(-2)^5=-256$.

Common mistakes, and the answer each one gives:

- Used ar^n, applying the ratio one time too many → 512
- Added the ratio each time instead of multiplying → -2

15

Answer: 511

The last term is $4+13\times5=69$, and a sum of an arithmetic sequence is the number of terms times the average of the first and last: $14\times\dfrac{4+69}{2}=511$.

Common mistakes, and the answer each one gives:

- Multiplied the number of terms by the LAST term rather than the average → 966
- Multiplied the number of terms by the FIRST term → 56

16

Answer: -113

The nth term is $a+(n-1)d$ — the step is taken 15 times, not 16: $7+15\times-8=-113$.

Common mistakes, and the answer each one gives:

- Used $a+nd$, taking the step one time too many → -121
- Multiplied the first term by the step → -56

17

Answer: 64

The nth term is ar^{n-1}, so the ratio is applied 3 times: $8\times(2)^3=64$.

Common mistakes, and the answer each one gives:

- Used ar^n, applying the ratio one time too many → 128
- Added the ratio each time instead of multiplying → 14

18

Answer: 666

The last term is $6+11\times 9=105$, and a sum of an arithmetic sequence is the number of terms times the average of the first and last: $12\times\dfrac{6+105}{2}=666$.

Common mistakes, and the answer each one gives:

- Multiplied the number of terms by the LAST term rather than the average → 1260
- Multiplied the number of terms by the FIRST term → 72

19

Answer: -158

The nth term is $a+(n-1)d$ — the step is taken 22 times, not 23: $-4+22\times-7=-158$.

Common mistakes, and the answer each one gives:

- Used $a+nd$, taking the step one time too many → -165
- Multiplied the first term by the step → 28

20

Answer: 48

The nth term is ar^{n-1}, so the ratio is applied 3 times: $6\times(2)^3=48$.

Common mistakes, and the answer each one gives:

- Used ar^n, applying the ratio one time too many → 96
- Added the ratio each time instead of multiplying → 12

21

Answer: 945

The last term is $0+14\times9=126$, and a sum of an arithmetic sequence is the number of terms times the average of the first and last: $15\times\dfrac{0+126}{2}=945$.

Common mistakes, and the answer each one gives:

- Multiplied the number of terms by the LAST term rather than the average → 1890
- Multiplied the number of terms by the FIRST term → 0

22

Answer: 42

The nth term is $a + (n-1)d$ — the step is taken 15 times, not 16: $-3 + 15 \times 3 = 42$.

Common mistakes, and the answer each one gives:

- Used $a + nd$, taking the step one time too many → 45
- Multiplied the first term by the step → -9

23

Answer: $\frac{3}{64}$

The nth term is ar^{n-1}, so the ratio is applied 6 times: $3 \times \left(\frac{1}{2}\right)^6 = \frac{3}{64}$.

Common mistakes, and the answer each one gives:

- Used ar^n, applying the ratio one time too many → $\frac{3}{128}$
- Added the ratio each time instead of multiplying → 6

24

Answer: 494

The last term is $-10 + 12 \times 8 = 86$, and a sum of an arithmetic sequence is the number of terms times the average of the first and last: $13 \times \dfrac{-10 + 86}{2} = 494$.

Common mistakes, and the answer each one gives:

- Multiplied the number of terms by the LAST term rather than the average → 1118
- Multiplied the number of terms by the FIRST term → -130

25

Answer: 158

The nth term is $a + (n-1)d$ — the step is taken 26 times, not 27: $2 + 26 \times 6 = 158$.

Common mistakes, and the answer each one gives:

- Used $a + nd$, taking the step one time too many → 164
- Multiplied the first term by the step → 12

26

Answer: 13122

The nth term is ar^{n-1}, so the ratio is applied 7 times: $6 \times (3)^7 = 13122$.

Common mistakes, and the answer each one gives:

- Used ar^n, applying the ratio one time too many → 39366
- Added the ratio each time instead of multiplying → 27

27

Answer: 338

The last term is $-4 + 12 \times 5 = 56$, and a sum of an arithmetic sequence is the number of terms times the average of the first and last: $13 \times \dfrac{-4+56}{2} = 338$.

Common mistakes, and the answer each one gives:

- Multiplied the number of terms by the LAST term rather than the average → 728
- Multiplied the number of terms by the FIRST term → -52

28

Answer: 90

The nth term is $a+(n-1)d$ — the step is taken 13 times, not 14: $-1+13\times 7=90$
.

Common mistakes, and the answer each one gives:

- Used $a+nd$, taking the step one time too many → 97
- Multiplied the first term by the step → -7

29

Answer: 972

The nth term is ar^{n-1}, so the ratio is applied 5 times: $4\times(3)^5=972$.

Common mistakes, and the answer each one gives:

- Used ar^n, applying the ratio one time too many → 2916
- Added the ratio each time instead of multiplying → 19

30

Answer: 1287

The last term is $12+17\times 7=131$, and a sum of an arithmetic sequence is the number of terms times the average of the first and last: $18\times\dfrac{12+131}{2}=1287$.

Common mistakes, and the answer each one gives:

- Multiplied the number of terms by the LAST term rather than the average → 2358
- Multiplied the number of terms by the FIRST term → 216

OMPT-A mixed paper

30 questions drawn from every sheet on the OMPT-A syllabus, and nothing outside it.

Questions

1

Calculate and give your answer as a fraction in lowest terms: $\frac{5}{11} - \frac{2}{11}$

Answer: ______________________

2

Calculate exactly, without a calculator: $\left(\frac{25}{4}\right)^{-\frac{3}{2}}$

Answer: ______________________

3

Solve and give the LARGER solution: $|4x + 2| = 5$

Answer: ______________________

4

Calculate exactly, as a fraction in lowest terms: $\frac{7}{4} + \frac{2}{11} \times \frac{3}{8}$

Answer: ______________________

5

Write as a single fraction and simplify: $\dfrac{8}{x+2}+\dfrac{3}{x+6}$

Answer: ______________________

6

Expand and simplify: $(5x+7)(5x-7)$

Answer: ______________________

7

Factorise fully: x^2-6x-7

Answer: ______________________

8

Simplify to a single power of x: $\dfrac{x^7\cdot x^5}{x^2}$

Answer: ______________________

9

Simplify fully: $\dfrac{x+5}{x+2}\div\dfrac{x-5}{x+2}$

Answer: ______________________

10

Give the gradient of the line through $A(3;\ 6)$ and $B(0;\ 15)$.

Answer: ____________________

11

Solve for x: $7\left(x-9\right)=4x-8$

Answer: ____________________

12

Solve for x: $\dfrac{x-9}{4}=\dfrac{x+1}{7}$

Answer: ____________________

13

Solve the system and give the value of x: $6x+1y=-32$ and $2x-1y=-16$

Answer: ____________________

14

Solve the system and give the value of x: $y=21-4x$ and $5x+5y=45$

Answer: ____________________

15

Solve $x^2 - 6x = 0$ and give the LARGER root.

Answer: ______________________

16

Solve exactly and give the LARGER solution: $2x^2 - 6x - 9 = 0$

Answer: ______________________

17

The parabola $f(x) = -2x^2 + 24x - 81$ has a maximum. At what value of x does it occur?

Answer: ______________________

18

A parabola and a line meet where $x^2 + 14x + 19 = 4x - 2$. Give the LARGER of the two x-coordinates.

Answer: ______________________

19

Give the equation of the VERTICAL asymptote of $f(x) = \dfrac{8 - 2x}{2x + 8}$

Answer: ______________________

20

Simplify fully: $\dfrac{x^2-5x-6}{x^2+6x+5}$

Answer: ______________________

21

Expand and simplify: $4\left(5x-5\right)^2+9$

Answer: ______________________

22

Solve for x: $\dfrac{3x+4}{x-3}=2$

Answer: ______________________

23

Solve for x: $\left(x+2\right)^3=-1$

Answer: ______________________

24

Write as a single logarithm: $2\log_3(x)+\log_3(8)$. Give only the ARGUMENT of the resulting logarithm.

Answer: ______________________

25

Solve for x: $\log_3(x+8) = \log_3(13)$

Answer: ____________________

26

Solve for x: $3^{3x+3} = 27$

Answer: ____________________

27

Evaluate exactly: $\log_4(8)$

Answer: ____________________

28

Differentiate: $f(x) = \left(8x^2+1\right)^4$

Answer: ____________________

29

$f(x) = 3x^3 - \frac{9x^2}{2} - 180x$. Give the x-coordinate of the local MAXIMUM.

Answer: ____________________

30

Differentiate with respect to x: $f(x) = \dfrac{4x - 8}{x^2 + 8}$

Answer: ______________________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: $\frac{3}{11}$

Write both over the common denominator 11, combine the numerators, then cancel: $\frac{3}{11}$.

Common mistakes, and the answer each one gives:

- Added (or subtracted) numerators and denominators separately → 3

2

Answer: $\frac{8}{125}$

A negative exponent turns the fraction over, and the fraction $\frac{3}{2}$ means the square root raised to the power 3: $\left(\dfrac{4}{25}\right)^{3/2} = \frac{8}{125}$.

Common mistakes, and the answer each one gives:

- Ignored the minus sign, so the fraction was never turned over → $\frac{125}{8}$
- Took the root but never applied the power → $\frac{2}{5}$
- Turned the fraction over and stopped there → $\frac{4}{25}$

3

Answer: $\frac{3}{4}$

The bars mean the inside is 5 away from zero in EITHER direction, so there are two equations: $4x+2=5$ and $4x+2=-5$. They give $\frac{3}{4}$ and $-\frac{7}{4}$; the larger is $\frac{3}{4}$.

Common mistakes, and the answer each one gives:

- Gave the smaller of the two solutions → $-\frac{7}{4}$
- Solved the positive branch, then negated the answer instead of solving the second branch → $-\frac{3}{4}$

4

Answer: $\frac{20}{11}$

Multiplication comes before addition, so work out $\dfrac{2}{11}\times\dfrac{3}{8}=\frac{3}{44}$ first, then add $\dfrac{7}{4}$: $\frac{20}{11}$.

Common mistakes, and the answer each one gives:

- Worked strictly left to right, adding before multiplying → $\frac{255}{352}$

5

Answer: $\frac{11x+54}{(x+2)(x+6)}$

The common denominator is $(x+2)(x+6)$. $\dfrac{8(x+6)+3(x+2)}{(x+2)(x+6)}=\frac{11x+54}{(x+2)(x+6)}$.

Common mistakes, and the answer each one gives:

- Added numerators and denominators separately → $\frac{11}{2x+8}$
- Used $(x+2+6)$ as the common denominator → $\frac{11}{x+8}$

6

Answer: $25x^2 - 49$

$(p \pm q)^2 = p^2 \pm 2pq + q^2$ and $(p+q)(p-q) = p^2 - q^2$. Here that gives $25x^2 - 49$.

Common mistakes, and the answer each one gives:

- Kept a middle term; in this product the two cancel → $25x^2 + 70x - 49$
- Added the squares instead of subtracting → $25x^2 + 49$
- Squared only the first term → $25x^2 - 7$

7

Answer: $(x-7)\,(x+1)$

Find two numbers whose PRODUCT is -7 and whose SUM is 6: they are -1 and 7. So the factorisation is $(x-7)\,(x+1)$.

Common mistakes, and the answer each one gives:

- Used the numbers with their signs unchanged in the brackets → $x^2 + 6x - 7$
- Matched the sum to the constant and the product to the middle term → $x^2 - 7x + 6$

8

Answer: x^{10}

Multiplying adds the exponents and dividing subtracts them: $7 + 5 - 2 = 10$, so the answer is x^{10}.

Common mistakes, and the answer each one gives:

- Multiplied the exponents instead of adding them → x^{33}
- Divided the exponents instead of subtracting → x^{6}

9

Answer: $\frac{x+5}{x-5}$

Dividing by a fraction is multiplying by its reciprocal: $\dfrac{x+5}{x+2} \times \dfrac{x+2}{x-5}$. The $x+2$ then cancels, leaving $\frac{x+5}{x-5}$.

Common mistakes, and the answer each one gives:

- Multiplied straight across without flipping the second fraction → $\frac{x^2-25}{x^2+4x+4}$
- Flipped the FIRST fraction instead of the second → $\frac{x^2+4x+4}{x^2-25}$

10

Answer: -3

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{15 - (6)}{0 - (3)} = -3.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $-\frac{1}{3}$
- Subtracted the coordinates in opposite orders → 3

11

Answer: $\frac{55}{3}$

Expand the bracket: $7x - 63 = 4x - 8$. Collect the x terms on one side and the numbers on the other, then divide: $x = \frac{55}{3}$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → $\frac{1}{3}$
- Moved a term across without changing its sign → $\frac{79}{3}$

12

Answer: $\frac{67}{3}$

Cross-multiply to clear both denominators: $7\left(x-9\right)=4\left(x+1\right)$. Expand, collect the x terms and divide: $x=\frac{67}{3}$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → $\frac{64}{3}$
- Added the fractions instead of cross-multiplying → $\frac{59}{11}$

13

Answer: -6

Eliminate y by scaling and adding, or substitute. The solution is $x=-6$, $y=4$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → 4

14

Answer: 4

The first equation already gives y, so put it straight into the second: $5x+5\left(21-4x\right)=45$. That leaves one unknown, and $x=4$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → 5
- Substituted into the equation it came from, which says nothing → 9

15

Answer: 6

$x\,(x-6)=0$, so $x=0$ or $x=6$. The larger is 6.

