education

MPUMALANGA PROVINCE

REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICS PAPER 2

SEPTEMBER 2023

MARKING GUIDELINES

MARKS: 150

This marking guidelines consist of 18 pages.

NOTE:

- If a candidate answered a question TWICE, mark only the FIRST attempt.
- If a candidate crossed out an answer and did not redo it, mark the crossed-out answer.
- Consistent accuracy applies to ALL aspects of the marking guidelines.
- Assuming values/answers in order to solve a problem is unacceptable.

LET WEL:

- *As 'n kandidaat 'n vraag TWEE keer beantwoord het, sien slegs die EERSTE poging na.*
- *As 'n kandidaat 'n antwoord deurgehaal en nie oorgedoen het nie, sien die deurgehaalde antwoord na.*
- *Volgehoue akkuraatheid is op ALLE aspekte van die nasienriglyn van toepassing.*
- *Dit is onaanvaarbaar om waardes/antwoorde te veronderstel om 'n probleem op te los.*

QUESTION/*VRAAG* 1

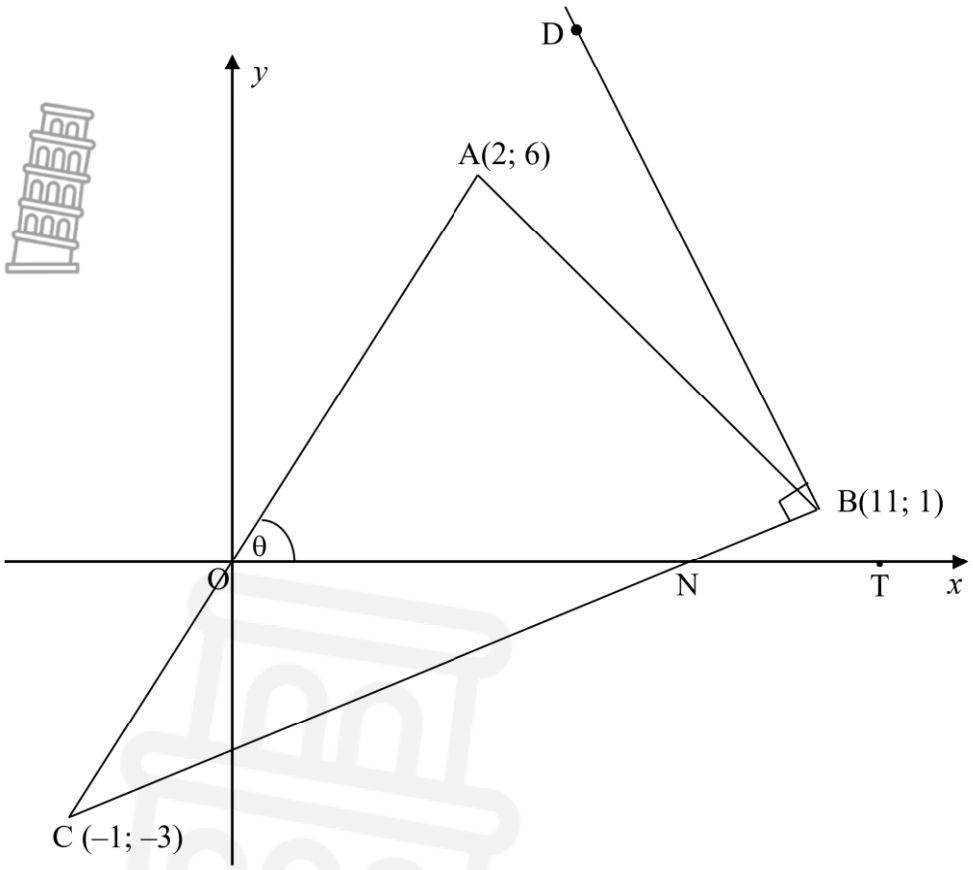
71	83	88	91	92	92	95	97	104	108	109	110	111	115	129

1.1	$\frac{1495}{15} = 99,67$	✓✓ 99,67 (2)
1.2	$\sigma = 14,06$	✓SD (1)
1.3	$99,67 - 14,06 = 85,61$ $\frac{2}{15} \times 100 = 13,33\%$	✓boundary ✓ $\frac{2}{15}$ ✓answer (3)
1.4.1	96,67	✓answer (1)
1.4.2	14,06	✓answer (1)
		[8]

