TRIGONOMETRY

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. Simplify to one ratio, then a sum of two sines

Official DBE marking guideline · May/June 2022 · Q6 · 12 marks

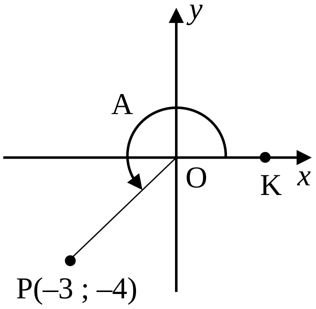
QUESTION/*VRAAG* 6

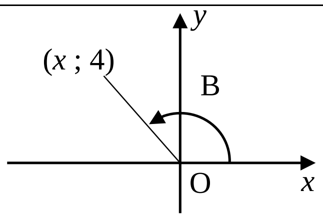
6.1	$\frac{\sin 10°}{\cos 440°} + \tan(360° - \theta).\sin 2\theta$ $= \frac{\cos 80°}{\cos 80°} - \tan\theta(2\sin\theta\cos\theta)$ $= 1 - \frac{\sin\theta}{\cos\theta}(2\sin\theta\cos\theta)$ $= 1 - 2\sin^2\theta$ $= \cos 2\theta$	✓ $-\tan\theta$ ✓ cos 80° ✓ co-ratio ✓ double angle ✓ quotient identity ✓ answer (6)
6.2.1	$\sin(60° + 2x) + \sin(60° - 2x) = k\cos 2x$ $(\sin 60°\cos 2x + \cos 60°\sin 2x) + (\sin 60°\cos 2x - \cos 60°\sin 2x) = k\cos 2x$ $2\sin 60°\cos 2x = k\cos 2x$ $2\left(\frac{\sqrt{3}}{2}\right)\cos 2x = k\cos 2x$ $\therefore k = \sqrt{3}$	✓ both expansions correct ✓ special ∠s ✓ answer (3)
6.2.2	$\tan 60°[\sin(60° + 2x) + \sin(60° - 2x)]$ $= \tan 60°[k\cos 2x]$ $= \sqrt{3}(\sqrt{3}\cos 2x)$ $= 3(2\cos^2 x - 1)$ $= 3\left(2\left(\sqrt{t}\right)^2 - 1\right)$ $= 6(\sqrt{t})^2 - 3$ $= 6t - 3$	✓ special ∠ ✓ double ∠s ✓ answer i.t.o *t* (3)
		[12]

2. cos A from a point, then the double and compound angles

Official DBE marking guideline · November 2024 · Q5 · 12 marks

QUESTION/*VRAAG* 5



5.1.1	$r = 5$ $\cos A = -\frac{3}{5}$	✓ $r = 5$ ✓ answer (2)
5.1.2	$\cos 2A = 2\cos^2 A - 1$ $= 2\left(-\frac{3}{5}\right)^2 - 1$ $= -\frac{7}{25}$	✓ substitution of $\cos A$ into double angle formula ✓ answer (2)
	OR/*OF* $\cos 2A = \cos^2 A - \sin^2 A$ $= \left(-\frac{3}{5}\right)^2 - \left(-\frac{4}{5}\right)^2$ $= -\frac{7}{25}$	✓ substitution of $\cos A$ & $\sin A$ into double angle formula ✓ answer (2)
	OR/*OF* $\cos 2A = 1 - 2\sin^2 A$ $= 1 - 2\left(-\frac{4}{5}\right)^2$ $= -\frac{7}{25}$	✓ substitution of $\sin A$ into double angle formula ✓ answer (2)
5.1.3	 $x = -3$ $\sin(A - B) = \sin A\cos B - \cos A\sin B$ $= \left(-\frac{4}{5}\right)\left(-\frac{3}{5}\right) - \left(-\frac{3}{5}\right)\left(\frac{4}{5}\right)$ $= \frac{12}{25} + \frac{12}{25}$ $= \frac{24}{25}$	✓ $x = -3$ ✓✓ substitution into the compound angle formula ✓ answer (4)

5.2	$\dfrac{\cos\left(\frac{\alpha}{2}-45°\right)\sin\left(\frac{\alpha}{2}-45°\right)}{2}$ $=\dfrac{2\cos\left(\frac{\alpha}{2}-45°\right)\sin\left(\frac{\alpha}{2}-45°\right)}{2.2}$ $=\dfrac{\sin(\alpha-90°)}{4}$ $=\dfrac{-\cos\alpha}{4}$ $=\dfrac{-p}{4}$ **OR/*OF*** $=-\dfrac{1}{4}p$	✓ multiply by $\frac{2}{2}$ ✓ double angle ✓ co function ✓ answer (4)
	OR/*OF* $\dfrac{\cos\left(\frac{\alpha}{2}-45°\right)\sin\left(\frac{\alpha}{2}-45°\right)}{2}$ $=\dfrac{\left[\cos\frac{\alpha}{2}\cos 45°+\sin\frac{\alpha}{2}\sin 45°\right]\left[\sin\frac{\alpha}{2}\cos 45°-\cos\frac{\alpha}{2}\sin 45°\right]}{2}$ $=\dfrac{\left[\frac{\sqrt{2}}{2}\cos\frac{\alpha}{2}+\frac{\sqrt{2}}{2}\sin\frac{\alpha}{2}\right]\left[\frac{\sqrt{2}}{2}\sin\frac{\alpha}{2}-\frac{\sqrt{2}}{2}\cos\frac{\alpha}{2}\right]}{2}$ $=\dfrac{\frac{1}{2}\sin^2\frac{\alpha}{2}-\frac{1}{2}\cos^2\frac{\alpha}{2}}{2}$ $=\dfrac{-\frac{1}{2}\left(\cos^2\frac{\alpha}{2}-\sin^2\frac{\alpha}{2}\right)}{2}$ $=-\dfrac{\cos 2\left(\frac{\alpha}{2}\right)}{4}$ $=-\dfrac{\cos\alpha}{4}$ $=-\dfrac{1}{4}p$	**OR/*OF*** ✓ expansion ✓ special angles ✓ double angle ✓ answer (4)
		[12]

3. Two identities to prove, one of them a difference of sines

Official DBE marking guideline · May/June 2025 · Q6 · 13 marks

QUESTION/*VRAAG* 6

6.1	LHS $= 2\cos^2(45° + x)$ $= 2\cos^2(45° + x) + 1 - 1$ $= \cos[2(45° + x)] + 1$ $= \cos(90° + 2x) + 1$ $= (-\sin 2x) + 1$ $= 1 - \sin 2x$ = RHS **OR/*OF*** LHS $= 2\cos^2(45° + x)$ $= 2(\cos(45° + x))^2$ $= 2(\cos 45°\cos x - \sin 45°\sin x)^2$ $= 2\left(\frac{\sqrt{2}}{2}\cos x - \frac{\sqrt{2}}{2}\sin x\right)^2$ $= 2\left(\frac{1}{2}\cos^2 x - \sin x\cos x + \frac{1}{2}\sin^2 x\right)$ $= \cos^2 x - 2\sin x\cos x + \sin^2 x$ $= 1 - \sin 2x$ = RHS	✓ $+ 1 - 1$ ✓ double angle ✓ simplification ✓ reduction (4) ✓ compound ∠ expansion ✓ subst. special ∠ values ✓ simplification ✓ $\sin^2 x + \cos^2 x = 1$ (4)
6.2.1	LHS $= \sin(A - B) - \sin(A + B)$ $= \sin A\cos B - \cos A\sin B - (\sin A\cos B + \cos A\sin B)$ $= \sin A\cos B - \cos A\sin B - \sin A\cos B - \cos A\sin B$ $= -2\cos A\sin B$ = RHS	✓ $\sin A\cos B - \cos A\sin B$ ✓ $-\sin A\cos B - \cos A\sin B$ (2)
6.2.2	$\sin 4x - \sin 10x$ $= \sin(7x - 3x) - \sin(7x + 3x)$ $= -2\cos 7x\sin 3x$	✓ $4x = 7x - 3x$ & $10x = 7x + 3x$ ✓ answer (2)
6.2.3	$\sin 4x - \sin 10x = \sin 3x$ $-2\cos 7x\sin 3x = \sin 3x$ $2\cos 7x\sin 3x + \sin 3x = 0$ $\sin 3x(2\cos 7x + 1) = 0$ $\sin 3x = 0$ or $\cos 7x = -\frac{1}{2}$ $3x = 0°$ $7x = 120°$ or $7x = 240°$ $x = 0°$ $x = 17{,}14°$ $x = 34{,}29°$ N/A	✓ substitution ✓ factorisation ✓ both equations ✓ answer ✓ answer (5)
		[13]

4. Derive cos(alpha + beta), then use it to simplify

Official DBE marking guideline · November 2021 · Q6 · 15 marks

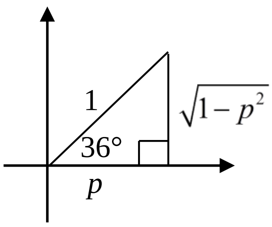
QUESTION/*VRAAG* 6

6.1.1	$\cos(\alpha+\beta)$ $=\cos(\alpha-(-\beta))$ $=\cos\alpha\cos(-\beta)+\sin\alpha\sin(-\beta)$ $=\cos\alpha\cos\beta+\sin\alpha(-\sin\beta)$ $=\cos\alpha\cos\beta-\sin\alpha\sin\beta$	✓ $\cos(\alpha-(-\beta))$ ✓ expansion ✓ reduction (3)
6.1.2	$2\cos 6x\cos 4x-\cos 10x+2\sin^2 x$ $=2\cos 6x\cos 4x-\cos(6x+4x)+2\sin^2 x$ $=2\cos 6x\cos 4x-(\cos 6x\cos 4x-\sin 6x\sin 4x)+2\sin^2 x$ $=\cos 6x\cos 4x+\sin 6x\sin 4x+2\sin^2 x$ $=\cos 2x+2\sin^2 x$ $=1-2\sin^2 x+2\sin^2 x$ $=1$	✓ $\cos 10x=\cos(6x+4x)$ ✓ expansion of $\cos(6x+4x)$ ✓ $\cos 2x$ ✓ $1-2\sin^2 x$ ✓ answer (5)
6.2	$\tan x=2\sin 2x$ $\frac{\sin x}{\cos x}=2(2\sin x\cos x)$ $\sin x=4\sin x\cos^2 x$ $4\sin x\cos^2 x-\sin x=0$ $\sin x(4\cos^2 x-1)=0$ $\sin x=0$ or $\cos^2 x=\frac{1}{4}$ $\cos x=-\frac{1}{2}$ $x=180°+k.360°;\ k\in Z$ or $x=120°+k.360°;\ k\in Z$ $x=240°+k.360°;\ k\in Z$ **OR/*OF*** $\tan x=2\sin 2x$ $\frac{\sin x}{\cos x}=4\sin x\cos x$ $\sin x=4\sin x\cos^2 x$ $4\sin x\cos^2 x-\sin x=0$ $4\sin x(1-\sin^2 x)-\sin x=0$ $3\sin x-4\sin^3 x=0$ $\sin x(3-4\sin^2 x)=0$ $\sin x=0$ or $\sin^2 x=\frac{3}{4}$ $\sin x=\frac{\sqrt{3}}{2}$ or $\sin x=-\frac{\sqrt{3}}{2}$ $x=180^\circ+k.360^\circ,k\in Z$ or $x=120^\circ+k.360^\circ,k\in Z$ or $x=240^\circ+k.360^\circ,k\in Z$	✓ quotient identity ✓ double angle identity ✓ factors ✓ both equations ✓ $x=180°$ ✓ $x=120°$& $240°$ **OR/OF** $x=\pm 120°$ ✓ $k.360°;\ k\in Z$ (7) ✓ quotient identity ✓ identity ✓ factors ✓ both equations ✓ $x=180°$ ✓ $x=120°$& $240°$ **OR/OF** $x=\pm 120°$ ✓ $k.360°;\ k\in Z$ (7)
		[15]

5. Reduce to a single ratio, then prove an identity

Official DBE marking guideline · November 2021 · Q5 · 17 marks

QUESTION/*VRAAG* 5

5.1	$\dfrac{\sin 140°.\sin(360° - x)}{\cos 50°.\tan(-x)}$ $= \dfrac{\sin 40°(-\sin x)}{\sin 40°(-\tan x)}$ $= \dfrac{-\sin x}{-\dfrac{\sin x}{\cos x}}$ $= \cos x$	✓ sin40° ✓ $-\sin x$ ✓ co-ratio ✓ $-\tan x$ ✓ $\tan x = \dfrac{\sin x}{\cos x}$ ✓ answer (6)
5.2	$\text{LHS} = \dfrac{-2\sin^2 x + \cos x + 1}{1 - \cos(540° - x)}$ $\qquad \text{RHS} = 2\cos x - 1$ $\text{LHS} = \dfrac{-2(1-\cos^2 x) + \cos x + 1}{1 - (-\cos x)}$ $\text{LHS} = \dfrac{-2 + 2\cos^2 x + \cos x + 1}{1 + \cos x}$ $\text{LHS} = \dfrac{2\cos^2 x + \cos x - 1}{1 + \cos x}$ $\text{LHS} = \dfrac{(2\cos x - 1)(\cos x + 1)}{1 + \cos x}$ $\text{LHS} = 2\cos x - 1$ $\therefore$ LHS = RHS	✓ identity i. t. o. $\cos x$ ✓ $\cos(540° - x) = -\cos x$ ✓ standard form ✓ factors (4)
5.3.1	$\sin 36° = \sqrt{1 - p^2}$ $\tan 36° = \dfrac{\sqrt{1-p^2}}{p}$  **OR/*OF*** $\cos^2 36° = 1 - \sin^2 36°$ $\cos 36° = \sqrt{1 - (1 - p^2)}$ $= p$ $\tan 36° = \dfrac{\sin 36°}{\cos 36°}$ $= \dfrac{\sqrt{1-p^2}}{p}$	✓ method ✓ value of p ✓ answer (3) ✓ method ✓ cos 36° = p ✓ answer (3)