Common mistakes, and the answer each one gives:

- Gave the smaller root → 0
- Read the roots off with the signs unchanged → 0

16

Answer: $\frac{3}{2}+\frac{3\sqrt{3}}{2}$

The discriminant is $b^2-4ac=108$, which is positive but not a perfect square, so the roots are irrational and the formula is needed: $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$. The larger root is $\frac{3}{2}+\frac{3\sqrt{3}}{2}$.

Common mistakes, and the answer each one gives:

- Used $+b$ in the numerator instead of $-b$ → $-\frac{3}{2}+\frac{3\sqrt{3}}{2}$
- Divided by a instead of $2a$ → $3+3\sqrt{3}$
- Gave the smaller root → $\frac{3}{2}-\frac{3\sqrt{3}}{2}$

17

Answer: 6

The turning point of ax^2+bx+c sits at $x=-\dfrac{b}{2a}$. Here $a=-2$ and $b=24$, so $x=-\dfrac{24}{2(-2)}=6$. (Completing the square gives $-2\,(x-6)^2-9$, which shows the same thing.)

Common mistakes, and the answer each one gives:

- Used $\dfrac{b}{2a}$ without the minus sign → -6
- Gave the MAXIMUM VALUE instead of where it happens → -9

18

Answer: -3

Where the graphs meet, the two expressions are equal. Bring everything to one side: $x^2 + 10x + 21 = 0$, which factorises as $(x+3)(x+7)$. The roots are -7 and -3.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -7
- Read the roots straight off the brackets with the signs unchanged → 7

19

Answer: -4

The vertical asymptote sits where the denominator is zero: $2x + 8 = 0$, so $x = -4$. (The horizontal one is $y = -1$, the ratio of the leading coefficients.)

Common mistakes, and the answer each one gives:

- Set the NUMERATOR to zero (that gives the x-intercept) → 4
- Gave the horizontal asymptote instead → -1
- Forgot the sign when solving → 4

20

Answer: $\frac{x-6}{x+5}$

Factorise both: $\dfrac{(x-6)(x+1)}{(x+1)(x+5)}$. The factor $x+1$ is common to both and cancels, leaving $\frac{x-6}{x+5}$.

Common mistakes, and the answer each one gives:

- Cancelled the x^2 terms, which are terms and not factors → $\frac{-5x-6}{6x+5}$
- Cancelled the wrong bracket → $\frac{x+1}{x+5}$

21

Answer: $100x^2 - 200x + 109$

Square the bracket FIRST, then multiply by 4, then add the constant — the order matters. $(5x-5)^2 = 25x^2 - 50x + 25$, and the whole thing comes to $100x^2 - 200x + 109$.

Common mistakes, and the answer each one gives:

- Multiplied the bracket by the outside number before squaring → $400x^2 - 800x + 409$
- Squared each term inside the bracket separately → $100x^2 + 109$

22

Answer: -10

Multiply both sides by $x-3$: $3x+4 = 2\left(x-3\right)$. Expand, collect and divide: $x = -10$. (Check it is not $x = 3$, which the original forbids.)

Common mistakes, and the answer each one gives:

- Multiplied only the numerator by the right-hand side → $-\frac{2}{3}$
- Set the denominator to zero, which is the EXCLUDED value → 3

23

Answer: -3

A cube is undone by a cube root, and unlike a square root it keeps the sign: $\sqrt[3]{-1} = -1$. So $x+2 = -1$ and $x = -3$.

Common mistakes, and the answer each one gives:

- Divided by 3 instead of taking the cube root → $-\frac{7}{3}$
- Took the cube root but lost the sign → -1

24

Answer: $8x^2$

The power rule turns $2\log_3(x)$ into $\log_3(x^2)$, and the product rule combines the two into $\log_3(8x^2)$.

Common mistakes, and the answer each one gives:

- Added the arguments instead of multiplying them → x^2+8
- Multiplied by the power instead of raising to it → $16x$

25

Answer: 5

Equal logarithms with the same base have equal arguments, so $x+8=13$ and $x=5$. Check the domain: $x+8>0$ holds.

Common mistakes, and the answer each one gives:

- Subtracted the shift from the wrong side → 21
- Treated the log as a multiplier and divided → $\frac{13}{8}$

26

Answer: 0

Write the right-hand side as a power of 3: $27=3^3$. With the same base on both sides the exponents must be equal, so $3x+3=3$ and $x=0$.

Common mistakes, and the answer each one gives:

- Set the exponent equal to 27 instead of to 3 → 8
- Forgot to move the constant in the exponent across → 1

27

Answer: $\frac{3}{2}$

Write both numbers as powers of 2: $4 = 2^2$ and $8 = 2^3$. Then $\log_4 8 = \dfrac{3}{2} = \frac{3}{2}$, because the base has to be raised to that power to reach the argument.

Common mistakes, and the answer each one gives:

- Divided the two numbers → 2
- Turned the fraction of exponents upside down → $\frac{2}{3}$

28

Answer: $64x\left(8x^2+1\right)^3$

Outer power 4, inner $8x^2+1$, so $f' = 4(8x^2+1)^3 \cdot 16x$. This gives $f'(x) = 64x\left(8x^2+1\right)^3$.

Common mistakes, and the answer each one gives:

- Differentiated each part separately and combined them → $4\left(8x^2+1\right)^3$

29

Answer: -4

$f'(x) = 9x^2 - 9x - 180 = 0$ at $x = -4$ and $x = 5$. $f''(x) = 18x - 9$, and $f''(-4) = -81 < 0$, so $x = -4$ is the maximum.

Common mistakes, and the answer each one gives:

- Gave the local MINIMUM instead → 5
- Gave the y-value rather than the x-coordinate → 456
- Solved f(x) = 0 instead of f'(x) = 0 → 0

30

Answer: $\frac{-4x^2+16x+32}{x^4+16x^2+64}$

The quotient rule is $\dfrac{u'v - uv'}{v^2}$ — and the ORDER of the two products matters, unlike the product rule. With $u = 4x - 8$ and $v = x^2 + 8$: $u' = 4$ and $v' = 2x$, giving $\frac{-4x^2+16x+32}{x^4+16x^2+64}$.

Common mistakes, and the answer each one gives:

- Wrote $uv' - u'v$ in the numerator, the two products swapped → $\frac{4x^2-16x-32}{x^4+16x^2+64}$
- Differentiated top and bottom separately → $\frac{2}{x}$

OMPT-B mixed paper

30 questions drawn from every sheet on the OMPT-B syllabus, and nothing outside it.

Questions

1

Calculate and give your answer as a fraction in lowest terms: $\frac{3}{8}+\frac{1}{4}$

Answer: ______________________

2

Calculate exactly, without a calculator: $\left(\frac{27}{125}\right)^{-\frac{2}{3}}$

Answer: ______________________

3

Solve and give the LARGER solution: $|6x+8|=12$

Answer: ______________________

4

Calculate exactly, as a fraction in lowest terms: $\frac{1}{5}+\frac{1}{3}\times\frac{5}{7}$

Answer: ______________________

5

Write as a single fraction and simplify: $\frac{9}{x+5}+\frac{9}{x+3}$

Answer: ______________________

6

Expand and simplify: $(5x+4)(5x-4)$

Answer: ______________________

7

Factorise fully: $x^2+10x+16$

Answer: ______________________

8

Simplify to a single power of x: $\frac{x^3 \cdot x^8}{x^5}$

Answer: ______________________

9

Simplify fully: $\frac{x-3}{x+6} \div \frac{x-5}{x+6}$

Answer: ______________________

10

Give the gradient of the line through $A(-4;\ -4)$ and $B(-2;\ 3)$.

Answer: ____________________

11

Solve for x: $3\left(x-5\right)=7x-7$

Answer: ____________________

12

Solve for x: $\dfrac{x-7}{2}=\dfrac{x-4}{6}$

Answer: ____________________

13

Solve the system and give the value of x: $5x+5y=25$ and $6x-6y=-30$

Answer: ____________________

14

Solve the system and give the value of x: $y=6-3x$ and $2x+5y=-22$

Answer: ____________________

15

Solve $x^2 - 4x - 5 = 0$ and give the LARGER root.

Answer: ________________

16

Solve exactly and give the LARGER solution: $3x^2 + 5x - 9 = 0$

Answer: ________________

17

The parabola $f(x) = -2x^2 + 24x - 72$ has a maximum. At what value of x does it occur?

Answer: ________________

18

A parabola and a line meet where $x^2 - 5x - 2 = x + 5$. Give the LARGER of the two x-coordinates.

Answer: ________________

19

Give the equation of the VERTICAL asymptote of $f(x) = \dfrac{2 - 2x}{x + 8}$

Answer: ________________

20

Simplify fully: $\dfrac{x^2 - 7x + 6}{x^2 - 36}$

Answer: ________________________

21

Expand and simplify: $5\left(3x - 4\right)^2 + 4$

Answer: ________________________

22

Solve for x: $\dfrac{3x}{x - 6} = 8$

Answer: ________________________

23

Solve for x: $\left(x + 1\right)^3 = -64$

Answer: ________________________

24

Write as a single logarithm: $2\log_{10}(x) + \log_{10}(11)$. Give only the ARGUMENT of the resulting logarithm.

Answer: ________________________

25

Solve for x: $\log_5(x+2) = \log_5(8)$

Answer: ____________________

26

Solve for x: $2^{4x-3} = 2$

Answer: ____________________

27

Evaluate exactly: $\log_8(16)$

Answer: ____________________

28

Differentiate: $f(x) = \left(2x^2 + 1\right)^3$

Answer: ____________________

29

$f(x) = 3x^3 - 144x$. Give the x-coordinate of the local MAXIMUM.

Answer: ____________________

30

Differentiate with respect to x: $f(x) = \dfrac{4x - 2}{x^2 + 1}$

Answer: ______________________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: $\frac{5}{8}$

Write both over the common denominator 8, combine the numerators, then cancel: $\frac{5}{8}$.

Common mistakes, and the answer each one gives:

- Added (or subtracted) numerators and denominators separately → $\frac{1}{3}$

2

Answer: $\frac{25}{9}$

A negative exponent turns the fraction over, and the fraction $\frac{2}{3}$ means the cube root raised to the power 2: $\left(\dfrac{125}{27}\right)^{2/3} = \frac{25}{9}$.

Common mistakes, and the answer each one gives:

- Ignored the minus sign, so the fraction was never turned over → $\frac{9}{25}$
- Took the root but never applied the power → $\frac{5}{3}$
- Turned the fraction over and stopped there → $\frac{125}{27}$

3

Answer: $\frac{2}{3}$

The bars mean the inside is 12 away from zero in EITHER direction, so there are two equations: $6x + 8 = 12$ and $6x + 8 = -12$. They give $\frac{2}{3}$ and $-\frac{10}{3}$; the larger is $\frac{2}{3}$.

Common mistakes, and the answer each one gives:

- Gave the smaller of the two solutions → $-\frac{10}{3}$
- Solved the positive branch, then negated the answer instead of solving the second branch → $-\frac{2}{3}$

4

Answer: $\frac{46}{105}$

Multiplication comes before addition, so work out $\dfrac{1}{3} \times \dfrac{5}{7} = \frac{5}{21}$ first, then add $\dfrac{1}{5}$: $\frac{46}{105}$.

Common mistakes, and the answer each one gives:

- Worked strictly left to right, adding before multiplying → $\frac{8}{21}$

5

Answer: $\frac{18(x+4)}{(x+3)(x+5)}$

The common denominator is $(x+5)(x+3)$. $\dfrac{9(x+3)+9(x+5)}{(x+5)(x+3)} = \frac{18(x+4)}{(x+3)(x+5)}$.

Common mistakes, and the answer each one gives:

- Added numerators and denominators separately → $\frac{18}{2x+8}$
- Used $(x+5+3)$ as the common denominator → $\frac{18}{x+8}$

6

Answer: $25x^2 - 16$

$(p \pm q)^2 = p^2 \pm 2pq + q^2$ and $(p+q)(p-q) = p^2 - q^2$. Here that gives $25x^2 - 16$.

Common mistakes, and the answer each one gives:

- Kept a middle term; in this product the two cancel → $25x^2 + 40x - 16$
- Added the squares instead of subtracting → $25x^2 + 16$
- Squared only the first term → $25x^2 - 4$

7

Answer: $(x+2)(x+8)$

Find two numbers whose PRODUCT is 16 and whose SUM is -10: they are -8 and -2. So the factorisation is $(x+2)(x+8)$.

Common mistakes, and the answer each one gives:

- Used the numbers with their signs unchanged in the brackets → $x^2-10x+16$
- Matched the sum to the constant and the product to the middle term → $x^2+9x-10$

8

Answer: x^6

Multiplying adds the exponents and dividing subtracts them: $3+8-5=6$, so the answer is x^6.

Common mistakes, and the answer each one gives:

- Multiplied the exponents instead of adding them → x^{19}
- Divided the exponents instead of subtracting → $x^{\frac{11}{5}}$

9

Answer: $\frac{x-3}{x-5}$

Dividing by a fraction is multiplying by its reciprocal: $\dfrac{x-3}{x+6}\times\dfrac{x+6}{x-5}$. The $x+6$ then cancels, leaving $\frac{x-3}{x-5}$.