QUESTION/*VRAAG* 2

2.1.1	True	✓ answer (1)
2.1.2	Positively skewed / Skewed to the right	✓ answer (1)
2.1.3	Range for company A $= 800 - 200 = 600$ Range for company B $= 600 - 100 = 500$ Biggest range : Company A	✓ both ranges ✓Company A (2)
2.1.4	$20 \times 75\% = 15$ workers	✓75% ✓ 15 workers (2)
2.2.1	$y = 5965,51 - 2,93x$	✓ 5329,84 ✓ –2,61 ✓ equation (3)
2.2.2	$r = -0,49$	✓ (1)
2.2.3	$y = 5965,51 - 2,93(2018)$ $= 52,77$ The correlation coefficient is moderate thus the value is fairly reliably predicted.	✓ prediction ✓ answer + reason (2)
		[12]

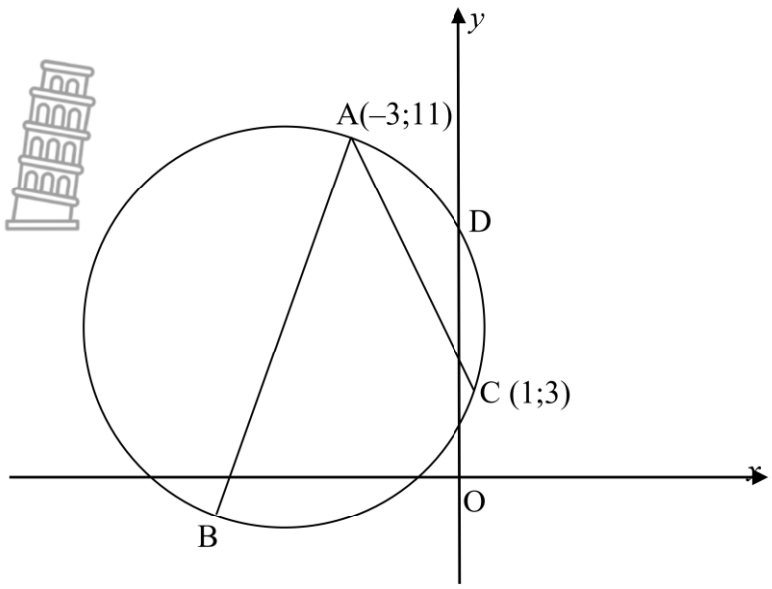
QUESTION/*VRAAG* 3



3.1.1	$N:(x\,;0)$ $m_{NC}=\dfrac{0-(-3)}{x-(-1)}=\dfrac{1}{3}$ $x+1=9$ $x=8$ OR $y-(-3)=\dfrac{1}{3}(x-(-1))$ $y=\dfrac{1}{3}x-\dfrac{8}{3}$ *For* $y=0:x=8$	✓ subst into gradient formula ✓ answer (2) ✓ subst into equation ✓ answer

3.1.2	$\tan\theta = 3$ $\theta = 71{,}565...°$ $\tan B\hat{N}T = \frac{1}{3}$ $B\hat{N}T = 18{,}434...°$ $\hat{C} = 71{,}565...° - 18{,}434...°$ $= 53{,}13°$ Accept $\hat{C} = 53{,}14°$	✓substitution ✓θ ✓substitution ✓ $B\hat{N}T$ ✓ answer (5)
3.2	$y - 6 = 3(x - 2)$ $y = 3x$	✓substitution ✓equation (2)
3.3	$m_{\perp} = -3$ $y - 1 = -3(x - 11)$ $y = -3x + 34$ $3x = -3x + 34$ $6x = 34$ $x = \frac{17}{3} = 5{,}67$ $y = 3\left(\frac{17}{3}\right) = 17$	✓ $m_{\perp} = -3$ ✓equation ✓setting equations equal ✓value of x ✓value of y (5)
		[14]

