FINAL

KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

MATHEMATICS P2

PREPARATORY EXAMINATION

SEPTEMBER 2025

MARKING GUIDELINES

NATIONAL SENIOR CERTIFICATE

GRADE 12

MARKS: 150

These marking guidelines consist of 14 pages.

NOTE:

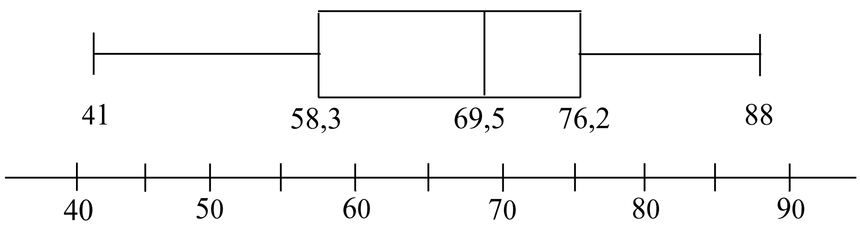
- If a candidate answers a question TWICE, only mark the FIRST attempt.
- If a candidate has crossed out an attempt of a question and not redone the question, mark the crossed-out version.
- Consistent accuracy applies in ALL aspects of the Marking Guidelines. Stop marking at the second calculation error.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

GEOMETRY	
S	**A mark for a correct statement (A statement mark is independent of a reason)**
R	**A mark for the correct reason (A reason mark may only be awarded if the statement is correct)**
S/R	**Award a mark if statement AND reason are both correct.**

QUESTION 1

1.1	$a = 169,60$ $b = -0,90$ $\hat{y} = 169,60 - 0,90x$ Answer only: Full marks	✓A value of a ✓A value of b ✓CA answer (3)
1.2	$r = -0,93$	✓A answer (1)
1.3	A strong negative correlation	✓CA answer (1)
1.4	$y = 169,60 - 0,90(33)$ $y = 139,90$ m $y \approx 140$ m Answer only: Full marks	✓CA substitution ✓CA answer (2)
1.5	$-0,90 \times 15 = -13,50$ Decrease in legibility distance per 15 years ≈ 14 m Penalise only once for incorrect rounding: Only in question 1.4 or 1.5.	✓CA substitution ✓CA answer (2)
		[9]

QUESTION 2

2.1		✓A minimum and maximum ✓A Q_2 (accept 69 – 70) ✓A Q_1 (accept 58 – 58,5) and Q_3 (accept 75,5 – 76,5) (3)
2.2	skewed to the left	✓CA answer (1)
2.3	skewed to the left	✓CA answer (1)
2.4.1	12,63	✓A answer (1)
2.4.2	mean = 63,93 $(\text{mean}-\sigma;\ \text{mean}+\sigma) = (51,30;\ 76,56)$ 6 trees have heights outside 1 standard deviation from the mean	✓A mean ✓CA $\text{mean}-\sigma$ ✓CA $\text{mean}+\sigma$ ✓CA answer (4)
		[10]

QUESTION 3

3.1	$m_{BG} = \frac{0-4}{6-(-4)}$ $= \frac{-2}{5}$	✓A substitution in gradient formula ✓CA answer (2)
3.2	Equation of DF: $5y+2x+60=0$ $5y=-2x-60$ $y=\frac{-2}{5}x-12$ BG and DF have equal gradients ($m_{BG}=m_{DF}=\frac{-2}{5}$) Therefore BG || DF.	✓A $y=\frac{-2}{5}x-12$ ✓A $m_{BG}=m_{DF}=\frac{-2}{5}$ (2)
3.3	D is the point of intersection of AD and DF. $\therefore \frac{1}{2}x+6=\frac{-2}{5}x-12$ $5x+60=-4x-120$ $x=-20$ $y=\frac{1}{2}(-20)+6$ $=-4$ $D(-20;-4)$	✓CA equating ✓CA x-coordinate ✓CA substitution ✓CA y-coordinate (4)

