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**SA EXAM
PAPERS**

SEPTEMBER 2017 MATHEMATICS PAPER 2 / WISKUNDE VRAESTEL 2
MEMORANDUM

NOTE:

- If a candidate answers a question TWICE, mark only the first one.
- Consistent accuracy applies in ALL aspects of the marking memorandum.

LET WEL:

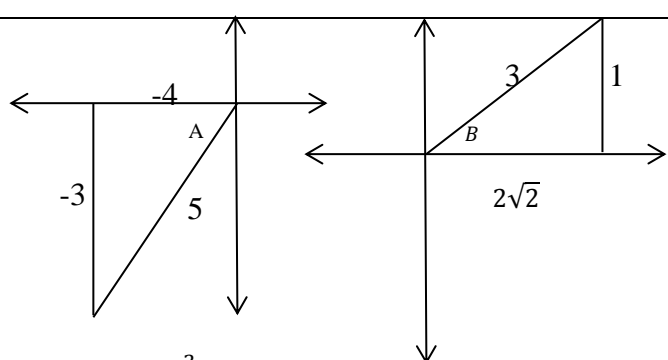
- Indien 'n kandidaat 'n vraag TWEE keer beantwoord, merk slegs die eerste poging.
- Volgehoue akkuraatheid is deurgaans op ALLE aspekte van die memorandum van toepassing.

		SUGGESTED ANSWER/ VOORGESTELDE ANTWOORD			DESCRIPTORS/BESKRYWERS	Marks
QUESTION/ VRAAG 1						
1.1		Percentage of income (x)	Frequency	Cumulative Frequency	✓ frequency column/ <i>Frekwensie kolom</i> ✓ first 3 points on C. f column/ <i>Iste 3 punte op Kf kolom</i> ✓ last 2 points on C. f column/ <i>laaste 2 punte op Kf kolom</i>	(3)
		$20 < x \leq 30$	10	10		
		$30 < x \leq 40$	15	25		
		$40 < x \leq 50$	20	45		
		$50 < x \leq 60$	10	55		
		$60 < x \leq 70$	5	60		
	1.2.1	$60 - 45$ = 15 people spent more than 50% on their income on education			✓ 45 ✓ Answer/ <i>Antwoord</i>	(2)
	1.2.2	<i>Median</i> = $\approx 42 - 43$			✓✓ Answer/ <i>Antwoord</i>	(2)
	1.3	$40 < x \leq 50$ OR $x \in (40; 50]$			✓ Answer/ <i>Antwoord</i> Accept/ <i>Aanvaar</i> : from 40 to 50 / <i>van 40 tot 50</i>	(1)
						[8]

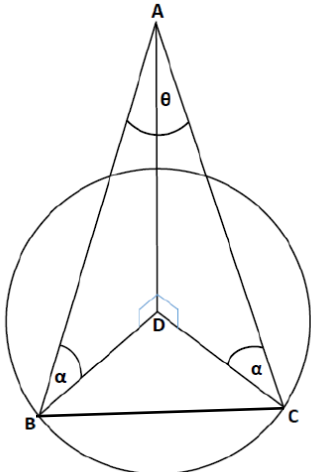
SUGGESTED ANSWER/ VOORGESTELDE ANTWOORD		DESCRIPTORS/BE SKRYWERS	Marks
QUESTION/ VRAAG 2			
2.1 & 2.3		<ul style="list-style-type: none"> ✓ Plotting 5 - 8 points correct/ Afsteek van 5 – 8 punte korrek ✓ Plotting 9 -10 points correct/ Afsteek van 9 – 10 punte korrek <p>2.3 Regression line/ Regressielyn:</p> <ul style="list-style-type: none"> ✓ y -int: ≈ 29 ✓ Passing through $\approx (30; 56)$ 	(2) (2)
2.2	$a = 29,22$ (29,21542 ...) $b = 0.89$ $\therefore y = 29,22 + 0,89x$	<ul style="list-style-type: none"> ✓ a ✓ b ✓ equation / vergelyking 	(3)
2.3	On graph/ <i>Op grafiek</i>		
2.4	$r = 0,66$ Moderately positive relationship/ <i>redelike (matige) positiewe verwantskap</i>	<ul style="list-style-type: none"> ✓ r ✓ Moderately positive/ <i>Redelike positiewe</i> 	(2)
2.5	Mean/ <i>Gemiddelde</i> , $\bar{x} = \frac{559}{10} = 55,90$ Standard deviation/ <i>Standaardafwyking</i> : $\sigma = 11.36$	<ul style="list-style-type: none"> ✓ $\frac{559}{10}$ ✓ 55,90 ✓✓ $\sigma = 11.36$ 	(4)
2.6	<p style="text-align: center;">44,54 ←————→ 67,26</p> <p style="text-align: center;">55,90</p> <p>6 scores lie within one σ/ <i>6 Punte val binne een σ</i></p>	<ul style="list-style-type: none"> ✓ Interval ✓ Answer/Antw 	(2)
			[15]

