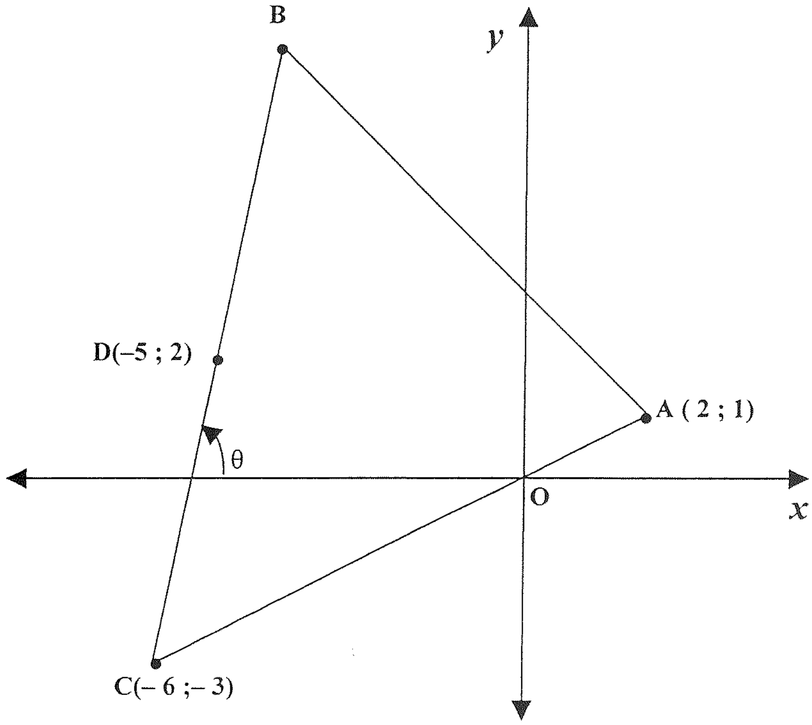
POSSIBLE ANSWERS - OCT / NOV 2006

MATHEMATICS STANDARG GRADE PAPER TWO NOVEMBER 2006	
Question1	[25]

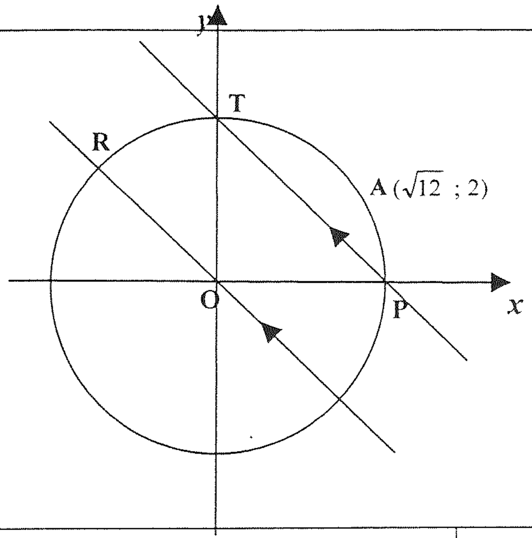
1.1			
1.1	AC $= \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ ✓M $= \sqrt{(2+6)^2 + (1+3)^2}$ ✓A $= \sqrt{64 + 16}$ $= \sqrt{80}$ or $4\sqrt{5}$ ✓C/A	(3)	1M for dist. formula 1A for substitution 1CA for simplification **wrong formula –B/D no marks** **no penalty if value further given in decimal form** **answer only full marks**
1.2.1	$m_{DC} = \dfrac{y_2 - y_1}{x_2 - x_1}$ ✓M $= \dfrac{2+3}{-5+6}$ ✓A $= 5$ ✓CA	(3)	1M for formula 1A for substitution 1CA for simplification **answer only full marks**