3.4	At E: $x=-4$ Substitute in the equation of DF: $y=\frac{-2}{5}(-4)-12$ $=\frac{-52}{5}=-10,4$ $\therefore \text{BE}=4-(-10,4)$ $=14,4$ units **OR** $5y+2x+60=0$ $5y+2(-4)+60=0$ $5y=-52$ $y=-10,4$ $\therefore \text{BE}=4-(-10,4)$ $=14,4$ units	✓CA substitution ✓CA y-value ✓CA subtraction ✓CA answer (4) **OR** ✓A substitution ✓CA y-value ✓CA subtraction ✓CA answer (4)
3.5	x-value at $\text{D}-(-4)$ $=-20-(-4)=-16$ $\therefore$ Height of $\Delta\text{BDE}=16$ units Area of ΔBDE $=\frac{1}{2}\times\text{BE}\times\text{height}$ $=\frac{1}{2}\times 14,4\times 16$ $=115,2 \text{ units}^2$ Area of parm DJEB $=2\times$ area of ΔBDE $=230,4 \text{ units}^2$ **OR** x-value at $\text{D}-(-4)$ $=-20-(-4)=-16$ $\therefore$ Height of parm DJEB $=16$ units Area of parm DJEB $=\text{BE}\times\text{height}$ $=14,4\times 16$ $=230,4 \text{ units}^2$ **OR**	✓CA height of ΔBDE $=16$ units ✓CA substitution ✓CA area of ΔBDE ✓CA answer (4) **OR** ✓CA height of parm DJEB $=16$ units ✓A formula ✓CA substitution ✓CA answer (4) **OR**

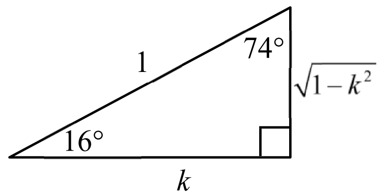
	$m_{\text{BD}}=\dfrac{1}{2}=\tan\mathrm{B\hat{C}G}$ $\mathrm{B\hat{C}G}=26{,}57°$ $\mathrm{C\hat{B}E}=180°-(90°+26{,}57°)$ [sum of $\angle$s of Δ] $=63{,}43°$ $\mathrm{BD}=\sqrt{(-4-(-20))^2+(4-(-4))^2}$ $=8\sqrt{5}$ Area of ΔBDE $=\dfrac{1}{2}(\mathrm{BD})(\mathrm{BE})\sin\mathrm{C\hat{B}E}$ $=\dfrac{1}{2}(8\sqrt{5})(14{,}4)\sin 63{,}43°$ $=115{,}2\text{ units}^2$ Area of parm DJEB $=2\times$area of ΔBDE $=230{,}4\text{ units}^2$	✓CA size of $\mathrm{C\hat{B}E}$ ✓CA substitution ✓CA area of ΔBDE ✓CA answer (4)
		[16]

QUESTION 4

4.1.1 (a)	$\mathrm{M}(-3\,;\,4)$	✓A answer (1)
4.1.1 (b)	$\text{radius}=\sqrt{26}=5{,}10\text{ units}$	✓A answer (1)
4.1.2	$m_{\text{tangent}}=-\dfrac{1}{5}$ $\therefore m_{\text{diameter}}=5$ Substitute m_{diameter} and $\mathrm{M}(-3\,;\,4)$: $4=5(-3)+c$ $\therefore c=19$ $y=5x+19$	✓A gradient of diameter ✓CA substitution ✓CA answer (3)
4.1.3	$(x+3)^2+(y-4)^2=26$ $(x+3)^2+(5x+19-4)^2=26$ $x^2+6x+9+25x^2+150x+225=26$ $26x^2+156x+208=0$ $x^2+6x+8=0$ $(x+4)(x+2)=0$ $x=-4$ or $x=-2$ $y=-1$ or $y=9$ $\mathrm{R}(-4\,;\,-1)$	✓CA substitution ✓CA simplification ✓CA standard form ✓CA x-values ✓CA y-values ✓CA answer (6)