Common mistakes, and the answer each one gives:

- Multiplied straight across without flipping the second fraction → $\frac{x^2-8x+15}{x^2+12x+36}$
- Flipped the FIRST fraction instead of the second → $\frac{x^2+12x+36}{x^2-8x+15}$

10

Answer: $\frac{7}{2}$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{3 - (-4)}{-2 - (-4)} = \frac{7}{2}.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $\frac{2}{7}$
- Subtracted the coordinates in opposite orders → $-\frac{7}{2}$

11

Answer: -2

Expand the bracket: $3x - 15 = 7x - 7$. Collect the x terms on one side and the numbers on the other, then divide: $x = -2$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → $\frac{1}{2}$
- Moved a term across without changing its sign → $-\frac{29}{4}$

12

Answer: $\frac{17}{2}$

Cross-multiply to clear both denominators: $6\left(x - 7\right) = 2\left(x - 4\right)$. Expand, collect the x terms and divide: $x = \frac{17}{2}$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → $\frac{19}{2}$
- Added the fractions instead of cross-multiplying → $\frac{25}{4}$

13

Answer: 0

Eliminate y by scaling and adding, or substitute. The solution is $x = 0$, $y = 5$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → 5

14

Answer: 4

The first equation already gives y, so put it straight into the second: $2x + 5\left(6 - 3x\right) = -22$. That leaves one unknown, and $x = 4$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → -6
- Substituted into the equation it came from, which says nothing → 9

15

Answer: 5

$\left(x - 5\right)\left(x + 1\right) = 0$, so $x = 5$ or $x = -1$. The larger is 5.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -1
- Read the roots off with the signs unchanged → 1

16

Answer: $-\frac{5}{6}+\frac{\sqrt{133}}{6}$

The discriminant is $b^2-4ac=133$, which is positive but not a perfect square, so the roots are irrational and the formula is needed: $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$. The larger root is $-\frac{5}{6}+\frac{\sqrt{133}}{6}$.

Common mistakes, and the answer each one gives:

- Used $+b$ in the numerator instead of $-b$ → $\frac{5}{6}+\frac{\sqrt{133}}{6}$
- Divided by a instead of $2a$ → $-\frac{5}{3}+\frac{\sqrt{133}}{3}$
- Gave the smaller root → $-\frac{\sqrt{133}}{6}-\frac{5}{6}$

17

Answer: 6

The turning point of ax^2+bx+c sits at $x=-\dfrac{b}{2a}$. Here $a=-2$ and $b=24$, so $x=-\dfrac{24}{2(-2)}=6$. (Completing the square gives $-2\left(x-6\right)^2$, which shows the same thing.)

Common mistakes, and the answer each one gives:

- Used $\dfrac{b}{2a}$ without the minus sign → -6
- Gave the MAXIMUM VALUE instead of where it happens → 0

18

Answer: 7

Where the graphs meet, the two expressions are equal. Bring everything to one side: $x^2-6x-7=0$, which factorises as $\left(x-7\right)\left(x+1\right)$. The roots are -1 and 7.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -1
- Read the roots straight off the brackets with the signs unchanged → 1

19

Answer: -8

The vertical asymptote sits where the denominator is zero: $x + 8 = 0$, so $x = -8$. (The horizontal one is $y = -2$, the ratio of the leading coefficients.)

Common mistakes, and the answer each one gives:

- Set the NUMERATOR to zero (that gives the x-intercept) → 1
- Gave the horizontal asymptote instead → -2
- Forgot the sign when solving → 8

20

Answer: $\frac{x-1}{x+6}$

Factorise both: $\dfrac{(x-6)(x-1)}{(x-6)(x+6)}$. The factor $x - 6$ is common to both and cancels, leaving $\frac{x-1}{x+6}$.

Common mistakes, and the answer each one gives:

- Cancelled the x^2 terms, which are terms and not factors → $\frac{7x}{36} - \frac{1}{6}$
- Cancelled the wrong bracket → $\frac{x-6}{x+6}$

21

Answer: $45x^2 - 120x + 84$

Square the bracket FIRST, then multiply by 5, then add the constant — the order matters. $(3x-4)^2 = 9x^2 - 24x + 16$, and the whole thing comes to $45x^2 - 120x + 84$.

Common mistakes, and the answer each one gives:

- Multiplied the bracket by the outside number before squaring → $225x^2 - 600x + 404$
- Squared each term inside the bracket separately → $45x^2 + 84$

22

Answer: $\frac{48}{5}$

Multiply both sides by $x-6$: $3x = 8\,(x-6)$. Expand, collect and divide: $x = \frac{48}{5}$. (Check it is not $x = 6$, which the original forbids.)

Common mistakes, and the answer each one gives:

- Multiplied only the numerator by the right-hand side → $\frac{8}{3}$
- Set the denominator to zero, which is the EXCLUDED value → 6

23

Answer: -5

A cube is undone by a cube root, and unlike a square root it keeps the sign: $\sqrt[3]{-64} = -4$. So $x+1=-4$ and $x=-5$.

Common mistakes, and the answer each one gives:

- Divided by 3 instead of taking the cube root → $-\frac{67}{3}$
- Took the cube root but lost the sign → 3

24

Answer: $11x^2$

The power rule turns $2\log_{10}(x)$ into $\log_{10}(x^2)$, and the product rule combines the two into $\log_{10}(11x^2)$.

Common mistakes, and the answer each one gives:

- Added the arguments instead of multiplying them → x^2+11
- Multiplied by the power instead of raising to it → $22x$

25

Answer: 6

Equal logarithms with the same base have equal arguments, so $x+2=8$ and $x=6$. Check the domain: $x+2>0$ holds.

Common mistakes, and the answer each one gives:

- Subtracted the shift from the wrong side → 10
- Treated the log as a multiplier and divided → 4

26

Answer: 1

Write the right-hand side as a power of 2: $2=2^1$. With the same base on both sides the exponents must be equal, so $4x-3=1$ and $x=1$.

Common mistakes, and the answer each one gives:

- Set the exponent equal to 2 instead of to 1 → $\frac{5}{4}$
- Forgot to move the constant in the exponent across → $\frac{1}{4}$

27

Answer: $\frac{4}{3}$

Write both numbers as powers of 2: $8=2^3$ and $16=2^4$. Then $\log_8 16=\dfrac{4}{3}=\frac{4}{3}$, because the base has to be raised to that power to reach the argument.

Common mistakes, and the answer each one gives:

- Divided the two numbers → 2
- Turned the fraction of exponents upside down → $\frac{3}{4}$

28

Answer: $12x\left(2x^2+1\right)^2$

Outer power 3, inner $2x^2+1$, so $f'=3(2x^2+1)^2\cdot 4x$. This gives $f'(x) = 12x\left(2x^2+1\right)^2$.

Common mistakes, and the answer each one gives:

- Differentiated each part separately and combined them → $3\left(2x^2+1\right)^2$

29

Answer: -4

$f'(x) = 9x^2 - 144 = 0$ at $x=-4$ and $x=4$. $f''(x) = 18x$, and $f''(-4) = -72 < 0$, so $x=-4$ is the maximum.

Common mistakes, and the answer each one gives:

- Gave the local MINIMUM instead → 4
- Gave the y-value rather than the x-coordinate → 384
- Solved f(x) = 0 instead of f'(x) = 0 → 0

30

Answer: $\frac{-4x^2+4x+4}{x^4+2x^2+1}$

The quotient rule is $\dfrac{u'v-uv'}{v^2}$ — and the ORDER of the two products matters, unlike the product rule. With $u=4x-2$ and $v=x^2+1$: $u'=4$ and $v'=2x$, giving $\frac{-4x^2+4x+4}{x^4+2x^2+1}$.

Common mistakes, and the answer each one gives:

- Wrote $uv'-u'v$ in the numerator, the two products swapped → $\frac{4x^2-4x-4}{x^4+2x^2+1}$
- Differentiated top and bottom separately → $\frac{2}{x}$

OMPT-C mixed paper

30 questions drawn from every sheet on the OMPT-C syllabus, and nothing outside it.

Questions

1

Calculate and give your answer as a fraction in lowest terms: $\frac{3}{2} - \frac{1}{5}$

Answer: ____________________

2

Calculate exactly, without a calculator: $\left(\frac{1}{8}\right)^{-\frac{2}{3}}$

Answer: ____________________

3

Solve and give the LARGER solution: $|5x| = 9$

Answer: ____________________

4

Calculate exactly, as a fraction in lowest terms: $\frac{8}{11} + \frac{4}{11} \times \frac{9}{8}$

Answer: ____________________

5

Write as a single fraction and simplify: $\dfrac{4}{x+4} + \dfrac{5}{x+6}$

Answer: ____________________

6

Expand and simplify: $(5x+6)(5x-6)$

Answer: ____________________

7

Factorise fully: $x^2 - 3x - 4$

Answer: ____________________

8

Simplify to a single power of x: $\dfrac{x^7 \cdot x^2}{x^6}$

Answer: ____________________

9

Simplify fully: $\dfrac{x+7}{x-3} \div \dfrac{x-2}{x-3}$

Answer: ____________________

10

Give the gradient of the line through $A(2;\ -2)$ and $B(-2;\ -7)$.

Answer: ____________________

11

Solve for x: $7\,(x+9)=5x-8$

Answer: ____________________

12

Solve for x: $\dfrac{x+2}{5}=\dfrac{x-7}{3}$

Answer: ____________________

13

A right-angled triangle has a hypotenuse of 26 and one leg of 10. How long is the other leg?

Answer: ____________________

14

Two angles of a triangle are 61° and 34°. How many degrees is the third?

Answer: ____________________

15

What is the sum of the interior angles of a polygon with 8 sides, in degrees?

Answer: ____________________

16

A circle has a radius of 8. What is its area? Leave your answer in terms of π.

Answer: ____________________

17

How far apart are the points $(6, 5)$ and $(16, 29)$?

Answer: ____________________

18

Calculate and give your answer as a fraction in lowest terms: $\frac{7}{8} - \frac{2}{7}$

Answer: ____________________

19

Calculate exactly, without a calculator: $\left(\frac{49}{9}\right)^{-\frac{3}{2}}$

Answer: ____________________

20

Solve and give the LARGER solution: $|6x+3|=9$

Answer: ______________________

21

Calculate exactly, as a fraction in lowest terms: $\frac{8}{5}+\frac{1}{10}\times\frac{4}{9}$

Answer: ______________________

22

Write as a single fraction and simplify: $\frac{5}{x+2}+\frac{9}{x+1}$

Answer: ______________________

23

Expand and simplify: $(6x-2)^2$

Answer: ______________________

24

Factorise fully: x^2-2x-3

Answer: ______________________

25

Simplify to a single power of x: $\dfrac{x^7 \cdot x^3}{x^3}$

Answer: ____________________

26

Simplify fully: $\dfrac{x+6}{x+7} \div \dfrac{x+5}{x+7}$

Answer: ____________________

27

Give the gradient of the line through $A(-1;\ -5)$ and $B(-5;\ 4)$.

Answer: ____________________

28

Solve for x: $4\,(x-1) = 7x + 9$

Answer: ____________________

29

Solve for x: $\dfrac{x+1}{5} = \dfrac{x-5}{6}$

Answer: ____________________

30

A right-angled triangle has legs of length 20 and 21. How long is its hypotenuse?

Answer: ______________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: $\frac{13}{10}$

Write both over the common denominator 10, combine the numerators, then cancel: $\frac{13}{10}$.

Common mistakes, and the answer each one gives:

- Added (or subtracted) numerators and denominators separately → $-\frac{2}{3}$

2

Answer: 4

A negative exponent turns the fraction over, and the fraction $\frac{2}{3}$ means the cube root raised to the power 2: $\left(\frac{8}{1}\right)^{2/3} = 4$.

Common mistakes, and the answer each one gives:

- Ignored the minus sign, so the fraction was never turned over → $\frac{1}{4}$
- Took the root but never applied the power → 2
- Turned the fraction over and stopped there → 8

3

Answer: $\frac{9}{5}$

The bars mean the inside is 9 away from zero in EITHER direction, so there are two equations: $5x = 9$ and $5x = -9$. They give $\frac{9}{5}$ and $-\frac{9}{5}$; the larger is $\frac{9}{5}$.

Common mistakes, and the answer each one gives:

- Gave the smaller of the two solutions → $-\frac{9}{5}$
- Solved the positive branch, then negated the answer instead of solving the second branch → $-\frac{9}{5}$

4

Answer: $\frac{25}{22}$

Multiplication comes before addition, so work out $\dfrac{4}{11} \times \dfrac{9}{8} = \frac{9}{22}$ first, then add $\dfrac{8}{11}$: $\frac{25}{22}$.

Common mistakes, and the answer each one gives:

- Worked strictly left to right, adding before multiplying → $\frac{27}{22}$

5

Answer: $\frac{9x+44}{(x+4)(x+6)}$

The common denominator is $(x+4)(x+6)$. $\dfrac{4(x+6)+5(x+4)}{(x+4)(x+6)} = \frac{9x+44}{(x+4)(x+6)}$.