5.3.2	$\cos 108°$ $= -\cos 72°$ $= -\cos(2\times 36°)$ $= -(2\cos^2 36° - 1)$ $= -2p^2 + 1$	✓ reduction ✓ double angle ✓ expansion ✓ answer i. t. o. p (4)
	OR/*OF* $\cos 108°$ $= -\cos 72°$ $= -\cos(2\times 36°)$ $= -(1 - 2\sin^2 36°)$ $= -1 + 2\left(\sqrt{1-p^2}\right)^2$ $= -1 + 2(1-p^2)$ $= -2p^2 + 1$	✓ reduction ✓ double angle ✓ expansion ✓ answer i. t. o. p (4)
	OR/*OF* $\cos 108°$ $= -\cos 72°$ $= -\cos(2\times 36°)$ $= -(\cos^2 36° - \sin^2 36°)$ $= -\left(p^2 - \left(\sqrt{1-p^2}\right)^2\right)$ $= -\left(p^2 - (1-p^2)\right)$ $= -2p^2 + 1$	✓ reduction ✓ double angle ✓ expansion ✓ answer i. t. o. p (4)
	OR/*OF* $\cos 108°$ $= \cos(2\times 54°)$ $= 2\cos^2 54° - 1$ $= 2(1-p^2) - 1$ $= 1 - 2p^2$	✓ double angle ✓✓ expansion ✓ answer i. t. o. p (4)
	OR/*OF* $\cos 108° = \cos(72° + 36°)$ $= \cos 72° \cos 36° - \sin 72° \sin 36°$ $= (2\cos^2 36° - 1)\cos 36° - (2\sin 36° \cos 36°)\sin 36°$ $= 2\cos^3 36° - \cos 36° - 2\cos 36° \sin^2 36°$ $= 2p^3 - p - 2p\left(\sqrt{1-p^2}\right)^2$ $= 2p^3 - p - 2p + 2p^3$ $= 4p^3 - 3p$	✓ expansion ✓ both double angle identities ✓ value of sin 36° ✓ answer i. t. o. p (4)
		[17]

6. Simplify, then everything in terms of cos 35 = m

Official DBE marking guideline · May/June 2021 · Q5 · 18 marks

QUESTION/VRAAG 5

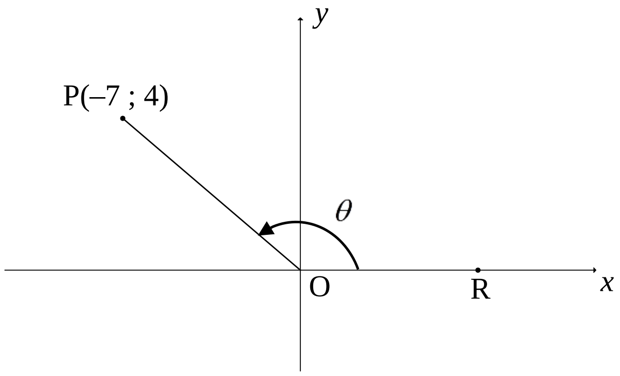
5.1	$\tan(-x).\cos x.\sin(x-180°)-1$ $=-\tan x.\cos x.\sin(-(180°-x))-1$ $=\frac{-\sin x}{\cos x}.\cos x.(-\sin x)-1$ $=\sin^2 x-1$ $=-\cos^2 x$	✓ $-\tan x$ ✓ $-\sin x$ ✓ $\frac{-\sin x}{\cos x}$ ✓ $\sin^2 x-1$ ✓ answer (5)
5.2.1	$\cos 215°$ $=-\cos 35°$ $=-m$	✓ reduction ✓ answer (2)
5.2.2	$\sin 20°$ $=\cos 70°$ $=\cos 2(35°)$ $=2\cos^2 35°-1$ $=2m^2-1$ OR $=\sin(55°-35°)$ $=\sin 55°\cos 35°-\cos 55°\sin 35°$ $=m.m-\sqrt{1-m^2}.\sqrt{1-m^2}$ $=m^2-(1-m^2)$ $=2m^2-1$	✓ co-function ✓ double angle expansion ✓ answer in terms of m (3) ✓ compound angle expansion ✓ $\cos 55°=\sqrt{1-m^2}$ or $\sin 35°=\sqrt{1-m^2}$ ✓ answer in terms of m (3)
5.3	$\cos 4x.\cos x+\sin 4x.\sin x=-0,7$ $\cos(4x-x)=-0,7$ ref $\angle$ = 45,57…° $3x=180°-45,57...°+k.360°$ or $3x=180°+45,57...°+k.360°$ $3x=134,43°+k.360°$ or $3x=225,57°+k.360°$ $x=44,81°+k.120°$; $k\in Z$ $x=75,19°+k.120°$; $k\in Z$	✓ compound angle ✓ $3x$ = 134,43° or 225,57° ✓ x = 44,81° or 75,19° ✓ + k.120°; $k\in Z$ (4)

5.4	$\text{RHS} = \cos^2 x - \sin^2 x$	
	$\text{LHS} = \dfrac{\sin 4x.\cos 2x - 2\cos 4x.\sin x.\cos x}{\tan 2x}$	
	$= \dfrac{\sin 4x.\cos 2x - \cos 4x.\sin 2x}{\frac{\sin 2x}{\cos 2x}}$	✓ $\sin 2x$ ✓ $\dfrac{\sin 2x}{\cos 2x}$
	$= \sin(4x - 2x)\left(\dfrac{\cos 2x}{\sin 2x}\right)$	✓ $\sin(4x - 2x)$
	$= \cos 2x$	✓ $\cos 2x$
	$= \cos^2 x - \sin^2 x$	
	LHS = RHS	(4)
		[18]

7. A point in the second quadrant, and the ratios it fixes

Official DBE marking guideline · May/June 2022 · Q5 · 18 marks

QUESTION/VRAAG 5



5.1.1	$OP=\sqrt{(-7)^2+(4)^2}$ $=\sqrt{65}$ Answer only 2/2	✓ substitution ✓ answer (2)
5.1.2(a)	$\tan\theta=\frac{4}{-7}$	✓ answer (1)
5.1.2(b)	$\cos(\theta-180°)=-\cos\theta$ $=\frac{7}{\sqrt{65}}$	✓ reduction ✓ answer (2)
5.2	$\sin x\cos x+\sin x=3\cos^2 x+3\cos x$ $\sin x\cos x+\sin x-3\cos^2 x-3\cos x=0$ $\sin x(\cos x+1)-3\cos x(\cos x+1)=0$ $(\cos x+1)(\sin x-3\cos x)=0$ $\cos x=-1$ or $\sin x=3\cos x$ $\tan x=3$ $x=180°+k.360°$ or $x=71{,}57°+k.180°$; $k\in Z$ **OR/*OF*** $\sin x\cos x+\sin x=3\cos^2 x+3\cos x$ $\sin x\cos x+\sin x-3\cos^2 x-3\cos x=0$ $\sin x(\cos x+1)-3\cos x(\cos x+1)=0$ $(\cos x+1)(\sin x-3\cos x)=0$ $\cos x=-1$ or $\sin x=3\cos x$ $\tan x=3$ $x=180°+k.360°$ or $x=71{,}57°+k.360°$ or $x=251{,}57°+k.360°$; $k\in Z$	✓ RHS = 0 ✓ grouping ✓ factors ✓ both equations ✓ $x=180°$ ✓ $x=71{,}57°$ ✓ $+k.180°$; $k\in Z$ (7) ✓ RHS = 0 ✓ grouping ✓ factors ✓ both equations ✓ $x=180°$ ✓ $x=71{,}57°$ and $251{,}57°$ ✓ $+k.360°$; $k\in Z$ (7)

5.3.1	$\text{LHS} = \frac{\sin 3x}{1-\cos 3x} \times \frac{1+\cos 3x}{1+\cos 3x}$ $= \frac{(\sin 3x)(1+\cos 3x)}{(1-\cos 3x)(1+\cos 3x)}$ $= \frac{(\sin 3x)(1+\cos 3x)}{1-\cos^2 3x}$ $= \frac{(\sin 3x)(1+\cos 3x)}{\sin^2 3x}$ $= \frac{1+\cos 3x}{\sin 3x}$ = RHS **OR/*OF*** $\text{LHS} = \frac{\sin 3x}{1-\cos 3x} \times \frac{\sin 3x}{\sin 3x}$ $= \frac{\sin^2 3x}{\sin 3x(1-\cos 3x)}$ $= \frac{1-\cos^2 3x}{\sin 3x(1-\cos 3x)}$ $= \frac{(1-\cos 3x)(1+\cos 3x)}{\sin 3x(1-\cos 3x)}$ $= \frac{1+\cos 3x}{\sin 3x}$ = RHS	✓ multiply by "1" ✓ $1-\cos^2 3x$ ✓ square identity (3) ✓ multiply by "1" ✓ square identity ✓ factors (3)
5.3.2	undefined when $\sin 3x = 0$ and $1-\cos 3x = 0$ $3x = 0°$ or $3x = 180°$ and $3x = 0°$ or $3x = 360°$ $x = 0°$ or $x = 60°$	✓ $\sin 3x = 0$ and $1-\cos 3x = 0$ ✓ $0°$ ✓ $60°$ (3)
		[18]

8. Derive cos(x + y) from the identity given, then apply it

Official DBE marking guideline · November 2024 · Q6 · 18 marks

QUESTION/VRAAG 6

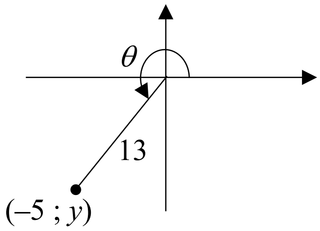
6.1.1	$\cos(x+y)=\cos(x-(-y))$ $=\cos x\cos(-y)+\sin x\sin(-y)$ $=\cos x\cos y-\sin x\sin y$	✓ $(x+y)=(x-(-y))$ ✓ correct expansion (2)
6.1.2	LHS $=\dfrac{\cos(90°-x)\cos y+\sin(-y)\cos(180°+x)}{\cos x\cos(360°+y)+\sin(360°-x)\sin y}$ $=\dfrac{(\sin x)\cos y+(-\sin y)(-\cos x)}{\cos x(\cos y)+(-\sin x)\sin y}$ $=\dfrac{\sin x\cos y+\cos x\sin y}{\cos x\cos y-\sin x\sin y}$ $=\dfrac{\sin(x+y)}{\cos(x+y)}$ $=\tan(x+y)$ = RHS	✓ $\cos(90°-x)=\sin x$ ✓ $\sin(-y)=-\sin y$ ✓ $\cos(180°+x)=-\cos x$ ✓ $\cos(360°+y)=\cos y$ ✓ $\sin(360°-x)=-\sin x$ ✓ compound angle formulae (6)
6.2	$\sqrt{6\sin^2 x-11\cos(90°+x)+7}=2$ $6\sin^2 x-11\cos(90°+x)+7=4$ $6\sin^2 x-11(-\sin x)+7=4$ $6\sin^2 x+11\sin x+3=0$ $(3\sin x+1)(2\sin x+3)=0$ $\sin x=-\dfrac{1}{3}$ **OR/*OF*** $\sin x=-\dfrac{3}{2}$ ref$\angle=19{,}47°$ no solution x = 199,47° or x = 340,53°	✓squaring both sides ✓ $\cos(90°+x)=-\sin x$ ✓ factors ✓ both equations ✓✓ answers (6)
6.3.1	$g(x)=\dfrac{4-8\sin^2 x}{3}$ $=\dfrac{4(1-2\sin^2 x)}{3}$ $=\dfrac{4\cos 2x}{3}$ Maximum value of cos $2x$ is 1 $\therefore$ maximum value of $g(x)=\dfrac{4}{3}$	✓ factors ✓ $\dfrac{4\cos 2x}{3}$ ✓ answer (3)

	OR/OF $4-8\sin^2 x$ is a maximum when $\sin^2 x$ is a minimum Minimum value of $\sin^2 x$ is 0 $\therefore$ max. value of $g(x)=\frac{4-8(0)}{3}$ $g(x)=\frac{4}{3}$ **OR/*OF*** $\sin x=\frac{-(0)}{2\left(-\frac{8}{3}\right)}$ $\sin x=0$ $\therefore$ max. value of $g(x)=\frac{4-8(0)}{3}$ $g(x)=\frac{4}{3}$	**OR/OF** ✓ min of $\sin^2 x=0$ ✓ $g(x)=\frac{4-8(0)}{3}$ ✓ answer (3) **OR/*OF*** ✓ $\sin x=\frac{-(0)}{2\left(-\frac{8}{3}\right)}$ ✓ $\sin x=0$ ✓ answer (3)
6.3.2	$x = 180°$	✓ 180° (1)
		[18]

9. cos theta = 5/13 with the quadrant given, then a simplification

Official DBE marking guideline · May/June 2025 · Q5 · 19 marks

QUESTION/*VRAAG* 5

5.1.1	$y^2 = \sqrt{13^2 - (-5)^2}$ [Pythagoras] $y = -12$  $\sin^2\theta$ $= \left(-\frac{12}{13}\right)^2$ $= \frac{144}{169}$ **OR/*OF*** $\sin^2\theta = 1 - \cos^2\theta$ $\sin^2\theta = 1 - \left(-\frac{5}{13}\right)^2$ $\sin^2\theta = \frac{144}{169}$	✓ $y = -12$ ✓ substitution ✓ answer (3) ✓ square identity ✓ substitution ✓ answer (3)
5.1.2	$\tan(360° - \theta)$ $= -\tan\theta$ $= -\left(\frac{-12}{-5}\right)$ $= -\frac{12}{5}$	✓ $-\tan\theta$ ✓ answer (2)
5.1.3	$\cos(\theta - 135°)$ $= \cos\theta\cos 135° + \sin\theta\sin 135°$ $= \cos\theta(-\cos 45°) + \sin\theta(\sin 45°)$ $= \left(-\frac{5}{13}\right)\left(-\frac{\sqrt{2}}{2}\right) + \left(-\frac{12}{13}\right)\left(\frac{\sqrt{2}}{2}\right)$ OR $\left(-\frac{5}{13}\right)\left(-\frac{1}{\sqrt{2}}\right) + \left(-\frac{12}{13}\right)\left(\frac{1}{\sqrt{2}}\right)$ $= -\frac{7\sqrt{2}}{26}$ $\qquad = -\frac{7}{13\sqrt{2}}$	✓ cpd. ∠ expansion ✓ reduction ✓ substitution ✓ answer (4)