	SUGGESTED ANSWER/ VOORGESTELDE ANTWOORD	DESCRIPTORS/BESKRYWERS	Marks
QUESTION/ VRAAG 3			
3.1	$m_{TQ} = \frac{4-0}{0-3}$ $= \frac{-4}{3}$	✓ Subst in gradient formula/ <i>Vervang in gradiënt formule</i> ✓ Answer/Antwoord	(2)
3.2	$RQ = \sqrt{(10-3)^2 + (7-0)^2}$ $= \sqrt{49 + 49}$ $= \sqrt{98} \text{ Units/ eenhede}$	✓ Substitute/ <i>Vervang</i> ✓ Answer/Antwoord	(2)
3.3	$m_{TQ} = \frac{4-0}{0-3} = \frac{-4}{3} \quad \text{or/of} \quad m_{TF} = m_{TQ}$ $\therefore y = \frac{-4}{3}x + 4 \quad \therefore \frac{-8-4}{k} = \frac{-4}{3}$ $\therefore -8 = \frac{-4}{3}(k) + 4 \quad -4k = 3(-12)$ $\therefore -12 = \frac{-4}{3}(k) \quad \therefore k = 9$	✓ eqn of/ <i>vgl van TQ or</i> gradients = ✓ Subst/ <i>vervang (k; -8) or</i> gradient of TF ✓ Simplify/ <i>Vereenv or</i> cross × ✓ Answer/Antwoord	(4)
3.4	S(7: 11)	✓ $x = 7$ ✓ $y = 11$	(2)
3.5	$\widehat{TSR} = \widehat{TQR}$.opp \angle of \parallel^m / \dots teenoorst. \angle van \parallel^m $m_{TQ} = \frac{-4}{3} \quad m_{RQ} = 1$ $\tan \alpha = \frac{-4}{3} \quad \tan \beta = 1$ $RA/VH = 53,13^\circ \quad \beta = 45^\circ$ $\alpha = 126,87^\circ$ $\therefore \widehat{TSR} = \alpha - \beta$ $\therefore \widehat{TSR} = 81,87^\circ$	✓ $\widehat{TSR} = \widehat{TQR}$ ✓ $\tan \alpha = \frac{-4}{3}$ ✓ $\tan \beta = 1$ ✓ $\alpha = 126,87^\circ$ ✓ $\beta = 45^\circ$ ✓ Answer/Antwoord	(6)
3.6	$MQ = \sqrt{(2)^2 + (2)^2}$ $= \sqrt{8}$ But/Maar $RQ = \sqrt{98} \quad \dots \text{ calc. in q 3.2}$ $\therefore \text{Ratio} = \frac{\sqrt{8}}{\sqrt{98}}$ $= \frac{2}{7}$	✓ $\sqrt{8}$ ✓ $\frac{\sqrt{8}}{\sqrt{98}}$ ✓ Answer/ <i>Antwoord</i>	(3)
			[19]