Common mistakes, and the answer each one gives:

- Added numerators and denominators separately → $\frac{9}{2x+10}$
- Used $(x+4+6)$ as the common denominator → $\frac{9}{x+10}$

6

Answer: $25x^2 - 36$

$(p \pm q)^2 = p^2 \pm 2pq + q^2$ and $(p+q)(p-q) = p^2 - q^2$. Here that gives $25x^2 - 36$.

Common mistakes, and the answer each one gives:

- Kept a middle term; in this product the two cancel → $25x^2 + 60x - 36$
- Added the squares instead of subtracting → $25x^2 + 36$
- Squared only the first term → $25x^2 - 6$

7

Answer: $(x-4)(x+1)$

Find two numbers whose PRODUCT is -4 and whose SUM is 3: they are 4 and -1. So the factorisation is $(x-4)(x+1)$.

Common mistakes, and the answer each one gives:

- Used the numbers with their signs unchanged in the brackets → $x^2 + 3x - 4$
- Matched the sum to the constant and the product to the middle term → $x^2 - 4x + 3$

8

Answer: x^3

Multiplying adds the exponents and dividing subtracts them: $7 + 2 - 6 = 3$, so the answer is x^3.

Common mistakes, and the answer each one gives:

- Multiplied the exponents instead of adding them → x^8
- Divided the exponents instead of subtracting → $x^{\frac{3}{2}}$

9

Answer: $\frac{x+7}{x-2}$

Dividing by a fraction is multiplying by its reciprocal: $\dfrac{x+7}{x-3} \times \dfrac{x-3}{x-2}$. The $x-3$ then cancels, leaving $\frac{x+7}{x-2}$.

Common mistakes, and the answer each one gives:

- Multiplied straight across without flipping the second fraction → $\frac{x^2+5x-14}{x^2-6x+9}$
- Flipped the FIRST fraction instead of the second → $\frac{x^2-6x+9}{x^2+5x-14}$

10

Answer: $\frac{5}{4}$

$m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{-7-(-2)}{-2-(2)} = \frac{5}{4}$.

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $\frac{4}{5}$
- Subtracted the coordinates in opposite orders → $-\frac{5}{4}$

11

Answer: $-\frac{71}{2}$

Expand the bracket: $7x + 63 = 5x - 8$. Collect the x terms on one side and the numbers on the other, then divide: $x = -\frac{71}{2}$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → $-\frac{17}{2}$
- Moved a term across without changing its sign → $-\frac{47}{2}$

12

Answer: $\frac{41}{2}$

Cross-multiply to clear both denominators: $3\left(x+2\right)=5\left(x-7\right)$. Expand, collect the x terms and divide: $x=\frac{41}{2}$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → $\frac{13}{2}$
- Added the fractions instead of cross-multiplying → $\frac{29}{8}$

13

Answer: 24

Rearrange Pythagoras: the missing leg squared is $26^2-10^2=576$, so the leg is $\sqrt{576}=24$.

Common mistakes, and the answer each one gives:

- Subtracted the lengths instead of their squares → 16
- Added the squares, which is the rule for the HYPOTENUSE → $2\sqrt{194}$

14

Answer: 85

The three angles of any triangle add to 180°, so the third is $180-61-34=85$.

Common mistakes, and the answer each one gives:

- Used 360°, which is the angles round a POINT → 265
- Subtracted only one of the two given angles → 119

15

Answer: 1080

A polygon with 8 sides splits into 6 triangles from one corner, and each triangle contributes 180°: $(8-2) \times 180 = 1080$.

Common mistakes, and the answer each one gives:

- Multiplied the number of sides by 180 without subtracting 2 → 1440
- Gave the EXTERIOR angle sum, which is 360 for every polygon → 360

16

Answer: 64π

Area $= \pi r^2 = \pi \times 8^2 = 64\pi$.

Common mistakes, and the answer each one gives:

- Used the circumference formula $2\pi r$ → 16π
- Doubled the radius instead of squaring it → 16π

17

Answer: 26

The horizontal gap is 10 and the vertical gap is 24, so Pythagoras gives $\sqrt{10^2 + 24^2} = \sqrt{676} = 26$.

Common mistakes, and the answer each one gives:

- Added the two gaps instead of using Pythagoras → 34
- Forgot the square root → 676

18

Answer: $\frac{33}{56}$

Write both over the common denominator 56, combine the numerators, then cancel: $\frac{33}{56}$
.

Common mistakes, and the answer each one gives:

- Added (or subtracted) numerators and denominators separately → 5

19

Answer: $\frac{27}{343}$

A negative exponent turns the fraction over, and the fraction $\frac{3}{2}$ means the square root raised to the power 3: $\left(\frac{9}{49}\right)^{3/2} = \frac{27}{343}$.

Common mistakes, and the answer each one gives:

- Ignored the minus sign, so the fraction was never turned over → $\frac{343}{27}$
- Took the root but never applied the power → $\frac{3}{7}$
- Turned the fraction over and stopped there → $\frac{9}{49}$

20

Answer: 1

The bars mean the inside is 9 away from zero in EITHER direction, so there are two equations: $6x + 3 = 9$ and $6x + 3 = -9$. They give 1 and -2; the larger is 1.

Common mistakes, and the answer each one gives:

- Gave the smaller of the two solutions → -2
- Solved the positive branch, then negated the answer instead of solving the second branch → -1

21

Answer: $\frac{74}{45}$

Multiplication comes before addition, so work out $\dfrac{1}{10} \times \dfrac{4}{9} = \frac{2}{45}$ first, then add $\dfrac{8}{5}$: $\frac{74}{45}$.

Common mistakes, and the answer each one gives:

- Worked strictly left to right, adding before multiplying → $\frac{34}{45}$

22

Answer: $\frac{14x+23}{(x+1)(x+2)}$

The common denominator is $(x+2)(x+1)$. $\dfrac{5(x+1)+9(x+2)}{(x+2)(x+1)} = \frac{14x+23}{(x+1)(x+2)}$.

Common mistakes, and the answer each one gives:

- Added numerators and denominators separately → $\frac{14}{2x+3}$
- Used $(x+2+1)$ as the common denominator → $\frac{14}{x+3}$

23

Answer: $36x^2 - 24x + 4$

$(p \pm q)^2 = p^2 \pm 2pq + q^2$ and $(p+q)(p-q) = p^2 - q^2$. Here that gives $36x^2 - 24x + 4$.

Common mistakes, and the answer each one gives:

- Squared each term and left out the middle term → $36x^2 + 4$
- Gave the middle term the wrong sign → $36x^2 + 24x + 4$
- Doubled the whole bracket instead of squaring it → $12x - 4$

24

Answer: $\left(x-3\right)\left(x+1\right)$

Find two numbers whose PRODUCT is -3 and whose SUM is 2: they are -1 and 3. So the factorisation is $\left(x-3\right)\left(x+1\right)$.

Common mistakes, and the answer each one gives:

- Used the numbers with their signs unchanged in the brackets → x^2+2x-3
- Matched the sum to the constant and the product to the middle term → x^2-3x+2

25

Answer: x^7

Multiplying adds the exponents and dividing subtracts them: $7+3-3=7$, so the answer is x^7.

Common mistakes, and the answer each one gives:

- Multiplied the exponents instead of adding them → x^{18}
- Divided the exponents instead of subtracting → $x^{\frac{10}{3}}$

26

Answer: $\frac{x+6}{x+5}$

Dividing by a fraction is multiplying by its reciprocal: $\dfrac{x+6}{x+7}\times\dfrac{x+7}{x+5}$. The $x+7$ then cancels, leaving $\frac{x+6}{x+5}$.

Common mistakes, and the answer each one gives:

- Multiplied straight across without flipping the second fraction → $\frac{x^2+11x+30}{x^2+14x+49}$
- Flipped the FIRST fraction instead of the second → $\frac{x^2+14x+49}{x^2+11x+30}$

27

Answer: $-\frac{9}{4}$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{4 - (-5)}{-5 - (-1)} = -\tfrac{9}{4}.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $-\frac{4}{9}$
- Subtracted the coordinates in opposite orders → $\frac{9}{4}$

28

Answer: $-\frac{13}{3}$

Expand the bracket: $4x - 4 = 7x + 9$. Collect the x terms on one side and the numbers on the other, then divide: $x = -\frac{13}{3}$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → $-\frac{10}{3}$
- Moved a term across without changing its sign → $\frac{14}{3}$

29

Answer: -31

Cross-multiply to clear both denominators: $6\left(x+1\right) = 5\left(x-5\right)$. Expand, collect the x terms and divide: $x = -31$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → -11
- Added the fractions instead of cross-multiplying → $\frac{19}{11}$

30

Answer: 29

Pythagoras: the square on the hypotenuse equals the sum of the squares on the legs. $20^2 + 21^2 = 841$, and $\sqrt{841} = 29$.

Common mistakes, and the answer each one gives:

- Added the legs instead of their squares → 41
- Subtracted the squares, which finds a LEG not the hypotenuse → $\sqrt{41}$

OMPT-D mixed paper

30 questions drawn from every sheet on the OMPT-D syllabus, and nothing outside it.

Questions

1

Calculate and give your answer as a fraction in lowest terms: $\frac{7}{8} + \frac{2}{11}$

Answer: ______________________

2

Calculate exactly, without a calculator: $\left(\frac{16}{25}\right)^{-\frac{3}{2}}$

Answer: ______________________

3

Solve and give the LARGER solution: $|3x + 2| = 9$

Answer: ______________________

4

Calculate exactly, as a fraction in lowest terms: $\frac{4}{11} + \frac{8}{7} \times \frac{2}{11}$

Answer: ______________________

5

Write as a single fraction and simplify: $\frac{7}{x+5}+\frac{3}{x+4}$

Answer: ____________________

6

Expand and simplify: $(3x-8)^2$

Answer: ____________________

7

Factorise fully: $x^2-6x-27$

Answer: ____________________

8

Simplify to a single power of x: $\frac{x^8\cdot x^4}{x^2}$

Answer: ____________________

9

Simplify fully: $\frac{x+4}{x+7}\div\frac{x}{x+7}$

Answer: ____________________

10

Give the gradient of the line through $A(1;\ 8)$ and $B(3;\ 16)$.

Answer: ____________________

11

Solve for x: $2\,(x-6)=3x+6$

Answer: ____________________

12

Solve for x: $\dfrac{x+4}{3}=\dfrac{x-3}{4}$

Answer: ____________________

13

Solve the system and give the value of x: $5x+5y=0$ and $4x-5y=36$

Answer: ____________________

14

Solve the system and give the value of x: $y=-3x-5$ and $5x+5y=5$

Answer: ____________________

15

Solve $x^2 + 2x - 8 = 0$ and give the LARGER root.

Answer: ____________________

16

Solve exactly and give the LARGER solution: $3x^2 + 6x - 8 = 0$

Answer: ____________________

17

The parabola $f(x) = -3x^2 - 36x - 106$ has a maximum. At what value of x does it occur?

Answer: ____________________

18

A parabola and a line meet where $x^2 - x - 18 = 2x - 8$. Give the LARGER of the two x-coordinates.

Answer: ____________________

19

Give the equation of the VERTICAL asymptote of $f(x) = \dfrac{3x+2}{2x+7}$

Answer: ____________________

20

Simplify fully: $\dfrac{x^2 - 5x - 6}{x^2 - 6x - 7}$

Answer: ______________________

21

Expand and simplify: $3\left(4x-4\right)^2-3$

Answer: ______________________

22

Solve for x: $\dfrac{6x+9}{x+3} = 7$

Answer: ______________________

23

Solve for x: $\left(x-3\right)^3 = -8$

Answer: ______________________

24

Write as a single logarithm: $5\log_5(x) + \log_5(11)$. Give only the ARGUMENT of the resulting logarithm.

Answer: ______________________

25

Solve for x: $\log_5(x+1) = \log_5(6)$

Answer: ______________________

26

Solve for x: $2^{2x-3} = 4$

Answer: ______________________

27

Evaluate exactly: $\log_4(8)$

Answer: ______________________

28

Differentiate: $f(x) = x^4 e^{8x}$

Answer: ______________________

29

$f(x) = 2x^3 - 12x^2 - 126x$. Give the x-coordinate of the local MAXIMUM.

Answer: ______________________

30

Differentiate with respect to x: $f(x) = \dfrac{x+4}{x^2+6}$

Answer: ______________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: $\frac{93}{88}$

Write both over the common denominator 88, combine the numerators, then cancel: $\frac{93}{88}$.

Common mistakes, and the answer each one gives:

- Added (or subtracted) numerators and denominators separately → $\frac{9}{19}$

2

Answer: $\frac{125}{64}$

A negative exponent turns the fraction over, and the fraction $\frac{3}{2}$ means the square root raised to the power 3: $\left(\frac{25}{16}\right)^{3/2} = \frac{125}{64}$.

Common mistakes, and the answer each one gives:

- Ignored the minus sign, so the fraction was never turned over → $\frac{64}{125}$
- Took the root but never applied the power → $\frac{5}{4}$
- Turned the fraction over and stopped there → $\frac{25}{16}$

3

Answer: $\frac{7}{3}$

The bars mean the inside is 9 away from zero in EITHER direction, so there are two equations: $3x + 2 = 9$ and $3x + 2 = -9$. They give $\frac{7}{3}$ and $-\frac{11}{3}$; the larger is $\frac{7}{3}$.