5.2	$\dfrac{2\cos(180°-x)\sin(-x)}{1-2\cos^2(90°-x)}$ $=\dfrac{2(-\cos x)(-\sin x)}{1-2\sin^2 x}$ $=\dfrac{2\sin x\cos x}{\cos 2x}$ $=\dfrac{\sin 2x}{\cos 2x}$ $=\tan 2x$	✓ $\cos(180°-x)=-\cos x$ ✓ $\sin(-x)=-\sin x$ ✓ $\cos^2(90°-x)=\sin^2 x$ ✓ $1-2\sin^2 x=\cos 2x$ ✓ $2\sin x\cos x=\sin 2x$ ✓ answer (6)
5.3	$(\tan 92°)(\tan 94°)(\tan 96°)...(\tan 176°)(\tan 178°)$ $=\left(\dfrac{\sin 92°}{\cos 92°}\right)\left(\dfrac{\sin 94°}{\cos 94°}\right)\left(\dfrac{\sin 96°}{\cos 96°}\right)...\left(\dfrac{\sin 176°}{\cos 176°}\right)\left(\dfrac{\sin 178°}{\cos 178°}\right)$ $=\left(\dfrac{\cos 2°}{-\sin 2°}\right)\left(\dfrac{\cos 4°}{-\sin 4°}\right)\left(\dfrac{\cos 6°}{-\sin 6°}\right)...\left(\dfrac{\sin 4°}{-\cos 4°}\right)\left(\dfrac{\sin 2°}{-\cos 2°}\right)$ $=1$ **OR** $(\tan 92°)(\tan 94°)(\tan 96°)...(\tan 176°)(\tan 178°)$ $=(\tan 92°)(\tan 94°)(\tan 96°)....(-\tan 4°)(-\tan 2°)$ $=\left(\dfrac{\sin 92°}{\cos 92°}\right)\left(\dfrac{\sin 94°}{\cos 94°}\right)\left(\dfrac{\sin 96°}{\cos 96°}\right)...\left(-\dfrac{\sin 4°}{\cos 4°}\right)\left(-\dfrac{\sin 2°}{\cos 2°}\right)$ $=\left(\dfrac{\cos 2°}{-\sin 2°}\right)\left(\dfrac{\cos 4°}{-\sin 4°}\right)\left(\dfrac{\cos 6°}{-\sin 6°}\right)...\left(-\dfrac{\sin 4°}{\cos 4°}\right)\left(-\dfrac{\sin 2°}{\cos 2°}\right)$ $=1$	✓ quotient identity ✓ co-ratios ✓ reduction ✓ answer (4) ✓ reduction ✓ quotient identity ✓ co-ratios ✓ answer (4)
		[19]

10. Everything in terms of sin 40 = p, then an identity to prove

Official DBE marking guideline · May/June 2024 · Q5 · 26 marks

QUESTION/*VRAAG* 5

5.1.1	$\sin 220°$ $= -\sin 40°$ $= -p$	✓ $-\sin 40°$ ✓ answer (2)
5.1.2	$\cos^2 50°$ $= \sin^2 40°$ $= p^2$	✓ $\sin^2 40$ ✓ answer (2)
5.1.3	$\cos(-80°)$ $= \cos 80°$ $= 1 - 2\sin^2 40°$ $= 1 - 2p^2$ **OR** $\cos(-80°)$ $= \cos 80°$ $= \cos(30° + 50°)$ $= \cos 30° \cos 50° - \sin 30° \sin 50°$ $= \frac{\sqrt{3}p}{2} - \frac{\sqrt{1-p^2}}{2}$	✓ $\cos 80°$ ✓ double angle ✓ answer (3) ✓ $\cos 80°$ ✓ expansion ✓ answer (3)
5.2.1	LHS = $\tan x(1-\cos^2 x) + \cos^2 x$ $= \frac{\sin x}{\cos x}(\sin^2 x) + \cos^2 x$ $= \frac{\sin^3 x + \cos^3 x}{\cos x}$ $= \frac{(\sin x + \cos x)(\sin^2 x - \sin x \cos x + \cos^2 x)}{\cos x}$ $= \frac{(\sin x + \cos x)(1 - \sin x \cos x)}{\cos x}$ $=$ RHS **OR**	✓ $\frac{\sin x}{\cos x}$ ✓ $\sin^2 x$ ✓ simplification ✓ factorisation of cubes ✓ $\sin^2 x + \cos^2 x = 1$ (5)

	$\text{RHS}=\dfrac{(\sin x+\cos x)(1-\sin x\cos x)}{\cos x}$ $=\dfrac{\sin x-\sin^2 x\cos x+\cos x-\sin x\cos^2 x}{\cos x}$ $=\tan x-\sin^2 x+1-\sin x\cos x$ $=\tan x+\cos^2 x-\sin x\cos x$ $=\tan x\left(1-\dfrac{\sin x\cos x}{\tan x}\right)+\cos^2 x$ $=\tan x\left(1-\dfrac{\sin x\cos x}{\frac{\sin x}{\cos x}}\right)+\cos^2 x$ $=\tan x\left(1-\cos^2 x\right)+\cos^2 x$ $=\text{LHS}$	✓ multiplication ✓ $\div$ by $\cos x$ ✓ $-\sin^2 x+1=\cos^2 x$ ✓ factorisation ✓ $\tan x=\dfrac{\sin x}{\cos x}$ (5)
5.2.2	$\cos x=0$ or where $\tan x$ is undefined $x=90°+k.360°$ or $x=270°+k.360°$ $x=90°$ or $x=-90°$	✓ $\cos x=0$ or $\tan x$ undefined ✓ $x=90°$ ✓ $x=-90°$ (3)
5.3.1	$\dfrac{\sin 150°+\cos^2 x-1}{2}$ $=\dfrac{\sin 30°+\cos^2 x-1}{2}$ $=\dfrac{\frac{1}{2}-\left(1-\cos^2 x\right)}{2}$ $=\left(\dfrac{1}{2}-\sin^2 x\right)\times\dfrac{1}{2}$ $=\dfrac{1-2\sin^2 x}{4}$ $=\dfrac{\cos 2x}{4}$	✓ $\sin 30°$ ✓ $\sin 30°=\dfrac{1}{2}$ ✓ factor ✓ $1-\cos^2 x=\sin^2 x$ ✓ simplification ✓ answer in terms of $\cos 2x$ (6)
5.3.2	$\dfrac{\sin 150°+\cos^2 x-1}{2}=\dfrac{1}{25}$ $\dfrac{\cos 2x}{4}=\dfrac{1}{25}$ $\cos 2x=\dfrac{4}{25}$ $\text{ref}\angle=80,79...°$ $2x=80,79...°+k.360°$ or $2x=279,20...°+k.360°$ $x=40,40°+k.180°$ or $x=139,60°+k.180°$; $k\in Z$	✓ answer $5.3.1=\dfrac{1}{25}$ ✓ $2x=80,79°$ ✓ $2x=279,20...°$ ✓ $x=40,40°$ and $x=139,60°$ ✓ $+k.180°$; $k\in Z$ (5)

	OR $\dfrac{\sin 150° + \cos^2 x - 1}{2} = \dfrac{1}{25}$ $\sin 150° + \cos^2 x - 1 = \dfrac{2}{25}$ $\sin 30° + \cos^2 x - 1 = \dfrac{2}{25}$ $\cos^2 x = \dfrac{29}{50}$ $\cos x = \pm\sqrt{\dfrac{29}{50}}$ $x = 40,40° + k.360°$ or $x = 319,60° + k.360°$; $k \in Z$ or $x = 139,60° + k.360°$ or $x = 220,40° + k.360°$; $k \in Z$	✓ $\cos^2 x = \dfrac{29}{50}$ ✓ $x = 40,40°$ ✓ $x = 139,60°$ ✓ $x = 220,40°$ and $x = 319,60°$ ✓ $+ k.360°$; $k \in Z$ (5)
		[26]

11. 13 sin x + 3 = 0, and the whole chain that follows from it

Official DBE marking guideline · November 2022 · Q5 · 30 marks

QUESTION/*VRAAG* 5

5.1.1	$\sin(360°+x)$ $=\sin x$	✓ + ✓ sin x (2)
5.1.2	$x-\text{coordinate}=\sqrt{\left(\sqrt{13}\right)^2-(-3)^2}$ $=-2$ $\tan x=\frac{-3}{-2}$ $=\frac{3}{2}$ **OR/*OF*** $x-\text{coordinate}=\sqrt{\left(\sqrt{13}\right)^2-(3)^2}$ $=2$ $\tan x=\frac{3}{2}$	✓✓ substitution ✓ method (3) ✓✓ substitution ✓ method (3)
5.1.3	$\cos(180°+x)$ $=-\cos x$	✓ – ✓ cos x (2)
5.2	$\frac{\cos(90°+\theta)}{\sin(\theta-180°)+3\sin(-\theta)}$ $=\frac{-\sin\theta}{\sin\left(-\left(180°-\theta\right)\right)-3\sin\theta}$ $=\frac{-\sin\theta}{-\sin\theta-3\sin\theta}$ $=\frac{-\sin\theta}{-4\sin\theta}$ $=\frac{1}{4}$	✓ $-\sin\theta$ ✓ $-3\sin\theta$ ✓ $-\sin\theta$ ✓ simplification ✓ answer (5)

5.3	$(\cos x + 2\sin x)(3\sin 2x - 1) = 0$ $\cos x + 2\sin x = 0$ or $3\sin 2x - 1 = 0$ $\tan x = -\frac{1}{2}$; $\sin 2x = \frac{1}{3}$ ref $\angle = 26{,}565...°$; ref $\angle = 19{,}471...°$ $x = 153{,}43° + k.180°$; $k \in Z$; $x = 9{,}74° + k.180°$; $k \in Z$ **OR/*OF*** ; or $x = 153{,}43° + k.360°$; $k \in Z$; $x = 80{,}26° + k.180°$; $k \in Z$ or $x = 333{,}43° + k.360°$; $k \in Z$	✓ both equations ✓ $\tan x = -\frac{1}{2}$ ✓ $\sin 2x = \frac{1}{3}$ ✓ $x = 153{,}43°$ **OR** $x = 153{,}43°$ &333,43° ✓ $x = 9{,}74°$ & 80,26° ✓ $+ k.180°$; $k \in$ Z (6)
5.4.1	LHS $= \cos(x+y).\cos(x-y)$ $= [\cos x.\cos y - \sin x.\sin y][\cos x.\cos y + \sin x.\sin y]$ $= \cos^2 x.\cos^2 y - \sin^2 x.\sin^2 y$ $= (1-\sin^2 x)(1-\sin^2 y) - \sin^2 x.\sin^2 y$ $= 1 + \sin^2 x.\sin^2 y - \sin^2 x - \sin^2 y - \sin^2 x.\sin^2 y$ $= 1 - \sin^2 x - \sin^2 y$ = RHS	✓ expansion ✓ simplification ✓ square identity ✓ product (4)
5.4.2	$1 - \sin^2 45° - \sin^2 15°$ $= \cos(45° + 15°).\cos(45° - 15°)$ $= \cos 60°.\cos 30°$ $= \left(\frac{1}{2}\right)\left(\frac{\sqrt{3}}{2}\right)$ $= \frac{\sqrt{3}}{4}$ **OR/*OF***	✓ identifying *x* and *y* ✓ substitution ✓ answer (3)

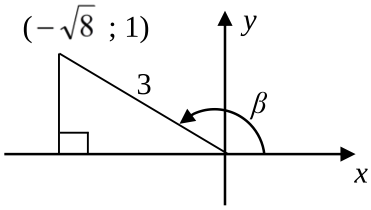
	$1-\sin^2 45°-\sin^2 15°$ $=\sin^2 15°+\cos^2 15°-\sin^2 45°-\sin^2 15°$ $=\cos^2 15°-\left(\frac{\sqrt{2}}{2}\right)^2$ $=\cos^2 15°-\frac{1}{2}$ $=\frac{2\cos^2 15°-1}{2}$ $=\frac{\cos 30°}{2}$ $=\frac{\sqrt{3}}{2}\times\frac{1}{2}$ $=\frac{\sqrt{3}}{4}$	✓ identity ✓ substitution ✓ answer (3)
	OR $1-\sin^2 45°-\sin^2 15°$ $=\cos^2 45°-\sin^2(45°-30°)$ $=\left(\frac{1}{\sqrt{2}}\right)^2-(\sin 45°\cos 30°-\cos 45°\sin 30°)^2$ $=\frac{1}{2}-\left(\frac{1}{\sqrt{2}}\times\frac{\sqrt{3}}{2}-\frac{1}{\sqrt{2}}\times\frac{1}{2}\right)^2$ $=\frac{1}{2}-\left(\frac{\sqrt{3}}{2\sqrt{2}}-\frac{1}{2\sqrt{2}}\right)^2$ $=\frac{1}{2}-\left(\frac{\sqrt{3}}{2\sqrt{2}}-\frac{1}{2\sqrt{2}}\right)^2$ $=\frac{1}{2}-\left(\frac{3}{8}-\frac{\sqrt{3}}{4}+\frac{1}{8}\right)$ $=\frac{\sqrt{3}}{4}$	✓ expansion ✓ substitution ✓ answer (3)

5.5.1	$16\sin x.\cos^3 x - 8\sin x.\cos x$ $= 8\sin x.\cos x(2\cos^2 x - 1)$ $= 4\sin 2x(\cos 2x)$ $= 2\sin 4x$ **OR/*OF*** $16\sin x.\cos^3 x - 8\sin x.\cos x$ $= 16\cos^2 x\left(\frac{1}{2}\sin 2x\right) - 8\left(\frac{1}{2}\sin 2x\right)$ $= 8(2\cos^2 x - 1)\left(\frac{1}{2}\sin 2x\right)$ $= 4\sin 2x.\cos 2x$ $= 2\sin 4x$	✓ factorisation ✓ 4sin2x ✓ cos2x ✓ double angle (4) ✓ factorisation ✓ $4\sin 2x$ ✓ cos2x ✓ double angle (4)
5.5.2	$16\sin x.\cos^3 x - 8\sin x.\cos x$ = 2sin4x Minimum at x = 67,5°	✓ answer (1)
		[30]

