ALGEBRA AND EQUATIONS

Solutions

DBE's own marking guidelines, in booklet order

Every solution here is a clip of the official DBE marking guideline published with the paper the question came from. The working, the mark ticks and the accepted alternatives are DBE's. Nothing has been rewritten or re-derived.

The numbers match the question booklet: solution 34 answers question 34, and the chapters are in the same order.

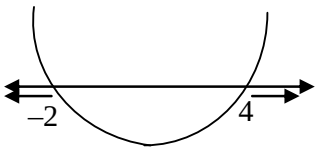
DBE writes one guideline for both languages, so these pages are bilingual and their marking notes are largely in English. That is DBE's own page, reproduced as printed.

A marking guideline is written for markers, not learners. It shows the shortest route to the marks, so where a step looks compressed, that is the guideline being terse rather than a step missing.

1. Four equations, a simultaneous pair, then 2^x times 3^y = 24

Official DBE marking guideline · May/June 2021 · Q1 · 24 marks

QUESTION/*VRAAG* 1

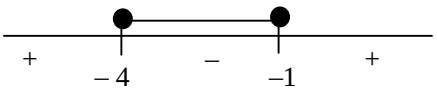
1.1.1	$x^2 - x - 20 = 0$ $(x-5)(x+4) = 0$ $x = 5$ or $x = -4$	✓factors ✓ $x = 5$ ✓ $x = -4$ (3)
1.1.2	$3x^2 - 2x - 6 = 0$ $x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(3)(-6)}}{2(3)}$ $x = \frac{1 \pm \sqrt{19}}{3}$ $x = -1{,}12$ or $x = 1{,}79$	✓substitution ✓simplification ✓ $x = -1{,}12$ ✓ $x = 1{,}79$ (4)
1.1.3	$(x-1)^2 > 9$ $x^2 - 2x - 8 > 0$ $(x-4)(x+2) > 0$ Critical values: $x = 4$ or $x = -2$  $x < -2$ or $x > 4$ **OR/OF** $(-\infty;-2)$ or $(4;\infty)$ **OR/OF** $x - 1 > 3$ or $x - 1 < -3$ $x > 4$ or $x < -2$	✓standard form ✓critical values ✓✓ $x < -2$ or $x > 4$ (4) **OR/OF** ✓✓ $(-\infty;-2)$ or $(4;\infty)$ **OR/OF** ✓ $x - 1 > 3$ ✓ $x - 1 < -3$ ✓✓ $x > 4$ or $x < -2$ (4)

1.1.4	$2\sqrt{x+6}+2=x$ $2\sqrt{x+6}=x-2$ $4(x+6)=(x-2)^2$ $4x+24=x^2-4x+4$ $x^2-8x-20=0$ $(x-10)(x+2)=0$ $x=10$ or $x\neq -2$	✓ isolating the surd ✓ $4x+24=x^2-4x+4$ ✓ $x=10$ ✓ $x\neq -2$ (4)
1.2	$4x=2-y$ . . . (1) $4x+y^2=8$. . . (2) $\therefore 2-y+y^2=8$ $y^2-y-6=0$ $(y-3)(y+2)=0$ $y=3$ or $y=-2$ $x=-\frac{1}{4}$ or $x=1$ **OR/OF** $y=-4x+2$ . . . (1) $4x+y^2=8$. . . (2) $4x+(-4x+2)^2=8$ $4x+16x^2-16x+4-8=0$ $16x^2-12x-4=0$ $4x^2-3x-1=0$ $(4x+1)(x-1)=0$ $x=-\frac{1}{4}$ or $x=1$ $y=3$ or $y=-2$	✓ $4x=2-y$ ✓substitution ✓standard form ✓y-values ✓x-values (5) **OR/OF** ✓ $y=-4x+2$ ✓substitution ✓standard form ✓x-values ✓y-values (5)
1.3	$2^x\times 3^y=(2^3\times 3)^6$ $2^x\times 3^y=2^{18}\times 3^6$ $2^x=2^{18}$ and $3^y=3^6$ $x=18$ and $y=6$ $\therefore x-y=18-6$ $\therefore x-y=12$	✓ $2^3\times 3$ ✓ 2^{18} or 3^6 ✓ $x=18$ or $y=6$ ✓ answer (A) (4)
		[24]