	SUGGESTED ANSWER/ VOORGESTELDE ANTWOORD	DESCRIPTORS/BESKRYWERS	Marks
QUESTION /VRAAG 4			
4.1	Radius to midpoint of chord/ <i>radius na midpt van koord</i>	✓ Answer/ <i>Antwoord</i>	(1)
4.2	$m_{TS} = -\frac{3}{3} \Rightarrow -1$ $\therefore m_{PN} = m_{TS} \times -1 \quad \dots \dots TS \perp NP$ $\therefore m_{PN} = 1$ $y - y_1 = m(x - x_1) \quad \text{OR/ OF} \quad y = mx + c$ $\therefore y - 8 = x + 3 \quad \quad \quad 8 = -3 + c$ $\quad \quad \quad \quad \quad \quad \quad \quad \quad \quad c = 5$ $\therefore y = x + 11$	✓ m_{TS} ✓✓ m_{PN} ✓ Subst (-3; 8) ✓ Equation/ <i>Vergelyking</i>	(5)
4.3	<i>Substitute P(0; y)</i> $y = 0 + 11$ $\therefore y = 11$ <i>Radius:</i> $11 - 5 = 6$ $\therefore y = -1$	✓ <i>Substitute P(0; y)</i> ✓ Answer/ <i>Antwoord</i> ✓ <i>Radius</i> ✓ Answer/ <i>Antwoord</i>	(4)
4.4	Substitute M (x: 0)/ <i>Stel M(x; 0)</i> $0 = x + 4 \Rightarrow x = -11$ $M = (-11; 0)$ $TO = 5, MO = 11$ $TM^2 = 5^2 + 11^2 \quad \dots \text{pyth}$ $\therefore MT = \sqrt{146}$	✓ Subst (x; 0) / <i>vervang (x; 0)</i> ✓ Length of TO/ <i>Lengte van TO</i> ✓ Length of MO/ <i>Lengte van MO</i> ✓ Answer/ <i>Antwoord</i>	(4)
4.5	$(x - a)^2 + (y - b)^2 = r^2$ TM is the diameter/ <i>is die middellyn</i> ⊙ TSM $r = \frac{\sqrt{146}}{2} \Rightarrow r^2 = \frac{146}{4}$ Centre of / <i>midpt</i> ⊙ TSM : Midp. of TM = $(\frac{x+x_1}{2}; \frac{y+y_1}{2})$ $= (\frac{-11+0}{2}; \frac{0+5}{2})$ $= (\frac{-11}{2}; \frac{5}{2})$ $\therefore (x + \frac{11}{2})^2 + (y - \frac{5}{2})^2 = \frac{146}{4} \text{ or } \frac{73}{2} \text{ or } 36,5$	✓ TM is the diameter of/ <i>is die middellyn van</i> ⊙ TSM ✓ $r = \frac{\sqrt{146}}{2}$ ✓ centre $(\frac{-11}{2}; \frac{5}{2})$ ✓ $(x + \frac{11}{2})^2 + (y - \frac{5}{2})^2$ ✓ $\frac{146}{4} \text{ or } \frac{73}{2} \text{ or } 36,5$	(5)
			[19]