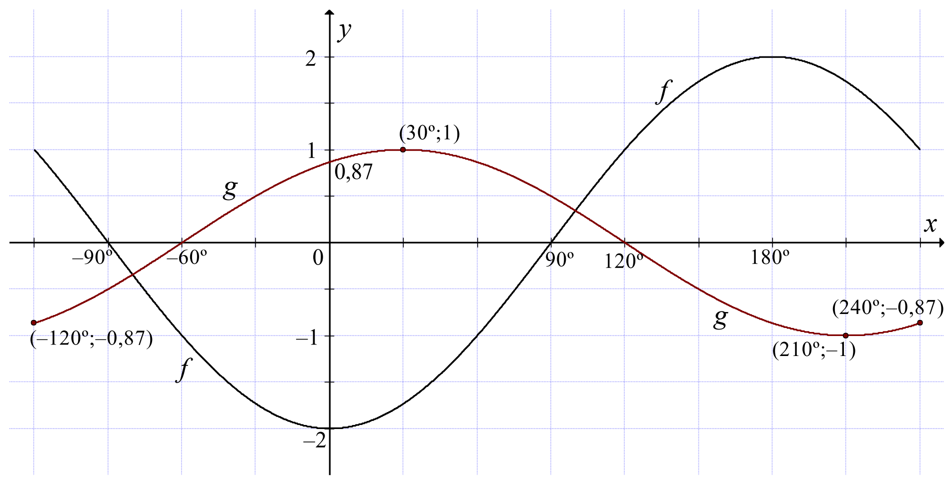
4.1.4	Substitute $R(-4\,;-1)$ in $y=-\frac{1}{5}x+k$: $-1=-\frac{1}{5}(-4)+k$ $k=-1-\frac{4}{5}=-\frac{9}{5}$	✓CA substitution ✓CA answer (2)
4.1.5	Let the $\angle$ of inclination of QRST $=\theta$ $\tan\theta=m_{\text{QRST}}$ $=-\frac{1}{5}$ $\therefore\theta=180°-11{,}31°=168{,}69°$ $\text{O}\hat{\text{Q}}\text{S}=180°-168{,}69°=11{,}31°$ $\therefore \text{O}\hat{\text{Q}}\text{S}=\text{O}\hat{\text{W}}\text{V}$ $\therefore$ WVSQ is a cyclic quadrilateral [converse: $\angle$s in the same segment]	✓A $\tan\theta=-\frac{1}{5}$ ✓A $\text{O}\hat{\text{Q}}\text{S}=11{,}31°$ ✓A $\text{O}\hat{\text{Q}}\text{S}=\text{O}\hat{\text{W}}\text{V}$ ✓CA reason (4)
4.2	$x^2+y^2+4x\cos\theta+8y\sin\theta+3=0$ $=x^2+4x\cos\theta+(2\cos\theta)^2+y^2+8y\sin\theta+(4\sin\theta)^2=-3+4\cos^2\theta+16\sin^2\theta$ $=(x+2\cos\theta)^2+(y+4\sin\theta)^2=-3+4\cos^2\theta+16\sin^2\theta$ $r^2=-3+4\cos^2\theta+16\sin^2\theta$ $=-3+4(1-\sin^2\theta)+16\sin^2\theta$ $=1+12\sin^2\theta$ $0\le\sin^2\theta\le 1$ for all values of θ $\therefore r^2=1+12\sin^2\theta\le 13$ for all values of θ and $\therefore r\le\sqrt{13}$ for all values of θ **OR** $x^2+y^2+4x\cos\theta+8y\sin\theta+3=0$ $=x^2+4x\cos\theta+(2\cos\theta)^2+y^2+8y\sin\theta+(4\sin\theta)^2=-3+4\cos^2\theta+16\sin^2\theta$ $=(x+2\cos\theta)^2+(y+4\sin\theta)^2=-3+4\cos^2\theta+16\sin^2\theta$ $r^2=-3+4\cos^2\theta+16\sin^2\theta$ $=-3+4\cos^2\theta+16(1-\cos^2\theta)$ $=13-12\cos^2\theta$ $0\le\cos^2\theta\le 1$ for all values of θ $\therefore r^2=13-12\cos^2\theta\le 13$ for all values of θ and $\therefore r\le\sqrt{13}$ for all values of θ	✓A completing the square ✓A expression for r^2 ✓A $r^2=1+12\sin^2\theta$ ✓A $\sin^2\theta\le 1$ ✓A $r^2\le 13$ (5) **OR** ✓A completing the square ✓A expression for r^2 ✓A $r^2=13-12\cos^2\theta$ ✓A $\cos^2\theta\ge 0$ ✓A $r^2\le 13$ (5)
		[22]