Common mistakes, and the answer each one gives:

- Gave the smaller of the two solutions → $-\frac{11}{3}$
- Solved the positive branch, then negated the answer instead of solving the second branch → $-\frac{7}{3}$

4

Answer: $\frac{4}{7}$

Multiplication comes before addition, so work out $\dfrac{8}{7} \times \dfrac{2}{11} = \frac{16}{77}$ first, then add $\dfrac{4}{11}$: $\frac{4}{7}$.

Common mistakes, and the answer each one gives:

- Worked strictly left to right, adding before multiplying → $\frac{232}{847}$

5

Answer: $\frac{10x+43}{(x+4)(x+5)}$

The common denominator is $(x+5)(x+4)$. $\dfrac{7(x+4)+3(x+5)}{(x+5)(x+4)} = \frac{10x+43}{(x+4)(x+5)}$.

Common mistakes, and the answer each one gives:

- Added numerators and denominators separately → $\frac{10}{2x+9}$
- Used $(x+5+4)$ as the common denominator → $\frac{10}{x+9}$

6

Answer: $9x^2 - 48x + 64$

$(p \pm q)^2 = p^2 \pm 2pq + q^2$ and $(p+q)(p-q) = p^2 - q^2$. Here that gives $9x^2 - 48x + 64$.

Common mistakes, and the answer each one gives:

- Squared each term and left out the middle term → $9x^2 + 64$
- Gave the middle term the wrong sign → $9x^2 + 48x + 64$
- Doubled the whole bracket instead of squaring it → $6x - 16$

7

Answer: $(x-9)\,(x+3)$

Find two numbers whose PRODUCT is -27 and whose SUM is 6: they are 9 and -3. So the factorisation is $(x-9)\,(x+3)$.

Common mistakes, and the answer each one gives:

- Used the numbers with their signs unchanged in the brackets → $x^2 + 6x - 27$
- Matched the sum to the constant and the product to the middle term → $x^2 - 7x + 6$

8

Answer: x^{10}

Multiplying adds the exponents and dividing subtracts them: $8 + 4 - 2 = 10$, so the answer is x^{10}.

Common mistakes, and the answer each one gives:

- Multiplied the exponents instead of adding them → x^{30}
- Divided the exponents instead of subtracting → x^6

9

Answer: $\frac{x+4}{x}$

Dividing by a fraction is multiplying by its reciprocal: $\dfrac{x+4}{x+7} \times \dfrac{x+7}{x}$. The $x+7$ then cancels, leaving $\frac{x+4}{x}$.

Common mistakes, and the answer each one gives:

- Multiplied straight across without flipping the second fraction → $\frac{x^2+4x}{x^2+14x+49}$
- Flipped the FIRST fraction instead of the second → $\frac{x^2+14x+49}{x^2+4x}$

10

Answer: 4

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{16-(8)}{3-(1)} = 4.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $\frac{1}{4}$
- Subtracted the coordinates in opposite orders → -4

11

Answer: -18

Expand the bracket: $2x - 12 = 3x + 6$. Collect the x terms on one side and the numbers on the other, then divide: $x = -18$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → -12
- Moved a term across without changing its sign → 0

12

Answer: -25

Cross-multiply to clear both denominators: $4\left(x+4\right)=3\left(x-3\right)$. Expand, collect the x terms and divide: $x=-25$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → -19
- Added the fractions instead of cross-multiplying → -1

13

Answer: 4

Eliminate y by scaling and adding, or substitute. The solution is $x=4$, $y=-4$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → -4

14

Answer: -3

The first equation already gives y, so put it straight into the second: $5x+5\left(-3x-5\right)=5$. That leaves one unknown, and $x=-3$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → 4
- Substituted into the equation it came from, which says nothing → 2

15

Answer: 2

$(x-2)(x+4)=0$, so $x=2$ or $x=-4$. The larger is 2.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -4
- Read the roots off with the signs unchanged → 4

16

Answer: $-1+\frac{\sqrt{33}}{3}$

The discriminant is $b^2-4ac=132$, which is positive but not a perfect square, so the roots are irrational and the formula is needed: $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$. The larger root is $-1+\frac{\sqrt{33}}{3}$.

Common mistakes, and the answer each one gives:

- Used $+b$ in the numerator instead of $-b$ → $1+\frac{\sqrt{33}}{3}$
- Divided by a instead of $2a$ → $-2+\frac{2\sqrt{33}}{3}$
- Gave the smaller root → $-\frac{\sqrt{33}}{3}-1$

17

Answer: -6

The turning point of ax^2+bx+c sits at $x=-\dfrac{b}{2a}$. Here $a=-3$ and $b=-36$, so $x=-\dfrac{-36}{2(-3)}=-6$. (Completing the square gives $-3\left(x+6\right)^2+2$, which shows the same thing.)

Common mistakes, and the answer each one gives:

- Used $\dfrac{b}{2a}$ without the minus sign → 6
- Gave the MAXIMUM VALUE instead of where it happens → 2

18

Answer: 5

Where the graphs meet, the two expressions are equal. Bring everything to one side: $x^2 - 3x - 10 = 0$, which factorises as $(x-5)(x+2)$. The roots are -2 and 5.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -2
- Read the roots straight off the brackets with the signs unchanged → 2

19

Answer: $-\frac{7}{2}$

The vertical asymptote sits where the denominator is zero: $2x + 7 = 0$, so $x = -\frac{7}{2}$. (The horizontal one is $y = \frac{3}{2}$, the ratio of the leading coefficients.)

Common mistakes, and the answer each one gives:

- Set the NUMERATOR to zero (that gives the x-intercept) → $-\frac{2}{3}$
- Gave the horizontal asymptote instead → $\frac{3}{2}$
- Forgot the sign when solving → $\frac{7}{2}$

20

Answer: $\frac{x-6}{x-7}$

Factorise both: $\dfrac{(x-6)(x+1)}{(x-7)(x+1)}$. The factor $x+1$ is common to both and cancels, leaving $\frac{x-6}{x-7}$.

Common mistakes, and the answer each one gives:

- Cancelled the x^2 terms, which are terms and not factors → $\frac{5x+6}{6x+7}$
- Cancelled the wrong bracket → $\frac{x+1}{x-7}$

21

Answer: $48x^2 - 96x + 45$

Square the bracket FIRST, then multiply by 3, then add the constant — the order matters. $(4x-4)^2 = 16x^2 - 32x + 16$, and the whole thing comes to $48x^2 - 96x + 45$.

Common mistakes, and the answer each one gives:

- Multiplied the bracket by the outside number before squaring → $144x^2 - 288x + 141$
- Squared each term inside the bracket separately → $48x^2 + 45$

22

Answer: -12

Multiply both sides by $x+3$: $6x + 9 = 7\,(x+3)$. Expand, collect and divide: $x = -12$. (Check it is not $x = -3$, which the original forbids.)

Common mistakes, and the answer each one gives:

- Multiplied only the numerator by the right-hand side → $-\frac{1}{3}$
- Set the denominator to zero, which is the EXCLUDED value → -3

23

Answer: 1

A cube is undone by a cube root, and unlike a square root it keeps the sign: $\sqrt[3]{-8} = -2$. So $x - 3 = -2$ and $x = 1$.

Common mistakes, and the answer each one gives:

- Divided by 3 instead of taking the cube root → $\frac{1}{3}$
- Took the cube root but lost the sign → 5

24

Answer: $11x^5$

The power rule turns $5\log_5(x)$ into $\log_5(x^5)$, and the product rule combines the two into $\log_5(11x^5)$.

Common mistakes, and the answer each one gives:

- Added the arguments instead of multiplying them → $x^5 + 11$
- Multiplied by the power instead of raising to it → $55x$

25

Answer: 5

Equal logarithms with the same base have equal arguments, so $x + 1 = 6$ and $x = 5$. Check the domain: $x + 1 > 0$ holds.

Common mistakes, and the answer each one gives:

- Subtracted the shift from the wrong side → 7
- Treated the log as a multiplier and divided → 6

26

Answer: $\frac{5}{2}$

Write the right-hand side as a power of 2: $4 = 2^2$. With the same base on both sides the exponents must be equal, so $2x - 3 = 2$ and $x = \frac{5}{2}$.

Common mistakes, and the answer each one gives:

- Set the exponent equal to 4 instead of to 2 → $\frac{7}{2}$
- Forgot to move the constant in the exponent across → 1

27

Answer: $\frac{3}{2}$

Write both numbers as powers of 2: $4 = 2^2$ and $8 = 2^3$. Then $\log_4 8 = \dfrac{3}{2} = \frac{3}{2}$, because the base has to be raised to that power to reach the argument.

Common mistakes, and the answer each one gives:

- Divided the two numbers → 2
- Turned the fraction of exponents upside down → $\frac{2}{3}$

28

Answer: $x^3\left(8x+4\right)e^{8x}$

$u = x^4$, $v = e^{8x}$, so $f' = u'v + uv'$. This gives $f'(x) = x^3\left(8x+4\right)e^{8x}$.

Common mistakes, and the answer each one gives:

- Differentiated each part separately and combined them → $32x^3e^{8x}$

29

Answer: -3

$f'(x) = 6x^2 - 24x - 126 = 0$ at $x = -3$ and $x = 7$. $f''(x) = 12x - 24$, and $f''(-3) = -60 < 0$, so $x = -3$ is the maximum.

Common mistakes, and the answer each one gives:

- Gave the local MINIMUM instead → 7
- Gave the y-value rather than the x-coordinate → 216
- Solved f(x) = 0 instead of f'(x) = 0 → 0

30

Answer: $\frac{-x^2-8x+6}{x^4+12x^2+36}$

The quotient rule is $\dfrac{u'v-uv'}{v^2}$ — and the ORDER of the two products matters, unlike the product rule. With $u=x+4$ and $v=x^2+6$: $u'=1$ and $v'=2x$, giving $\frac{-x^2-8x+6}{x^4+12x^2+36}$.

Common mistakes, and the answer each one gives:

- Wrote $uv'-u'v$ in the numerator, the two products swapped → $\frac{x^2+8x-6}{x^4+12x^2+36}$
- Differentiated top and bottom separately → $\frac{1}{2x}$

OMPT-E mixed paper

30 questions drawn from every sheet on the OMPT-E syllabus, and nothing outside it.

Questions

1

Calculate and give your answer as a fraction in lowest terms: $\frac{3}{7} - \frac{5}{9}$

Answer: ________________

2

Calculate exactly, without a calculator: $\left(\frac{25}{4}\right)^{-\frac{3}{2}}$

Answer: ________________

3

Solve and give the LARGER solution: $|6x - 8| = 8$

Answer: ________________

4

Calculate exactly, as a fraction in lowest terms: $\frac{5}{2} + \frac{1}{12} \times \frac{6}{5}$

Answer: ________________

5

Write as a single fraction and simplify: $\frac{2}{x+3} + \frac{6}{x+5}$

Answer: ____________________

6

Expand and simplify: $(3x+9)^2$

Answer: ____________________

7

Factorise fully: $x^2 + x - 6$

Answer: ____________________

8

Simplify to a single power of x: $\frac{x^4 \cdot x^5}{x^4}$

Answer: ____________________

9

Simplify fully: $\frac{x-2}{x+3} \div \frac{x+6}{x+3}$

Answer: ____________________

10

Give the gradient of the line through $A(3;\ 6)$ and $B(7;\ 15)$.

Answer: ______________________

11

Solve for x: $3\left(x-5\right)=4x+1$

Answer: ______________________

12

Solve for x: $\dfrac{x+6}{3}=\dfrac{x-8}{7}$

Answer: ______________________

13

Solve the system and give the value of x: $5x+2y=-8$ and $6x-5y=20$

Answer: ______________________

14

Solve the system and give the value of x: $y=3x-19$ and $2x+3y=-2$

Answer: ______________________

15

Solve $x^2 - 15x + 56 = 0$ and give the LARGER root.

Answer: ____________________

16

Solve exactly and give the LARGER solution: $2x^2 + 2x - 9 = 0$

Answer: ____________________

17

The parabola $f(x) = -3x^2 - 30x - 82$ has a maximum. At what value of x does it occur?

Answer: ____________________

18

A parabola and a line meet where $x^2 - 33 = -2x - 9$. Give the LARGER of the two x-coordinates.

Answer: ____________________

19

Give the equation of the VERTICAL asymptote of $f(x) = \dfrac{x+5}{x+6}$

Answer: ____________________

20

Simplify fully: $\dfrac{x^2 - x - 2}{x^2 + 7x + 6}$

Answer: ____________________

21

Expand and simplify: $2\left(5x - 5\right)^2 - 6$

Answer: ____________________

22

Solve for x: $\dfrac{4x - 7}{x - 5} = 5$

Answer: ____________________

23

Solve for x: $\left(x + 4\right)^3 = -1$

Answer: ____________________

24

Write as a single logarithm: $4\log_7(x) + \log_7(5)$. Give only the ARGUMENT of the resulting logarithm.

Answer: ____________________

25

Solve for x: $\log_5(x+1) = \log_5(6)$

Answer: ______________________

26

Solve for x: $5^{2x+4} = 625$

Answer: ______________________

27

Evaluate exactly: $\log_8(4)$

Answer: ______________________

28

For the data set $30, 20, 18, 6, 26, 29, 24$, give the exact MEDIAN.