	SUGGESTED ANSWER/ VOORGESTELDE ANTWOORD	DESCRIPTORS/BESKRYWERS	Marks
QUESTION /VRAAG 5			
5.1	 $5\left(\frac{-3}{5}\right) - 6\left(\frac{2\sqrt{2}}{3}\right)^2$ $= -3 - 6\left(\frac{8}{9}\right)$ $= -\frac{25}{3}$	<ul style="list-style-type: none"> ✓ figure 1 in correct quadrant; <i>r = 5 / figuur 1 in korrekte kwadrant; r = 5</i> ✓ figure 2 in correct quadrant; <i>x = 2√2 / figuur 2 in korrekte kwadrant; x = 2√2</i> ✓✓ substitution / <i>substitusie</i> ✓ Answer/ <i>Antwoord</i> 	(5)
5.2.1	$\cos(360 - 24^\circ)$ $= \cos 24^\circ = p$	<ul style="list-style-type: none"> ✓ $\cos 24^\circ$ ✓ Answer/ <i>Antwoord</i> 	(2)
5.2.2	$\cos 2(24^\circ)$ $= 2\cos^2 24^\circ - 1$ $= 2p^2 - 1$	<ul style="list-style-type: none"> ✓ $\cos 2(24^\circ)$ ✓ $2\cos^2 24^\circ - 1$ ✓ Answer/ <i>Antwoord</i> 	(3)
5.3	$LHS = \tan A$ $RHS = \frac{1 - \cos 2A}{\sin 2A}$ $= \frac{1 - (1 - 2\sin^2 A)}{2\sin A \cos A}$ $= \frac{2\sin^2 A}{2\sin A \cos A}$ $= \frac{\sin A}{\cos A}$ $= \tan A$	<ul style="list-style-type: none"> ✓ $1 - 2\sin^2 A$ ✓ $2\sin A \cos A$ ✓ simplify / <i>vereenvoudig</i> ✓ Answer/ <i>Antwoord</i> 	(4)
5.4	$\sin 20^\circ \cdot (\cos 40^\circ) + \cos 20^\circ \cdot \sin 40^\circ$ $= \sin(20^\circ + 40^\circ)$ $= \sin 60^\circ$ $= \frac{\sqrt{3}}{2}$	<ul style="list-style-type: none"> ✓ $\cos 40^\circ$ ✓ $\cos 20^\circ$ ✓ $\sin 40^\circ$ ✓ $\sin 60^\circ$ ✓ $\frac{\sqrt{3}}{2}$ 	(5)
5.5	$2\cos^2 \theta + 5\sin \theta + 1 = 0$ $\therefore 2(1 - \sin^2 \theta) + 5\sin \theta + 1 = 0$ $\therefore 2 - 2\sin^2 \theta + 5\sin \theta + 1 = 0$ $\therefore -2\sin^2 \theta + 5\sin \theta + 3 = 0$ $\therefore 2\sin^2 \theta - 5\sin \theta - 3 = 0$ $\therefore (2\sin \theta + 1)(\sin \theta - 3) = 0$ $\therefore \sin \theta = -\frac{1}{2}; \sin \theta \neq 3$ $\theta = 180^\circ + 30^\circ + 360^\circ n$ or /of $\theta = 360^\circ - 30^\circ + 360^\circ n$, $\therefore \theta = 210^\circ + 360^\circ n$ or /of $\theta = 330^\circ + 360^\circ n, n \in \mathbb{Z}$	<ul style="list-style-type: none"> ✓ $(1 - \sin^2 \theta)$ ✓ standard form/ <i>Standaardvorm</i> ✓ factors <i>faktore</i> ✓ $\sin \theta = -\frac{1}{2}$ ✓ $\sin \theta \neq 3$ ✓ 210° and/ en 330° ✓ $360^\circ n, n \in \mathbb{Z}$ 	(7)
			[26]

	SUGGESTED ANSWER/ VOORGESTELDE ANTWOORD	DESCRIPTORS/BESKRYWERS	Marks
QUESTION /VRAAG 6			
6.1	$a = 2$	✓ Answer/ <i>Antwoord</i>	(1)
6.2		✓ Max TPs / <i>Maks DPe</i> ✓ Min TP/ <i>Min DP</i> ✓ x-intercepts / <i>x-afsnitte</i>	(3)
6.3	180°	✓ 180°	(1)
6.4	$x = -90^\circ$ or $x = 90^\circ$	✓ $x = -90^\circ$ ✓ $x = 90^\circ$	(2)
6.5	$3 - 5.2 \sin x \cos x$ $= 3 - 5 \sin 2x$ $= 3 - 5(-1)$ $= 8$	✓ $- 5.2 \sin x \cos x$ ✓ $\sin 2x$ ✓ Answer/ <i>Antwoord</i>	(3)
			[10]