QUESTION 5

5.1.1	$y^2 = r^2 - x^2$ [Pythagoras] $= 1^2 - k^2$ $y = \sqrt{1-k^2}$  $\sin 344°$ $= -\sin 16°$ $= -\sqrt{1-k^2}$ **OR** $\sin 344°$ $= -\sin 16°$ $= -\sqrt{\sin^2 16°}$ $= -\sqrt{1-\cos^2 16°}$ $= -\sqrt{1-k^2}$	✓A $y = \sqrt{1-k^2}$ ✓A $-\sin 16°$ ✓CA answer (3) **OR** ✓A $-\sin 16°$ ✓A $-\sqrt{1-\cos^2 16°}$ ✓CA answer (3)
5.1.2	$\tan 106°$ $= \tan(180° - 74°)$ $= -\tan 74°$ $= -\frac{k}{\sqrt{1-k^2}}$ **OR** $\tan 106°$ $= \frac{\sin 106°}{\cos 106}$ $= \frac{\cos 16°}{-\sin 16}$ $= \frac{k}{-\sqrt{1-k^2}}$	✓A $\tan(180° - 74°)$ ✓A $-\tan 74°$ ✓CA answer (3) **OR** ✓A $\frac{\sin 106°}{\cos 106}$ ✓A $\frac{\cos 16°}{-\sin 16}$ ✓CA answer (3)
5.1.3	$\cos 16° = 2\cos^2 8° - 1$ $2\cos^2 8° = \cos 16° + 1$ $\cos^2 8° = \frac{\cos 16° + 1}{2}$ $\cos 8° = \sqrt{\frac{\cos 16° + 1}{2}}$ $= \sqrt{\frac{k+1}{2}}$	✓A $\cos 16° = 2\cos^2 8° - 1$ ✓A $\cos^2 8° = \frac{\cos 16° + 1}{2}$ ✓CA answer (3)