12. sin beta given with its quadrant - the longest question in the book

Official DBE marking guideline · November 2023 · Q5 · 31 marks

QUESTION/VRAAG 5

5.1.1	$\sin\beta = \frac{1}{3}$ $\quad\quad \beta \in (90°;270°)$  $x = -\sqrt{8} = -2\sqrt{2}$ $\cos\beta$ $= \frac{-2\sqrt{2}}{3}$ **OR** $\sin\beta = \frac{1}{3}$ $\quad\quad \beta \in (90°;270°)$ $\cos^2\beta = 1 - \sin^2\beta$ $\cos^2\beta = 1 - \left(\frac{1}{3}\right)^2$ $\cos^2\beta = \frac{8}{9}$ $\cos\beta = \frac{-\sqrt{8}}{3}$ $= \frac{-2\sqrt{2}}{3}$	✓ $x^2 + y^2 = r^2$ ✓ $x = -2\sqrt{2}$ ✓ answer (3) ✓ square identity ✓ $\cos^2\beta$ ✓ answer (3)
5.1.2	$\sin 2\beta$ $= 2\sin\beta\cos\beta$ $= 2\left(\frac{1}{3}\right)\left(\frac{-\sqrt{8}}{3}\right)$ $= \frac{-2\sqrt{8}}{9}$ **OR** $2\left(\frac{-2\sqrt{2}}{9}\right)$ $= \frac{-4\sqrt{2}}{9}$	✓ double angle ✓ substitution ✓ answer (3)
5.1.3	$\cos(450° - \beta)$ $= \cos(90° - \beta)$ $= \sin\beta$ $= \frac{1}{3}$ **OR**	✓ $\cos(90° - \beta)$ ✓ co-ratio ✓ answer (3)

	$\cos(450^\circ - \beta)$ $= \cos 450^\circ \cos\beta + \sin 450^\circ \sin\beta$ $= \cos 90^\circ \cos\beta + \sin 90^\circ \sin\beta$ $= \sin\beta$ $= \dfrac{1}{3}$	✓ expansion ✓ reduction ✓ answer (3)
5.2.1	LHS $= \dfrac{\cos^4 x + \sin^2 x.\cos^2 x}{1+\sin x}$ $= \dfrac{\cos^2 x\left(\cos^2 x + \sin^2 x\right)}{1+\sin x}$ $= \dfrac{1-\sin^2 x}{1+\sin x}$ $= \dfrac{(1-\sin x)(1+\sin x)}{1+\sin x}$ $= 1-\sin x$ = RHS	✓ factors ✓ $\sin^2 x + \cos^2 x = 1$ ✓ $\cos^2 x = 1-\sin^2 x$ ✓ factors (4)
	OR	
	LHS $= \dfrac{\cos^4 x + \sin^2 x.\cos^2 x}{1+\sin x}$ $= \dfrac{\cos^4 x + \left(1-\cos^2 x\right)\cos^2 x}{1+\sin x}$ $= \dfrac{\cos^4 x + \cos^2 x - \cos^4 x}{1+\sin x}$ $= \dfrac{1-\sin^2 x}{1+\sin x}$ $= \dfrac{(1-\sin x)(1+\sin x)}{1+\sin x}$ $= 1-\sin x$ = RHS	 ✓ $\sin^2 x = 1-\cos^2 x$ ✓ expansion ✓ $\cos^2 x = 1-\sin^2 x$ ✓ factors (4)
	OR	
	RHS $= 1-\sin x$ $= (1-\sin x)\times\dfrac{1+\sin x}{1+\sin x}$ $= \dfrac{1-\sin^2 x}{1+\sin x}$ $= \dfrac{\cos^2 x}{1+\sin x}$ $= \dfrac{\cos^2 x\left(\sin^2 x + \cos^2 x\right)}{1+\sin x}$ $= \dfrac{\cos^4 x + \cos^2 x.\sin^2 x}{1+\sin x}$ = LHS	✓ $\times\dfrac{1+\sin x}{1+\sin x}$ ✓ product ✓ $1-\sin^2 x = \cos^2 x$ ✓ $1 = \cos^2 x + \sin^2 x$ (4)

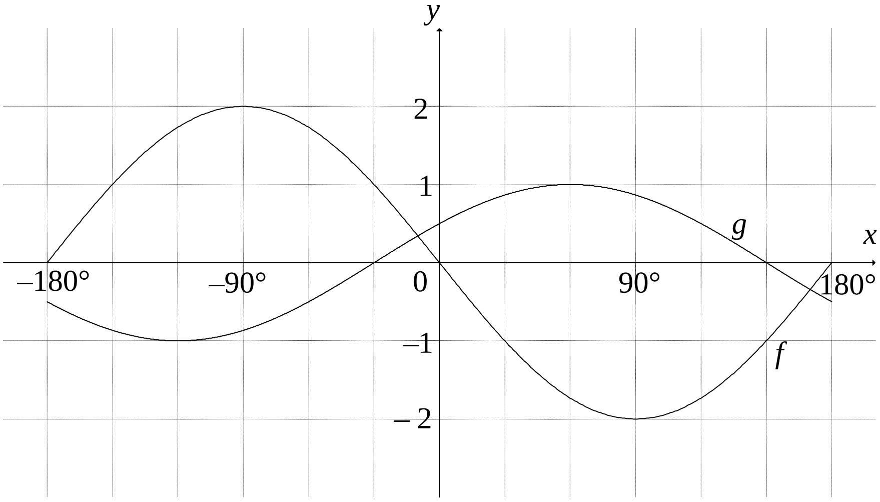
5.2.2	$\sin x+1=0$ $\sin x=-1$ ref. $\angle = 90°$ $x = 270°$	✓ $\sin x+1=0$ ✓ $x = 270°$ (2)
5.2.3	$y=\dfrac{\cos^4 x+\sin^2 x.\cos^2 x}{1+\sin x}$ $y=1-\sin x$ $\therefore$ Minimum = 0	 ✓✓ Minimum = 0 (2)
5.3.1	sin (A – B) $=\cos\left[90°-\left(\mathrm{A}-\mathrm{B}\right)\right]$ $=\cos\left[(90°-\mathrm{A})-(-\mathrm{B})\right]$ $=\cos\left(90°-\mathrm{A}\right)\cos\left(-\mathrm{B}\right)+\sin\left(90°-\mathrm{A}\right)\sin\left(-\mathrm{B}\right)$ $=\sin\mathrm{A}\cos\mathrm{B}+\cos\mathrm{A}\left(-\sin\mathrm{B}\right)$ $=\sin\mathrm{A}\cos\mathrm{B}-\cos\mathrm{A}\sin\mathrm{B}$ **OR** sin (A – B) $=\cos\left[90°-\left(\mathrm{A}-\mathrm{B}\right)\right]$ $=\cos\left[(90°+\mathrm{B})-\mathrm{A}\right]$ $=\cos\left(90°+\mathrm{B}\right)\cos\mathrm{A}+\sin\left(90°+\mathrm{B}\right)\sin\mathrm{A}$ $=-\sin\mathrm{B}\cos\mathrm{A}+\cos\mathrm{B}\sin\mathrm{A}$ $=\sin\mathrm{A}\cos\mathrm{B}-\cos\mathrm{A}\sin\mathrm{B}$	 ✓ co-ratio ✓ compound angle ✓ reduction (3) ✓ co-ratio ✓ compound angle ✓ reduction (3)
5.3.2	$\sin 48°\cos x-\cos 48°\sin x=\cos 2x$ $\sin\left(48°-x\right)=\cos 2x$ $\sin\left(48°-x\right)=\sin\left(90°-2x\right)$ $48°-x=90°-2x+k.360°$ or $48°-x=180°-\left(90°-2x\right)+k.360°$ $x=42°+k.360°$ $\quad -3x=42°+k.360°$ $x=-14°-k.120°$; $k \in$ Z **OR** $\sin 48°\cos x-\cos 48°\sin x=\cos 2x$ $\sin\left(48°-x\right)=\cos 2x$ $\cos\left(90°-48°+x\right)=\cos 2x$ $\cos\left(42°+x\right)=\cos 2x$ $42°+x=2x+k.360°$ or $42°+x=360°-2x+k.360°$ $-x=-42°+k.360°$ $\quad 3x=318°+k.360°$ $x=42°-k.360°$ $\quad x=106°+k.120°$; $k \in$ Z	 ✓ compound angle ✓ co-ratio ✓ both equations ✓ general solution ✓ general solution; $k \in$ Z (5) ✓ compound angle ✓ co-ratio ✓ both equations ✓ general solution ✓ general solution; $k \in$ Z (5)

5.4	$\frac{\sin 3x+\sin x}{\cos 2x+1}$ $=\frac{\sin(2x+x)+\sin(2x-x)}{\cos 2x+1}$ $=\frac{\sin 2x\cos x+\cos 2x\sin x+\sin 2x\cos x-\cos 2x\sin x}{2\cos^2 x-1+1}$ $=\frac{2\sin 2x\cos x}{2\cos^2 x}$ $=\frac{2(2\sin x\cos x)\cos x}{2\cos^2 x}$ $=\frac{4\sin x\cos^2 x}{2\cos^2 x}$ $=2\sin x$ **OR** $\frac{\sin 3x+\sin x}{\cos 2x+1}$ $=\frac{\sin(2x+x)+\sin x}{2\cos^2 x-1+1}$ $=\frac{\sin 2x\cos x+\cos 2x\sin x+\sin x}{2\cos^2 x}$ $=\frac{2\sin x\cos x\cos x+\cos 2x\sin x+\sin x}{2\cos^2 x}$ $=\frac{\sin x(2\cos^2 x+\cos 2x+1)}{2\cos^2 x}$ $=\frac{\sin x(2\cos^2 x+2\cos^2 x-1+1)}{2\cos^2 x}$ $=2\sin x$	✓ $3x=(2x+x)$ ✓ expansion ✓ double angle of cos2x ✓ simplification ✓ $\sin 2x=2\sin x\cos x$ ✓ answer (6) ✓ $3x=(2x+x)$ ✓ double angle of cos2x ✓ expansion ✓ $\sin 2x=2\sin x\cos x$ ✓ common factor ✓ answer (6)
		[31]

13. Draw a cosine onto a sine that is already sketched

Official DBE marking guideline · November 2021 · Q7 · 8 marks

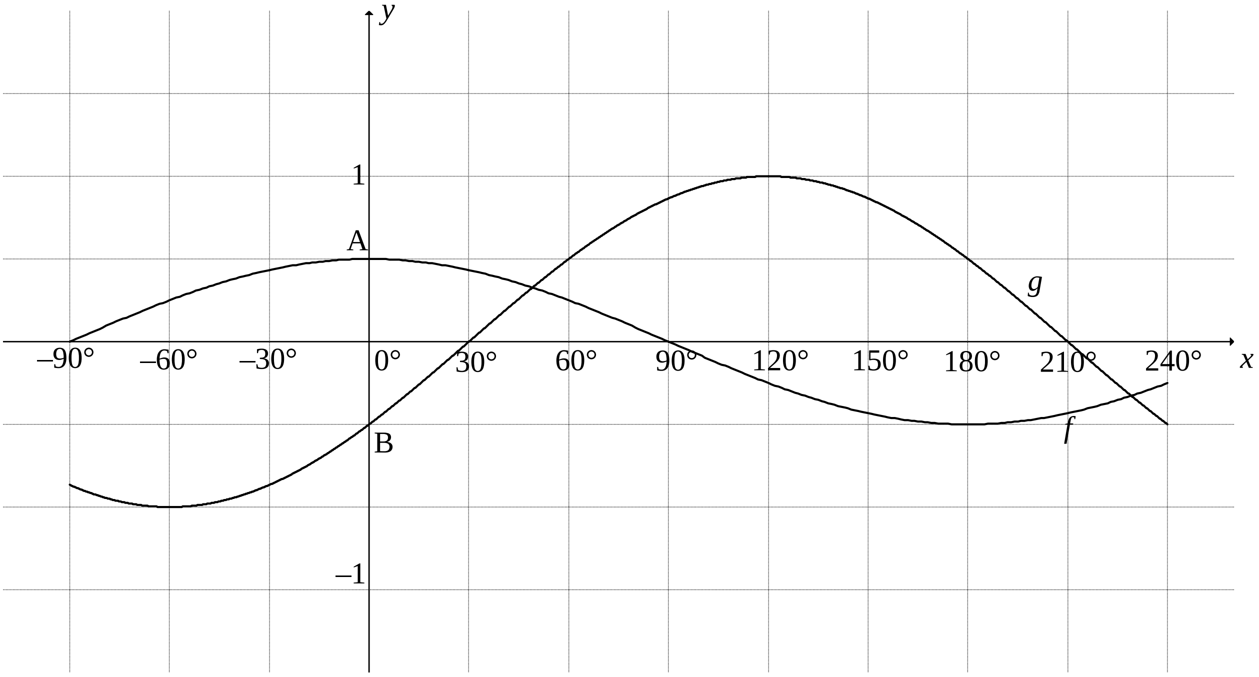
QUESTION/*VRAAG* 7

7.1		✓ both turning points ✓ both x intercepts (–30° & 150°) ✓ shape (3)
7.2	Period = 120°	✓✓ answer (2)
7.3	$x = -30°$	✓ answer (1)
7.4	Range of/*waardeversameling van g*: $y \in [-1;1]$ Range of/*Waardeversameling van* $\frac{1}{2}g$: $y \in \left[-\frac{1}{2};\frac{1}{2}\right]$ Range of/*Waardeversameling van* $\frac{1}{2}g + 1$: $y \in \left[\frac{1}{2};\frac{3}{2}\right]$ **OR/*OF*** Range of/*Waardeversameling van* $\frac{1}{2}g + 1$: $\frac{1}{2} \le y \le \frac{3}{2}$	✓ critical values ✓ correct notation (2) ✓ critical values ✓ correct notation (2)
		[8]