	SUGGESTED ANSWER/ VOORGESTELDE ANTWOORD	DESCRIPTORS/BESKRYWERS	Marks
QUESTION /VRAAG 7			
7.1	 $\cos \alpha = \frac{r}{AB}$ $AB = \frac{r}{\cos \alpha}$	<ul style="list-style-type: none"> ✓ expression AB / uitdrukking AB 	(1)
7.2	$\cos \alpha = \frac{r}{AC}$ $AC = \frac{r}{\cos \alpha}$ $BC^2 = AB^2 + AC^2 - 2AB \cdot AC \cos \theta$ $BC^2 = \left(\frac{r}{\cos \alpha}\right)^2 + \left(\frac{r}{\cos \alpha}\right)^2 - 2\left(\frac{r}{\cos \alpha}\right)\left(\frac{r}{\cos \alpha}\right) \cos \theta$ $BC^2 = \frac{2r^2}{\cos^2 \alpha} - \frac{2r^2 \cos \theta}{\cos^2 \alpha}$ $BC^2 = \frac{2r^2}{\cos^2 \alpha} (1 - \cos \theta)$ $BC = \frac{r\sqrt{2(1 - \cos \theta)}}{\cos \alpha}$ <p style="text-align: center;">OR</p> $\cos \alpha = \frac{r}{AC}$ $AC = \frac{r}{\cos \alpha}$ $\therefore AB = AC$ $BC^2 = 2AB^2 - 2AB^2 \cos \theta$ $BC^2 = AB^2(2 - 2\cos \theta)$ $BC = AB\sqrt{2 - 2\cos \theta}$ $BC = \frac{r}{\cos \alpha} \sqrt{2(1 - \cos \theta)}$	<ul style="list-style-type: none"> ✓ expression AC / uitdrukking AC ✓ cosine rule / cos reël ✓ substitution / substitusie ✓ common factor / gemeenskaplike faktor ✓ expression AC / uitdrukking AC ✓ cosine rule / cos reël ✓ substitution AB = AC / vervanging AB = AC ✓ common factor / gemeenskaplike faktor 	(4)

7.3	$100 = \frac{50(\sqrt{2(1 - \cos 30^\circ)})}{\cos \alpha}$ $\cos \alpha = \frac{50(\sqrt{2(1 - \cos 30^\circ)})}{100}$ $\alpha = 75^\circ$	<p>✓ substituting values of BC, r and θ / substitusie van waardes vir BC, r and θ</p> <p>✓ $\cos \alpha = \frac{50(\sqrt{2(1 - \cos 30^\circ)})}{100}$</p> <p>✓ $\alpha = 75^\circ$</p>	(3)
			[8]