5.2	$\cos^2(180°+x)\left[\tan(360°-x).\cos(90°+x)+\sin(x-90°).\cos180°\right]$ $=(-\cos x)^2\left[-\tan x.-\sin x+(-\cos x).-1\right]$ $=\cos^2 x\left[\dfrac{\sin x}{\cos x}.\sin x+\cos x\right]$ $=\sin^2 x\cos x+\cos^3 x$ $=\cos x(\sin^2 x+\cos^2 x)$ $=\cos x$	✓A $(-\cos x)^2$ ✓A $-\tan x$ ✓A $-\sin x$ ✓A $(-\cos x).-1$ ✓A $\dfrac{\sin x}{\cos x}$ ✓CA common factor ✓CA answer (7)
5.3.1	$\dfrac{\cos3\theta+\cos7\theta}{\cos5\theta}$ $=\dfrac{\cos(5\theta-2\theta)+\cos(5\theta+2\theta)}{\cos5\theta}$ $=\dfrac{\cos5\theta.\cos2\theta+\sin5\theta.\sin2\theta+\cos5\theta.\cos2\theta-\sin5\theta.\sin2\theta}{\cos5\theta}$ $=\dfrac{2\cos5\theta.\cos2\theta}{\cos5\theta}$ $=2\cos2\theta$	✓A $\dfrac{\cos(5\theta-2\theta)+\cos(5\theta+2\theta)}{\cos5\theta}$ ✓A expanding $\cos(5\theta-2\theta)$ ✓A expanding $\cos(5\theta+2\theta)$ ✓A $\dfrac{2\cos5\theta.\cos2\theta}{\cos5\theta}$ (4)
5.3.2	$\theta=22,5°$ $2\cos2\theta=2\cos(2\times22,5°)$ $=2\cos45°$ $=2\left(\dfrac{1}{\sqrt2}\right)=\sqrt2$	✓A $\theta=22,5°$ ✓A $2\cos45°$ ✓A answer (3)
5.4	$(4\sin3x+1)(\sin x-5\cos x)=0$ $\therefore 4\sin3x+1=0$ or $\sin x-5\cos x=0$ $\sin3x=-\dfrac14$ or $\sin x-5\cos x=0$ ref. $\angle$: $14,48°$ $3x=194,48°+k.360°,\ k\in Z$ $x=64,83°+k.120°,\ k\in Z$ or $3x=345,52°+k.360°,\ k\in Z$ $x=115,17°+k.120°,\ k\in Z$ $\dfrac{\sin x}{\cos x}=5$ $\tan x=5$ ref. $\angle$: $78,69°$ $x=78,69°+k.180°,\ k\in Z$ **OR** $x=78,69°+k.360°,\ k\in Z$ or $x=258,69°+k.360°,\ k\in Z$	✓A both equations ✓A $\sin3x=-\dfrac14$ ✓A $\tan x=5$ ✓CA $64,83°+k.120°$ or $115,17°+k.120°$ ✓CA $78,69°+k.180°$ **OR** $78,69°+k.360°$ or $258,69°+k.360°$ ✓A $k\in Z$ (6)
		[29]

QUESTION 6

6.1		✓A x-intercepts ✓A turning points ✓A endpoints ✓A shape (4)
6.2.1	360°	✓A answer (1)
6.2.2	$y \in [-5;-1]$ **OR** $-5 \leq y \leq -1$	✓✓A A answer (2) **OR** ✓✓A A answer (2)
6.2.3	2 solutions	✓CA answer (1)
6.3	$g(x) - k = 1$ $g(x) - 1 = k$ Critical values: -2 and 0 No real roots when: $k > 0$ or $k < -2$	✓A critical values ✓A $k > 0$ ✓A $k < -2$ (3)
6.4	$h(x) = -\sin x$	✓✓A A answer (2)
		[13]

QUESTION 7

7.1	$\frac{DC}{DA} = \cos 28°$ $DA = \frac{DC}{\cos 28°}$ $DA = 16,99\text{ m}$ $AB^2 = AD^2 + DB^2 - 2AD.DB.\cos A\hat{D}B$ $AB^2 = 16,99^2 + 20^2 - 2.16,99.20.\cos 52°$ $= 270,256....$ $AB = 16,44\text{ m}$	✓A $\frac{DC}{DA} = \cos 28°$ ✓A length of DA ✓A applying cosine rule in triangle ABC ✓CA substitution ✓CA answer (5)
7.2	In ΔGHJ: $\frac{GJ}{\sin a} = \frac{k}{\sin b}$ $\therefore GJ = \frac{k.\sin a}{\sin b}$ $\hat{J}_2 = a + b$ [exterior ∠ of Δ] Area of $\Delta GJL = \frac{1}{2} GJ.JL.\sin \hat{J}_2$ $= \frac{1}{2}\left(\frac{k \sin a}{\sin b}\right).k.\sin(a+b)$ $= \frac{k^2 \sin a.\sin(a+b)}{2 \sin b}$	✓A applying sine rule in triangle GHJ ✓A GJ subject of the formula ✓A $\hat{J}_2 = a + b$ ✓A applying area rule in triangle GJL ✓A substitution into area rule (5)
		[10]

