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NASIONALE SENIORSERTIFIKAAT-EKSAMEN

MATHEMATICS P2/*WISKUNDE V2*

MARKING GUIDELINES/*NASIENRIGLYNE*

2022

MARKS: 150
PUNTE: 150

These marking guidelines consist of 20 pages./
Hierdie nasienriglyne bestaan uit 20 bladsye.

NOTE:

- If a candidate answers a question TWICE, mark only the FIRST attempt.
- If a candidate has crossed out an attempt at an answer and not redone the question, mark the crossed-out version.
- Consistent accuracy applies in ALL aspects of the marking guidelines. Stop marking at the second calculation error.
- Assuming answers/values in order to solve a problem is NOT acceptable.

LET WEL:

- *As 'n kandidaat 'n vraag TWEE KEER beantwoord, sien slegs die EERSTE poging na.*
- *As 'n kandidaat 'n antwoord van 'n vraag doodtrek en nie oordoen nie, merk die doodgetrekte poging.*
- *Volgehoue akkuraatheid word in ALLE aspekte van die nasienriglyne toegepas. Hou op nasien by die tweede berekeningsfout.*
- *Aanvaar van antwoorde/waardes om 'n probleem op te los, word NIE toegelaat nie.*

GEOMETRY • *MEETKUNDE*	
S	**A mark for a correct statement** ***(A statement mark is independent of a reason)***
	'n Punt vir 'n korrekte bewering ***('n Punt vir 'n bewering is onafhanklik van die rede)***
R	**A mark for the correct reason** ***(A reason mark may only be awarded if the statement is correct)***
	'n Punt vir 'n korrekte rede ***('n Punt word slegs vir die rede toegeken as die bewering korrek is)***
S/R	**Award a mark if statement AND reason are both correct**
	Ken 'n punt toe as die bewering EN rede beide korrek is

QUESTION/*VRAAG* 1

1.1

Modal class: $9 < m \leq 11$

✓ answer (1)

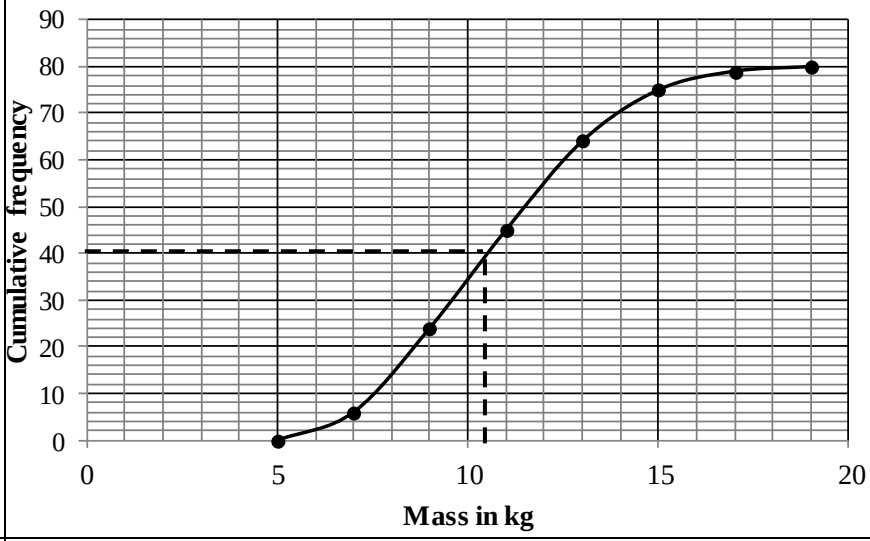
1.2

Mass (in kg)	Frequency	Cumulative frequency
$5 < m \leq 7$	6	6
$7 < m \leq 9$	18	24
$9 < m \leq 11$	21	45
$11 < m \leq 13$	19	64
$13 < m \leq 15$	11	75
$15 < m \leq 17$	4	79
$17 < m \leq 19$	1	80

✓ adding

✓ 80 (2)

1.3



✓ grounding (5 ; 0)

✓ points

✓ shape (3)

1.4

Median mass: 10,5 kg

✓✓ answer (2)

1.5.1

$$\bar{x} = \frac{(6\times 6 + 18\times 8 + 21\times 10 + 19\times 12 + 11\times 14 + 4\times 16 + 1\times 18)}{80}$$

$$= \frac{854}{80}$$

$$= 10{,}68$$

Answer only 2/2

✓ 854

✓ answer (2)

1.5.2

Learners' bags are heavier than the stipulated international guideline.
Estimated mean = 10,68 kg
10% of 80 kg
= 8 kg
10,68 kg > 8 kg