Answer: ______________________

29

For the data set $13, 27, 29, 12, 2$, give the exact RANGE.

Answer: ______________________

30

In how many different ORDERS can 3 of 7 distinct books be placed on a shelf?

Answer: ____________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: $-\frac{8}{63}$

Write both over the common denominator 63, combine the numerators, then cancel: $-\frac{8}{63}$.

Common mistakes, and the answer each one gives:

- Added (or subtracted) numerators and denominators separately → 1

2

Answer: $\frac{8}{125}$

A negative exponent turns the fraction over, and the fraction $\frac{3}{2}$ means the square root raised to the power 3: $\left(\dfrac{4}{25}\right)^{3/2} = \frac{8}{125}$.

Common mistakes, and the answer each one gives:

- Ignored the minus sign, so the fraction was never turned over → $\frac{125}{8}$
- Took the root but never applied the power → $\frac{2}{5}$
- Turned the fraction over and stopped there → $\frac{4}{25}$

3

Answer: $\frac{8}{3}$

The bars mean the inside is 8 away from zero in EITHER direction, so there are two equations: $6x - 8 = 8$ and $6x - 8 = -8$. They give $\frac{8}{3}$ and 0; the larger is $\frac{8}{3}$.

Common mistakes, and the answer each one gives:

- Gave the smaller of the two solutions → 0
- Solved the positive branch, then negated the answer instead of solving the second branch → $-\frac{8}{3}$

4

Answer: $\frac{13}{5}$

Multiplication comes before addition, so work out $\dfrac{1}{12} \times \dfrac{6}{5} = \frac{1}{10}$ first, then add $\dfrac{5}{2}$: $\frac{13}{5}$.

Common mistakes, and the answer each one gives:

- Worked strictly left to right, adding before multiplying → $\frac{31}{10}$

5

Answer: $\frac{4(2x+7)}{(x+3)(x+5)}$

The common denominator is $(x+3)(x+5)$. $\dfrac{2(x+5)+6(x+3)}{(x+3)(x+5)} = \frac{4(2x+7)}{(x+3)(x+5)}$.

Common mistakes, and the answer each one gives:

- Added numerators and denominators separately → $\frac{8}{2x+8}$
- Used $(x+3+5)$ as the common denominator → $\frac{8}{x+8}$

6

Answer: $9x^2 + 54x + 81$

$(p \pm q)^2 = p^2 \pm 2pq + q^2$ and $(p + q)(p - q) = p^2 - q^2$. Here that gives $9x^2 + 54x + 81$.

Common mistakes, and the answer each one gives:

- Squared each term and left out the middle term → $9x^2 + 81$
- Gave the middle term the wrong sign → $9x^2 - 54x + 81$
- Doubled the whole bracket instead of squaring it → $6x + 18$

7

Answer: $(x - 2)\,(x + 3)$

Find two numbers whose PRODUCT is -6 and whose SUM is -1: they are 2 and -3. So the factorisation is $(x - 2)\,(x + 3)$.

Common mistakes, and the answer each one gives:

- Used the numbers with their signs unchanged in the brackets → $x^2 - x - 6$
- Matched the sum to the constant and the product to the middle term → $x^2 - 1$

8

Answer: x^5

Multiplying adds the exponents and dividing subtracts them: $4 + 5 - 4 = 5$, so the answer is x^5.

Common mistakes, and the answer each one gives:

- Multiplied the exponents instead of adding them → x^{16}
- Divided the exponents instead of subtracting → $x^{\frac{9}{4}}$

9

Answer: $\frac{x-2}{x+6}$

Dividing by a fraction is multiplying by its reciprocal: $\dfrac{x-2}{x+3} \times \dfrac{x+3}{x+6}$. The $x+3$ then cancels, leaving $\frac{x-2}{x+6}$.

Common mistakes, and the answer each one gives:

- Multiplied straight across without flipping the second fraction → $\frac{x^2+4x-12}{x^2+6x+9}$
- Flipped the FIRST fraction instead of the second → $\frac{x^2+6x+9}{x^2+4x-12}$

10

Answer: $\frac{9}{4}$

$m = \dfrac{y_2 - y_1}{x_2 - x_1} = \dfrac{15-(6)}{7-(3)} = \frac{9}{4}$.

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $\frac{4}{9}$
- Subtracted the coordinates in opposite orders → $-\frac{9}{4}$

11

Answer: -16

Expand the bracket: $3x - 15 = 4x + 1$. Collect the x terms on one side and the numbers on the other, then divide: $x = -16$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → -6
- Moved a term across without changing its sign → -13

12

Answer: $-\frac{33}{2}$

Cross-multiply to clear both denominators: $7\left(x+6\right)=3\left(x-8\right)$. Expand, collect the x terms and divide: $x=-\frac{33}{2}$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → $-\frac{25}{2}$
- Added the fractions instead of cross-multiplying → $-\frac{9}{5}$

13

Answer: 0

Eliminate y by scaling and adding, or substitute. The solution is $x=0$, $y=-4$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → -4

14

Answer: 5

The first equation already gives y, so put it straight into the second: $2x+3\left(3x-19\right)=-2$. That leaves one unknown, and $x=5$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → -4
- Substituted into the equation it came from, which says nothing → 8

15

Answer: 8

$(x-8)(x-7)=0$, so $x=8$ or $x=7$. The larger is 8.

Common mistakes, and the answer each one gives:

- Gave the smaller root → 7
- Read the roots off with the signs unchanged → -7

16

Answer: $-\frac{1}{2}+\frac{\sqrt{19}}{2}$

The discriminant is $b^2-4ac=76$, which is positive but not a perfect square, so the roots are irrational and the formula is needed: $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$. The larger root is $-\frac{1}{2}+\frac{\sqrt{19}}{2}$.

Common mistakes, and the answer each one gives:

- Used $+b$ in the numerator instead of $-b$ → $\frac{1}{2}+\frac{\sqrt{19}}{2}$
- Divided by a instead of $2a$ → $-1+\sqrt{19}$
- Gave the smaller root → $-\frac{\sqrt{19}}{2}-\frac{1}{2}$

17

Answer: -5

The turning point of ax^2+bx+c sits at $x=-\dfrac{b}{2a}$. Here $a=-3$ and $b=-30$, so $x=-\dfrac{-30}{2(-3)}=-5$. (Completing the square gives $-3\left(x+5\right)^2-7$, which shows the same thing.)

Common mistakes, and the answer each one gives:

- Used $\dfrac{b}{2a}$ without the minus sign → 5
- Gave the MAXIMUM VALUE instead of where it happens → -7

18

Answer: 4

Where the graphs meet, the two expressions are equal. Bring everything to one side: $x^2 + 2x - 24 = 0$, which factorises as $(x-4)(x+6)$. The roots are -6 and 4.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -6
- Read the roots straight off the brackets with the signs unchanged → 6

19

Answer: -6

The vertical asymptote sits where the denominator is zero: $x + 6 = 0$, so $x = -6$. (The horizontal one is $y = 1$, the ratio of the leading coefficients.)

Common mistakes, and the answer each one gives:

- Set the NUMERATOR to zero (that gives the x-intercept) → -5
- Gave the horizontal asymptote instead → 1
- Forgot the sign when solving → 6

20

Answer: $\frac{x-2}{x+6}$

Factorise both: $\dfrac{(x-2)(x+1)}{(x+1)(x+6)}$. The factor $x+1$ is common to both and cancels, leaving $\frac{x-2}{x+6}$.

Common mistakes, and the answer each one gives:

- Cancelled the x^2 terms, which are terms and not factors → $\frac{-x-2}{7x+6}$
- Cancelled the wrong bracket → $\frac{x+1}{x+6}$

21

Answer: $50x^2 - 100x + 44$

Square the bracket FIRST, then multiply by 2, then add the constant — the order matters. $(5x - 5)^2 = 25x^2 - 50x + 25$, and the whole thing comes to $50x^2 - 100x + 44$.

Common mistakes, and the answer each one gives:

- Multiplied the bracket by the outside number before squaring → $100x^2 - 200x + 94$
- Squared each term inside the bracket separately → $50x^2 + 44$

22

Answer: 18

Multiply both sides by $x - 5$: $4x - 7 = 5\,(x - 5)$. Expand, collect and divide: $x = 18$. (Check it is not $x = 5$, which the original forbids.)

Common mistakes, and the answer each one gives:

- Multiplied only the numerator by the right-hand side → 3
- Set the denominator to zero, which is the EXCLUDED value → 5

23

Answer: -5

A cube is undone by a cube root, and unlike a square root it keeps the sign: $\sqrt[3]{-1} = -1$. So $x + 4 = -1$ and $x = -5$.

Common mistakes, and the answer each one gives:

- Divided by 3 instead of taking the cube root → $-\frac{13}{3}$
- Took the cube root but lost the sign → -3

24

Answer: $5x^4$

The power rule turns $4\log_7(x)$ into $\log_7(x^4)$, and the product rule combines the two into $\log_7(5x^4)$.

Common mistakes, and the answer each one gives:

- Added the arguments instead of multiplying them → $x^4 + 5$
- Multiplied by the power instead of raising to it → $20x$

25

Answer: 5

Equal logarithms with the same base have equal arguments, so $x + 1 = 6$ and $x = 5$. Check the domain: $x + 1 > 0$ holds.

Common mistakes, and the answer each one gives:

- Subtracted the shift from the wrong side → 7
- Treated the log as a multiplier and divided → 6

26

Answer: 0

Write the right-hand side as a power of 5: $625 = 5^4$. With the same base on both sides the exponents must be equal, so $2x + 4 = 4$ and $x = 0$.

Common mistakes, and the answer each one gives:

- Set the exponent equal to 625 instead of to 4 → $\frac{621}{2}$
- Forgot to move the constant in the exponent across → 2

27

Answer: $\frac{2}{3}$

Write both numbers as powers of 2: $8 = 2^3$ and $4 = 2^2$. Then $\log_8 4 = \dfrac{2}{3} = \frac{2}{3}$, because the base has to be raised to that power to reach the argument.

Common mistakes, and the answer each one gives:

- Divided the two numbers → $\frac{1}{2}$
- Turned the fraction of exponents upside down → $\frac{3}{2}$

28

Answer: 24

Put the values in order first — $6, 18, 20, 24, 26, 29, 30$ — then take the middle one: 24.

Common mistakes, and the answer each one gives:

- Gave the mean instead of the median → $\frac{153}{7}$
- Took the middle of the list AS WRITTEN, without sorting it first → 6

29

Answer: 27

The range is the largest value minus the smallest: $29 - 2 = 27$.

Common mistakes, and the answer each one gives:

- Gave the variance instead of the range → $\frac{2546}{25}$
- Added the distances from the mean without squaring them → $\frac{228}{25}$

30

Answer: 210

The first place has 7 candidates, the next 6, and so on for 3 places: $\frac{7!}{(7-3)!} = 210$.

Common mistakes, and the answer each one gives:

- Used combinations, which ignore the order → 35
- Arranged all of them rather than only the chosen ones → 5040

OMPT-F mixed paper

30 questions drawn from every sheet on the OMPT-F syllabus, and nothing outside it.

Questions

1

Write as a single fraction and simplify: $\dfrac{3}{x+6} + \dfrac{2}{x+5}$

Answer: ______________________

2

Expand and simplify: $(3x-2)^2$

Answer: ______________________

3

Factorise fully: $x^2 + 10x + 16$

Answer: ______________________

4

Simplify to a single power of x: $\dfrac{x^9 \cdot x^7}{x^5}$

Answer: ______________________

5

Simplify fully: $\dfrac{x-4}{x-2} \div \dfrac{x+4}{x-2}$

Answer: ____________________

6

Give the gradient of the line through $A(0;\ 0)$ and $B(4;\ 5)$.

Answer: ____________________

7

Solve for x: $2\left(x-8\right)=6x-9$

Answer: ____________________

8

Solve for x: $\dfrac{x-7}{4}=\dfrac{x+2}{5}$

Answer: ____________________

9

Solve $x^2+7x+6=0$ and give the LARGER root.

Answer: ____________________

10

Solve exactly and give the LARGER solution: $x^2 - 8x - 1 = 0$

Answer: ____________________

11

The parabola $f(x) = -2x^2 - 12x - 9$ has a maximum. At what value of x does it occur?

Answer: ____________________

12

A parabola and a line meet where $x^2 + 4x + 5 = 5 - 2x$. Give the LARGER of the two x-coordinates.

Answer: ____________________

13

Give the equation of the VERTICAL asymptote of $f(x) = \dfrac{2x+3}{x+6}$

Answer: ____________________

14

Simplify fully: $\dfrac{x^2 + 15x + 56}{x^2 - 49}$

Answer: ____________________

15

Expand and simplify: $3\left(2x+2\right)^2+4$

Answer: ____________________

16

Solve for x: $\dfrac{2x+8}{x-3}=7$

Answer: ____________________

17

Solve for x: $\left(x-4\right)^3=-64$

Answer: ____________________

18

Write as a single logarithm: $4\log_{10}(x)+\log_{10}(3)$. Give only the ARGUMENT of the resulting logarithm.