14. A cosine and a shifted sine on one set of axes

Official DBE marking guideline · May/June 2022 · Q7 · 10 marks

QUESTION/*VRAAG* 7



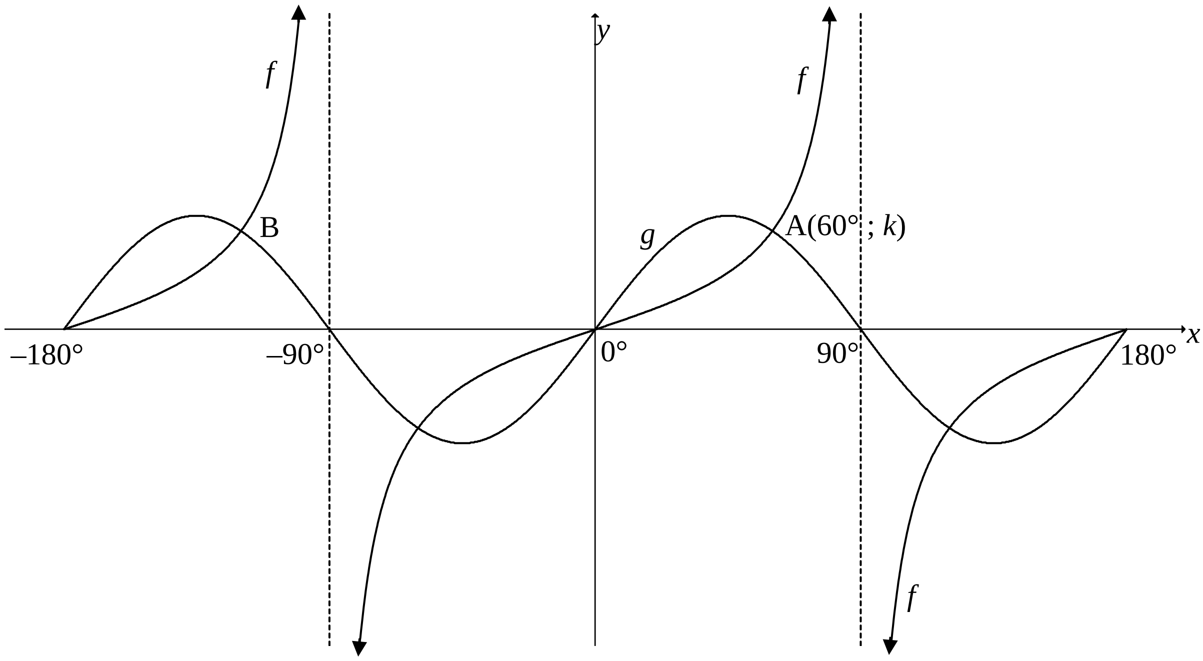
7.1	$A\left(0;\frac{1}{2}\right)$ $B\left(0;-\frac{1}{2}\right)$ $AB=\frac{1}{2}-\left(-\frac{1}{2}\right)$ $= 1$ unit Answer only 2/2	✓ y-values ✓ answer (2)
7.2	Range of $f:\ y\in\left[-\frac{1}{2};\ \frac{1}{2}\right]$ Range of $3f(x)+2:\ \ y\in\left[\frac{1}{2};\ 3\frac{1}{2}\right]$ **OR/*OF*** $\frac{1}{2}\le y\le 3\frac{1}{2}$	✓ critical values ✓ answer (2)
7.3	$x = 90°$	✓✓ $x = 90°$ (2)
7.4.1	$x\in(30°;\ 90°)\cup(210°;240°]$ **OR/*OF*** $30°<x<90°$ or $210°<x\le 240°$	✓ $x\in(30°;\ 90°)$ ✓ $(210°;240°]$ (2) ✓ $30°<x<90°$ ✓ $210°<x\le 240°$ (2)
7.4.2	$x\in(-55°;\ 125°)$ **OR/*OF*** $-55°<x<125°$	✓ critical values ✓ answer (2) ✓ critical values ✓ answer (2)

[10]

15. tan x against 2 sin 2x, and where the two cross

Official DBE marking guideline · November 2022 · Q6 · 10 marks

QUESTION/*VRAAG* 6



6.1	$180°$	✓ answer (1)
6.2.1	$k=\sqrt{3}=1{,}73$	✓ answer (1)
6.2.2	$B\left(-120°;\sqrt{3}\right)$	✓ $x=-120°$ (1)
6.3	Range of g: $y\in[-2;\ 2]$ Range of $2g(x)$: $y\in[-4;\ 4]$ **OR/*OF*** ANSWER ONLY: Full marks Range of g: $-2\le y\le 2$ Range of $2g(x)$: $-4\le y\ \le 4$	✓ $y\in[-2;\ 2]$ ✓ answer (2) ✓ $-2\le y\le 2$ ✓ answer (2)
6.4	$x\in[-65°;\ -5°]$ **OR/*OF*** $-65°\le x\le -5°$	✓✓ $x\in[-65°;\ -5°]$ (2) ✓✓ $-65°\le x\le -5°$ (2)
6.5	$\sin x.\cos x=p$ $4\sin x.\cos x=4p$ $2\sin 2x=4p$ $4p=\pm 2$ $\therefore\ p=-\frac{1}{2}$ or $\frac{1}{2}$ ANSWER ONLY: Full marks	✓ $2\sin 2x=4p$ ✓ $4p=\pm 2$ ✓ answers (3)
		[10]

16. Find a from where cos(x + a) meets sin 2x

Official DBE marking guideline · May/June 2024 · Q6 · 10 marks

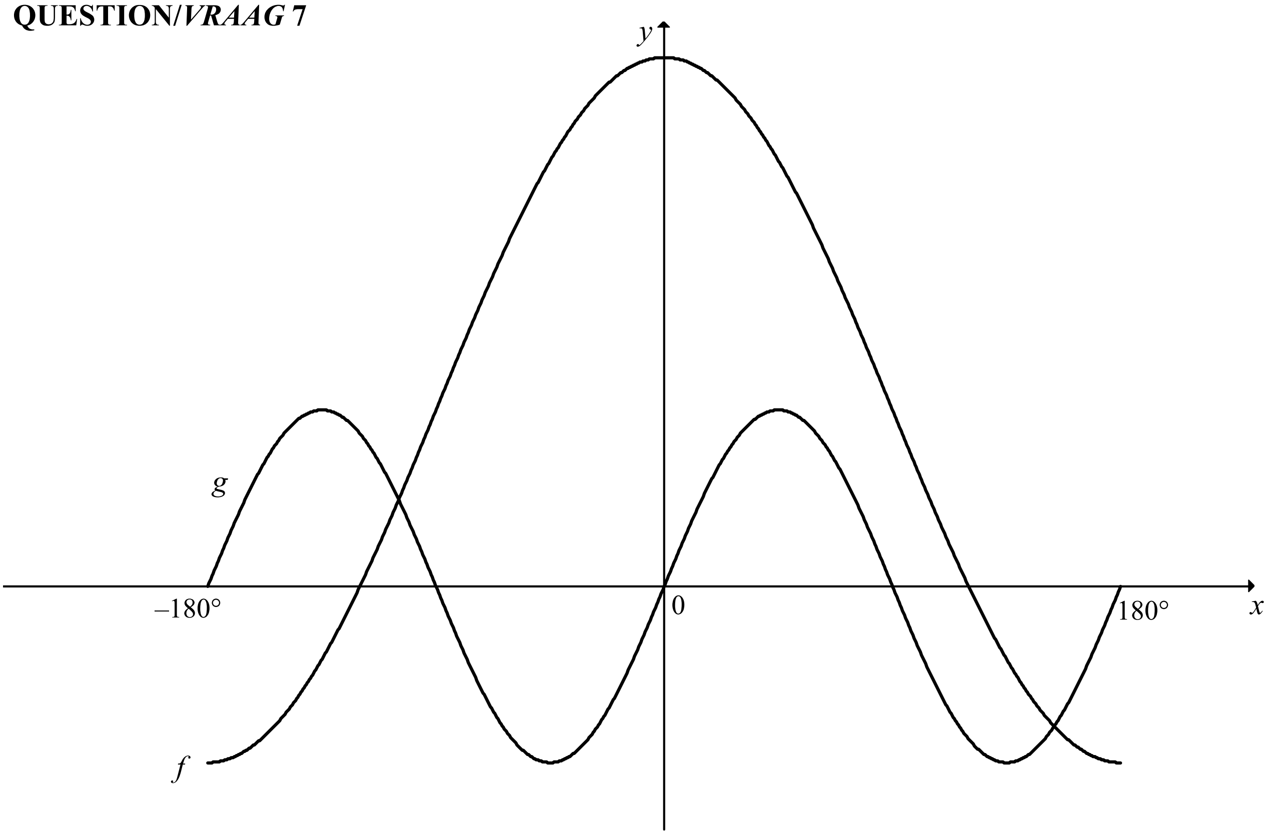
QUESTION/*VRAAG* 6

6.1	Period = $360°$	✓ $360°$ (1)
6.2	Amplitude $= 1$	✓ 1 (1)
6.3	$a = -45°$	✓ $a = -45°$ (1)
6.4	$\sin 2x = k$ $k = \sin(2\times165°)$ **OR** $k = \sin\left(2\times\left(-75°\right)\right)$ $k = \sin 330°$ $\quad$ $k = \sin\left(-150°\right)$ $k = -\sin 30°$ $k = -\frac{1}{2}$ **OR** $k = \cos\left(165° - 45°\right)$ **OR** $k = \cos\left(-75° - 45°\right)$ $k = \cos 120°$ $\quad$ $k = \cos\left(-120°\right)$ $k = -\cos 60°$ $k = -\frac{1}{2}$	✓ $-\sin 30°$ ✓ $-\frac{1}{2}$ (2) ✓ $-\cos 60°$ ✓ $-\frac{1}{2}$ (2)
6.5	Points of intersection are translated $60°$ to the left $x = -15°$	✓ $x = -15°$ (1)
6.6	$\sqrt{2}\sin 2x = \sin x + \cos x$ $\sin 2x = \frac{1}{\sqrt{2}}\sin x + \frac{1}{\sqrt{2}}\cos x$ $\sin 2x = \sin 45° \sin x + \cos 45° \cos x$ $\sin 2x = \cos\left(45° - x\right)$ **OR** $\sin 2x = \cos\left(x - 45°\right)$ $\therefore 2$ roots in the interval $x \in [-90°; 90°]$	✓ division by $\sqrt{2}$ ✓ special angles ✓ $\cos\left(45° - x\right)$ or $\cos\left(x - 45°\right)$ ✓ answer (4)
		[10]

17. Range, period, and where 2 cos x + 1 meets sin 2x

Official DBE marking guideline · May/June 2025 · Q7 · 10 marks

QUESTION/*VRAAG* 7



7.1	Range of f: $y \in [-1\ ;\ 3]$ **OR/*OF*** $-1 \leq y \leq 3$	✓ $y \in [-1\ ;\ 3]$ (1) ✓ $-1 \leq y \leq 3$ (1)
7.2	Period of g: 180°	✓ 180° (1)
7.3	f increasing: $x \in (-180°\ ;\ 0°)$ **OR/*OF*** $-180° < x < 0°$	✓ $x \in (-180°\ ;\ 0°)$ (1) ✓ $-180° < x < 0°$ (1)
7.4.1	$g(x).f'(x) < 0$ $x \in (-90°\ ;\ 0°) \cup (0°\ ;\ 90°)$ **OR/*OF*** $-90° < x < 0°$ or $0° < x < 90°$	✓ $x \in (-90°\ ;\ 0°)$ ✓ $x \in (0°\ ;\ 90°)$ (2) ✓ $-90° < x < 0°$ ✓ $0° < x < 90°$ (2)

7.4.2	$\cos x \leq -\frac{1}{2}$ $2\cos x + 1 \leq 0$ $x \in [-180° ; -120°] \cup [120° ; 180°]$ **OR/*OF*** $2\cos x + 1 \leq 0$ $-180° \leq x \leq -120°$ or $120° \leq x \leq 180°$	✓ $2\cos x + 1 \leq 0$ ✓ $x \in [-180° ; -120°]$ ✓ $x \in [120° ; 180°]$ (3) ✓ $2\cos x + 1 \leq 0$ ✓ $-180° \leq x \leq -120°$ ✓ $120° \leq x \leq 180°$ (3)
7.5	$g(x) = \sin 2x$ $h(x) = \sin 2(x - 45°)$ $= \sin(2x - 90°)$ $= -\sin(90° - 2x)$ $= -\cos 2x$	✓ $\sin(2x - 90°)$ ✓ equation of h (2)
		[10]

18. The asymptote of tan x, and reading the graph around it

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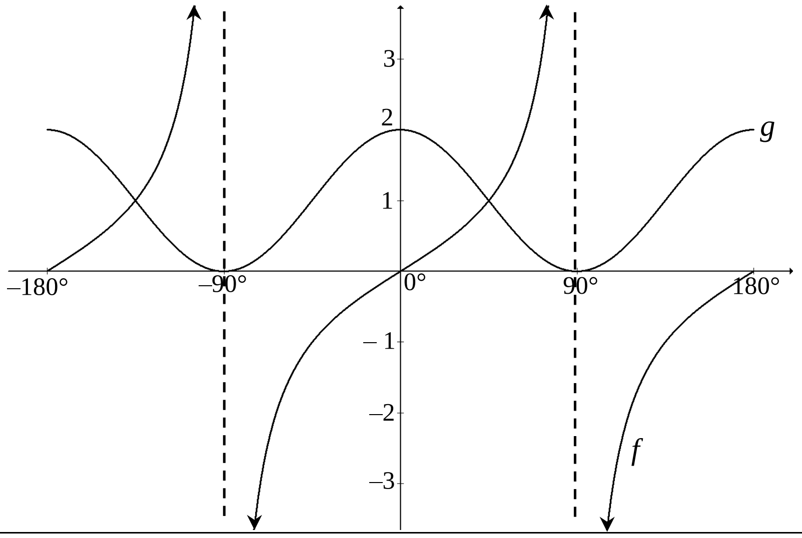
QUESTION/*VRAAG* 7

7.1	$x = 90°$	✓ $x = 90°$ (1)
7.2	$x = -180°$ or $x \in (-90°\ ;\ 0°]$ **OR/*OF*** $x = -180°$ or $-90° < x \leq 0°$	✓✓ answer (2) ✓✓ answer (2)
7.3.1	180°	✓ answer (1)
7.3.2		✓ turning points on x-axis: $x = -90°\ ;\ 90°$ ✓ shape ✓ turning point on y-axis at $(0\ ;\ 2)$ (3)
7.4	$2\cos^3 x - \sin x = 0$ $2\cos^3 x = \sin x$ $2\cos^2 x = \dfrac{\sin x}{\cos x}$ $2\cos^2 x = \tan x$ $2\cos^2 x - 1 = \tan x - 1$ $\cos 2x + 1 = \tan x$ $x = 45° + k.180°;\ k \in Z$ **OR/*OF*** $2\cos^3 x - \sin x = 0$ $\cos x\left(2\cos^2 x - \tan x\right) = 0$ $\cos x = 0$ or $2\cos^2 x = \tan x$ not valid $2\cos^2 x - 1 + 1 = \tan x$ $\cos 2x + 1 = \tan x$ $x = 45° + k.180°;\ k \in Z$	✓ $2\cos^2 x = \tan x$ ✓ $2\cos^2 x - 1 = \tan x - 1$ ✓ $\cos 2x + 1 = \tan x$ ✓ answer (4) **OR/*OF*** ✓ $2\cos^2 x = \tan x$ ✓ $2\cos^2 x - 1 + 1 = \tan x$ ✓ $\cos 2x + 1 = \tan x$ ✓ answer (4)
		[11]