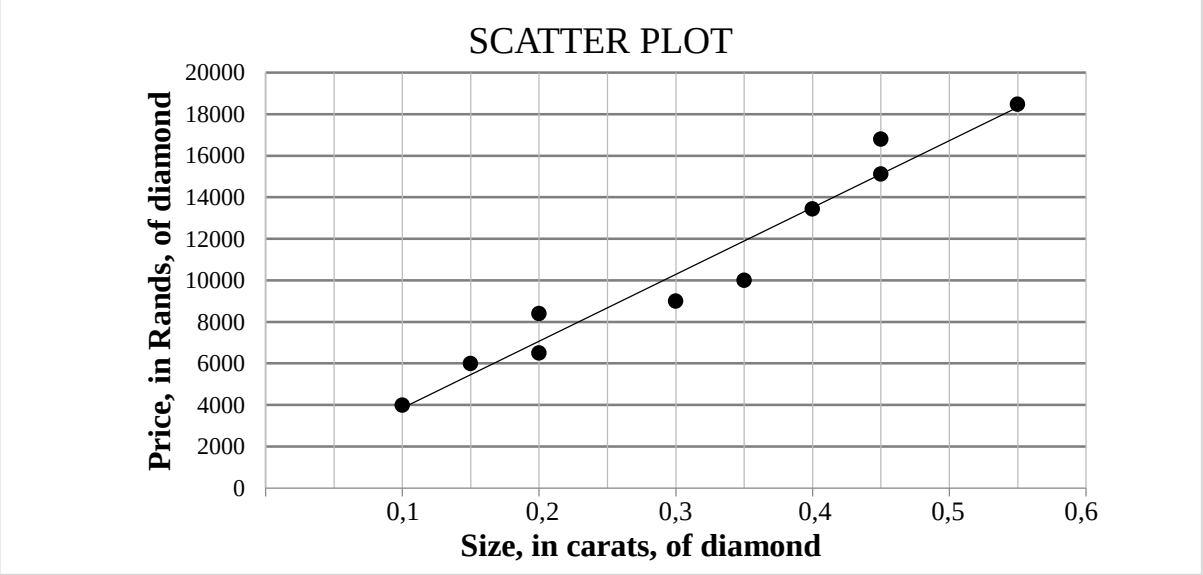
✓ answer

✓ 8 kg (2)

	OR/ *OF*	
	Learners' bags are heavier than the stipulated international guideline.	✓ answer
	Estimated mean $= \frac{10,68}{80} \times 100$	
	$= 13,35\%$	✓ 13,35%
	$13,35\% > 10\%$	(2)
		[12]

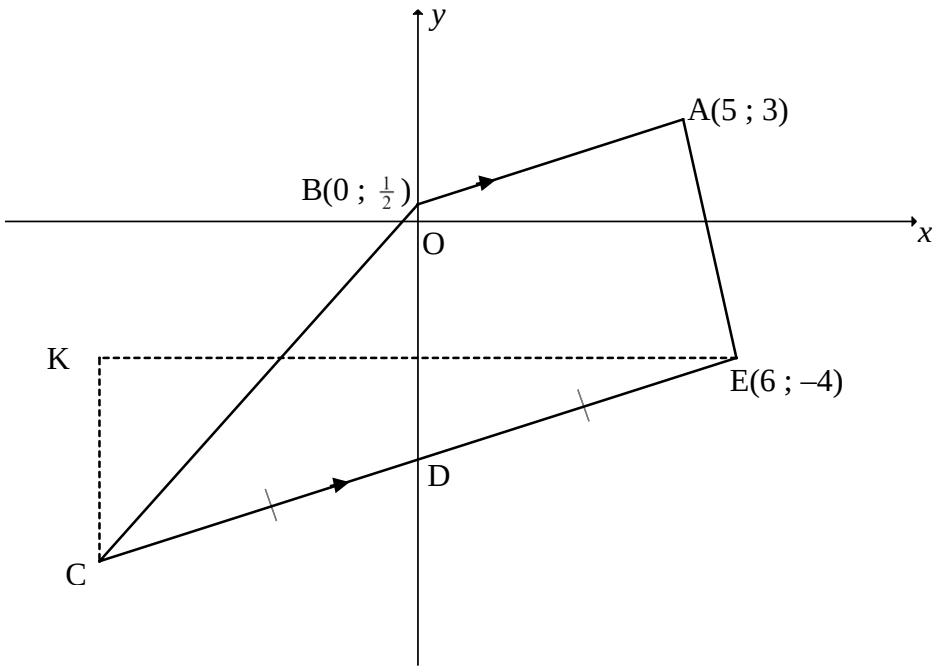
QUESTION/*VRAAG* 2

Size, in carats, of diamond (*x*)	0,1	0,15	0,2	0,2	0,3	0,35	0,4	0,45	0,45	0,55
Price, in rands, of diamond (*y*)	4 000	6 000	6 500	8 400	9 000	10 000	13 440	15 120	16 800	18 480