2. A simultaneous pair, then proving a root cannot be real

Official DBE marking guideline · November 2021 · Q1 · 24 marks

QUESTION/VRAAG 1

1.1.1	$x^2 - 2x - 24 = 0$ $(x-6)(x+4) = 0$ $x = 6$ or $x = -4$	✓factors ✓$x = 6$ ✓$x = -4$ (3)
1.1.2	$2x^2 - 3x - 3 = 0$ $x = \frac{3 \pm \sqrt{(-3)^2 - 4(2)(-3)}}{2(2)}$ $x = \frac{3 \pm \sqrt{33}}{4}$ $x = 2{,}19$ or $x = -0{,}69$	✓substitution into the correct formula ✓$x = 2{,}19$ ✓$x = -0{,}69$ (3)
1.1.3	$x^2 + 5x \leq -4$ $x^2 + 5x + 4 \leq 0$ $(x+4)(x+1) \leq 0$ Critical values: $x = -4$ or $x = -1$  $-4 \leq x \leq -1$ **OR/*OF*** $x \in [-4\,;\,-1]$	✓ standard form ✓ critical values ✓✓answer (4)
1.1.4	$\sqrt{x+28} = 2 - x$ $\left(\sqrt{x+28}\right)^2 = (2-x)^2$ $x + 28 = 4 - 4x + x^2$ $x^2 - 5x - 24 = 0$ $(x-8)(x+3) = 0$ $x \neq 8$ or $x = -3$	✓ squaring both sides ✓ standard form ✓ factors ✓ answers with selection (4)

1.2	$2y = 3 + x$ $x = 2y - 3$ **...** (1) $2xy + 7 = x^2 + 4y^2$ ... (2) $2y(2y-3) + 7 = (2y-3)^2 + 4y^2$ $4y^2 - 6y + 7 = 4y^2 - 12y + 9 + 4y^2$ $4y^2 - 6y + 2 = 0$ $2y^2 - 3y + 1 = 0$ $(2y-1)(y-1) = 0$ $y = \frac{1}{2}$ or $y = 1$ $x = -2$ or $x = -1$ **OR/*OF*** $2y = 3 + x$ $y = \frac{3}{2} + \frac{x}{2}$ ...(1) $2xy + 7 = x^2 + 4y^2$ ... (2) $2x\left(\frac{3}{2} + \frac{x}{2}\right) + 7 = x^2 + 4\left(\frac{3}{2} + \frac{x}{2}\right)^2$ $3x + x^2 + 7 = x^2 + 9 + 6x + x^2$ $x^2 + 3x + 2 = 0$ $(x+2)(x+1) = 0$ $x = -2$ or $x = -1$ $y = \frac{1}{2}$ or $y = 1$	✓equation 1 ✓substitution ✓simplification ✓standard form ✓y – values ✓x – values (6) **OR/*OF*** ✓equation 1 ✓substitution ✓simplification ✓standard form ✓x – values ✓y – values (6)
1.3	$\frac{n}{m} = \frac{p}{n}$ $n^2 = mp$ $\Delta = b^2 - 4ac$ $\Delta = n^2 - 4mp$, but $n^2 = mp$ $\Delta = n^2 - 4n^2$ **OR/*OF*** $\Delta = mp - 4mp$ $\Delta = -3n^2$ $\Delta = -3mp$ $n^2 > 0$ $mp > 0$ $\therefore -3n^2 < 0$ $\therefore -3mp < 0$ $\therefore \Delta < 0 \Rightarrow x$ is a non-real number	✓ $\frac{n}{m} = \frac{p}{n}$ ✓ $n^2 = mp$ ✓ $\Delta = -3n^2$ or $-3mp$ ✓ $\Delta < 0$ (4)
		[24]

3. Reciprocals in a simultaneous pair, then m + n from powers of 2 and 3

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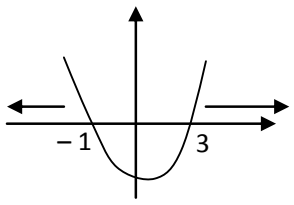
QUESTION 1/*VRAAG* 1