QUESTION/*VRAAG* 4

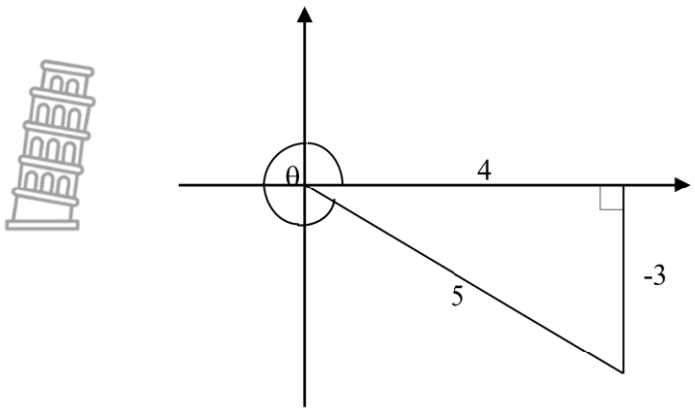


4.1	$m_{AC} = \frac{11-3}{-3-1} = \frac{8}{-4} = -2$ $mdpt_{AC} = (-1;7)$ $y-7 = \frac{1}{2}(x-(-1))$ $y = \frac{1}{2}x + \frac{15}{2}$	✓gradient of AC. ✓Midpt AC ✓⊥gradient and subst ✓ equation (4)
4.2	$\frac{1}{2}x + \frac{15}{2} = 3x + 20$ $-2,5x = 12,5$ $x = -5$ $y = 3(-5) + 20 = 5$ $\therefore \text{centre}(-5;5)$	✓ set equations equal ✓solve x ✓solve y (3)
4.3	$\text{radius} = \sqrt{(-5-(-3))^2 + (5-11)^2}$ $= \sqrt{40} = 2\sqrt{10}$ $\text{diameter} = 4\sqrt{10}$ units $= 12,65$	✓substitution in formula ✓radius ✓diameter (3)
4.4	$(x+5)^2 + (y-5)^2 = 40$	✓ $(x+5)$, $(y-5)$ ✓ 40 (2)

4.5	$m_{rad} = \frac{11-5}{-3-(-5)} = 3$ $m_{\tan} = -\frac{1}{3}$ $y-11 = -\frac{1}{3}(x-(-3))$ $y = -\frac{1}{3}x+10$ $(0;p):\ p = -\frac{1}{3}(0)+10$ $p = 10$	✓gradient ✓subst in form ✓equation ✓ value of p (4)
4.6	$(x+2)^2 + (y-7)^2 = \left(\sqrt{10}\right)^2$ $(x+2)^2 + (y-7)^2 = 10$	✓$(x+2)$ ✓$(y-7)$ ✓10 (3)
4.7	Centres: $(2;3)$ and $(-5;5)$ Distance between centres = $\sqrt{(2-(-5))^2+(3-5)^2}$ $= \sqrt{53} = 7,28$ Sum of radii = $2 + 2\sqrt{10} = 8,32$ Distance between centres < Sum of radii ∴ They will intesect.	✓subst of centres ✓distance ✓Sum of radii ✓conclusion (4)
		[23]

QUESTION 5

5.1



5.1.1	$(-3)^2+4^2 = r^2$ $r^2 = 25$ $r = 5$ $\sin\theta = \frac{-3}{5}$	✓value of r ✓ answer (2)
5.1.2	$\cos 2\theta = \cos^2\theta - \sin^2\theta$ $= \left(\frac{4}{5}\right)^2 - \left(\frac{-3}{5}\right)^2$ $= \frac{16}{25} - \frac{9}{25}$ $= \frac{7}{25}$	✓expansion ✓substitution ✓ answer (3)
5.1.3	$\cos(\theta+30°) = \cos\theta\cos 30° - \sin\theta\sin 30°$ $= \left(\frac{4}{5}\right)\left(\frac{\sqrt{3}}{2}\right) - \left(\frac{-3}{5}\right)\left(\frac{1}{2}\right)$ $= \frac{4\sqrt{3}+3}{10}$	✓expansion ✓substitution ✓ answer (3)
5.2	$(4\sin\alpha)^2 + (4\cos\alpha)^2$ $= 16\sin^2\alpha + 16\cos^2\alpha$ $= 16(\sin^2\alpha + \cos^2\alpha)$ $= 16(1) = 16$	✓simplification ✓answer (2)

5.3

$$\begin{aligned}&\sin(900°-x).\cos(-x)-\sin(x-180°).\sin(90°+x)\\&=\sin(180°-x).\cos(360°-x)-\sin(180°+x).\sin(90°+x)\\&=\sin x\cos x-(-\sin x)\cos x\\&=\sin x\cos x+\sin x\cos x\\&=2\sin x\cos x\\&=\sin 2x\end{aligned}$$