2.1	$a = 634{,}382\ldots$ $b = 32\ 189{,}263\ldots$ $\hat{y} = 634{,}38 + 32189{,}26x$ Answer only 3/3	✓ *a* ✓ *b* ✓ equation (3)
2.2	$\hat{y} = 634{,}38 + 32189{,}26(0{,}25)$ = R8 681,70 **OR/*OF*** $\hat{y} = \text{R}8\,681{,}70$ (if using calculator)	✓ substitution ✓ answer (2) ✓ ✓ answer (2)
2.3	Average price increase = R $\frac{32189{,}26}{20}$ per 0,05 carat = R1 609,46 per 0,05 carat **OR/*OF*** Average price increase = $0{,}05 \times 32\,189{,}26$ = R1 609,46 per 0,05 carat **OR/*OF*** at 0,3: $\hat{y} = \text{R}10\,291{,}16$ ∴ Average price increase = 10 291,16 – 8 681,70 = R1 609,46 per 0,05 carat Answer only 2/2	✓ divide gradient by 20 ✓ answer (2) ✓ multiply gradient by 0,05 ✓ answer (2) ✓ Estimated price of a 0,3 carat diamond ✓ answer (2)
2.4	The point (0,35 ; 11500) is closer to the least squares regression line.	✓ reason (1)
		[8]

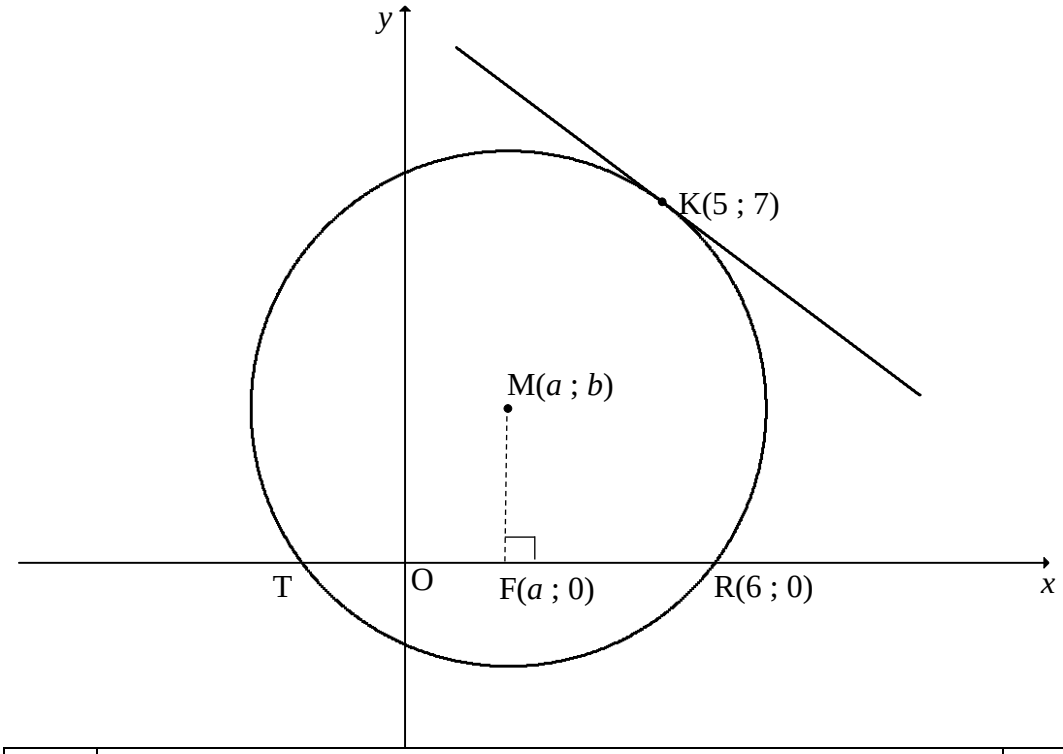
QUESTION/*VRAAG* 3



3.1	$m_{AB} = \frac{3-\frac{1}{2}}{5-0}$ $m_{AB} = \frac{1}{2}$ Answer only 2/2	✓ substitution ✓ answer (2)
3.2	$m_{CE} = m_{BA} = \frac{1}{2}$ $-4 = \frac{1}{2}(6) + c$ **OR/*OF*** $y-(-4) = \frac{1}{2}(x-6)$ $c = -7$ $y = \frac{1}{2}x - 7$	✓ gradient ✓ substitution of E ✓ answer (3)
3.3.1	D(0 ; –7) $\frac{x_C + 6}{2} = 0$ $\frac{y_C + (-4)}{2} = -7$ $x_C = -6$ $y_C = -10$ C(–6 ; –10) Answer only 3/3	✓ D(0 ; –7) ✓ $x_C = -6$ ✓ $y_C = -10$ (3)
3.3.2	Area $\Delta BCD = \frac{1}{2}(7,5)(6)$ = 22,5 Area $\Delta ABD = \frac{1}{2}(7,5)(5)$ = 18,75 Area ABCD = 22,5 + 18,75 = 41,25 units^2	✓ subst of correct base and height into the area formula ✓ area ΔBCD = 22,5 ✓ area ΔABD = 18,75 ✓ answer (4)