1.1.1	$x^2 + x - 12 = 0$ $(x-3)(x+4) = 0$ $x = 3$ or $x = -4$	✓factors/formula ✓answer ✓answer (3)
1.1.2	$3x^2 - 2x = 6$ $3x^2 - 2x - 6 = 0$ $x = \frac{2 \pm \sqrt{(-2)^2 - 4(3)(-6)}}{2(3)}$ $x = 1{,}79$ or $x = -1{,}12$	✓ standard form ✓ substitution into correct formula ✓ answer ✓ answer (4)
1.1.3	$\sqrt{2x+1} = x - 1$ $2x + 1 = (x-1)^2$ $2x + 1 = x^2 - 2x + 1$ $x^2 - 4x = 0$ $x(x-4) = 0$ $x = 0$ or $x = 4$ $x \neq 0$ or $x = 4$	✓ squaring both sides ✓ standard form ✓ both x-values ✓ valid answer (4)
1.1.4	$x^2 - 2x > 3$ $x^2 - 2x - 3 > 0$ $(x-3)(x+1) > 0$ CV's: $x = -1$; $x = 3$  $x < -1$ or $x > 3$	✓ standard form ✓ critical values/factors ✓✓answer (4)

1.2	$\frac{1}{x}+\frac{1}{y}=1 \quad \ldots \quad (1)$	
	$x+2=2y \quad \ldots \quad (2)$	
	$x=2y-2$	✓ $x=2y-2$
	$\frac{1}{2y-2}+\frac{1}{y}=1$	✓substitution
	$y+2y-2=2y^2-2y$	
	$2y^2-5y+2=0$	✓standard form
	$(2y-1)(y-2)=0$	
	$y=\frac{1}{2}$ or $y=2$	✓y-values
	$x=-1$ or $x=2$	✓x-values (5)
	OR/*OF*	**OR/*OF***
	$\frac{1}{x}+\frac{1}{y}=1 \quad \ldots \quad (1)$	
	$x+2=2y \quad \ldots \quad (2)$	
	$y=\frac{x}{2}+1$	✓ $y=\frac{x}{2}+1$
	$\frac{1}{x}+\frac{1}{\frac{x}{2}+1}=1$	✓substitution
	$\frac{1}{x}+\frac{2}{x+2}=1$	
	$x+2+2x=x^2+2x$	
	$x^2-x-2=0$	✓standard form
	$(x+1)(x-2)=0$	
	$x=-1$ or $x=2$	✓x-values
	$y=\frac{1}{2}$ or $y=2$	✓y-values (5)

1.3	$2^{m+1}+2^m=3^{n+2}-3^n$ $2^m(2+1)=3^n(3^2-1)$ $2^m(3)=3^n(8)$ $2^m(3)=3^n(2^3)$ $\therefore m=3$ and $n=1$ $\therefore m+n=4$ **OR/*OF*** $2^{m+1}+2^m=3^{n+2}-3^n$ $2^m(2+1)=3^n(3^2-1)$ $2^m(3)=3^n(8)$ $2^m(3)=3^n(2^3)$ $2^{m-3}=3^{n-1}$ Only true if $m-3=0$ and $n-1=0$ $\therefore m+n=4$	✓ factors ✓ $2^m(3)=3^n(2^3)$ (same bases) ✓ $m=3$ and $n=1$ ✓ $m+n=4$ (4) **OR/*OF*** ✓ factors ✓ $2^m(3)=3^n(2^3)$ (same bases) ✓ $m-3=0$ and $n-1=0$ ✓ $m+n=4$ (4)
		[24]

4. Show an expression is always even, then two exponential unknowns

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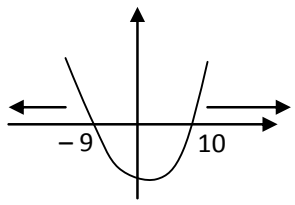
QUESTION1/*VRAAG* 1

1.1.1	$(3x-6)(x+2)=0$ $x=2$ or $x=-2$	✓ $x=2$ ✓ $x=-2$ (2)
1.1.2	$2x^2-6x+1=0$ $x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$ $x=\frac{6\pm\sqrt{(-6)^2-4(2)(1)}}{2(2)}$ $x=2{,}82$ or $x=0{,}18$	✓ correct substitution into correct formula ✓ 2,82 ✓ 0,18 (3)
1.1.3	$x^2-90>x$ $x^2-x-90>0$ $(x+9)(x-10)>0$ CV: $x=-9$ or $x=10$  $x<-9$ or $x>10$ **OR/OF** $(-\infty;-9)$ or $(10;\infty)$	✓ standard form ✓ critical values ✓✓ $x<-9$ or $x>10$ (4)