✓ $\sin x$
✓ $\cos x$
✓ $-\sin x$
✓ $\cos x$
✓ simplification
✓ double angle identity

(6)

5.4.1

$$\frac{\sin 7x+\sin x}{2\cos 3x}=\sin 4x$$

$$\begin{aligned}\text{LHS}&=\frac{\sin(4x+3x)+\sin(4x-3x)}{2\cos 3x}\\&=\frac{\sin 4x\cos 3x+\cos 4x\sin 3x+\sin 4x\cos 3x-\cos 4x\sin 3x}{2\cos 3x}\\&=\frac{\sin 4x\cos 3x+\sin 4x\cos 3x}{2\cos 3x}\\&=\frac{2\sin 4x\cos 3x}{2\cos 3x}\\&=\sin 4x=\text{RHS}\end{aligned}$$

✓ both brackets
✓ $\sin(4x+3x)$ expansion
✓ $\sin(4x-3x)$ expansion
✓ simplification

(4)

5.4.2

$$2\cos 3x=0$$
$$\cos 3x=0$$
$$3x=\begin{cases}90°+360°k\\-90°+360°k\end{cases}\quad\text{for}\quad k\in z$$
$$x=\begin{cases}30°+120°k\\-30°+120°k\end{cases}$$

OR

$$2\cos 3x=0$$
$$\cos 3x=0$$
$$3x=\begin{cases}90°+360°k\\270°+360°k\end{cases}\quad\text{for}\quad k\in z$$
$$x=\begin{cases}30°+120°k\\90°+120°k\end{cases}$$

✓ $2\cos 3x=0$
✓ $3x=\begin{cases}90°+360°k\\-90°+360°k\end{cases}$ for $k\in z$
✓ $x=\begin{cases}30°+120°k\\-30°+120°k\end{cases}$

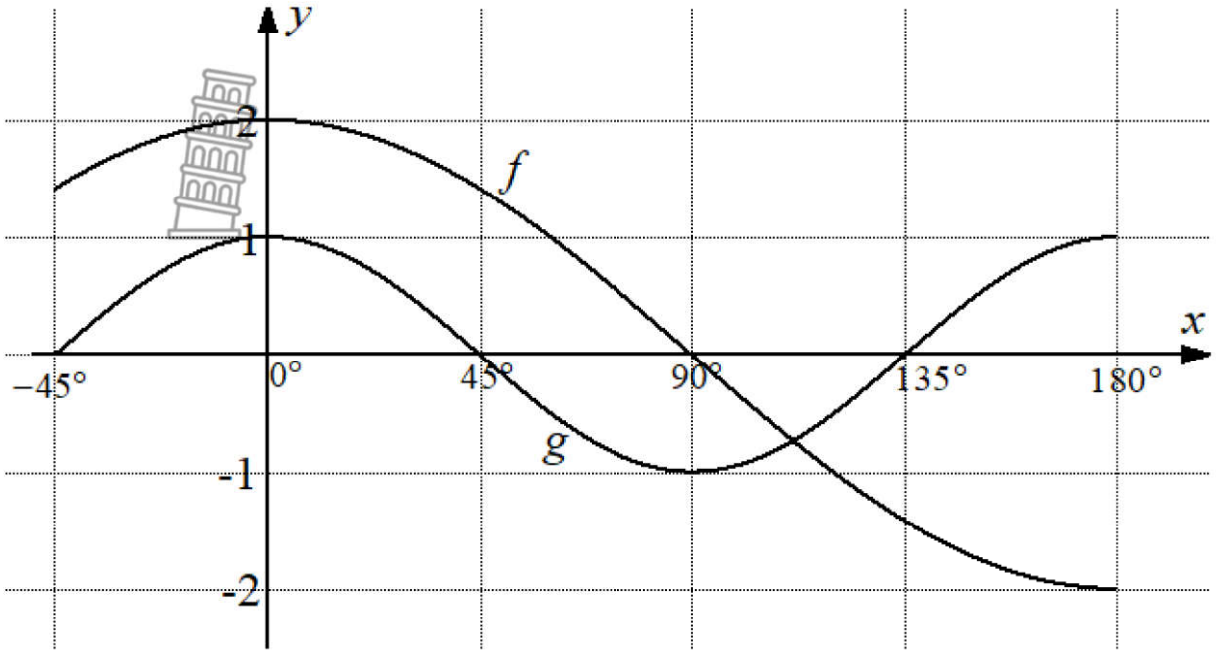
OR

✓ $2\cos 3x=0$
✓ $3x=\begin{cases}90°+360°k\\270°+360°k\end{cases}$ for $k\in z$
✓ $x=\begin{cases}30°+120°k\\90°+120°k\end{cases}$