1.2.2	$\tan\theta = m_{DC} = 5$ ✓M $\therefore \theta = 78{,}7°$ ✓CA (2)	1M for formula/ or implied 1CA for angle **If used $\sin\theta = m$ or $\cos\theta = m$ – no marks** **answer only full marks**
1.2.3	$m_{DE} = m_{DC}$ ✓M $m_{DE} = \frac{k-2}{-3+5}$ $= \frac{k-2}{2}$ ✓A $\therefore \frac{k-2}{2} = 5$ ✓CA $k - 2 = 10$ $\therefore k = 12$ ✓CA **OR** $m_{DE} = m_{EC}$ ✓M ✓A $\frac{k-2}{2} = \frac{k+3}{3}$ ✓CA $3k - 6 = 2k + 6$ $\therefore k = 12$ ✓CA **OR** $m_{EC} = m_{CD}$ ✓M ✓A $\frac{k+3}{3} = 5$ ✓CA $k + 3 = 15$ $\therefore k = 12$ ✓CA **OR** Line through DC ✓M $y = 5x + c$ $(-5; 2)$ $2 = -25 + c$ $\therefore c = 27$ ✓CA $y = 5x + 27$ $(-3; k)$ ✓CA $k = 5(-3) + 27$ $= 12$ ✓CA **or** $y - 2 = 5(x + 5)$ ✓M $y - 2 = 5x + 25$ $y = 5x + 27$ ✓CA **OR**	1M for the concept 1A for gradient of DE 1CA for subst. 1CA for the value 1M for using equation of str line 1CA for the value of c 1CA for substitution 1CA for the value

	$d_{DC} = \sqrt{(-5+6)^2 + (2+3)^2}$ $= \sqrt{26}$ $d_{CE} = \sqrt{(-3+6)^2 + (-3-k)^2}$ $= \sqrt{18+6k+k^2}$ $d_{DE} = \sqrt{(-2)^2 + (2-k)^2}$ $= \sqrt{8-4k+k^2}$ ✓A ✓A collinear, $\therefore CE = DC + DE$ $\sqrt{18+6k+k^2} = \sqrt{26} + \sqrt{8-4k+k^2}$ ✓CA .... $k = 12$ ✓CA (4)	2A for 3 distances 1CA for the correctly equating in terms of k 1CA for the answer **Answer only full marks**
1.2.4	$\frac{x_1 - 6}{2} = -5$ ✓M ; $\frac{y_1 - 3}{2} = 2$ ✓M $\therefore x_1 = -10 + 6$ $= -4$ ✓CA $\therefore y_1 = 4 + 3$ $= 7$ ✓CA $\therefore B(-4;7)$ **OR** DB = DC $\sqrt{(x+5)^2+(y-2)^2} = \sqrt{(-6+5)^2+(-3-2)^2}$ ✓M $\sqrt{(x+5)^2+(y-2)^2} = \sqrt{26}$ For line DC ✓M $y = 5x + 27$ $\sqrt{(x+5)^2+(5x+25)^2} = \sqrt{26}$ ✓CA $x^2 + 10x + 24 = 0$ $(x+6)(x+4) = 0$ $x = -4$ for B ✓CA $y = 7$ $\therefore B(-4;7)$ (4)	1M for correct formula 1M for correct substitution 2CA for x & y values **finding midpoint of DC max 2/4** 1M for distance formula 1M for DC 1CA for sub. 1CA for x and y values. **answer only full marks**