GEOMETRY/ MEETKUNDE

S: Statement/ *Bewering*

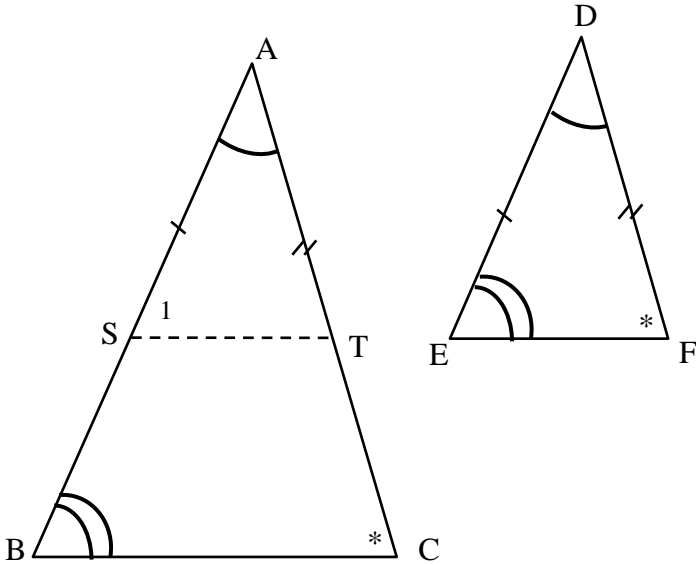
R: Reason/ *Rede*

S/R: Both Statement and Reason/ *Beide Bewering en Rede*

Allow for alternative methods/ *Kyk vir Alternatiewe metodes*

	SUGGESTED ANSWER/ VOORGESTELDE ANTWOORD	DESCRIPTORS/BESKRYWERS	Marks
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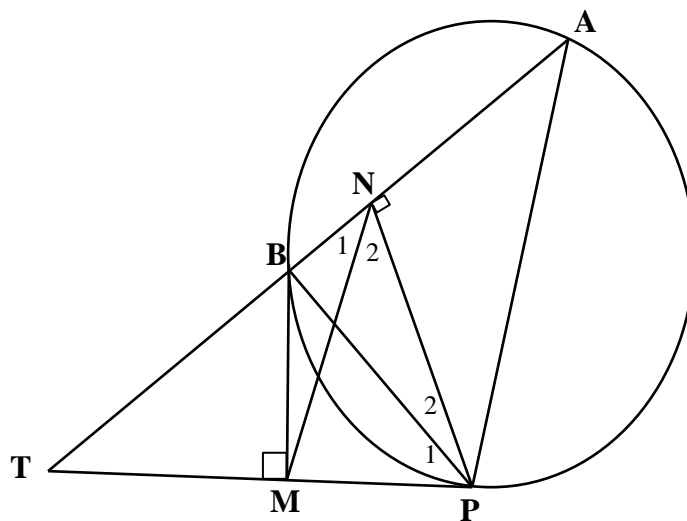
QUESTION /VRAAG 8			
8.1.1	90°	✓ S	(1)
8.1.2	Supplementary/ <i>supplementêr</i>	✓ S	(1)
8.2.1	$\hat{E}_1 = 54^\circ$... tan-chord thm/ <i>raaklyn-koordstelling</i>	✓ S ✓ R	(2)
8.2.2	$\hat{C}_1 = 36^\circ$... angle in semi-circle/ <i>hoek in halfsirkel</i> OR angle subt. By diameter/ <i>hoek onderspan deur midlyn</i>	✓ S ✓ R	(2)
8.2.3	$\hat{C}_3 = 35^\circ$... alt. \angle s; AB//CD / <i>verw. \anglee; AB//CD</i>	✓ S ✓ R	(2)
8.2.4	$\hat{A}\hat{E}D = 55^\circ$...opp \angle s of cyclic quad/ <i>teenoorst \anglee van kvh</i>	✓ S ✓ R	(2)
8.2.5	$\hat{E}_4 = 35^\circ$... subt by AC/ <i>ondersp deur AC</i> $\therefore \hat{E}_3 = 20^\circ$	✓ S ✓ R ✓ S	(3)
8.3	$\hat{B}\hat{A}C = 90^\circ$... tangent- radius/ <i>raaklyn- radius</i> And/ <i>en</i> $\hat{B}\hat{E}C = 90^\circ$... tangent- radius/ <i>raaklyn- radius</i> \therefore BECA is a cyclic quad/ <i>is 'n kvh ... opp. \angles suppl./ teenoorst \anglee suppl.</i> $\therefore \hat{D}\hat{B}E = \hat{A}\hat{C}E$... external \angle of cyclic quad/ <i>Buite \angle van kvh</i>	✓ S ✓ R ✓ S ✓ R ✓ R can only get this mark if BECA is proved a cyclic quad.	(5)
			[18]