1.1.4	$x-7\sqrt{x}=-12$ $x+12=7\sqrt{x}$ $(x+12)^2=\left(7\sqrt{x}\right)^2$ $x^2+24x+144=49x$ $x^2-25x+144=0$ $(x-16)(x-9)=0$ $x=16$ or $x=9$ **OR/*OF*** $x-7\sqrt{x}+12=0$ $\left(\sqrt{x}-3\right)\left(\sqrt{x}-4\right)=0$ or let $\sqrt{x}=k$ $\sqrt{x}=3$ or $\sqrt{x}=4$ $x=9$ or $x=16$	✓ isolating the root ✓ squaring both sides ✓ standard form ✓ both answers (4) **OR/*OF*** ✓ standard form ✓ factors ✓ answers ✓ both answers for x (4)
1.2	$2x-y=2$ $y=2x-2$ ……(1) $xy=4$ ……(2) (1) in (2): $x(2x-2)=4$ $2x^2-2x-4=0$ $x^2-x-2=0$ $(x-2)(x+1)=0$ $x=2$ or $x=-1$ $y=2$ $y=-4$	✓ eq 1 ✓ substitution ✓ standard form ✓ x-values ✓ y-values (5)

	OR/*OF*	**OR/*OF***
	$2x - y = 2$	
	$x = \frac{1}{2}y + 1 \quad \ldots\ldots\ldots(1)$	✓ eq 1
	$xy = 4 \quad \ldots\ldots\ldots(2)$	
	(1) in (2):	
	$y\left(\frac{1}{2}y + 1\right) = 4$	✓ substitution
	$\frac{1}{2}y^2 + y - 4 = 0$	✓ standard form
	$y^2 + 2y - 8 = 0$	
	$(y + 4)(y - 2) = 0$	
	$y = -4 \quad \text{or} \quad y = 2$	✓ *y*-values
	$x = -1 \qquad x = 2$	✓ *x*-values (5)
	OR/OF	**OR/OF**
	$2x - y = 2 \quad \ldots\ldots\ldots(1)$	
	$y = \frac{4}{x} \quad \ldots\ldots\ldots(2)$	✓ eq 2
	(2) in (1):	
	$2x - \frac{4}{x} = 2$	✓ substitution
	$2x^2 - 2x - 4 = 0$ $x^2 - x - 2 = 0$	✓ standard form
	$(x - 2)(x + 1) = 0$	
	$x = 2 \quad \text{or} \quad x = -1$ $y = 2 \qquad y = -4$	✓ *x*-values ✓ *y*-values (5)

	OR/OF $2x-y=2$ ……(1) $x=\frac{4}{y}$ ……(2) (2)in (1): $2\left(\frac{4}{y}\right)-y=2$ $8-y^2-2y=0$ $y^2+2y-8=0$ $(y+4)(y-2)=0$ $y=-4$ or $y=2$ $x=-1$ $x=2$	**OR/OF** ✓ eq 2 ✓ substitution ✓ standard form ✓ *y*-values ✓ *x*-values (5)
1.3	$2.5^n-5^{n+1}+5^{n+2}=2.5^n-5^n.5^1+5^n.5^2$ $=5^n(2-5+25)$ $=5^n(22)$ $2\left(5^n(11)\right)$ **OR/OF** Any integer multiplied by an even number will be even	✓ exp law ✓common factor ✓answer/explanation (3)
1.4	$\frac{3^{y+1}}{32}=\sqrt{96^x}$ $\frac{3^{y+1}}{2^5}=(96)^{\frac{x}{2}}$ $3^{y+1}.2^{-5}=2^{\frac{5x}{2}}.3^{\frac{x}{2}}$ $-5=\frac{5x}{2}$ $\therefore x=-2$ $y+1=\frac{x}{2}$ $y+1=\frac{-2}{2}$ $\therefore y=-2$	✓ $\frac{3^{y+1}}{2^5}=(96)^{\frac{x}{2}}$ ✓ $3^{y+1}.2^{-5}=2^{\frac{5x}{2}}.3^{\frac{x}{2}}$ ✓ $x=-2$ ✓ $y=-2$ (4)