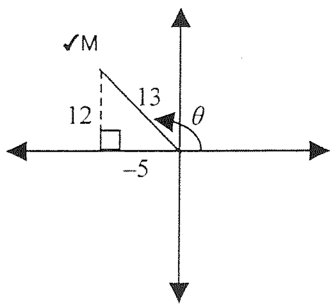
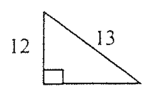
1.3.1	$PA^2 = PC^2$ ✓M $(x-2)^2 + (y-1)^2 = (x+6)^2 + (y+3)^2$ ✓A ✓A $x^2 - 4x + 4 + y^2 - 2y + 1 = x^2 + 12x + 36 + y^2 + 6y + 9$ ✓CA ✓CA $-16x - 8y - 40 = 0$ ✓A $2x + y + 5 = 0$ **OR** Midpoint of AC $= M(-2\,;-1)$ ✓M ✓A $m_{AC} = \dfrac{y_A - y_C}{x_A - x_C}$ $= \dfrac{1-(-3)}{2-(-6)}$ ✓CA $= \dfrac{1}{2}$ $m_{\perp} = -2$ ✓CA $y = -2x + c$ ✓CA $(-2\,;-1)$ or $y + 1 = -2(x+2)$ $-1 = (-2)(-2) + c$ $y + 1 = -2x + 4$ $\therefore c = -5$ ✓A $2x + y + 5 = 0$ $y = -2x - 5$ $2x + y + 5 = 0$ (6)	1M for equating the distances 2A for subst. 2CA for correct expansion 1A for conclusion mark only awarded if leading to correct equation. 1M for use of midpoint 1A for both co-ordinates of M 1CA for gradient of AC 1CA for perpendicular gradient 1CA for sub.in st.line equation 1A for the value of c /expansion **Answer only no marks**
1.3.2	$2x + y + 5 = 0$ L.H.S $= (2) + (-3) + 5$ ✓A $\neq 0$ ✓CA $\neq$ R.H.S $\therefore$ the point $(1\,;-3)$ **does not lie** on $2x + y + 5 = 0$ ✓CA (3) **OR** $2x + (-3) + 5 = 0$ ✓A $2x = -2$ $x = -1 \neq 1$ ✓CA $\therefore$ the point $(1\,;-3)$ **does not lie** on $2x + y + 5 = 0$ ✓CA	1A for subst. 1CA for showing L.H.S 1CA for the conclusion. 1A for substitution of x or y 1 CA for value 1 CA for the conclusion. **answer only 1 mark**

Question 2		[13]



2.1	$x^2 + y^2 = r^2$ $(\sqrt{12})^2 + 2^2 = r^2$ ✓M $12 + 4 = r^2$ $\therefore r^2 = 16$ } ✓A $x^2 + y^2 = 16$ (2)	If $(\sqrt{12})^2 + 2^2 = 16$ only $\frac{1}{2}$ 1M for eq. of the circle 1A for subst.of the pt. into the formula
2.2	✓A ✓A ✓A ✓A P (4; 0) ; T (0;4) (4)	2A each for correct P and T co-ordinates. **NB: If points P and T interchanged then max 2**
2.3	✓A ✓CA $y = 0x + 4$ $y = 4$ **OR** T (0;4) $x x_1 + y y_1 = r^2$ ✓A $0.x + 4.y = 16$ $y = 4$ ✓CA (2)	**If there is no equation(written 4) no mark** **1CA for c and 1A for m = 0** **If x = 4 then 0 marks.**

2.4.1	$m_{RO} = m_{PT}$ ✓M $= \dfrac{0-4}{4-0}$ ✓CA $= -1$ ✓CA (3)	1M for equal gradients PT // RO 1CA for subst. 1CA for value Answer only full marks.
2.4.2	$y = -x + 0 = -x$ ✓A ✓CA (2)	1CA for m 1A for c = 0

Question 3		[19]
3.1 Penalty 1 only for incorrect rounding off in either 3.1.1 or 3.1.2		
3.1.1	cosec 121° − tan 61° = − 0,64 ✓A ✓A (2)	1A for sub. 1A for correct value.
3.1.2	$\cos^2[121° + 2(61°)] = 0{,}21$ ✓A ✓A (2)	1A for sub. 1A for correct value.
3.2.1	$\text{cosec}\ \theta = \dfrac{13}{12} = \dfrac{r}{y}$ ✓A $x^2 + y^2 = r^2$ $x^2 + 12^2 = 13^2$ ✓A $x^2 = 169 - 144$ $= 25$ $\therefore x = -5$ $\therefore \cot\ \theta = -\dfrac{5}{12}$ ✓CA  **OR** $\cot\theta = -\sqrt{\text{cosec}^2\,\theta - 1}$ ✓A $= -\sqrt{(\frac{13}{12})^2 - 1}$ ✓A $= -\sqrt{\frac{25}{144}}$ ✓CA $= -\dfrac{5}{12}$ ✓CA (5)	1A for rewriting the eq. 1M for the diagram 1A for sub. into the eq. of circle  **Minimum requirements for sketch mark** 1CA for correct choice of x(sign −ve) 1CA for value for $\dfrac{x}{r}$ **answer only 1mark** **no sketch 4/5** **wrong sketch wrong answer3/5**