19. Period, amplitude, and a point that lies on f

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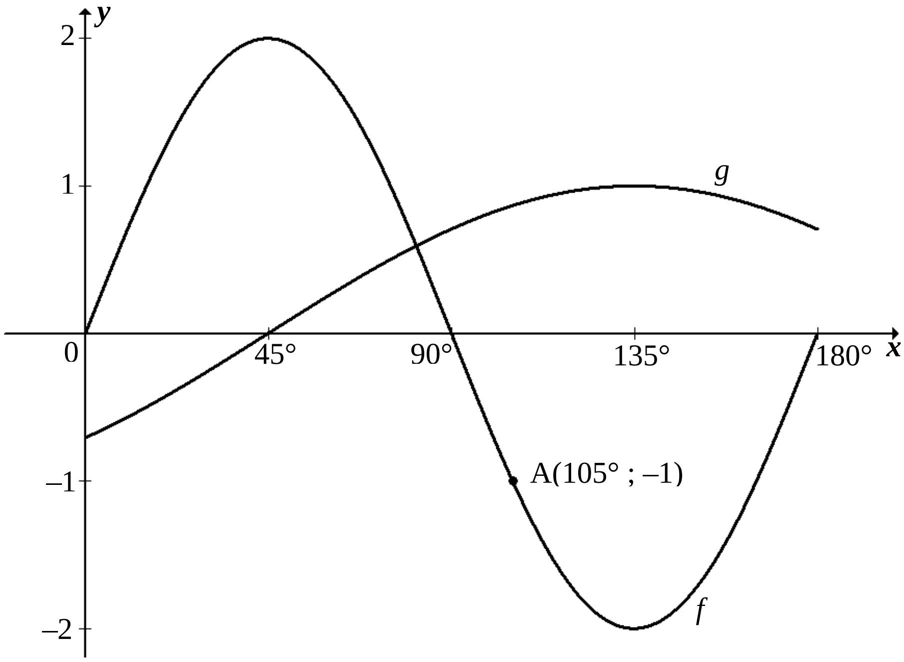
QUESTION/*VRAAG 6*



6.1	Period = 180°	✓ 180° (1)
6.2	$y \in \left[-\frac{\sqrt{2}}{2}\ ;1\right]$ **OR** $y \in [-0{,}71;1]$ **OR** $-\frac{\sqrt{2}}{2} \le y \le 1$	✓ $-\frac{\sqrt{2}}{2}$ ✓ $y \in \left[-\frac{\sqrt{2}}{2}\ ;1\right]$ (2)
6.3.1	$x \in (45°\ ;\ 90°)$ **OR** $45° < x < 90°$	✓✓ $x \in (45°\ ;\ 90°)$ (2)
6.3.2	$f(x)+1 \le 0$ $f(x) \le -1$ $x \in [105°\ ;\ 165°]$ **OR** $105° \le x \le 165°$	✓✓ $x \in [105°\ ;\ 165°]$ (2)
6.4	$p(x) = -2\sin 2x$ $-2\sin 2x = -1$ **OR** $2\sin 2x = 1$ k = 15° or k = 75°	✓ reading off $f(x) = 1$ or $-f(x) = -1$ ✓ 15° ✓ 75° (3)
6.5	$g(x) = -\cos(x+45°)$ $h(x) = -\cos(x+90°)$ $h(x) = \sin x$	✓ $-\cos(x+90°)$ ✓ answer (2)
		[12]

20. cos 2x against minus sin x, without a calculator

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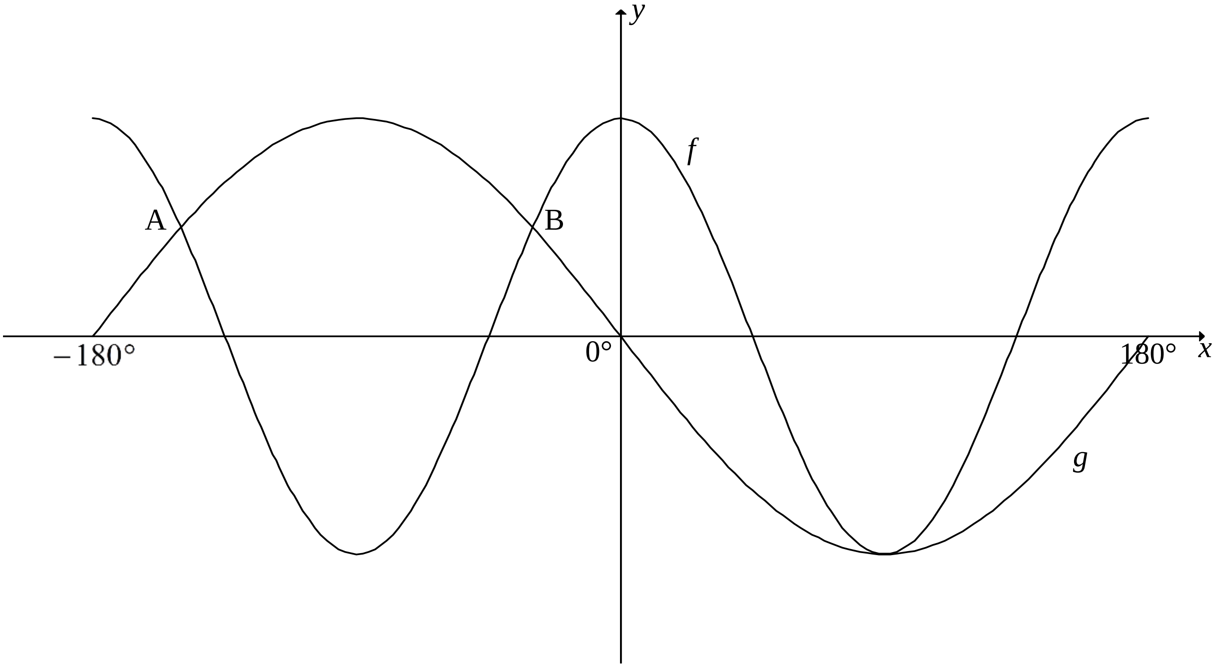
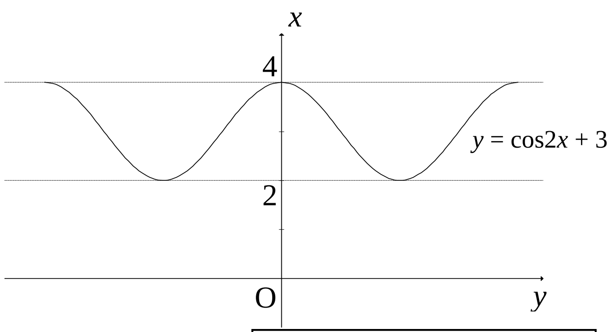
QUESTION/VRAAG 6

6.1	$1-2\sin^2 x=-\sin x$ $2\sin^2 x-\sin x-1=0$ $(2\sin x+1)(\sin x-1)=0$ $\sin x=-\frac{1}{2}$ or $\sin x=1$ ref $\angle=30°$; ref $\angle=90°$ $x=210°+k.360°$ or $x=330°+k.360°$; $x=90°+k.360°$ $x=-150°$ or $x=-30°$ or $x=90°$	✓ identity ✓ factors ✓ $\sin x=-\frac{1}{2}$ ✓ $\sin x=1$ ✓ –150° and –30° ✓ 90° (A) (6)
	OR	
	$\cos 2x=-\sin x$ $\cos 2x=-\cos(90°-x)$ $2x=180°-(90°-x)+k.360°$ or $2x=180°+(90°-x)+k.360°$ $2x=90°+x+k.360°$ or $2x=270°-x+k.360°$ $x=90°+k.360°$; $x=90°+k.120°$ $x=-150°$ or $x=-30°$ or $x=90°$	✓ co-functions ✓ $2x$ in quadrant 2 ✓ $2x$ in quadrant 3 ✓ both general solutions ✓ –150° and –30° ✓ 90° (A) (6)
	OR	
	$\cos 2x=-\sin x$ $\cos 2x=\cos(90°+x)$ $2x=90°+x+k.360°$ or $2x=360°-(90°+x)+k.360°$ $x=90°+k.360°$ or $3x=270°+k.360°$ $x=90°+k.120°$ $x=-150°$ or $x=-30°$ or $x=90°$	✓ co-functions ✓ $2x$ in quadrant 1 ✓ $2x$ in quadrant 4 ✓ both general solutions ✓ –150° and –30° ✓ 90° (A) (6)
	OR	
	$\cos 2x=-\sin x$ $\sin(90°-2x)=-\sin x$ $90°-2x=180+x+k.360°$ or $90°-2x=360°-x+k.360°$ $x=-30°+k.120°$; $x=-270°+k.360°$ $x=-150°$ or $x=-30°$ or $x=90°$	✓ co-functions ✓ 90°–$2x$ in quadrant 3 ✓ 90°–$2x$ in quadrant 4 ✓ both general solutions ✓ –150° and –30° ✓ 90° (A) (6)

6.2



6.2.1	A(–150°; 0,5) B(–30°; 0,5) AB = –30° – (–150°) AB = 120° Answer only: Full marks	✓ AB = –30° – (–150°) ✓ answer (2)
6.2.2	$x \in (0°;\ 90°)$ or $x \in (90°;\ 180°)$ **OR** $0° < x < 90°$ or $90° < x < 180°$	✓ $x \in (0°;\ 90°)$ ✓ $x \in (90°;\ 180°)$ (2) ✓ $0° < x < 90°$ ✓ $90° < x < 180°$ (2)
6.2.3	$\cos 2x = k - 3$ $k - 3 < -1$ or $k - 3 > 1$ $k < 2$ or $k > 4$ Answer only: Full marks **OR**  $k < 2$ or $k > 4$ Answer only: Full marks	✓ $k - 3 < -1$ or $k - 3 > 1$ ✓ $k < 2$ ✓ $k > 4$ (3) ✓ graph of $y = \cos 2x + 3$ ✓ $k < 2$ ✓ $k > 4$ (3)
		[13]

21. A vertical tower, an angle of depression, and an area q

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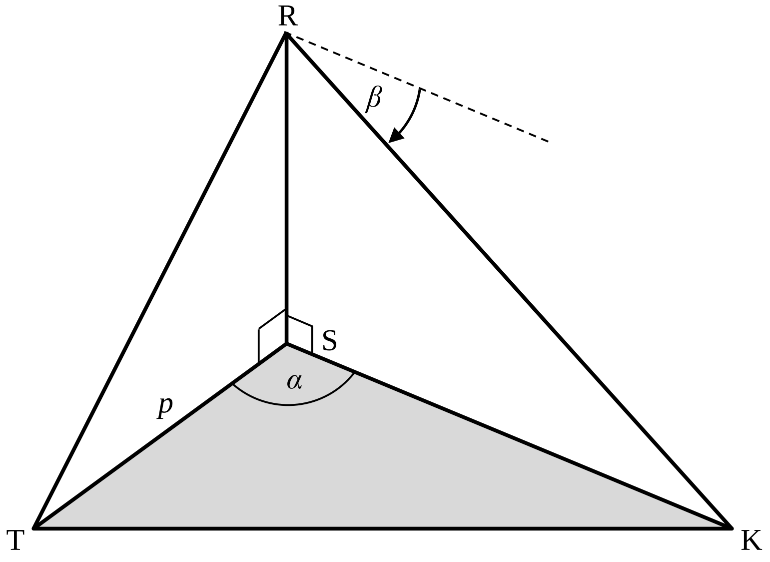
QUESTION/*VRAAG* 7



7.1	Area $\Delta STK = \frac{1}{2}p(SK)\sin\alpha$ $q = \frac{1}{2}p(SK)\sin\alpha$ $SK = \frac{q}{\frac{1}{2}p\sin\alpha}$ $= \frac{2q}{p\sin\alpha}$	✓ substitution into the correct formula ✓ answer (2)
7.2	$R\hat{K}S = \beta$ $\frac{RS}{SK} = \tan\beta$ $RS = \frac{2q\tan\beta}{p\sin\alpha}$ **OR** $\frac{RS}{\sin\beta} = \frac{SK}{\sin(90° - \beta)}$ $RS\cos\beta = SK\sin\beta$ $RS = SK\tan\beta$ $RS = \frac{2q\tan\beta}{p\sin\alpha}$	✓ $R\hat{K}S = \beta$ ✓ correct trig ratio (2) ✓ $R\hat{K}S = \beta$ ✓ $\tan\beta = \frac{\sin\beta}{\cos\beta}$ (2)
7.3	$70 = \frac{2(2500)\tan 42°}{80\sin\alpha}$ $\sin\alpha = \frac{25}{28}\tan 42°$ **OR** $\sin\alpha = 0{,}80...$ $\alpha = 53{,}51°$	✓ correct substitution of values into RS ✓ value of $\sin\alpha$ ✓ answer (3)
		[7]

22. A ramp into a building: its height, its angle and its length

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QUESTION/*VRAAG* 8

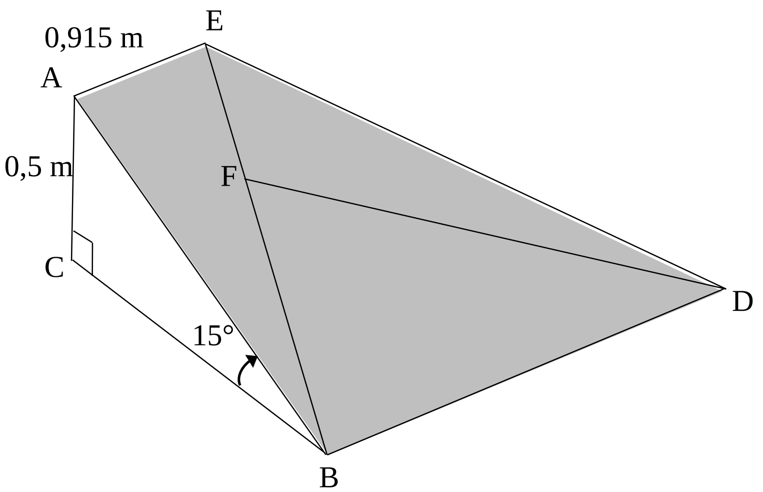

FIGURE I

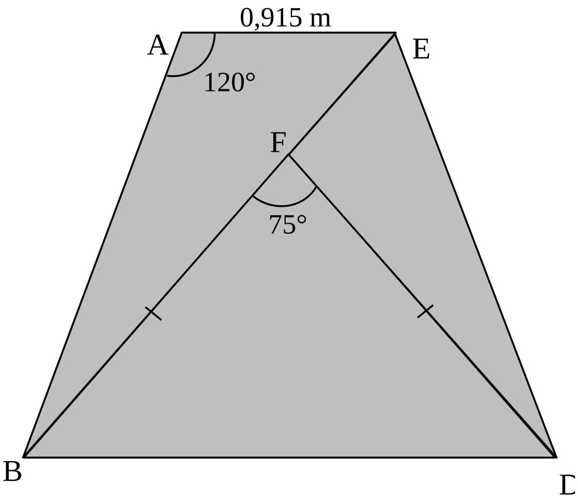

FIGURE II (top view)