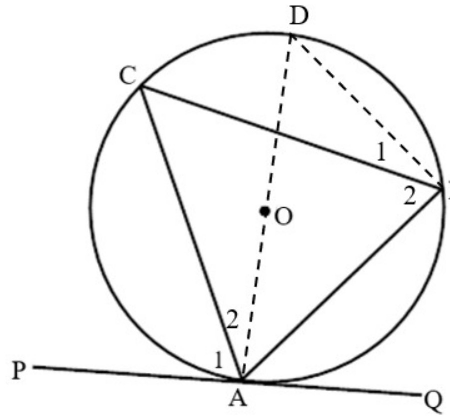
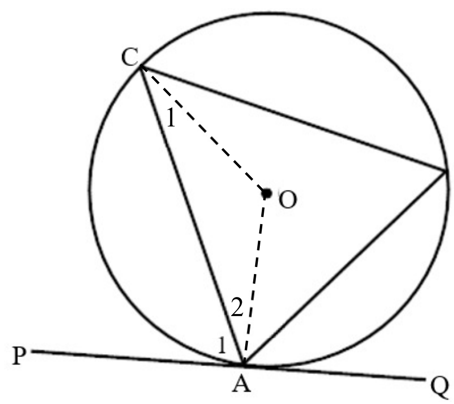
QUESTION 8

8.1.1	$\hat{O}_1 = 360° - 2x$ [$\angle$s around a point] $Q\hat{R}S = \frac{1}{2}\hat{O}_1$ [$\angle$ at the centre $= 2 \times \angle$ at the circumference] $= 180° - x$	✓S/R ✓R ✓A answer (3)
8.1.2	$\hat{Q}_1 = \hat{S}_2$ [$\angle$s opp. equal sides] $\hat{Q}_1 = \frac{180° - Q\hat{R}S}{2}$ [sum of $\angle$s of a Δ] $= \frac{180° - (180° - x)}{2}$ $= \frac{1}{2}x$	✓S/R ✓R ✓CA answer (3)
8.1.3	$\hat{P} = \hat{Q}_1 = \frac{1}{2}x$ [subtended by equal chords] **OR** $\hat{P} = \hat{S}_2 = \frac{1}{2}x$ [$\angle$s in the same segment]	✓ S (CA) ✓R (2) **OR** ✓ S (CA) ✓R (2)
8.2	In ΔACE, $\frac{AF}{FC} = \frac{ED}{DC}$ [prop. theorem; DF || EA] $= \frac{2}{3} = \frac{2k}{3k}$ $AF = HF$ [given] $= 2k$ $\therefore CH = 3k - 2k = k$ In ΔABC, $\frac{AG}{BG} = \frac{AH}{CH}$ [prop. theorem; BC || GH] $\frac{AG}{12} = \frac{4k}{1k}$ $\therefore AG = 4 \times 12 = 48$ units	✓S/R ✓A $\frac{2}{3}$ ✓A $CH = k$ ✓S ✓CA substitution ✓CA answer (6)
		[14]