3.4.1	K(–6 ; –4)	✓ $x_K = -6$ ✓ $y_K = -4$ (2)
3.4.2a	KC = 6 units; KE = 12 units; $CE = \sqrt{(6)^2 + (12)^2}$ [Pythagoras] $CE = \sqrt{180} = 6\sqrt{5} = 13,42$ Perimeter $\Delta KEC = 6 + 12 + \sqrt{180}$ = 31,42 units	✓ KC = 6 units ✓ KE = 12 units ✓ CE ✓ answer (4)
3.4.2b	$\tan K\hat{C}E = \frac{KE}{KC} = \frac{12}{6} = 2$ $K\hat{C}E = 63,43°$ **OR/*OF*** $\sin K\hat{C}E = \frac{KE}{CE} = \frac{12}{\sqrt{180}} = \frac{2\sqrt{5}}{5}$ $K\hat{C}E = 63,43°$ **OR/*OF*** $m_{CE} = \frac{1}{2}$ $\tan\theta = \frac{1}{2}$ $\theta = 26,57°$ $K\hat{C}E = 90° - 26,57°$ $K\hat{C}E = 63,43°$ **OR/*OF*** $KE^2 = KC^2 + CE^2 - 2(KC)(CE)\cos K\hat{C}E$ $(12)^2 = (6)^2 + \left(\sqrt{180}\right)^2 - 2(6)\left(\sqrt{180}\right)(\cos K\hat{C}E)$ $\cos K\hat{C}E = \frac{\sqrt{5}}{5}$ $K\hat{C}E = 63,43°$	✓ trig ratio ✓ $\tan K\hat{C}E = 2$ ✓ answer (3) ✓ trig ratio ✓ $\sin K\hat{C}E = \frac{12}{\sqrt{180}}$ ✓ answer (3) ✓ $\tan\theta = \frac{1}{2}$ ✓ $\theta = 26,57°$ ✓ answer (3) ✓ substitution into cosine rule ✓ trig ratio ✓ answer (3)
		[21]

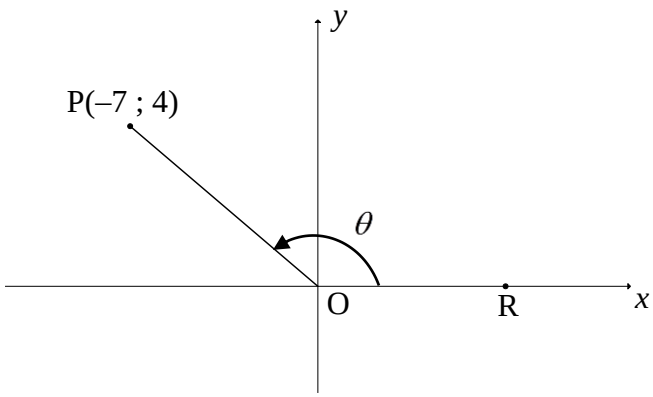
QUESTION/*VRAAG* 4



4.1.1	$y = x + 1$ $b = a + 1$	✓ $b = a + 1$ (1)
4.1.2	$MR^2 = MK^2$ $(a-6)^2 + (b-0)^2 = (a-5)^2 + (b-7)^2$ $(a-6)^2 + (a+1)^2 = (a-5)^2 + (a+1-7)^2$ $a^2 + 2a + 1 = a^2 - 10a + 25$ $12a = 24$ $a = 2$ $b = 3$ $\therefore$M(2 ; 3)	✓ equating radii / solving simultaneously ✓ substitution $b = a + 1$ ✓ $12a = 24$ ✓ $a = 2$ ✓ $b = 3$ (5)
4.2.1	$(6-2)^2 + (0-3)^2 = r^2$ $r = 5$ **OR/*OF*** $(2-5)^2 + (3-7)^2 = r^2$ $r = 5$ Answer only 2/2	✓ substitution R and M ✓ $r = 5$ (2) ✓ substitution K and M ✓ $r = 5$ (2)

4.2.2	T(–2 ; 0) TR = 8 units [line from centre ⊥ to chord] **OR/*OF*** M(2 ; 3) F(a ; 0) FR = 4 units TR = 8 units [line from centre ⊥ to chord] **OR/*OF*** $(x-2)^2+(0-3)^2=25$ $x^2-4x+4+9=25$ $x^2-4x-12=0$ $(x-6)(x+2)=0$ $x=6$ or $x=-2$ TR = 8 units Answer only 2/2	✓ T(–2 ; 0) ✓ answer (2) ✓ 4 units ✓ answer (2) ✓ x values ✓ answer (2)
4.3	$m_{\text{radius}}=\frac{7-3}{5-2}$ $m_{\text{radius}}=\frac{4}{3}$ $m_{\text{tangent}}=-\frac{3}{4}$ $7=-\frac{3}{4}(5)+c$ **OR/*OF*** $y-7=-\frac{3}{4}(x-5)$ $c=\frac{43}{4}$ $y=-\frac{3}{4}x+\frac{43}{4}$ $y=-\frac{3}{4}x+\frac{43}{4}$	✓ substitution ✓ $m_{\text{radius}}=\frac{4}{3}$ ✓ $m_{\text{tangent}}=-\frac{3}{4}$ ✓ substitution ✓ answer (5)
4.4.1	N(2 ; –2)	✓ $x_N=2$ ✓ $y_N=-2$ (2)
4.4.2	$(-2-2)^2+(0+2)^2=r^2$ $r^2=20$ $(x-2)^2+(y+2)^2=20$	✓ substitution ✓ $r^2=20$ ✓ answer (3)
		[20]