Answer: ____________________

19

Solve for x: $\log_2(x+8)=\log_2(12)$

Answer: ____________________

20

Solve for x: $5^{2x-1} = 3125$

Answer: ______________________

21

Evaluate exactly: $\log_{25}(625)$

Answer: ______________________

22

Differentiate: $f(x) = \left(9x^2 + 1\right)^4$

Answer: ______________________

23

$f(x) = 4x^3 + 6x^2 - 360x$. Give the x-coordinate of the local MAXIMUM.

Answer: ______________________

24

Differentiate with respect to x: $f(x) = \dfrac{6x+3}{x^2+7}$

Answer: ______________________

25

Differentiate with respect to x: $f(x) = \left(x^2 - 8\right)^2$

Answer: ____________________

26

Write as a single fraction and simplify: $\dfrac{7}{x+5} + \dfrac{3}{x+2}$

Answer: ____________________

27

Expand and simplify: $(5x+2)(5x-2)$

Answer: ____________________

28

Factorise fully: $x^2 + 2x - 3$

Answer: ____________________

29

Simplify to a single power of x: $\dfrac{x^7 \cdot x^4}{x^4}$

Answer: ____________________

30

Simplify fully: $\dfrac{x+1}{x-1} \div \dfrac{x+7}{x-1}$

Answer: ______________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: $\frac{5x+27}{(x+5)(x+6)}$

The common denominator is $(x+6)(x+5)$. $\dfrac{3(x+5)+2(x+6)}{(x+6)(x+5)} = \frac{5x+27}{(x+5)(x+6)}$.

Common mistakes, and the answer each one gives:

- Added numerators and denominators separately → $\frac{5}{2x+11}$
- Used $(x+6+5)$ as the common denominator → $\frac{5}{x+11}$

2

Answer: $9x^2 - 12x + 4$

$(p \pm q)^2 = p^2 \pm 2pq + q^2$ and $(p+q)(p-q) = p^2 - q^2$. Here that gives $9x^2 - 12x + 4$.

Common mistakes, and the answer each one gives:

- Squared each term and left out the middle term → $9x^2 + 4$
- Gave the middle term the wrong sign → $9x^2 + 12x + 4$
- Doubled the whole bracket instead of squaring it → $6x - 4$

3

Answer: $(x+2)(x+8)$

Find two numbers whose PRODUCT is 16 and whose SUM is -10: they are -2 and -8. So the factorisation is $(x+2)(x+8)$.

Common mistakes, and the answer each one gives:

- Used the numbers with their signs unchanged in the brackets → $x^2 - 10x + 16$
- Matched the sum to the constant and the product to the middle term → $x^2 + 9x - 10$

4

Answer: x^{11}

Multiplying adds the exponents and dividing subtracts them: $9+7-5=11$, so the answer is x^{11}.

Common mistakes, and the answer each one gives:

- Multiplied the exponents instead of adding them → x^{58}
- Divided the exponents instead of subtracting → $x^{\frac{16}{5}}$

5

Answer: $\frac{x-4}{x+4}$

Dividing by a fraction is multiplying by its reciprocal: $\dfrac{x-4}{x-2} \times \dfrac{x-2}{x+4}$. The $x-2$ then cancels, leaving $\frac{x-4}{x+4}$.

Common mistakes, and the answer each one gives:

- Multiplied straight across without flipping the second fraction → $\frac{x^2-16}{x^2-4x+4}$
- Flipped the FIRST fraction instead of the second → $\frac{x^2-4x+4}{x^2-16}$

6

Answer: $\frac{5}{4}$

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - (0)}{4 - (0)} = \tfrac{5}{4}.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $\frac{4}{5}$
- Subtracted the coordinates in opposite orders → $-\frac{5}{4}$

7

Answer: $-\frac{7}{4}$

Expand the bracket: $2x - 16 = 6x - 9$. Collect the x terms on one side and the numbers on the other, then divide: $x = -\frac{7}{4}$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → $\frac{1}{4}$
- Moved a term across without changing its sign → $-\frac{17}{2}$

8

Answer: 43

Cross-multiply to clear both denominators: $5\left(x - 7\right) = 4\left(x + 2\right)$. Expand, collect the x terms and divide: $x = 43$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → 37
- Added the fractions instead of cross-multiplying → 3

9

Answer: -1

$(x+1)(x+6)=0$, so $x=-1$ or $x=-6$. The larger is -1.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -6
- Read the roots off with the signs unchanged → 6

10

Answer: $4+\sqrt{17}$

The discriminant is $b^2-4ac=68$, which is positive but not a perfect square, so the roots are irrational and the formula is needed: $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$. The larger root is $4+\sqrt{17}$.

Common mistakes, and the answer each one gives:

- Used $+b$ in the numerator instead of $-b$ → $-4+\sqrt{17}$
- Divided by a instead of $2a$ → $8+2\sqrt{17}$
- Gave the smaller root → $4-\sqrt{17}$

11

Answer: -3

The turning point of ax^2+bx+c sits at $x=-\dfrac{b}{2a}$. Here $a=-2$ and $b=-12$, so $x=-\dfrac{-12}{2(-2)}=-3$. (Completing the square gives $-2\left(x+3\right)^2+9$, which shows the same thing.)

Common mistakes, and the answer each one gives:

- Used $\dfrac{b}{2a}$ without the minus sign → 3
- Gave the MAXIMUM VALUE instead of where it happens → 9

12

Answer: 0

Where the graphs meet, the two expressions are equal. Bring everything to one side: $x^2 + 6x = 0$, which factorises as $x\,(x + 6)$. The roots are -6 and 0.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -6
- Read the roots straight off the brackets with the signs unchanged → 6

13

Answer: -6

The vertical asymptote sits where the denominator is zero: $x + 6 = 0$, so $x = -6$. (The horizontal one is $y = 2$, the ratio of the leading coefficients.)

Common mistakes, and the answer each one gives:

- Set the NUMERATOR to zero (that gives the x-intercept) → $-\frac{3}{2}$
- Gave the horizontal asymptote instead → 2
- Forgot the sign when solving → 6

14

Answer: $\frac{x+8}{x-7}$

Factorise both: $\dfrac{(x + 7)\,(x + 8)}{(x - 7)\,(x + 7)}$. The factor $x + 7$ is common to both and cancels, leaving $\frac{x+8}{x-7}$.

Common mistakes, and the answer each one gives:

- Cancelled the x^2 terms, which are terms and not factors → $-\frac{15x}{49} - \frac{8}{7}$
- Cancelled the wrong bracket → $\frac{x+7}{x-7}$

15

Answer: $12x^2 + 24x + 16$

Square the bracket FIRST, then multiply by 3, then add the constant — the order matters. $(2x + 2)^2 = 4x^2 + 8x + 4$, and the whole thing comes to $12x^2 + 24x + 16$.

Common mistakes, and the answer each one gives:

- Multiplied the bracket by the outside number before squaring → $36x^2 + 72x + 40$
- Squared each term inside the bracket separately → $12x^2 + 16$

16

Answer: $\frac{29}{5}$

Multiply both sides by $x - 3$: $2x + 8 = 7\,(x - 3)$. Expand, collect and divide: $x = \frac{29}{5}$. (Check it is not $x = 3$, which the original forbids.)

Common mistakes, and the answer each one gives:

- Multiplied only the numerator by the right-hand side → $-\frac{1}{2}$
- Set the denominator to zero, which is the EXCLUDED value → 3

17

Answer: 0

A cube is undone by a cube root, and unlike a square root it keeps the sign: $\sqrt[3]{-64} = -4$. So $x - 4 = -4$ and $x = 0$.

Common mistakes, and the answer each one gives:

- Divided by 3 instead of taking the cube root → $-\frac{52}{3}$
- Took the cube root but lost the sign → 8

18

Answer: $3x^4$

The power rule turns $4\log_{10}(x)$ into $\log_{10}(x^4)$, and the product rule combines the two into $\log_{10}(3x^4)$.

Common mistakes, and the answer each one gives:

- Added the arguments instead of multiplying them → x^4+3
- Multiplied by the power instead of raising to it → $12x$

19

Answer: 4

Equal logarithms with the same base have equal arguments, so $x+8=12$ and $x=4$. Check the domain: $x+8>0$ holds.

Common mistakes, and the answer each one gives:

- Subtracted the shift from the wrong side → 20
- Treated the log as a multiplier and divided → $\frac{3}{2}$

20

Answer: 3

Write the right-hand side as a power of 5: $3125=5^5$. With the same base on both sides the exponents must be equal, so $2x-1=5$ and $x=3$.

Common mistakes, and the answer each one gives:

- Set the exponent equal to 3125 instead of to 5 → 1563
- Forgot to move the constant in the exponent across → $\frac{5}{2}$

21

Answer: 2

Write both numbers as powers of 5: $25 = 5^2$ and $625 = 5^4$. Then $\log_{25} 625 = \dfrac{4}{2} = 2$, because the base has to be raised to that power to reach the argument.

Common mistakes, and the answer each one gives:

- Divided the two numbers → 25
- Turned the fraction of exponents upside down → $\frac{1}{2}$

22

Answer: $72x\left(9x^2+1\right)^3$

Outer power 4, inner $9x^2+1$, so $f' = 4(9x^2+1)^3 \cdot 18x$. This gives $f'(x) = 72x\left(9x^2+1\right)^3$.

Common mistakes, and the answer each one gives:

- Differentiated each part separately and combined them → $4\left(9x^2+1\right)^3$

23

Answer: -6

$f'(x) = 12x^2 + 12x - 360 = 0$ at $x = -6$ and $x = 5$. $f''(x) = 24x + 12$, and $f''(-6) = -132 < 0$, so $x = -6$ is the maximum.

Common mistakes, and the answer each one gives:

- Gave the local MINIMUM instead → 5
- Gave the y-value rather than the x-coordinate → 1512
- Solved f(x) = 0 instead of f'(x) = 0 → 0

24

Answer: $\frac{-6x^2-6x+42}{x^4+14x^2+49}$

The quotient rule is $\dfrac{u'v-uv'}{v^2}$ — and the ORDER of the two products matters, unlike the product rule. With $u=6x+3$ and $v=x^2+7$: $u'=6$ and $v'=2x$, giving $\frac{-6x^2-6x+42}{x^4+14x^2+49}$.

Common mistakes, and the answer each one gives:

- Wrote $uv'-u'v$ in the numerator, the two products swapped → $\frac{6x^2+6x-42}{x^4+14x^2+49}$
- Differentiated top and bottom separately → $\frac{3}{x}$

25

Answer: $4x^3-32x$

Differentiate the outside, keeping the inside as it is, then multiply by the derivative of the inside: $2\left(x^2-8\right)^1\times 2x$, which expands to $4x^3-32x$.

Common mistakes, and the answer each one gives:

- Forgot to multiply by the derivative of the inside → $2x^2-16$
- Differentiated the inside and raised THAT to the power → $4x^2$

26

Answer: $\frac{10x+29}{(x+2)(x+5)}$

The common denominator is $(x+5)(x+2)$. $\dfrac{7(x+2)+3(x+5)}{(x+5)(x+2)}=\frac{10x+29}{(x+2)(x+5)}$.

Common mistakes, and the answer each one gives:

- Added numerators and denominators separately → $\frac{10}{2x+7}$
- Used $(x+5+2)$ as the common denominator → $\frac{10}{x+7}$

27

Answer: $25x^2 - 4$

$(p \pm q)^2 = p^2 \pm 2pq + q^2$ and $(p+q)(p-q) = p^2 - q^2$. Here that gives $25x^2 - 4$.

Common mistakes, and the answer each one gives:

- Kept a middle term; in this product the two cancel → $25x^2 + 20x - 4$
- Added the squares instead of subtracting → $25x^2 + 4$
- Squared only the first term → $25x^2 - 2$

28

Answer: $(x-1)\,(x+3)$

Find two numbers whose PRODUCT is -3 and whose SUM is -2: they are -3 and 1. So the factorisation is $(x-1)\,(x+3)$.

Common mistakes, and the answer each one gives:

- Used the numbers with their signs unchanged in the brackets → $x^2 - 2x - 3$
- Matched the sum to the constant and the product to the middle term → $x^2 + x - 2$

29

Answer: x^7

Multiplying adds the exponents and dividing subtracts them: $7 + 4 - 4 = 7$, so the answer is x^7.

Common mistakes, and the answer each one gives:

- Multiplied the exponents instead of adding them → x^{24}
- Divided the exponents instead of subtracting → $x^{\frac{11}{4}}$

30

Answer: $\frac{x+1}{x+7}$

Dividing by a fraction is multiplying by its reciprocal: $\dfrac{x+1}{x-1} \times \dfrac{x-1}{x+7}$. The $x-1$ then cancels, leaving $\frac{x+1}{x+7}$.

Common mistakes, and the answer each one gives:

- Multiplied straight across without flipping the second fraction → $\frac{x^2+8x+7}{x^2-2x+1}$
- Flipped the FIRST fraction instead of the second → $\frac{x^2-2x+1}{x^2+8x+7}$

OMPT-G mixed paper

30 questions drawn from every sheet on the OMPT-G syllabus, and nothing outside it.

Questions

1

Give the gradient of the line through $A(-4;\ -4)$ and $B(-3;\ -10)$.