3.2.2	$\tan\theta - \sec\theta = -\frac{12}{5} - (-\frac{13}{5})$ ✓CA ✓CA $= \frac{-12+13}{5}$ ✓CA $= \frac{1}{5}$ ✓A (4)	2CA for sub. 1CA for simplification 1A for value. **answer only 1mark**
3.3	$\frac{\sin(180° + x).\tan 135°}{\text{cosec}(90° - x).\cos(360° - x)}$ $= \frac{(-\sin x).(-1)}{\sec x.\cos x}$ ✓A ✓A ✓A ✓A $= \frac{\sin x}{\frac{1}{\cos x}.\cos x}$ ✓A $= \sin x$ ✓CA (6)	3A's for correct reduction formula 1A for correct value of tan 135° 1A for identity 1CAfor simplification **Answer only full marks.**

Question 4	[12]

4.1	a = −2 ✓A b = 1 ✓A c = 45° ✓A d = 90° ✓A e = −1 ✓A (5)	5A's for correct values Award marks for co-ordinate answers if values clearly identifiable with correct alphabetical values
4.2.1	$x = 0°$ ✓A (1)	1A for correct x-value
4.2.2	$x \in [0°; 90°)$ ✓A ✓CA ✓A or $x \in [0°; d)$ or $0° \le x < 90°$ or $0° \le x < d$ (3)	1A for 0° 1CA for 90° or d Accept $x < 90°$, as domain given 1A for the correct notation
4.2.3	$x \in (45°; 90°)$ ✓CA ✓CA ✓A or $x \in (c; d)$ or $45° < x < 90°$ or $c < x < d$ (3)	2CA's for end values 1A for the correct notation Accept x between 45° and 90°

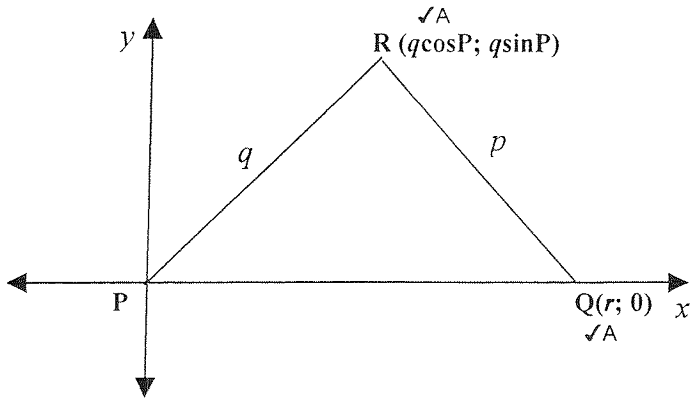
Question 5		[8]

5.1	$(\tan^2\theta + 1)(1 - \sin^2\theta)$ ✓A ✓A $= \sec^2\theta \cdot \cos^2\theta$ ✓A $= \dfrac{1}{\cos^2\theta} \cdot \cos^2\theta$ $= 1$ ✓A **OR** $(\tan^2\theta + 1)(1 - \sin^2\theta)$ ✓A ✓A $= \left(\dfrac{\sin^2\theta}{\cos^2\theta} + 1\right)(\cos^2\theta)$ ✓CA $= \left(\dfrac{\sin^2\theta + \cos^2\theta}{\cos^2\theta}\right) \cdot \cos^2\theta$ or $\sin^2\theta + \cos^2\theta$ $= 1$ ✓A $= 1$ **OR** $(\tan^2\theta + 1)(1 - \sin^2\theta)$ $= \tan^2\theta - \sin^2\theta - \sin^2\theta\tan^2\theta + 1$ $= (\tan^2\theta + 1) - \sin^2\theta(\tan^2\theta + 1)$ ✓A $= \sec^2\theta - \sin^2\theta \cdot \sec^2\theta$ ✓A $= \sec^2\theta(1 - \sin^2\theta)$ ✓A $= \sec^2\theta \cdot \cos^2\theta$ $= 1$ ✓A (4)	3As for identities 1A for simplification. 2A's for identities 1CA for simplification 1A for simplification. no mark for the expansion and grouping 1A for identity 1A for factorising 1A for identity 1A for simplification **answer only max. of 1**
5.2	$\sin 2\alpha = -0{,}4$ ref $\angle = 23{,}578177°$ ✓A ✓A $2\alpha = 180° + \text{ref}\angle$ ✓CA $= 203{,}578177°$ ✓CA $\alpha = 101{,}79°$ (4)	1A for ref ∠ **division by 2 in step 1 or 2 max.2** 1A for correct quadrant 1CA for 2α 1CA for dividing by 2 **answer only full marks**