QUESTION/*VRAAG* 5



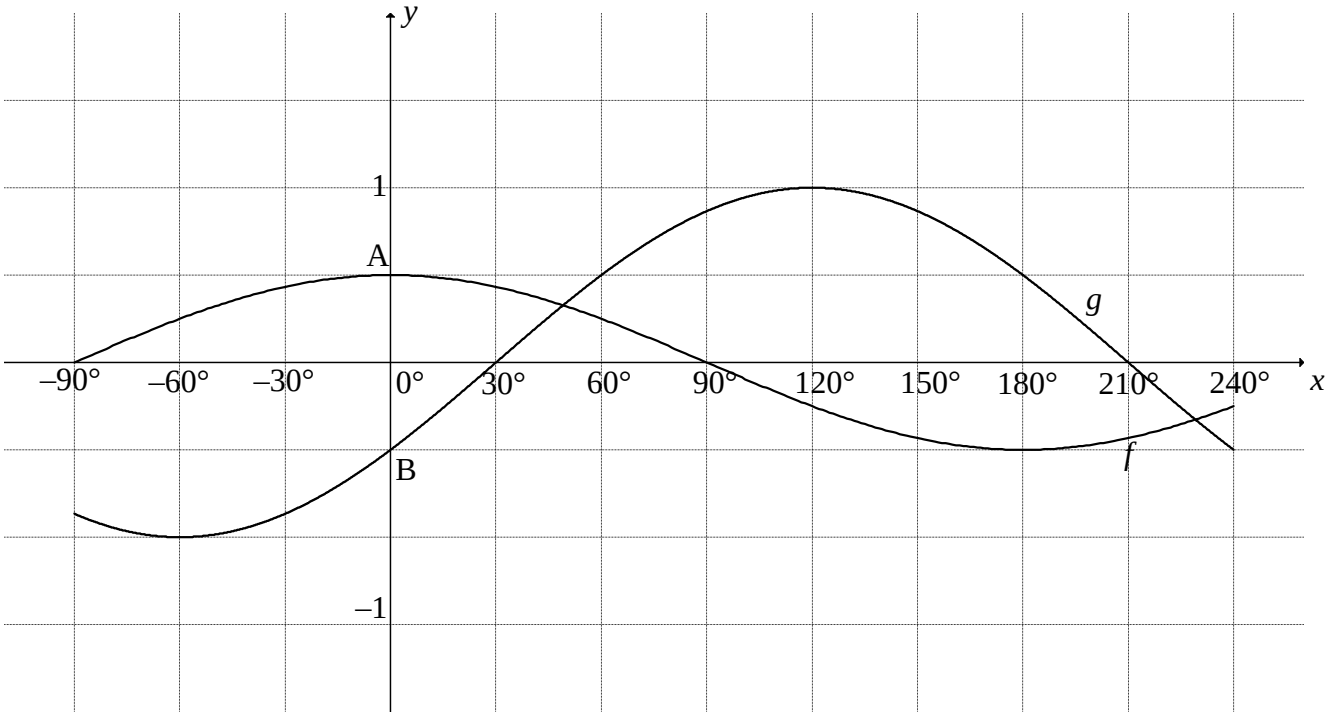
5.1.1	$OP=\sqrt{(-7)^2+(4)^2}$ $=\sqrt{65}$ Answer only 2/2	✓ substitution ✓ answer (2)
5.1.2(a)	$\tan\theta=\frac{4}{-7}$	✓ answer (1)
5.1.2(b)	$\cos(\theta-180°) = -\cos\theta$ $= \frac{7}{\sqrt{65}}$	✓ reduction ✓ answer (2)
5.2	$\sin x\cos x+\sin x=3\cos^2 x+3\cos x$ $\sin x\cos x+\sin x-3\cos^2 x-3\cos x=0$ $\sin x(\cos x+1)-3\cos x(\cos x+1)=0$ $(\cos x+1)(\sin x-3\cos x)=0$ $\cos x=-1$ 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]

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	$\tan 60°[\sin(60° + 2x) + \sin(60° - 2x)]$ $= \tan 60°[k\cos 2x]$ $= \sqrt{3}\left(\sqrt{3}\cos 2x\right)$ $= 3(2\cos^2 x - 1)$ $= 3\left(2\left(\sqrt{t}\right)^2 - 1\right)$ $= 6\left(\sqrt{t}\right)^2 - 3$ $= 6t - 3$	✓ special ∠ ✓ double ∠s ✓ answer i.t.o t (3)
		[12]

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]