Answer: ____________________

2

Solve for x: $2\left(x+8\right)=7x+6$

Answer: ____________________

3

Solve for x: $\dfrac{x-3}{4}=\dfrac{x-1}{7}$

Answer: ____________________

4

Solve the system and give the value of x: $5x+2y=9$ and $3x-3y=-24$

Answer: ____________________

5

Solve the system and give the value of x: $y = -x$ and $3x + 2y = -5$

Answer: ____________________

6

Solve $x^2 + 9x + 14 = 0$ and give the LARGER root.

Answer: ____________________

7

Solve exactly and give the LARGER solution: $x^2 + 7x + 2 = 0$

Answer: ____________________

8

The parabola $f(x) = -3x^2 + 30x - 69$ has a maximum. At what value of x does it occur?

Answer: ____________________

9

A parabola and a line meet where $x^2 - 6x + 8 = x + 2$. Give the LARGER of the two x-coordinates.

Answer: ____________________

10

Give the equation of the VERTICAL asymptote of $f(x) = \dfrac{x+8}{x+5}$

Answer: ______________________

11

Simplify fully: $\dfrac{x^2-16}{x^2-4x-32}$

Answer: ______________________

12

Expand and simplify: $2\left(3x-3\right)^2-5$

Answer: ______________________

13

Solve for x: $\dfrac{4x+1}{x-3}=2$

Answer: ______________________

14

Solve for x: $\left(x\right)^3=-27$

Answer: ______________________

15

Write as a single logarithm: $3\log_2(x) + \log_2(3)$. Give only the ARGUMENT of the resulting logarithm.

Answer: ______________________

16

Solve for x: $\log_2(x+9) = \log_2(16)$

Answer: ______________________

17

Solve for x: $2^{4x+1} = 32$

Answer: ______________________

18

Evaluate exactly: $\log_{25}(15625)$

Answer: ______________________

19

Give the exact value: $\sin\left(\frac{\pi}{2}\right)$

Answer: ______________________

20

Give the SMALLEST NON-NEGATIVE solution: $6\cos(x) = 3$

Answer: ______________________

21

Simplify as far as possible: $3\tan(x)\cos(x)$

Answer: ______________________

22

A right-angled triangle has a hypotenuse of 10 and one leg of 6. How long is the other leg?

Answer: ______________________

23

Two angles of a triangle are 92° and 42°. How many degrees is the third?

Answer: ______________________

24

What is the sum of the interior angles of a polygon with 24 sides, in degrees?

Answer: ______________________

25

A circle has a radius of 4. What is its area? Leave your answer in terms of π.

Answer: ______________________

26

How far apart are the points $(-5, 1)$ and $(1, 9)$?

Answer: ______________________

27

An arithmetic sequence starts at 7 and goes up by 8 each time. What is its 16th term?

Answer: ______________________

28

A geometric sequence starts at 2 and each term is 2 times the one before. What is its 8th term?

Answer: ______________________

29

An arithmetic sequence starts at -1 and goes up by 1 each time. What is the sum of its first 17 terms?

Answer: ______________________

30

Give the gradient of the line through $A(7;\ -2)$ and $B(6;\ -10)$.

Answer: ______________________________

Answers

Every answer below was re-derived independently before this page was built.

1

Answer: -6

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-10 - (-4)}{-3 - (-4)} = -6.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $-\frac{1}{6}$
- Subtracted the coordinates in opposite orders → 6

2

Answer: 2

Expand the bracket: $2x + 16 = 7x + 6$. Collect the x terms on one side and the numbers on the other, then divide: $x = 2$.

Common mistakes, and the answer each one gives:

- Multiplied only the x by the number outside the bracket → $\frac{2}{5}$
- Moved a term across without changing its sign → $\frac{28}{5}$

3

Answer: $\frac{17}{3}$

Cross-multiply to clear both denominators: $7\left(x - 3\right) = 4\left(x - 1\right)$. Expand, collect the x terms and divide: $x = \frac{17}{3}$.

Common mistakes, and the answer each one gives:

- Multiplied only the numerators by the other denominator → $\frac{20}{3}$
- Added the fractions instead of cross-multiplying → $\frac{25}{11}$

4

Answer: -1

Eliminate y by scaling and adding, or substitute. The solution is $x=-1$, $y=7$.

Common mistakes, and the answer each one gives:

- Solved for y instead of x → 7

5

Answer: -5

The first equation already gives y, so put it straight into the second: $3x+2\left(-x\right)=-5$. That leaves one unknown, and $x=-5$.

Common mistakes, and the answer each one gives:

- Gave the value of y rather than of x → 5
- Substituted into the equation it came from, which says nothing → -3

6

Answer: -2

$\left(x+2\right)\left(x+7\right)=0$, so $x=-2$ or $x=-7$. The larger is -2.

Common mistakes, and the answer each one gives:

- Gave the smaller root → -7
- Read the roots off with the signs unchanged → 7

7

Answer: $-\frac{7}{2}+\frac{\sqrt{41}}{2}$

The discriminant is $b^2-4ac=41$, which is positive but not a perfect square, so the roots are irrational and the formula is needed: $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$. The larger root is $-\frac{7}{2}+\frac{\sqrt{41}}{2}$.

Common mistakes, and the answer each one gives:

- Used $+b$ in the numerator instead of $-b$ → $\frac{\sqrt{41}}{2}+\frac{7}{2}$
- Divided by a instead of $2a$ → $-7+\sqrt{41}$
- Gave the smaller root → $-\frac{7}{2}-\frac{\sqrt{41}}{2}$

8

Answer: 5

The turning point of ax^2+bx+c sits at $x=-\dfrac{b}{2a}$. Here $a=-3$ and $b=30$, so $x=-\dfrac{30}{2(-3)}=5$. (Completing the square gives $-3\left(x-5\right)^2+6$, which shows the same thing.)

Common mistakes, and the answer each one gives:

- Used $\dfrac{b}{2a}$ without the minus sign → -5
- Gave the MAXIMUM VALUE instead of where it happens → 6

9

Answer: 6

Where the graphs meet, the two expressions are equal. Bring everything to one side: $x^2-7x+6=0$, which factorises as $\left(x-6\right)\left(x-1\right)$. The roots are 1 and 6.

Common mistakes, and the answer each one gives:

- Gave the smaller root → 1
- Read the roots straight off the brackets with the signs unchanged → -1

10

Answer: -5

The vertical asymptote sits where the denominator is zero: $x + 5 = 0$, so $x = -5$. (The horizontal one is $y = 1$, the ratio of the leading coefficients.)

Common mistakes, and the answer each one gives:

- Set the NUMERATOR to zero (that gives the x-intercept) → -8
- Gave the horizontal asymptote instead → 1
- Forgot the sign when solving → 5

11

Answer: $\frac{x-4}{x-8}$

Factorise both: $\dfrac{(x-4)(x+4)}{(x-8)(x+4)}$. The factor $x + 4$ is common to both and cancels, leaving $\frac{x-4}{x-8}$.

Common mistakes, and the answer each one gives:

- Cancelled the x^2 terms, which are terms and not factors → $\frac{4}{x+8}$
- Cancelled the wrong bracket → $\frac{x+4}{x-8}$

12

Answer: $18x^2 - 36x + 13$

Square the bracket FIRST, then multiply by 2, then add the constant — the order matters. $(3x-3)^2 = 9x^2 - 18x + 9$, and the whole thing comes to $18x^2 - 36x + 13$.

Common mistakes, and the answer each one gives:

- Multiplied the bracket by the outside number before squaring → $36x^2 - 72x + 31$
- Squared each term inside the bracket separately → $18x^2 + 13$

13

Answer: $-\frac{7}{2}$

Multiply both sides by $x-3$: $4x+1=2\left(x-3\right)$. Expand, collect and divide: $x=-\frac{7}{2}$. (Check it is not $x=3$, which the original forbids.)

Common mistakes, and the answer each one gives:

- Multiplied only the numerator by the right-hand side → $\frac{1}{4}$
- Set the denominator to zero, which is the EXCLUDED value → 3

14

Answer: -3

A cube is undone by a cube root, and unlike a square root it keeps the sign: $\sqrt[3]{-27}=-3$. So $x=-3$ and $x=-3$.

Common mistakes, and the answer each one gives:

- Divided by 3 instead of taking the cube root → -9
- Took the cube root but lost the sign → 3

15

Answer: $3x^3$

The power rule turns $3\log_2(x)$ into $\log_2(x^3)$, and the product rule combines the two into $\log_2(3x^3)$.

Common mistakes, and the answer each one gives:

- Added the arguments instead of multiplying them → x^3+3
- Multiplied by the power instead of raising to it → $9x$

16

Answer: 7

Equal logarithms with the same base have equal arguments, so $x + 9 = 16$ and $x = 7$. Check the domain: $x + 9 > 0$ holds.

Common mistakes, and the answer each one gives:

- Subtracted the shift from the wrong side → 25
- Treated the log as a multiplier and divided → $\frac{16}{9}$

17

Answer: 1

Write the right-hand side as a power of 2: $32 = 2^5$. With the same base on both sides the exponents must be equal, so $4x + 1 = 5$ and $x = 1$.

Common mistakes, and the answer each one gives:

- Set the exponent equal to 32 instead of to 5 → $\frac{31}{4}$
- Forgot to move the constant in the exponent across → $\frac{5}{4}$

18

Answer: 3

Write both numbers as powers of 5: $25 = 5^2$ and $15625 = 5^6$. Then $\log_{25} 15625 = \frac{6}{2} = 3$, because the base has to be raised to that power to reach the argument.

Common mistakes, and the answer each one gives:

- Divided the two numbers → 625
- Turned the fraction of exponents upside down → $\frac{1}{3}$

19

Answer: 1

$\frac{\pi}{2}$ is a special angle, so the value is exact rather than a decimal. Read it off the unit circle: $\sin\left(\frac{\pi}{2}\right) = 1$.

Common mistakes, and the answer each one gives:

- Gave the cosine instead → 0
- Worked in degrees, reading the number as an angle in degrees → $\sin\left(\frac{\pi}{360}\right)$

20

Answer: $\frac{\pi}{3}$

Divide by 6 first: $\cos(x) = \frac{1}{2}$. That is a special value, and the smallest angle at or above zero with it is $\frac{\pi}{3}$. (Others follow every 2π, and there is a second one inside the first turn unless the value is 1.)

Common mistakes, and the answer each one gives:

- Gave the other solution inside the first turn, which is larger → $\frac{5\pi}{3}$
- Forgot to divide by the coefficient before taking the inverse → 0

21

Answer: $3\sin(x)$

Use $\sin^2(x) + \cos^2(x) = 1$ and $\tan(x) = \dfrac{\sin(x)}{\cos(x)}$. Here that reduces the expression to $3\sin(x)$.

Common mistakes, and the answer each one gives:

- Cancelled to the cosine rather than the sine → $3\cos(x)$
- Left the tangent untouched → $3\tan(x)$

22

Answer: 8

Rearrange Pythagoras: the missing leg squared is $10^2 - 6^2 = 64$, so the leg is $\sqrt{64} = 8$.

Common mistakes, and the answer each one gives:

- Subtracted the lengths instead of their squares → 4
- Added the squares, which is the rule for the HYPOTENUSE → $2\sqrt{34}$

23

Answer: 46

The three angles of any triangle add to $180°$, so the third is $180 - 92 - 42 = 46$.

Common mistakes, and the answer each one gives:

- Used $360°$, which is the angles round a POINT → 226
- Subtracted only one of the two given angles → 88

24

Answer: 3960

A polygon with 24 sides splits into 22 triangles from one corner, and each triangle contributes $180°$: $(24 - 2) \times 180 = 3960$.

Common mistakes, and the answer each one gives:

- Multiplied the number of sides by 180 without subtracting 2 → 4320
- Gave the EXTERIOR angle sum, which is 360 for every polygon → 360

25

Answer: 16π

Area $= \pi r^2 = \pi \times 4^2 = 16\pi$.

Common mistakes, and the answer each one gives:

- Used the circumference formula $2\pi r$ → 8π
- Doubled the radius instead of squaring it → 8π

26

Answer: 10

The horizontal gap is 6 and the vertical gap is 8, so Pythagoras gives $\sqrt{6^2 + 8^2} = \sqrt{100} = 10$.

Common mistakes, and the answer each one gives:

- Added the two gaps instead of using Pythagoras → 14
- Forgot the square root → 100

27

Answer: 127

The nth term is $a + (n-1)d$ — the step is taken 15 times, not 16: $7 + 15 \times 8 = 127$.

Common mistakes, and the answer each one gives:

- Used $a + nd$, taking the step one time too many → 135
- Multiplied the first term by the step → 56

28

Answer: 256

The nth term is ar^{n-1}, so the ratio is applied 7 times: $2 \times (2)^7 = 256$.

Common mistakes, and the answer each one gives:

- Used ar^n, applying the ratio one time too many → 512
- Added the ratio each time instead of multiplying → 16

29

Answer: 119

The last term is $-1 + 16 \times 1 = 15$, and a sum of an arithmetic sequence is the number of terms times the average of the first and last: $17 \times \dfrac{-1+15}{2} = 119$.

Common mistakes, and the answer each one gives:

- Multiplied the number of terms by the LAST term rather than the average → 255
- Multiplied the number of terms by the FIRST term → -17

30

Answer: 8

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-10 - (-2)}{6 - (7)} = 8.$$

Common mistakes, and the answer each one gives:

- Inverted the fraction (run over rise) → $\frac{1}{8}$
- Subtracted the coordinates in opposite orders → -8