Question 6	[24]

6.1

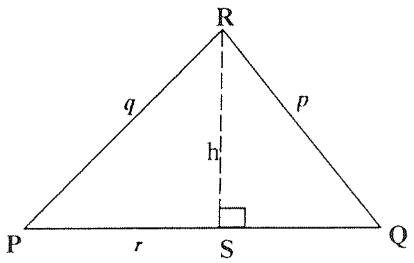
If a wrong sketch is used then full marks if concluded correct and 4/6 if not concluded



1A for coordinates of R
1A for coordinates of Q

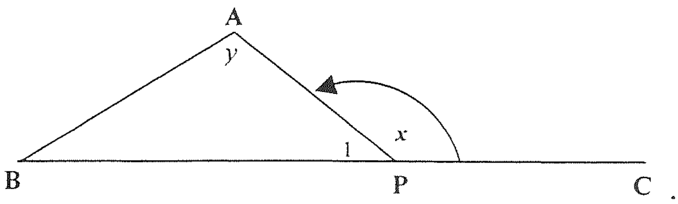
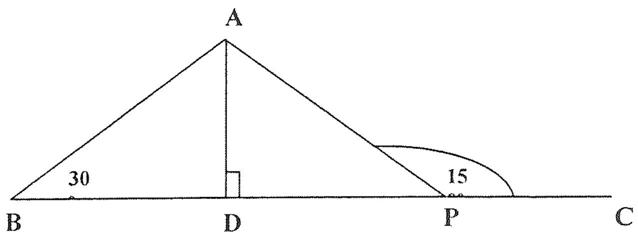
$RQ^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$ ✓M	1M for formula
$RQ^2 = (q\cos P - r)^2 + (q\sin P - 0)^2$ ✓A	1A for sub.
$p^2 = q^2\cos^2 P - 2qr\cos P + r^2 + q^2\sin^2 P$ ✓A	1A for expansion
$= q^2(\cos^2 P + \sin^2 P) + r^2 - 2qr\cos P$ ✓A	1 A for identity
$p^2 = q^2 + r^2 - 2(q)(r)\cos P$	