(3)

5.5	$\sin(3x+20°)=\cos x$ $\sin(3x+20°)=\sin(90°-x)$ $3x+20°=90°-x+360°k \quad k\in z$ $4x=70°+360°k$ $x=17{,}5°+90°k$ *OR* $3x+20°=180°-(90°-x)+360°k \quad k\in z$ $3x+20°=180°-90°+x+360°k$ $2x=70°+360°k$ $x=35°+180°k$ OR $\sin(3x+20°)=\cos x$ $\cos[90°-(3x+20°)]=\cos x$ $-3x+70°=x+360°k \quad k\in z$ $-4x=-70°+360°k$ $x=17{,}5°+90°k$ *OR* $-3x+70°=-x+360°k \quad k\in z$ $-2x=-70°+360°k$ $x=35°+180°k$	✓ $\sin(90-x)$ ✓ $3x+20°=90°-x+360°k \quad k\in z$ ✓ $x=17{,}5°+90°k$ ✓ $3x+20°=180°-(90°-x)+360°k$ ✓ $2x=70°+360°k$ ✓ $x=35°+180°k$ (6) ✓ $\cos[90°-(3x+20°)]$ ✓ $-4x=-70°+360°k$ ✓ $x=17{,}5°+90°k$ ✓ $-3x+70°=-x+360°k \quad k\in z$ ✓ $-2x=-70°+360°k$ ✓ $x=35°+180°k$
		[29]

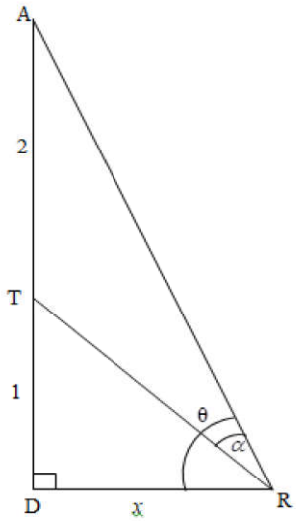
QUESTION 6



6.1	180°	✓answer (1)
6.2		✓critical values ✓notation (2)
6.3	Range of g: $y \in [-1; 1]$ Range of $3g$: $y \in [-3; 3]$ Range of $y = 3g(x) - 1$: $-4 \le y \le 2$ or $y \in [-4; 2]$	✓critical values ✓notation (2)
6.4	$2\cos x = \frac{1}{2}$ $\cos x = \frac{1}{4}$ $x = 75{,}5°$ $-45° \le x \le 75{,}5°$	✓equation ✓ $x = 75{,}5°$ ✓critical values ✓notation (4)
6.5	$\frac{1}{2}\cos^2 x - \frac{1}{4}$ $= \frac{1}{4}(2\cos^2 x - 1)$ $= \frac{1}{4}(\cos 2x)$ $= \frac{1}{4}(-1)$ $= -\frac{1}{4}$	✓factor ✓double angle ✓min of cos2x ✓answer (4)

		[13]