	OR/OF $\frac{3^{y+1}}{32} = \sqrt{96^x}$ $\left(\frac{3^{y+1}}{2^5}\right)^2 = \left(\sqrt{(96)^x}\right)^2$ $\frac{3^{2y+2}}{2^{10}} = 2^{5x}.3^x$ $3^{2y+2}.2^{-10} = 2^{5x}.3^x$ $-10 = 5x$ $\therefore x = -2$ $2y + 2 = -2$ $\therefore y = -2$	**OR/OF** ✓ $\left(\frac{3^{y+1}}{2^5}\right)^2 = \left(\sqrt{(96)^x}\right)^2$ ✓ $3^{2y+2}.2^{-10} = 2^{5x}.3^x$ ✓ $x = -2$ ✓ $y = -2$ (4)
		[25]

5. A rectangle from its perimeter and area, then a divisibility proof

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QUESTION 1/*VRAAG* 1

1.1.1	$x^2-3x-10=0$ $(x+2)(x-5)=0$ $x=-2$ or $x=5$	✓factors/formula ✓answer ✓answer (3)
1.1.2	$3x^2+6x+1=0$ $x=\frac{-(6)\pm\sqrt{(6)^2-4(3)(1)}}{2(3)}$ $x=-1{,}82$ or $x=-0{,}18$	✓correct substitution into correct formula ✓answer ✓answer (3)
1.1.3	$2^{x+4}+2^x=8\,704$ $2^x(16+1)=8\,704$ $2^x=512$ OR/OF $2^x=512$ $=2^9$ $x=9$ $x=\log_2 512=9$	✓factorisation ✓ simplify to exponential eq ✓ answer (3)
1.1.4	$(x-8)(x+2)\le 0$ CV: $x=8$ or $x=-2$ $\therefore -2\le x\le 8$ OR/OF $x\in[-2\,;8]$	✓critical values ✓✓ answer (3)
1.1.5	$x+3\sqrt{x+2}=2$ $3\sqrt{x+2}=2-x$ $9(x+2)=4-4x+x^2$ $x^2-13x-14=0$ $(x-14)(x+1)=0$ $x\neq 14$ or $x=-1$	✓isolating the surd ✓squaring both sides(method) ✓standard form ✓answer with selection (4)

1.2	$(y-3)(x+2)=32$ $yx+2y-3x-6=32 \quad ....(1)$ $2(y-3)+2(x+2)=24$ $y+x-1=12$ $y=13-x \qquad ....(2)$ $(13-x)x+2(13-x)-3x-6=32$ $13x-x^2+26-2x-3x-6-32=0$ $-x^2+8x-12=0$ $x^2-8x+12=0$ $(x-6)(x-2)=0$ $x=6 \quad \text{or} \quad x=2$ $y=13-6 \quad \text{or} \quad y=13-2$ $y=7 \qquad y=11$ **OR/*OF*** $(y-3)(x+2)=32$ $yx+2y-3x-6=32 \quad ....(1)$ $2(y-3)+2(x+2)=24$ $y+x-1=12$ $x=13-y \qquad ....(2)$ $y(13-y)+2y-3(13-y)-6=32$ $13y-y^2+2y-39+3y-6-32=0$ $-y^2+18y-77=0$ $y^2-18y+77=0$ $(y-7)(y-11)=0$ $y=7 \quad \text{or} \quad y=11$ $x=13-7 \quad \text{or} \quad x=13-11$ $x=6 \qquad x=2$	✓ setting up eq 1 (Area) ✓ setting up eq 2 (Perimeter) ✓substitution ✓standard form ✓x-values ✓y-values (6) **OR/*OF*** ✓setting up eq 1 (Area) ✓setting up eq 2 (Perimeter) ✓substitution ✓standard form ✓y-values ✓x-values (6)
1.3	$(1+x^m+x^{-n})^2-\left(1-x^m-x^{-n}\right)^2$ $=\left[1+x^m+x^{-n}-\left(1-x^m-x^{-n}\right)\right]\left[1+x^m+x^{-n}+\left(1-x^m-x^{-n}\right)\right]$ $=(2)\left(2x^m+2x^{-n}\right)$ **OR/*OF*** $(1+x^m+x^{-n})^2=1+x^m+x^{-n}+x^m+x^{2m}+x^{m-n}+x^{-n}+x^{m-n}+x^{-2n}$ $=1+2x^m+2x^{-n}+2x^{m-n}+x^{2m}+x^{-2n}$ $(1-x^m-x^{-n})^2=1-2x^m-2x^{-n}+2x^{m-n}+x^{2m}+x^{-2n}$ $(1+x^m+x^{-n})^2-(1-x^m-x^{-n})^2=4x^m+4x^{-n}$ $=4(x^m+x^{-n})$ $=(2)\left(2x^m+2x^{-n}\right)$	✓ factorisation ✓ 2 ✓$\left(2x^m+2x^{-n}\right)$ (3) **OR/*OF*** ✓ expansion ✓ 4 ✓ (x^m+x^{-n}) (3)
		[25]