QUESTION/*VRAAG* 8

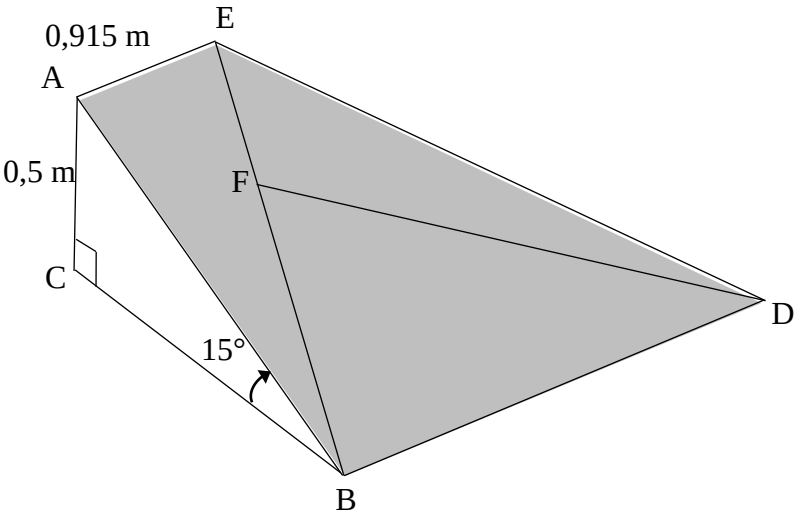


FIGURE I

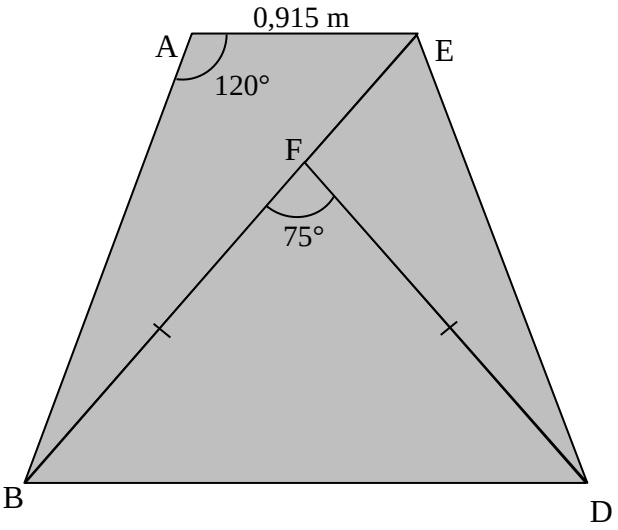
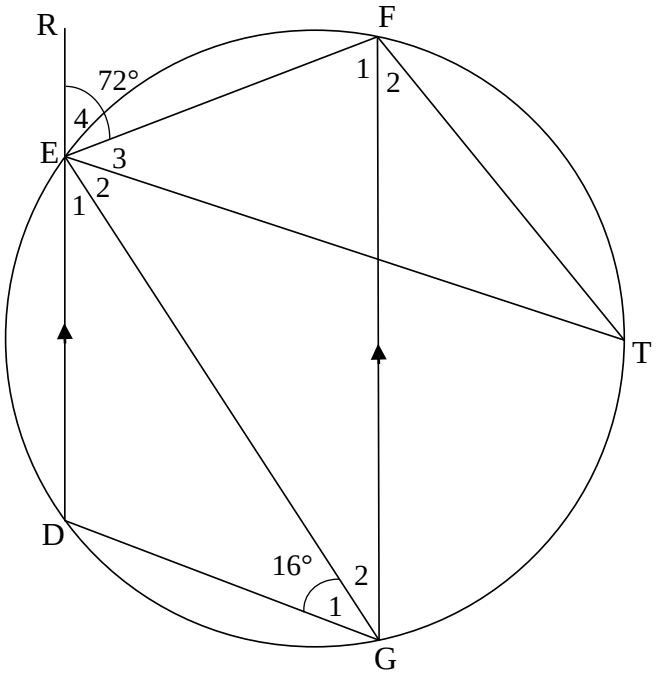


FIGURE II (top view)