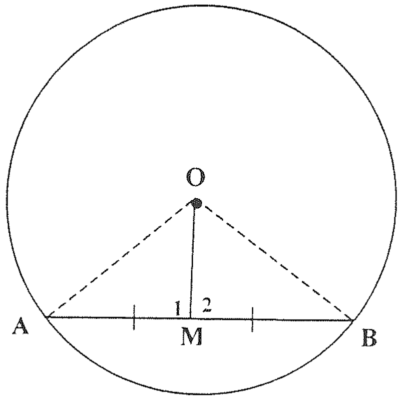
OR

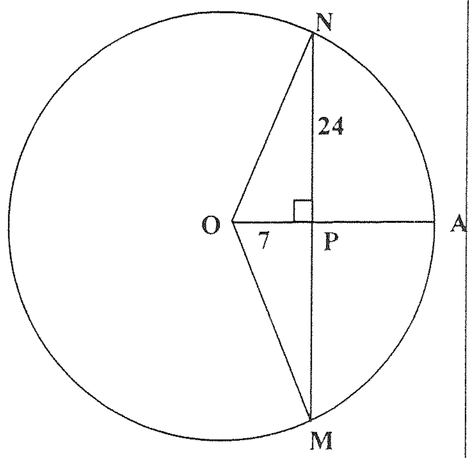
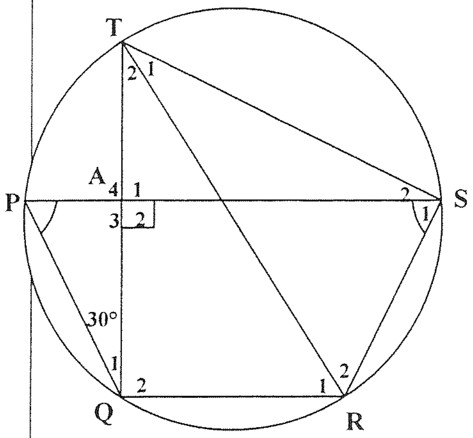


Constr: Draw RS ⊥ PQ ✓M	1M for construction
Proof:	
$p^2 = h^2 + SQ^2$ ✓A	1A for Pythagoras
$= h^2 + (r - PS)^2$	
$= h^2 + r^2 - 2r\,PS + PS^2$ ✓A	1A for expansion
but $h^2 + PS^2 = q^2$ ✓A	1A for Pythagoras
$\cos P = \frac{PS}{q}$ ✓A	1A for cos P
$PS = q\cos P$ ✓A	1 A for manipulation
$p^2 = q^2 + r^2 - 2(q)(r)\cos P$ (6)	

6.2.1	$f^2 = d^2 + e^2 - 2de\cos F$ ✓M $12^2 = 5^2 + 8^2 - 2(5)(8)\cos F$ ✓A $144 = 25 + 64 - 80\cos F$ $144 = 89 - 80\cos F$ $\cos F = \frac{89-144}{80}$ ✓CA $= -0{,}6875$ ref ∠ $= 46{,}567°$ ✓CA $\hat{F} = 133{,}43°$ ✓CA **OR** $\cos F = \frac{d^2 + e^2 - f^2}{2de}$ ✓M $= \frac{5^2 + 8^2 - 12^2}{2(5)(8)}$ ✓A $= -\frac{55}{80}$ ✓CA $= -0{,}6875$ ref ∠ $= 46{,}567°$ ✓CA $\hat{F} = 133{,}43°$ ✓CA (5)	1M for formula or it is implied 1A for sub. 1CA cosF 1CA for ref ∠ 1CA for angle. 1M for formula or it is implied 1A for sub. 1CA cos F 1CA for ref ∠ 1CA for angle **answer only full marks**
6.2.2	Area of ΔDEF $= \frac{1}{2} de \sin F$ ✓M $= \frac{1}{2}(5)(8)\sin 133{,}43°$ ✓CA $= 14{,}52$ square units ✓CA (3)	1M for formula or if implied 1CA for sub. 1CA for value

6.3.1	$A\hat{P}B = 180° - x$ ✓A (1)	1A	
6.3.2	$\frac{AB}{\sin A\hat{P}B} = \frac{BP}{\sin A}$ ✓M $\frac{AB}{\sin(180° - x)} = \frac{BP}{\sin A}$ ✓A $\therefore AB = \frac{BP}{\sin y}.\sin(180° - x)$ ✓CA $= \frac{BP\ .\sin x}{\sin y}$ ✓A (4)	1 M for sine rule or if implied 1A for sub. 1CA for manipulation 1A for reduction	
6.3.3	$AB = \frac{BP\ .\sin x}{\sin y}$ ✓A $= \frac{50.\sin 150°}{\sin 120°}$ ✓A $= \frac{50.\frac{1}{2}}{\frac{\sqrt{3}}{2}}$ ✓A ✓A $= \frac{50}{\sqrt{3}}$ ✓CA **OR** Draw AD ⊥ BP ✓M $\therefore\ BD = \frac{BP}{2}$ (isosceles Δ) ✓A $\therefore \frac{AB}{25} = \sec 30°$ ✓A $AB = \frac{25}{\cos 30°}$ $= \frac{25}{\frac{\sqrt{3}}{2}}$ ✓A $= \frac{50}{\sqrt{3}}$ ✓CA (5)	1A for sub. 1A for y 2A for surds if surds are not shown max 3 1CA for simplification  answer only full marks	