6. A substitution into an exponential equation, then a ratio of powers of 2

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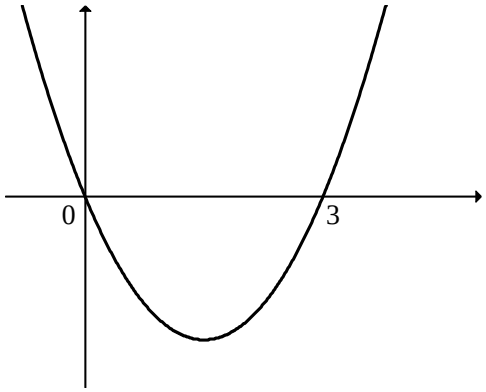
QUESTION/*VRAAG* 1

1.1.1	$x^2 + 2x - 15 = 0$ $(x+5)(x-3) = 0$ $x = -5$ or $x = 3$	✓ factors ✓ $x = -5$ ✓ $x = 3$ (3)
1.1.2	$5x^2 - x - 9 = 0$ $x = \frac{-(-1) \pm \sqrt{(-1)^2 - 4(5)(-9)}}{2(5)}$ $x = \frac{1 \pm \sqrt{181}}{10}$ $x = 1{,}45$ or $x = -1{,}25$	✓substitution into the correct formula ✓ $x = 1{,}45$ ✓ $x = -1{,}25$ (3)
1.1.3	$x^2 \leq 3x$ $x^2 - 3x \leq 0$ $x(x-3) \leq 0$  $0 \leq x \leq 3$ OR $x \in [0;3]$	✓ standard form ✓ factors ✓✓ answer (4)
1.2.1	$a + \frac{64}{a} = 16$ $a^2 - 16a + 64 = 0$ $(a-8)^2 = 0$ $a = 8$	✓ standard form ✓ factors ✓ answer (3)

1.2.2	$2^x + 2^{6-x} = 16$ $2^x + \frac{64}{2^x} = 16$ $2^x = 8$ (from 1.2.1) $2^x = 2^3$ $x = 3$	✓ exp law ✓ $2^x = 8$ ✓ answer (3)
1.3	$\sqrt{\frac{2^{1002}(1+2^4)}{17(2)^{998}}}$ $= \sqrt{\frac{2^4(17)}{17}}$ $= \sqrt{2^4}$ $= 2^2$ = 4	✓common factor ✓second factor ✓simplification ✓answer (4)
1.4	$2x - y = 2 \quad \ldots(1)$ $\frac{1}{x} - 3y = 1 \quad \ldots(2)$ $y = 2x - 2$ $\frac{1}{x} - 3(2x-2) = 1$ $\frac{1}{x} - 6x + 6 - 1 = 0$ $1 - 6x^2 + 6x - x = 0$ $-6x^2 + 5x + 1 = 0$ $6x^2 - 5x - 1 = 0$ $(6x+1)(x-1) = 0$ $x = -\frac{1}{6}$ or $x = 1$ $y = 2\left(-\frac{1}{6}\right) - 2$ or $y = 2(1) - 2$ $y = -\frac{7}{3}$ or $y = 0$	✓ $y = 2x - 2$ ✓substitution ✓simplification ✓standard form ✓*x*-values ✓*y*-values (6)

OR/*OF*

$x = \frac{2+y}{2}$ …(1)

OR/*OF*

$\frac{1}{x} - 3y = 1$ …(2)

✓ $x = \frac{2+y}{2}$

$\frac{1}{\frac{2+y}{2}} - 3y = 1$

✓substitution

$\frac{2}{2+y} - 3y = 1$

$\frac{2-6y-3y^2}{2+y} = 1$

$2 - 6y - 3y^2 = 2 + y$

$-3y^2 - 7y = 0$

✓simplification

$-y(3y+7) = 0$

✓standard form

$y = 0$ or $y = -\frac{7}{3}$

$x = 1$ or $x = -\frac{1}{6}$

✓*y*-values

✓*x*-values

(6)
[26]