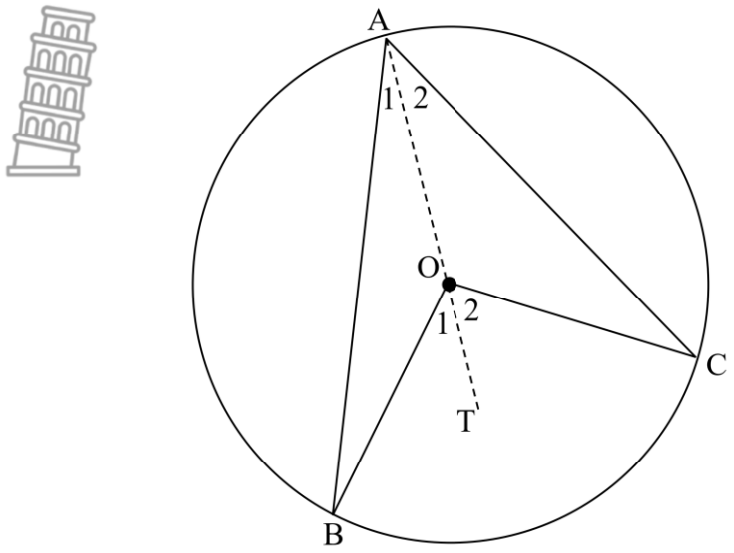
QUESTION 7



7.1	$\hat{TRD} = \theta - \alpha$ $\cos(\theta-\alpha) = \frac{x}{TR}$ $TR = \frac{x}{\cos(\theta-\alpha)}$	✓ $\hat{TRD}$ ✓cos definition (2)
7.2	$\hat{A} = 90° - \theta$ $\frac{TR}{\sin(90°-\theta)} = \frac{AT}{\sin\alpha}$ $\frac{TR}{\cos\theta} = \frac{2}{\sin\alpha}$ $TR = \frac{2\cos\theta}{\sin\alpha}$ $\frac{x}{\cos(\theta-\alpha)} = \frac{2\cos\theta}{\sin\alpha}$ $x = \frac{2\cos\theta\cos(\theta-\alpha)}{\sin\alpha}$	✓ x ✓ TR ✓ Subst in area-rule ✓answer (4)

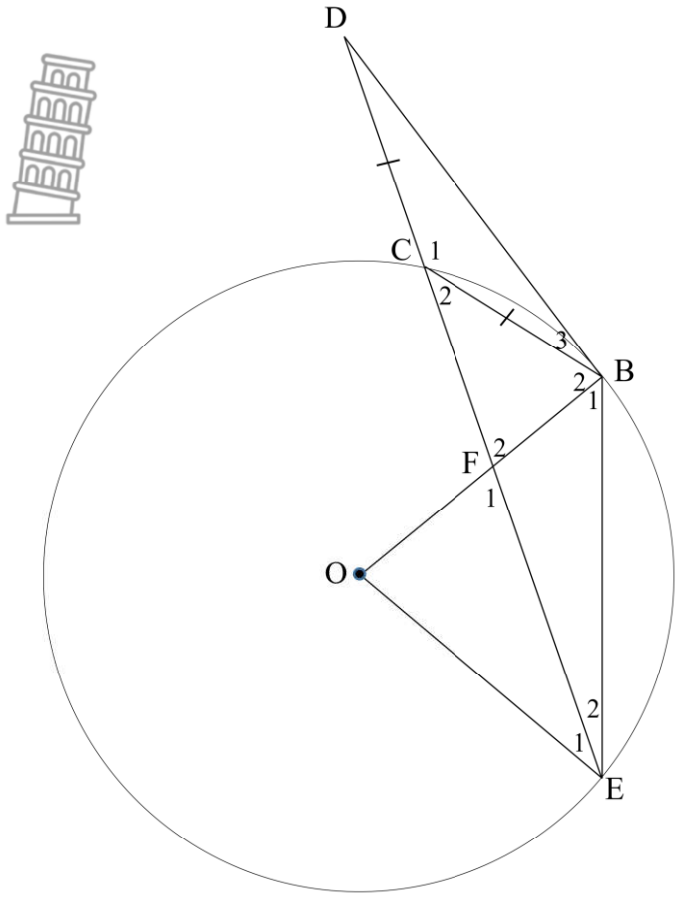
7.3	$x = \dfrac{2\cos 68,33\cos(68,33-28°)}{\sin 28°}$ $= 1,1992...$ $TR = \dfrac{1,1992}{\cos(\theta-\alpha)}$ $= 1,5730...$ $\hat{A} = 21,67°$ $A\hat{T}R = 130,33°$ $Area\,\Delta ATR = \dfrac{1}{2}(2)(1,5730)\sin 130,33°$ $= 1,1992...$ $= 1,20\,units^2$	✓ x ✓ TR ✓ subst in area formula ✓answer (4)
		[10]