8.1	$\frac{0,5}{AB}=\sin 15°$ $AB=\frac{0,5}{\sin 15°}$ $AB=1,93\ \text{m}$ Answer only 2/2	✓ trig ratio ✓ answer (2)
8.2	$BE^2=AB^2+AE^2-2(AB)(AE)\cos B\hat{A}E$ $BE^2=(1,93)^2+(0,915)^2-2(1,93)(0,915)(\cos 120°)$ $BE=2,52\ \text{m}$	✓ correct use of cosine rule ✓ substitution ✓ answer (3)
8.3	$BF=FD=\frac{5}{7}(2,52)\ =1,80\ \text{m}$ $\text{Area }\Delta BFD=\frac{1}{2}(BF)(FD)\sin B\hat{F}D$ $=\frac{1}{2}(1,8)(1,8)(\sin 75°)$ $=1,56\ \text{m}^2$	✓ BF ✓ correct substitution into the area rule ✓ answer (3)
		[8]

23. A point directly above a triangle, with 2AD = BC

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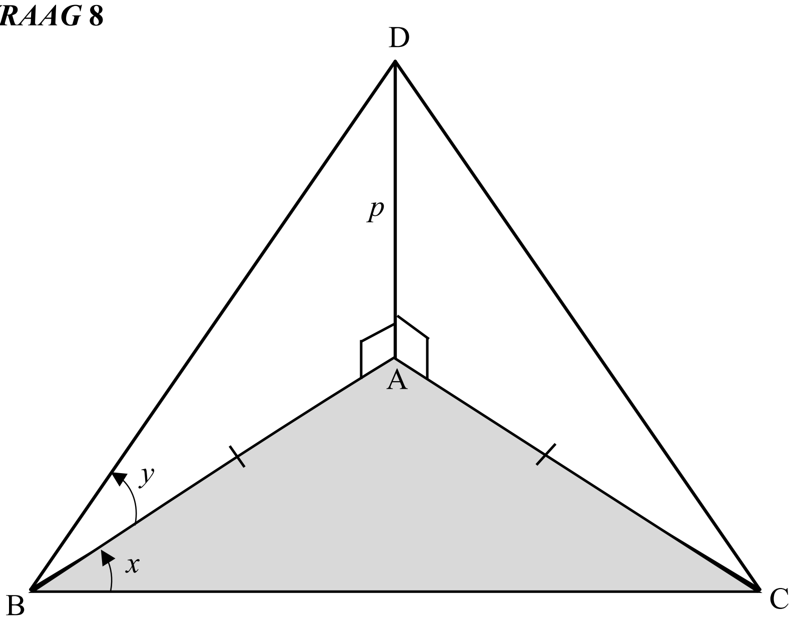
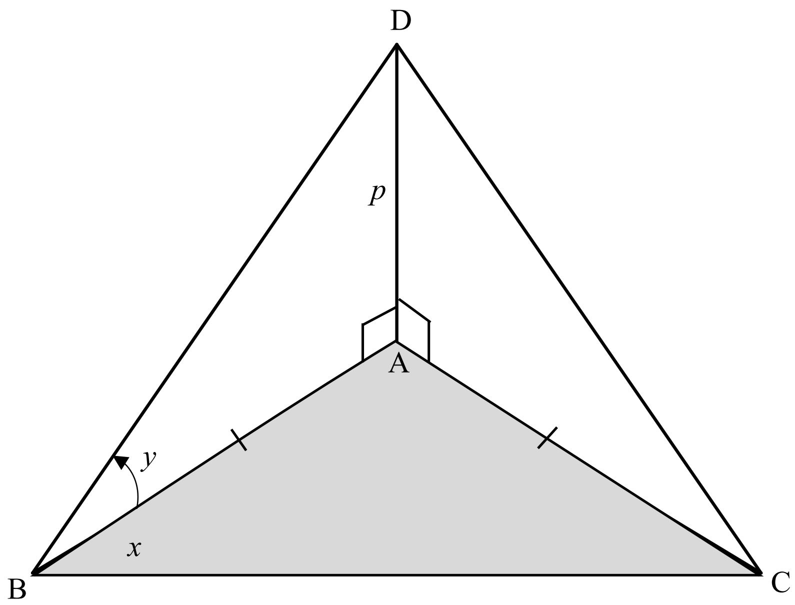
QUESTION/*VRAAG* 8



8.1	$\tan y = \dfrac{p}{AB}$ $AB = \dfrac{p}{\tan y}$	✓ correct trig ratio ✓ answer (2)
8.2	In ΔBAC: $\dfrac{\sin B\hat{A}C}{BC} = \dfrac{\sin A\hat{C}B}{AB}$ $\dfrac{\sin(180° - 2x)}{2p} = \dfrac{\sin x}{\left(\dfrac{p}{\tan y}\right)}$ $\dfrac{\sin 2x}{2p} = \sin x \times \left(\dfrac{\tan y}{p}\right)$ $\dfrac{2\sin x \cos x}{2p} = \sin x \times \left(\dfrac{\tan y}{p}\right)$ $2\cos x = \left(\dfrac{\tan y}{p}\right)(2p)$ $\cos x = \tan y$	✓ correct use of sine-rule ✓ substitute BC & AB ✓ $\sin(180° - 2x) = \sin 2x$ ✓ $\sin 2x = 2\sin x \cos x$ (4)



8.2	**OR/*OF*** In ΔBAC: $BC^2 = AB^2 + AC^2 - 2(AB)(AC)\cos B\hat{A}C$ $(2p)^2 = \left(\frac{p}{\tan y}\right)^2 + \left(\frac{p}{\tan y}\right)^2 - 2\left(\frac{p}{\tan y}\right)\left(\frac{p}{\tan y}\right)\cos(180° - 2x)$ $4p^2 = \frac{2p^2}{\tan^2 y} - \frac{2p^2(-\cos 2x)}{\tan^2 y}$ $4p^2\tan^2 y = 2p^2(1+\cos 2x)$ $\tan^2 y = \frac{1+2\cos^2 x - 1}{2}$ $\tan^2 y = \cos^2 x$ $\tan y = \cos x$	✓ correct use of cos-rule ✓ substitute AB & BC ✓ $\cos(180° - 2x) = -\cos 2x$ ✓ $\cos 2x = 2\cos^2 x - 1$ (4)
8.3	$\cos x = \tan y$ $\tan y = \cos 60°$ $\tan y = 0{,}5$ $y = 26{,}57°$	✓ substitution of 60° ✓ answer (2)
		[8]

24. Two boards meeting at right angles

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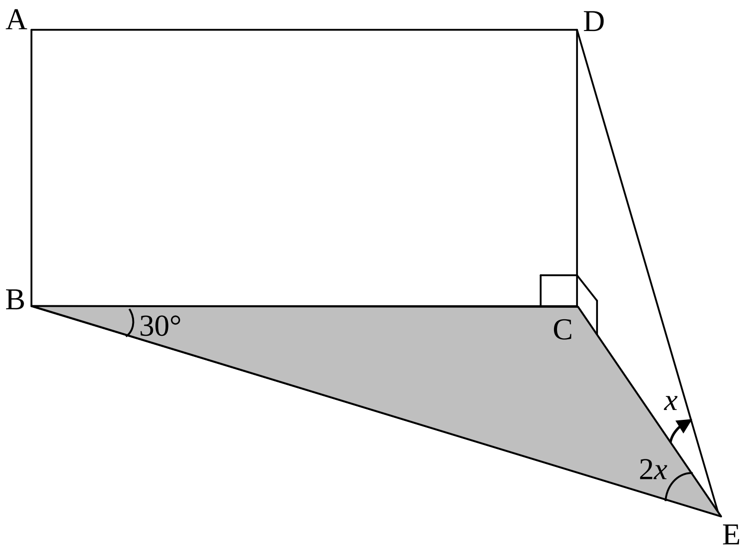
QUESTION/VRAAG 7



7.1	In ΔBCE: $\dfrac{CE}{\sin\hat{B}} = \dfrac{BC}{\sin B\hat{E}C}$ $\dfrac{CE}{\sin 30^\circ} = \dfrac{BC}{\sin 2x}$ $CE = \dfrac{BC\sin 30^\circ}{\sin 2x}$ In ΔCDE: $\dfrac{DC}{CE} = \tan D\hat{E}C$ $DC = \dfrac{BC.\sin 30^\circ}{\sin 2x}(\tan x)$ $DC = \dfrac{BC}{4\sin x\cos x}\left(\dfrac{\sin x}{\cos x}\right)$ $DC = \dfrac{BC}{4\cos^2 x}$	✓ correct use of sine rule ✓ $CE = \dfrac{BC\sin 30^\circ}{\sin 2x}$ ✓ correct trig ratio ✓ Subst CE ✓ $2\sin x\cos x$ ✓ $\dfrac{\sin x}{\cos x}$ (6)

7.2	$DC = \dfrac{BC}{4\cos^2 30°}$ $= \dfrac{BC}{4\left(\dfrac{\sqrt{3}}{2}\right)^2}$ $= \dfrac{BC}{3}$ $\therefore BC = 3DC$ But AB = DC [opp sides of rectangle/*teenoorst. sye v reghoek*] $\therefore BC = 3AB$ Area of rectangle = (AB)(BC) = (AB)(3AB) $=3AB^2$	✓ $DC == \dfrac{BC}{3}$ ✓ $BC = 3AB$ ✓ substitution into area formula (3)
		[9]

25. Two observers 19 m apart, and a building 16 m high

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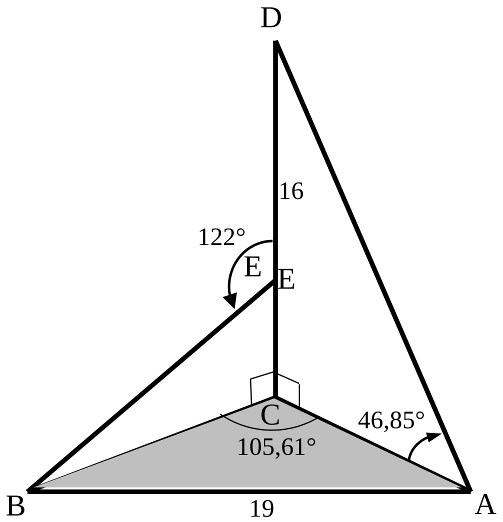
QUESTION/*VRAAG* 8



8.1	$\tan D\hat{A}C = \dfrac{DC}{AC}$ $AC = \dfrac{16}{\tan\ 46{,}85^\circ}$ $AC = 15\text{ m}$	✓ correct subs into trig ratio ✓ answer (2)
8.2	$(AB)^2 = (BC)^2 + (AC)^2 - 2(BC)(AC)\cos B\hat{C}A$ $(19)^2 = x^2 + (15)^2 - 2x(15)\cos 105{,}61^\circ$ $x^2 + 8{,}07x - 136 = 0$ $x = \dfrac{-8{,}07 \pm \sqrt{(8{,}07)^2 - 4(1)(-136)}}{2(1)}$ $x = 8{,}30\text{ m}$ or $x \neq -16{,}38\text{ m}$ $B\hat{E}C = 58^\circ$ **OR/*OF*** $E\hat{B}C = 32^\circ$ $\tan B\hat{E}C = \dfrac{BC}{EC}$; $\tan E\hat{B}C = \dfrac{EC}{BC}$ $EC = \dfrac{8{,}3}{\tan 58^\circ}$; $EC = 8{,}3\tan 32^\circ$ $EC = 5{,}19\text{ m}$; $EC = 5{,}19\text{ m}$ $DE = 10{,}81\text{ m}$; $DE = 10{,}81\text{ m}$	✓ correct subst. into cosine rule ✓ quadratic equation in std form ✓ correct subst. into quadratic formula ✓ length of BC ✓ size of $B\hat{E}C$ **OR/*OF*** $E\hat{B}C$ ✓ length of EC ✓ answer (7)

	OR/*OF*	**OR/*OF***
	$\frac{\sin 105{,}61^\circ}{19}=\frac{\sin C\hat{B}A}{15}$	✓ correct subst. into sine rule
	$C\hat{B}A = 49{,}5^\circ$	
	$B\hat{A}C = 24{,}89^\circ$	✓ $B\hat{A}C$
	$\frac{BC}{\sin 24{,}89^\circ}=\frac{19}{\sin 105{,}61^\circ}$	✓ correct subst. into sine formula
	BC = 8,3 m	✓ length of BC
	$B\hat{E}C = 58^\circ$ **OR/*OF*** $E\hat{B}C = 32^\circ$	✓ size of $B\hat{E}C$ **OR/*OF*** $E\hat{B}C$
	$\tan B\hat{E}C = \frac{BC}{EC}$ **OR/*OF*** $\tan E\hat{B}C = \frac{EC}{BC}$	
	$EC = \frac{8{,}3}{\tan 58^\circ}$ **OR/*OF*** $EC = 8{,}3\tan 32^\circ$	
	$EC = 5{,}19$ m **OR/*OF*** $EC = 5{,}19$ m	✓ length of EC
	$DE = 10{,}81$ m **OR/*OF*** $DE = 10{,}81$ m	✓ answer
		(7)
		[9]