7. An exponential equation, then a telescoping product P x T

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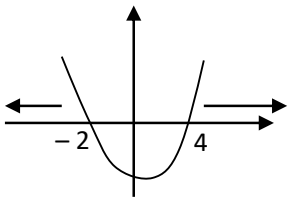
QUESTION 1/*VRAAG* 1

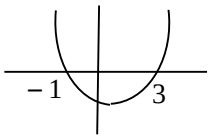
1.1.1	$3x^2 + 5x = 0$ $x(3x + 5) = 0$ $x = 0 \quad \text{or} \quad x = -\frac{5}{3}$	✓ $x = 0$ ✓ $x = -\frac{5}{3}$ (2)
1.1.2	$4x^2 + 3x - 5 = 0$ $x = \frac{-(3) \pm \sqrt{(3)^2 - 4(4)(-5)}}{2(4)}$ $x = 0{,}80 \quad \text{or} \quad x = -1{,}55$	✓ correct substitution into correct formula ✓ answer ✓ answer (3)
1.1.3	$(x-1)^2 - 9 \geq 0$ $x^2 - 2x - 8 \geq 0$ $(x-4)(x+2) \geq 0$ $x = 4 \quad \text{or} \quad x = -2$ $x \leq -2 \quad \text{or} \quad x \geq 4$ 	✓ standard form ✓ critical values ✓✓ $x \leq -2$ or $x \geq 4$ (4)
1.1.4	$5^{2x} - 5^x = 0$ $5^x(5^x - 1) = 0$ $5^x \neq 0 \quad \text{or} \quad 5^x = 1$ $x = 0$ **OR/OF** $5^{2x} = 5^x$ $2x = x$ $2x - x = 0$ $x = 0$	✓ common factor ✓ $5^x \neq 0$ ✓ $5^x = 1$ ✓ $x = 0$ (4) **OR/OF** ✓ $5^{2x} = 5^x$ ✓ $2x = x$ ✓ $2x - x = 0$ ✓ $x = 0$ (4)

1.1.5	$\frac{x}{\sqrt{20-x}}=1$ $x=\sqrt{20-x}$ $x^2=20-x$ $x^2+x-20=0$ $(x+5)(x-4)=0$ $x=4$ or $x\neq -5$	✓ isolating the surd ✓ squaring both sides ✓ standard form ✓ answers ✓ selection (5)
1.2	$2x^2-y^2=7$ …. (1) $x+y=9$ …. (2) $y=9-x$ $2x^2-(9-x)^2=7$ $2x^2-81+18x-x^2=7$ $x^2+18x-88=0$ $(x+22)(x-4)=0$ $x=-22$ or $x=4$ $y=31$ or $y=5$ **OR/*OF*** $2x^2-y^2=7$ …. (1) $x+y=9$ …. (2) $x=9-y$ $2(9-y)^2-y^2=7$ $2(81-18y+y^2)-y^2-7=0$ $162-36y+2y^2-y^2-7=0$ $y^2-36y+155=0$ $(y-31)(y-5)=0$ $y=31$ or $y=5$ $x=-22$ or $x=4$	✓ $y=9-x$ ✓ substitution ✓ standard form ✓ x-values ✓ y-values (5) **OR/*OF*** ✓ $x=9-y$ ✓ substitution ✓ standard form ✓ y-values ✓ x-values (5)
1.3	$P\times T=(1-a)(1+a)(1+a^2)(1+a^4)...(1+a^{512})$ $P\times T=(1-a^2)(1+a^2)(1+a^4)...(1+a^{512})$ $P\times T=(1-a^4)(1+a^4)...(1+a^{512})$ $P\times T=(1-a^8)...(1+a^{512})$ $P\times T=(1-a^{512})(1+a^{512})$ $=1-a^{1024}$	✓ $(1-a^4)$ ✓ $(1-a^{512})$ ✓ $1-a^{1024}$ (3)
		[26]