QUESTION 8



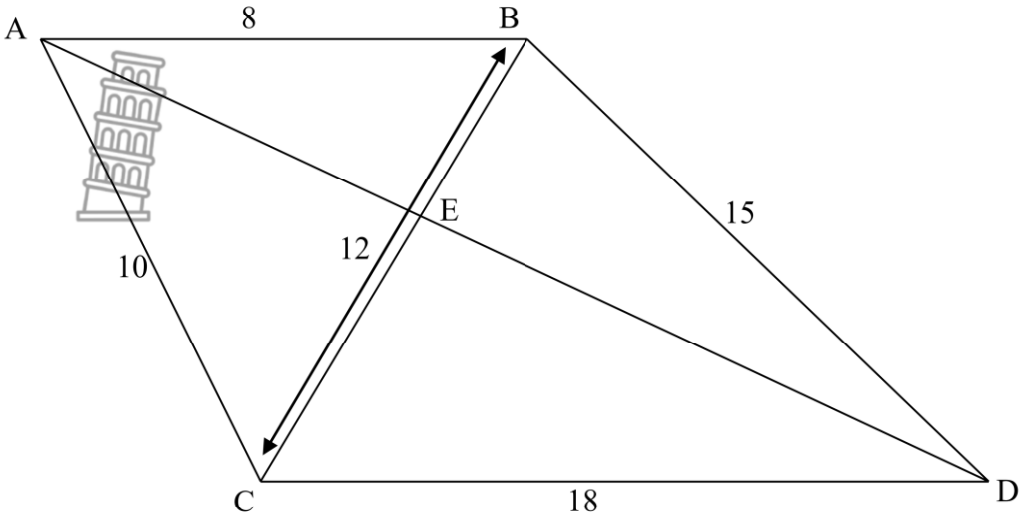
8.1	Draw line from A through O to T let $\hat{A}_1 = x$ and $\hat{A}_2 = y$ $\hat{A}_1 = \hat{B} = x \quad (\angle\text{'s opp = sides})$ $\hat{O}_1 = 2x \quad (ext\angle \text{ of } \Delta)$ similarly $\hat{O}_2 = 2y$ $B\hat{O}C = 2x + 2y = 2(x + y)$ $\therefore B\hat{O}C = 2 \times B\hat{A}C$	✓construction ✓S/R ✓ S/R ✓S ✓deduction (5)

8.2



8.2.1	$\hat{D} = x \ (\angle \ opp = sides)$ $\hat{E}_2 = x \ (\text{tan-chord theorem})$	✓S ✓R ✓S ✓R (4)
8.2.2	$\hat{C}_2 = 2x \ (\text{ext}\angle \ of \ \Delta)$ $2\hat{C}_2 = E\hat{O}B = 4x \ (\angle \text{at centre} = 2 \times \angle \text{ at circumf})$	✓S/R ✓S ✓R (3)
8.2.3	$O\hat{B}D = 90° \ (\tan \perp rad)$ $\hat{B}_2 = 90° - x$	✓S ✓R (2)
8.2.4	$O\hat{B}D = 90° \ (\tan \perp rad)$ $\hat{F}_2 = 180° - x - O\hat{B}D \ (\text{sum}\angle s \ \Delta)$ $\hat{F}_2 = 90° - x$ $\therefore BC = FC \ (\text{opp} \angle\text{'s} =)$ $\therefore DC = BC = FC$	✓S ✓S ✓S/R (3)
		[17]