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

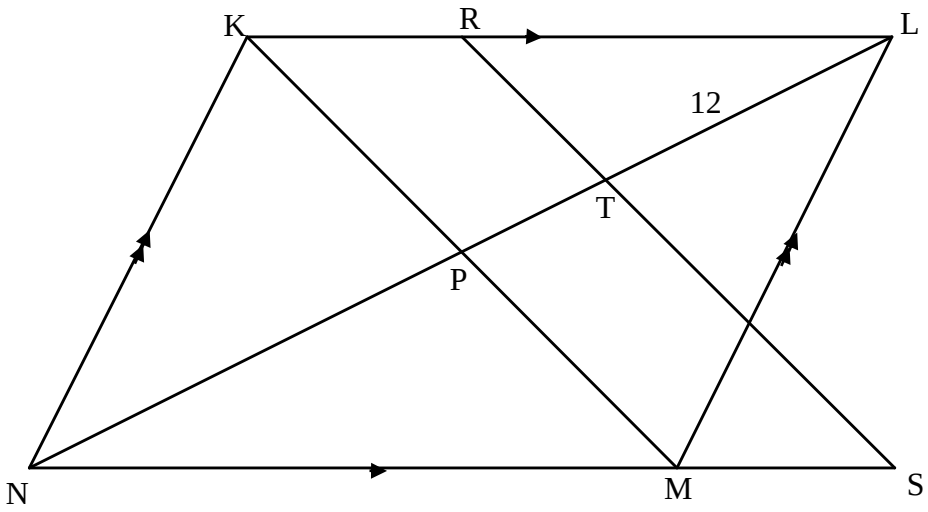
QUESTION/*VRAAG* 9

9.1



9.1.1	$D\hat{G}F = \hat{E}_4 = 72°$ [ext ∠ of cyclic quad/ *buite ∠ v kvh*]	✓ S ✓ R (2)
9.1.2	$\hat{G}_2 = 72° - 16° = 56°$ $\hat{T} = \hat{G}_2 = 56°$ [∠s in the same seg/ *∠e in dies.* ⊙ *segment*]	✓ S ✓ S / R (2)
9.1.3	$\hat{F}_1 = \hat{E}_4 = 72°$ [alt ∠s; DE || GF / *verw. ∠e*; DE || GF] $\therefore G\hat{E}F = 52°$ [sum of ∠s in Δ / *∠e van* Δ] **OR/*OF*** $\hat{E}_1 = 56°$ [alt ∠s; DE || GF / *verw. ∠e*; DE || GF] $\therefore G\hat{E}F = 52°$ [∠s on a str. line/ *∠e op 'n reguitlyn*]	✓ S / R ✓ S (2) ✓ S / R ✓ S (2)

9.2

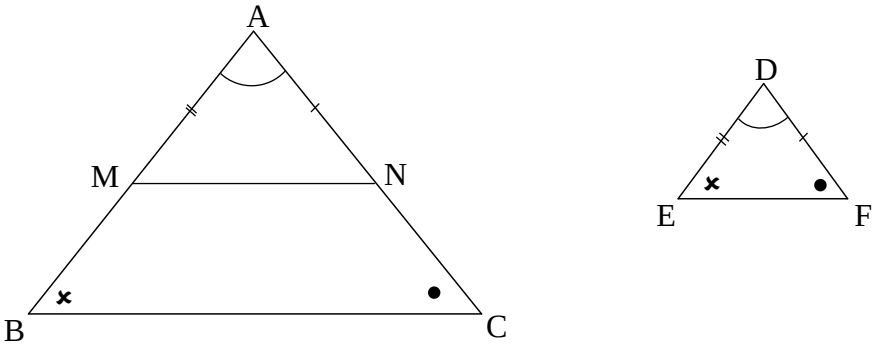


9.2.1	NP = PL = 16 [diag of ||m / *hoeklyne van ||m*] PT = 4 NP : PT = 16 : 4 = 4 : 1	✓ S ✓ R ✓ S ✓ answer (4)
9.2.2	NM : MS = 4 : 1 NP : PT = NM : MS KM ‖ RS [line divides two sides of Δ in prop / *Lyn verdeel 2 sye v Δ eweredig*] **OR/*OF*** [converse prop theorem / *omgekeerde lyn ‖ een sy v Δ*]	✓ S ✓ R (2)
9.2.3	$\frac{RL}{KL} = \frac{TL}{LP}$ [prop theorem; KM ‖ RS **OR** line ‖ one side of Δ / *Lyn ‖ een sy v Δ*] $RL = \frac{12 \times 21}{16}$ = 15,75	✓ S ✓ R ✓ S ✓ answer (4)

	OR / *OF* NM : MS = 4 : 1 KR = MS = 5,25 [opp side of ||^{m} / *teenoorst. sye van* ||^{m}] KL = NM = 21 RL + 5,25 = 21 RL = 15,75	✓ S ✓ R ✓ S ✓ answer (4)
		[16]