8. A simultaneous pair, then when an endless product stays an integer

Official DBE marking guideline · November 2024 · Q1 · 27 marks

QUESTION 1/*VRAAG* 1

1.1.1	$x(x-3)=0$ $x=0$ or $x=3$	✓ $x=0$ ✓ $x=3$ (2)
1.1.2	$2x^2-4x+1=0$ $x=\dfrac{-(-4)\pm\sqrt{(-4)^2-4(2)(1)}}{2(2)}$ $x=1{,}71$ or $x=0{,}29$ Answer only: $\frac{4}{4}$	✓ standard form ✓ correct substitution in correct formula ✓ answer ✓ answer (4)
1.1.3	$x^2-2x-3>0$ $(x-3)(x+1)>0$ CV: $x=3$ or $x=-1$  Answer only: $\frac{3}{4}$ $x<-1$ or $x>3$ **OR/*OF*** $x\in(-\infty;-1)\cup(3;\infty)$	✓factors ✓ critical values ✓✓ answer (4)
1.1.4	$2^{2x}-2^{x+2}-32=0$ $2^{2x}-2^2.2^x-32=0$ $(2^x-8)(2^x+4)=0$ $2^x=8$ or $2^x\neq-4$ $2^x=2^3$ no solution $x=3$ Answer only: $\frac{1}{5}$	✓use of exponential law ✓factors ✓ $2^x=8$ ✓ $2^x\neq-4$ ✓ answer (5)
1.1.5	$\sqrt{-2x+4}-x=2$ $\sqrt{-2x+4}=2+x$ $\left(\sqrt{-2x+4}\right)^2=(2+x)^2$ $-2x+4=4+4x+x^2$ $x^2+6x=0$ $x(x+6)=0$ $x=0$ or $x\neq-6$	✓ isolating the root ✓ squaring both sides ✓ standard form ✓ answers with selection (4)

1.2	$y = 3 - 2x$ … (1) $y^2 + xy = 2$ … (2) Subs (1) into (2): $(3-2x)^2 + (3-2x)x = 2$ $4x^2 - 12x + 9 - 2x^2 + 3x - 2 = 0$ $2x^2 - 9x + 7 = 0$ $(2x-7)(x-1) = 0$ $x = \frac{7}{2}$ or $x = 1$ $y = -4$ $y = 1$ **OR/*OF*** $x = \frac{3-y}{2}$ … (1) $y^2 + xy = 2$ … (2) Subs (1) into (2): $y^2 + \left(\frac{3-y}{2}\right)y = 2$ $2y^2 + 3y - y^2 - 4 = 0$ $y^2 + 3y - 4 = 0$ $(y+4)(y-1) = 0$ $y = -4$ or $y = 1$ $x = \frac{7}{2}$ or $x = 1$	✓ eq 1 ✓ substitution ✓ standard form ✓ both *x*-values ✓ both *y*-values (5) **OR/*OF*** ✓ eq 1 ✓ substitution ✓ standard form ✓ both *y*-values ✓ both *x*-values (5)
1.3	Product = $\frac{3}{2}\times\frac{4}{3}\times\frac{5}{4}\times\ldots\times\frac{n}{n-1}\times\frac{n+1}{n} = \frac{n+1}{2}$ The product will be an integer value when $n + 1$ is divisible by 2 i.e. $n \in \{3;5;7;\ldots\}$ Therefore, *n* must be an odd number, greater than 2. **OR/*OF*** For $n = 2$ the product is $\frac{3}{2}$ For $n = 3$ the product is $\left(\frac{3}{2}\right)\left(\frac{4}{3}\right) = 2$ For $n = 4$ the product is $\left(\frac{3}{2}\right)\left(\frac{4}{3}\right)\left(\frac{5}{4}\right) = \frac{5}{2}$ For $n = 5$ the product is $\left(\frac{3}{2}\right)\left(\frac{4}{3}\right)\left(\frac{5}{4}\right)\left(\frac{6}{5}\right) = 3$ $n \in \{3;5;7;\ldots\}$ Therefore, *n* must be an odd number, greater than 2.	✓ $\frac{3}{2}\times\frac{4}{3}\times\frac{5}{4}\times\ldots\times\frac{n+1}{n}$ ✓ statement $\left(\frac{n+1}{2}\right)$ ✓ *n* is odd for $n > 2$ (3) **OR/*OF*** ✓ generation of the four products ✓ identifying the pattern when *n* is odd ✓ *n* is odd for $n > 2$ (3)
		[27]