26. A hook on a gallery ceiling, seen from three points

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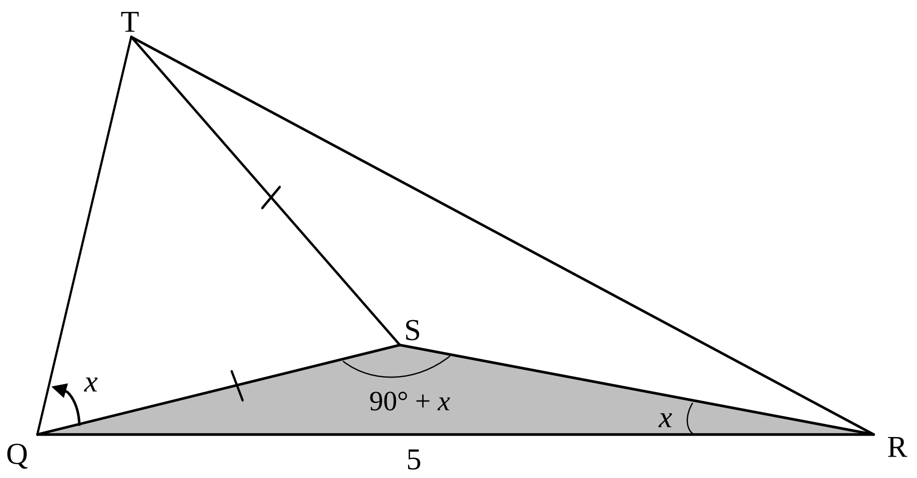
QUESTION/*VRAAG* 8



8.1	In ΔSQR: $\frac{QS}{\sin x}=\frac{QR}{\sin(90°+x)}$ $\frac{QS}{\sin x}=\frac{5}{\cos x}$ $QS=\frac{5\sin x}{\cos x}$ $QS=5\tan x$	✓ correct use of sine rule ✓ $\sin(90°+x)=\cos x$ ✓ $QS=\frac{5\sin x}{\cos x}$ (3)
8.2	$\frac{QT}{\sin(180°-2x)}=\frac{TS}{\sin x}$ $\frac{QT}{\sin 2x}=\frac{5\tan x}{\sin x}$ $QT=\frac{5\tan x\sin 2x}{\sin x}$ $QT=\frac{5\left(\frac{\sin x}{\cos x}\right)(2\sin x\cos x)}{\sin x}$ $QT=\frac{5\sin x\,(2\sin x)}{\sin x}$ $QT=10\sin x$	✓ correct use of sine rule ✓ TS = QS = $5\tan x$ ✓ $QT=\frac{5\tan x\sin 2x}{\sin x}$ ✓ $\tan x=\frac{\sin x}{\cos x}$ ✓ $\sin 2x=2\sin x\cos x$ (5)

	OR/*OF* $QT^2 = QS^2 + TS^2 - 2QS.TS\cos Q\hat{S}T$ $QT^2 = (5\tan x)^2 + (5\tan x)^2 - 2(5\tan x).(5\tan x)\cos(180° - 2x)$ $QT^2 = 50\tan^2 x - 50\tan^2 x(-\cos 2x)$ $QT^2 = 50\tan^2 x(1+\cos 2x)$ $QT^2 = 50\tan^2 x(1+2\cos^2 x - 1)$ $QT^2 = 50\tan^2 x(2\cos^2 x)$ $QT^2 = 100\dfrac{\sin^2 x}{\cos^2 x}(\cos^2 x)$ $QT^2 = 100\sin^2 x$ $QT = 10\sin x$	✓ correct use of cos rule ✓ TS = QS = 5tan$x$ ✓ $\cos 2x = 2\cos^2 x - 1$ & reduction ✓ $\tan x = \dfrac{\sin x}{\cos x}$ ✓ $QT^2 = 100\sin^2 x$ (5)
	OR/*OF* $TS^2 = QS^2 + TQ^2 - 2QS.TQ.\cos x$ $(5\tan x)^2 = (5\tan x)^2 + TQ^2 - 2(5\tan x).TQ.\cos x$ $0 = TQ^2 - 2(5\tan x).TQ.\cos x$ $0 = TQ\left[TQ - 10\tan x.\cos x\right]$ $TQ = 10\tan x.\cos x \quad (TQ \neq 0)$ $= 10\dfrac{\sin x}{\cos x}.\cos x$ $= 10\sin x$	✓ correct use of cos rule ✓ TS = QS = 5tan$x$ ✓ quadratic equation ito TQ ✓ TQ = 10tan x . cos x ✓ $\tan x = \dfrac{\sin x}{\cos x}$ (5)
8.3	$\text{Area of } \Delta TQR = \dfrac{1}{2}.TQ.QR\sin T\hat{Q}R$ $= \dfrac{1}{2}(10\sin 25°)(5)(\sin 70°)$ $= 9{,}93\,\text{unit}^2$	✓ correct substitution into the area rule ✓ answer (2)
		[10]

27. A flagpole and the two cables anchoring it

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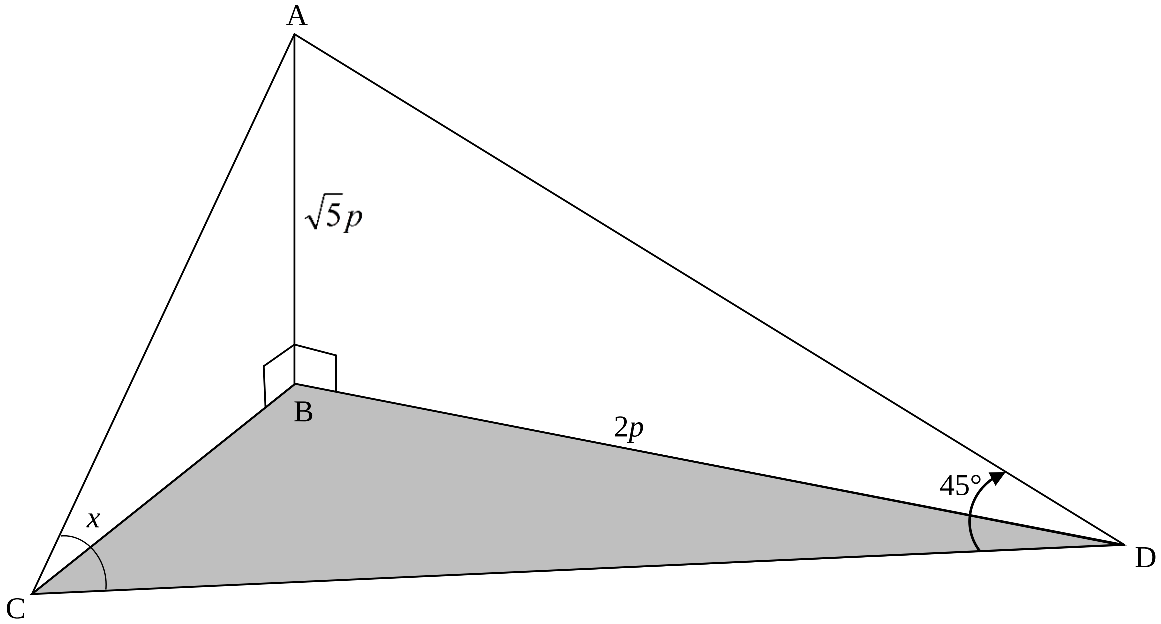
QUESTION/*VRAAG* 7



7.1	$AD^2 = AB^2 + BD^2$ $AD^2 = (\sqrt{5}p)^2 + (2p)^2$ $AD^2 = 9p^2$ $AD = 3p$	✓ substitution in Pythagoras ✓ answer (2)
7.2	$\dfrac{CD}{\sin(135° - x)} = \dfrac{3p}{\sin x}$ $CD = \dfrac{3p\sin(135° - x)}{\sin x}$ $CD = \dfrac{3p(\sin 135° \cos x - \cos 135° \sin x)}{\sin x}$ $CD = \dfrac{3p(\sin 45° \cos x + \cos 45° \sin x)}{\sin x}$ $CD = \dfrac{3p\left(\dfrac{\sqrt{2}}{2}\cos x + \dfrac{\sqrt{2}}{2}\sin x\right)}{\sin x}$ $CD = \dfrac{3p\left(\dfrac{\sqrt{2}}{2}\right)(\cos x + \sin x)}{\sin x}$ $CD = \dfrac{3p(\sin x + \cos x)}{\sqrt{2}\sin x}$	✓ correct use of sine rule ✓ $135° - x$ ✓ compound angle ✓ special values ✓ factorisation (5)

7.3	Area $\Delta ADC = \frac{1}{2}(AD)(CD)\sin A\hat{D}C$ $= \frac{1}{2}(3p)\left(\frac{3p(\sin x + \cos x)}{\sqrt{2}\sin x}\right)(\sin 45°)$ $= \frac{1}{2}(30)\left(\frac{30(\sin 110° + \cos 110°)}{\sqrt{2}\sin 110°}\right)\sin 45°$ $= 143{,}11 m^2$	✓ correct use of area rule ✓ substitution in area rule ✓ answer (3)
		[10]

28. Derive the area rule, then put it to work

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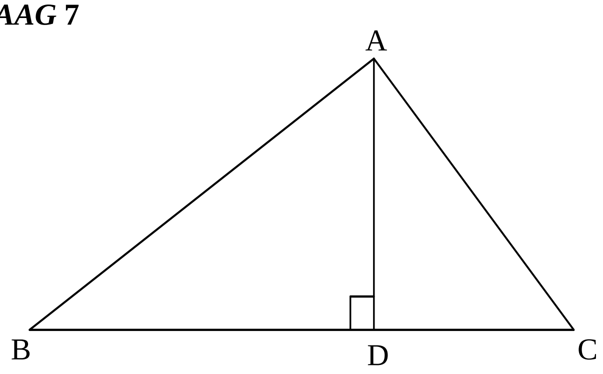
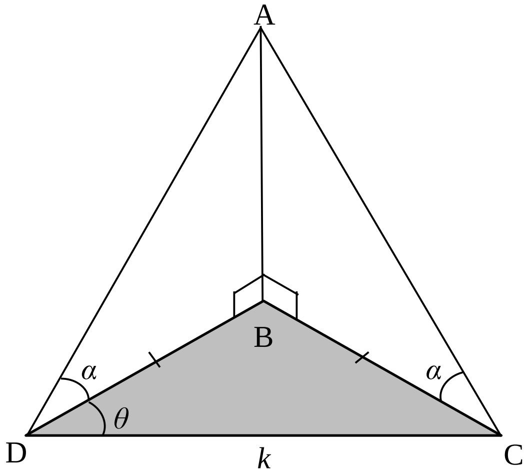
QUESTION/*VRAAG* 7

7.1



7.1.1	$\sin\hat{B} = \frac{AD}{AB}$ $AD = AB\sin\hat{B}$	✓ $\sin\hat{B} = \frac{AD}{AB}$ ✓ answer (2)
7.1.2	Area of $\Delta ABC = \frac{1}{2}(BC)(AD)$ $\therefore$ Area of $\Delta ABC = \frac{1}{2}(BC)(AB)\sin\hat{B}$	✓ $\frac{1}{2}(BC)(AD)$ (1)

7.2



7.2.1	In ΔADB $\sin\alpha = \frac{AB}{AD}$ $AD = \frac{AB}{\sin\alpha}$ In ΔABC $\sin\alpha = \frac{AB}{AC}$ $AC = \frac{AB}{\sin\alpha}$ $AD = AC$ **OR** In ΔADB and ΔACB	✓ $\sin\alpha = \frac{AB}{AD}$ ✓ $\sin\alpha = \frac{AB}{AC}$ (2)

	AB = AB [common side] $\hat{ABD} = \hat{ABC} = 90°$ [given] BD = BC [given] $\Delta ADB \equiv \Delta ACB$ [S∠S] $\therefore$ AD = AC	✓ $\Delta ADB \equiv \Delta ACB$ ✓ R (2)
	OR In ΔADB and ΔACB $\hat{ADB} = \hat{ACB} = \alpha$ [given] $\hat{ABD} = \hat{ABC} = 90°$ [given] AB = AB **OR** BD = BC [common side **OR** given] $\therefore$ $\Delta ADB \equiv \Delta ACB$ [∠∠S] $\therefore$ AD = AC	✓ $\Delta ADB \equiv \Delta ACB$ ✓ R (2)
	OR $AD^2 = AB^2 + DB^2$ [Pythagoras] $AC^2 = AB^2 + BC^2$ [Pythagoras] But DB = BC [given] $\therefore AD^2 = AC^2$ $\therefore$ AD = AC	✓ both Pythagoras statements ✓ DB = BC (2)
7.2.2	$\frac{BD}{\sin\theta} = \frac{k}{\sin(180° - 2\theta)}$ $BD = \frac{k\sin\theta}{\sin 2\theta}$ $BD = \frac{k\sin\theta}{2\sin\theta\cos\theta}$ $BD = \frac{k}{2\cos\theta}$	✓ substitution of $(180° - 2\theta)$ into sine rule ✓ reduction ✓ double angle (3)
	OR $BC^2 = k^2 + BD^2 - 2k(BD)\cos\theta$ $BD^2 = k^2 + BD^2 - 2k(BD)\cos\theta$ $k^2 - 2k(BD)\cos\theta = 0$ $2k(BD)\cos\theta = k^2$ $\therefore BD = \frac{k}{2\cos\theta}$	✓ substitution into cosine-rule ✓ substitution BC with BD into cosine-rule ✓ simplification in terms of BD (3)

7.2.3	Area of $\Delta BCD = \frac{1}{2}(DC)(BD)(\sin C\hat{D}B)$ $= \frac{1}{2}k\left(\frac{k}{2\cos\theta}\right)\sin\theta$ $= \frac{1}{4}k^2\tan\theta$ **OR** Area of $\Delta BCD = \frac{1}{2}(BD)(BC)(\sin(180° - 2\theta))$ $= \frac{1}{2}\left(\frac{k}{2\cos\theta}\right)\left(\frac{k}{2\cos\theta}\right)(\sin 2\theta)$ $= \frac{2k^2\sin\theta\cos\theta}{8\cos\theta\cos\theta}$ $= \frac{1}{4}k^2\tan\theta$	✓ substitution into area rule ✓ $\frac{\sin\theta}{\cos\theta} = \tan\theta$ ✓ $\frac{1}{4}k^2\tan\theta$ (3) ✓ substitution into area rule ✓ $\frac{\sin\theta}{\cos\theta} = \tan\theta$ ✓ $\frac{1}{4}k^2\tan\theta$ (3)
		[11]