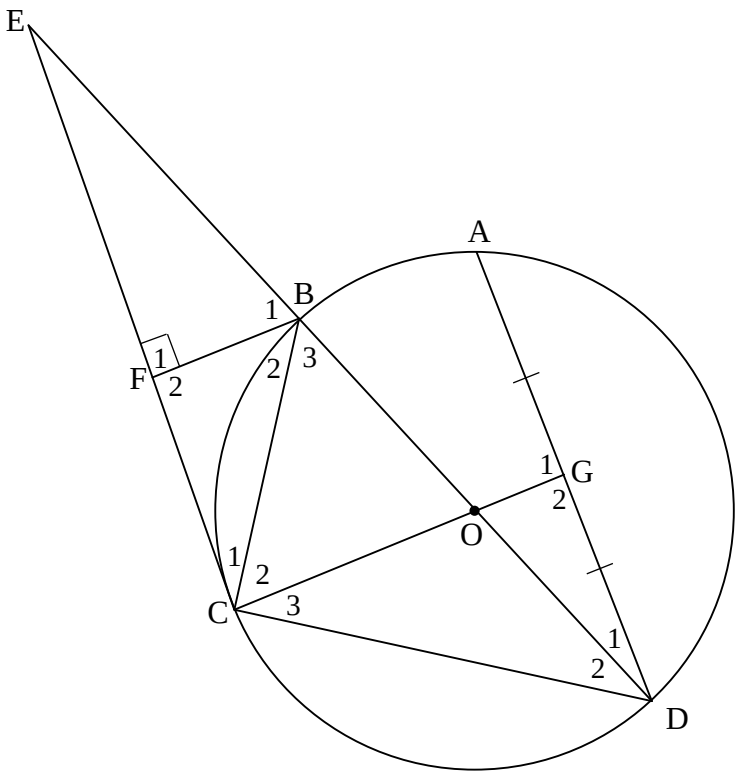
QUESTION/*VRAAG* 10

10.1



10.1	Constr: Let M and N lie on AB and AC respectively such that AM = DE and AN = DF. Draw MN. Proof: In Δ AMN and Δ DEF AM = DE [Constr / *Konstruksie*] AN = DF [Constr / *Konstruksie*] $\hat{A} = \hat{D}$ [Given /*Gegee*] $\therefore\ \Delta AMN \equiv \Delta DEF$ [*s*, ∠, *s*] $\therefore A\hat{M}N = \hat{E} = \hat{B}$ MN ‖ BC [corresp ∠'s are equal/ *ooreenk. ∠e gelyk*] $\frac{AB}{AM} = \frac{AC}{AN}$ [line ‖ one side of Δ **OR/*OF*** prop theorem; MN ‖BC / *Lyn* ‖ *een sy v* Δ] $\therefore\ \frac{AB}{DE} = \frac{AC}{DF}$ [AM = DE and AN = DF]	✓Constr ✓S ✓R ✓S /R ✓S ✓R (6)

10.2



10.2.1(a)	$F\hat{C}O = 90°$ [tan ⊥ radius / *raaklyn ⊥ radius*] $\hat{F}_1 = 90°$ [BF ⊥ EC] $\therefore F\hat{C}O = \hat{F}_1 = 90°$ FB ‖ CG [corresp ∠s = / *ooreenk. ∠ gelyk*]	✓ S / R ✓ S ✓ R (3)
10.2.1(b)	In ΔFCB and ΔCDB $B\hat{C}D = 90°$ [∠ in semi-circle / $\angle \frac{1}{2}\odot$] $\hat{F}_2 = 90°$ [BF ⊥ EC] $\therefore \hat{F}_2 = B\hat{C}D = 90°$ $\hat{C}_1 = \hat{D}_2$ [tan chord theorem / ∠ *tussen rkl en koord*] $\hat{B}_2 = \hat{B}_3$ [sum of ∠s in Δ / ∠*e van* Δ] $\therefore$ ΔFCB ||| ΔCDB **OR/*OF*** In ΔFCB and ΔCDB $B\hat{C}D = 90°$ [∠ in semi-circle / $\angle \frac{1}{2}\odot$] $\hat{F}_2 = 90°$ [BF ⊥ EC] $\therefore \hat{F}_2 = B\hat{C}D = 90°$ $\hat{C}_1 = \hat{D}_2$ [tan chord theorem / ∠ *tussen rkl en koord*] $\therefore$ ΔFCB ||| ΔCDB [∠,∠,∠]	 ✓ S /R ✓ S ✓ S ✓ R ✓ S ✓ S / R ✓ S ✓ S ✓ R ✓ R (5)

10.2.2	$\hat{G}_1 = 90°$ [line from centre to midpt of chord / *midpt. ⊙; midpt. koord*]	✓ R (1)
10.2.3	In ΔGCD and ΔCDB $\hat{G}_2 = B\hat{C}D = 90°$ $\hat{C}_3 = \hat{D}_2$ [∠s opp equal sides /∠*e teenoor gelyke sye*] $G\hat{D}C = \hat{B}_3$ [sum of ∠s in Δ /∠*e van* Δ] $\therefore \Delta GCD \text{ ||| } \Delta CDB$ [∠,∠,∠] $\therefore \frac{CD}{DB} = \frac{CG}{CD}$ [||| Δs] $\therefore CD^2 = CG.DB$	✓ identifying Δs ✓ S ✓ S / R ✓ S **OR** ✓ R ✓ S (5)
10.2.4	$\frac{BC}{DB} = \frac{FB}{BC}$ [ΔFCB ||| ΔCDB] $\therefore BC^2 = DB.FB$ $CD^2 + BC^2 = CG.DB + DB.FB$ $DB^2 = DB(CG + FB)$ $DB = CG + FB$	✓ S ✓ R ✓ S ✓ sum ✓ $DB^2 = CD^2 + BC^2$ (5)
		[25]

TOTAL/*TOTAAL*: 150