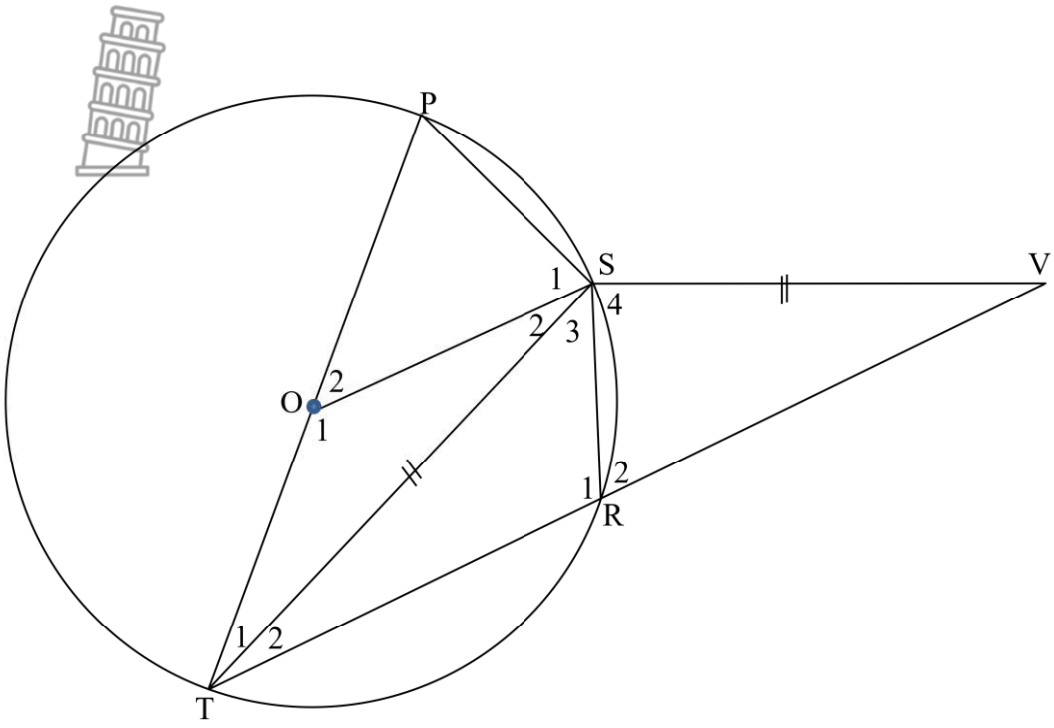
QUESTION 9



9.1	*In* ΔBCA *and* ΔCDB $\frac{BC}{CD}=\frac{12}{18}=\frac{2}{3}$ $\frac{AB}{BC}=\frac{8}{12}=\frac{2}{3}$ $\frac{AC}{DB}=\frac{10}{15}=\frac{2}{3}$ $\Delta BCA \text{ ||| } \Delta CDB \ (\text{sides in proportion})$	✓ S ✓S ✓ S ✓ S/R (4)
9.2	$A\hat{B}C = B\hat{C}D \ (\Delta BCA \text{ ||| } \Delta CDB)$ $\therefore AB \parallel CD \quad (\text{alt} \angle s =)$	✓S ✓R (2)
9.3	In ΔABE and ΔDCE: $A\hat{B}C = B\hat{C}D \ (\text{proven})$ $A\hat{E}B = C\hat{E}D \ (\text{vertically opp} \angle)$ $\Delta ABE \text{ ||| } \Delta DCE \ (\angle\angle\angle)$ $\frac{AB}{DC}=\frac{BE}{CE} \quad (|||\Delta' s)$ $\frac{8}{18}=\frac{x}{12-x}$ $8(12-x)=18x$ $96-8x=18x$ $96=26x$ $x=3,69$ $CE=8,31$	✓ ΔABE ||| ΔDCE ✓ $\frac{AB}{DC}=\frac{BE}{CE}$ ✓ $\frac{8}{18}=\frac{x}{12-x}$ ✓ CE = 8,31 (4)

			[10]

QUESTION 10



10.1	$\hat{P}\hat{S}T = 90°$ $(\angle \text{in semi-circle})$	✓ S ✓ R (2)
10.2	$\hat{T}_1 = \hat{T}_2$ $(ST \text{ is a bisector})$ $\hat{T}_2 = \hat{V}$ $(\angle \text{opp} = \text{sides})$ $\hat{T}_1 = \hat{V}$ $\hat{R}_2 = \hat{P}$ $(\text{ext} \angle \text{of cyclic quad})$ $\hat{S}_4 = P\hat{S}T = 90°(\text{sum } \angle \text{ of } \Delta)$	✓ S ✓ S ✓ S ✓ R ✓ S + R (5)
10.3	$\Delta TSO \text{ ||| } \Delta TVS$ $\hat{T}_1 = \hat{T}_2$ $(ST \text{ is a bisector})$ $\hat{S}_2 = \hat{V} =$ $(both = \hat{T}_1)$ $\hat{O}_1 = T\hat{S}V$ $(3rd \angle \Delta)$ $\Delta TSO \text{ ||| } \Delta TVS$ $(\angle\angle\angle)$	✓ S ✓ S ✓ S/ R (3)

10.4	$\frac{TS}{TV}=\frac{OS}{VS}$ $\Delta TSO \text{ ||| } \Delta TVS$ $(\angle\angle\angle)$ $TS.VS = OS.TV$ *but* $TS = VS$ *given* *and* $OS = \frac{1}{2}PT$ *both radii* $\therefore VS.VS = \frac{1}{2}PT.TV$ $\therefore 2VS^2 = PT.TV$	✓ S ✓ S ✓S+R ✓substitution (4)
		[14]

TOTAL: 150