	SUGGESTED ANSWER/ VOORGESTELDE ANTWOORD	DESCRIPTORS/BESKRYWERS	Marks
QUESTION /VRAAG 9			
9.1			
	<p>Constr./ <i>Konstr</i>: Draw ST with S on AB and T on AC such that AS = DE and AT = DF/ <i>Trek ST met S op AB en T op AC sodat AS = DE en AT = DF</i></p> <p>$\triangle AST \equiv \triangle DEF \dots S, \angle, S$</p> <p>$\therefore \hat{S}_1 = \hat{E} \dots$ from/ <i>vanaf</i> congruency/ <i>kongruensie</i> $= \hat{B} \dots$ given / <i>gegee</i></p> <p>$\therefore ST \parallel BC \dots$ corresp. $\angle s =$ / <i>ooreenk.</i> $\angle e =$</p> <p>$\therefore \frac{AB}{AS} = \frac{AC}{AT}$</p> <p>$\therefore \frac{AB}{DE} = \frac{AC}{DF}$ (Constr/ <i>Konstr</i>: AS = DE and/ <i>en</i> AT = DF)</p>	<p>✓ Constr./ <i>Konstr</i> – can be on diagram/ <i>kan op diagram wees</i></p> <p>✓ S/R ; Congruency/ <i>Kongruensie</i></p> <p>✓ $\hat{S}_1 = \hat{E}$ $= \hat{B}$</p> <p>✓ S: $ST \parallel BC$ ✓ R</p> <p>✓ S: $\frac{AB}{AS} = \frac{AC}{AT}$</p> <p>✓ R</p>	(7)
9.2.1	<p>$\hat{Q}_1 = \hat{Q}_2 \dots$ given/ <i>gegee</i> $= \hat{N}_2 \dots$ alt. $\angle s$; $MN \parallel QR$ / <i>verw.</i> $\angle e$; $MN \parallel QR$</p> <p>$\therefore MN = MQ \dots$ sides opp = $\angle s$ / <i>syte teenoor</i> = $\angle e$</p> <p>$\therefore \triangle QMN$ is isosceles/ <i>gelykbenig</i></p>	<p>✓ S: $\hat{Q}_1 = \hat{Q}_2$ $= \hat{N}_2$</p> <p>✓ R</p> <p>✓ R</p>	(3)
9.2.2	<p><u>In $\triangle PMN$ and/ <i>en</i> $\triangle PQR$:</u></p> <ol style="list-style-type: none"> P is common/ <i>P is gemeen</i> $\hat{N}_1 = \hat{R} \dots$ corr./ <i>ooreenk</i> $\angle s$; $MN \parallel QR$ <p>$\triangle PMN \equiv \triangle PQR \dots (\angle, \angle, \angle)$ or $3^{\text{rd}} \angle$ given</p>	<p>✓ S</p> <p>✓ S ✓ R</p> <p>✓ R (\angle, \angle, \angle) or $3^{\text{rd}} \angle$ given</p>	(4)

9.2.3	<p>From/ vanaf /// in 9.2.2:</p> $\frac{PM}{PQ} = \frac{MN}{QR} = \frac{PN}{PR}$ $\therefore \frac{PM}{5} = \frac{MN}{7,5}$ $\therefore \frac{PM}{MN} = \frac{5}{7,5} = \frac{2}{3}$ $\therefore \frac{PM}{MQ} = \frac{2}{3} \quad \dots \quad MQ = MN \text{ from/ vanaf } 9.2.1$ $\therefore \frac{PN}{NR} = \frac{2}{3} \quad \dots \quad \text{Prop thm/ ewer.stelling; } MN \parallel QR \text{ or/ of}$ <p style="text-align: center;">line // to 1 side of Δ / lyn // aan 1 sy van Δ</p>	<p>✓ Proportionality/ Eweredigheid</p> <p>✓ Subst/verv $PQ = 5$ and/ en $QR = 7,5$</p> <p>✓ $\frac{PM}{MN} = \frac{2}{3}$</p> <p>✓ $\frac{PM}{MQ} = \frac{2}{3}$</p> <p>✓ $\frac{PN}{NR} = \frac{2}{3}$</p>	(5)
			[19]

SUGGESTED ANSWER/ VOORGESTELDE ANTWOORD	DESCRIPTORS/BESKRYWERS	Marks
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QUESTION /VRAAG 10



10.1	$\widehat{BMT} = 90^\circ = \widehat{BNP}$ \therefore BMPN is a cyclic quad/ is 'n kvh ... ext $\angle =$ int opp \angle / buite $\angle =$ teenoorst binne \angle	<p>✓ S</p> <p>✓ R</p>	(2)
10.2	$\widehat{N}_1 = \widehat{P}_1$... subtended by/ onderspan deur BM But/ Maar $\widehat{P}_1 = \widehat{A}$... tan-chord thm/ raakl-koordstelling \therefore NM // AP ... corresp/ ooreenk. \angle s = $\therefore \frac{TN}{AN} = \frac{TM}{MP}$	<p>✓ S ✓ R</p> <p>✓ S ✓ R</p> <p>✓ S ✓ R</p>	(6)
			[16]

Total/Totaal: [150]