QUESTION 9

9.1	In ΔDSF and ΔOGH: 1. $\hat{S}_2 = \hat{F}_1$ [alt. $\angle$s; DF || SG] $\hat{S}_2 = \hat{H}$ [$\angle$s in the same segment] $\therefore \hat{F}_1 = \hat{H}$ 2. $DF = DS$ [tangents from the same point] $\therefore \hat{F}_1 = \hat{S}_1$ [$\angle$s opp. equal sides] $OG = OH$ [radii] $\hat{H} = O\hat{G}H$ [$\angle$s opp. equal sides] $\therefore \hat{S}_1 = O\hat{G}H$ 3. $\hat{D} = \hat{O}_1$ [sum of $\angle$s of a Δ] $\therefore \Delta DSF \parallel\!\mid \Delta OGH$ [$\angle\angle\angle$]	✓ S/R ✓S/R ✓S ✓S/R ✓S/R ✓R (for sum of $\angle$s of a Δ **OR** $\angle\angle\angle$) (6)
9.2	$O\hat{R}G = 90°$ [alternate $\angle$s; DF || SG] $RG^2 = OG^2 - OR^2$ [Pythagoras] $= 7{,}5^2 - 6^2$ $= 20{,}25$ $\therefore RG = 4{,}5$ units $\therefore SG = 9$ units [line from centre $\perp$ to chord] $O\hat{R}G = 90°$ can also be proved using corresponding or co-interior angles.	✓S/R ✓ A substitution in Pythagoras ✓ A length of RG ✓S (CA)/R (4)
		[10]

QUESTION 10

10.1		
	Construction: Draw diameter AOD and join DB	✓ construction
	$\hat{A}_1 + \hat{A}_2 = 90°$ [tangent ⊥ radius]	✓S ✓R
	$\hat{B}_1 + \hat{B}_2 = 90°$ [∠ in a semicircle]	✓S/R
	But: $\hat{A}_2 = \hat{B}_1$ [∠s in the same segment]	✓S/R
	$\therefore \hat{A}_1 = \hat{B}_2$	
	or $C\hat{A}P = A\hat{B}C$	(5)
	OR	**OR**
		
	Construction: Draw radii CO and AO.	✓ construction
	$\hat{A}_1 + \hat{A}_2 = 90°$ or $\hat{A}_1 = 90° - \hat{A}_2$ [tangent ⊥ radius]	✓S ✓R
	$\hat{A}_2 = \hat{C}_1$ [∠s opp. equal sides]	✓S/R
	$A\hat{O}C = 180° - 2\hat{A}_2$ [sum of ∠s of Δ]	
	$\therefore A\hat{B}C = 90° - \hat{A}_2$ [∠ at centre = 2 × ∠ at circumference]	✓S/R
	$\therefore A\hat{B}C = \hat{A}_1$	
	or $C\hat{A}P = A\hat{B}C$	(5)

10.2.1	$\hat{A} = \hat{D}_2$ [ext. $\angle$ of cyclic quadrilateral] $\hat{D}_2 = \hat{B}_4$ [tan-chord-theorem] $\hat{B}_4 = \hat{B}_1$ [vertically opp. $\angle$s] $\therefore \hat{A} = \hat{B}_1$ $\therefore AE = AB$ [$\angle$s opp. equal sides]	✓S ✓R ✓S ✓R ✓S/R ✓R (6)
10.2.2	In ΔEBC and ΔEDB: 1. $\hat{E}_2 = \hat{E}_2$ [common] 2. $\hat{B}_2 = \hat{C}$ [tan-chord-theorem] 3. $\hat{D}_1 = E\hat{B}C$ [sum of $\angle$s of a Δ] $\therefore \Delta EBC \parallel\!\mid \Delta EDB$ [$\angle\angle\angle$] $\therefore \dfrac{EB}{EC} = \dfrac{ED}{EB}$ [$\parallel\!\mid$ Δs] $\dfrac{EA}{EC} = \dfrac{ED}{EA}$ [EA = EB] $\therefore \dfrac{EA}{ED} = \dfrac{EC}{EA}$ $\therefore$ ED, EA and EC form a geometric sequence.	✓S selecting triangles ✓S ✓S/R ✓R (for sum of $\angle$s of a Δ **OR** $\angle\angle\angle$) ✓ S/R ✓ S (6)
		[17]

TOTAL: 150