Question 7		[22]
7.1	Const: Join OA and OB ✓M Proof: In Δ AOM and Δ BOM AM = MB (given) OA = OB ✓S (radii) OM = OM (common side) Δ AOM $\equiv$ Δ BOM (SSS) ✓R $\therefore \hat{M}_1 = \hat{M}_2$ ($\equiv$) ✓S $\therefore \hat{M}_1 = \hat{M}_2 = 90°$ (adj. $\angle$s on a str.line) ✓S/R $\therefore$ OM $\perp$ AB **OR** Const: Join OA and OB✓M Proof: In Δ AOM and Δ BOM AM = MB (given) OM = OB ✓S (radii) $\hat{A} = \hat{B}$ ($\angle$ s opp = sides) Δ AOM $\equiv$ Δ BOM (S$\angle$S)✓R $\therefore \hat{M}_1 = \hat{M}_2$ ($\equiv$) ✓S $\therefore \hat{M}_1 = \hat{M}_2 = 90°$ (adj. $\angle$s on a str.line) ✓S/R $\therefore$ OM $\perp$ AB (5)	

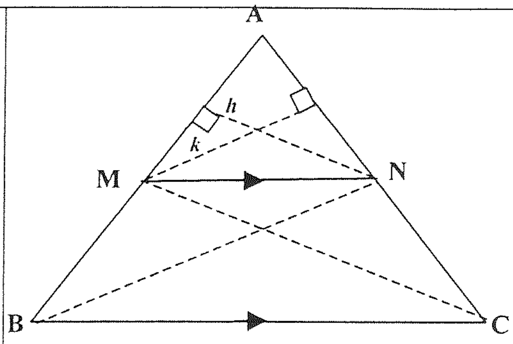
7.2	PN = PM = 24 units ✓S ($\perp$ line from centre to chord.) ✓R $\therefore ON = \sqrt{OP^2 + PN^2}$ ✓S or $OM = \sqrt{OP^2 + PM^2}$ $= \sqrt{7^2 + 24^2}$ $= \sqrt{625}$ = 25 units ✓CA PA = (25 – 7) units = 18 units ✓CA (5)	 Answer only 4/5
7.3.1	$\hat{P} = 60°$ ✓S (sum $\angle$ s in a Δ) $\hat{S}_1 = \hat{P} = 60°$ ✓S (given) $Q\hat{T}S = \hat{P} = 60°$ ✓S ($\angle$ s in the same segment) ✓R **OR** $\hat{Q}_1 = \hat{S}_2 = 30°$ ($\angle$ s in the same segment) $\therefore Q\hat{T}S = 60°$ ✓S (sum $\angle$ s in a Δ) $\hat{P} = 60°$ ✓S ($\angle$ s in the same segment) ✓R $\hat{S}_1 = \hat{P} = 60°$ ✓S (given) (4)	

7.3.2	$Q\hat{R}S = 120°$ ✓S (opp ∠s of a cyclic quad.) ✓R (2)	
7.3.3	$\hat{S}_1 + Q\hat{R}S = 180°$ ✓S $\therefore PS \parallel QR$ (co-interior ∠ s, supplementary) ✓R **OR** $P\hat{Q}R = 120°$ (opp. ∠ s of a cyclic quad.) $\hat{P} + P\hat{Q}R = 180°$ ✓S $\therefore PS \parallel QR$ (co-interior ∠ s supplementary) ✓R **OR** $\hat{Q}_2 + T\hat{S}R = 180°$ (opp ∠ s of a cyclic quad.) $\therefore \hat{Q}_2 = 90°$ ✓S $\hat{A}_1 = \hat{Q}_2 = 90°$ or $\hat{A}_2 = \hat{Q}_2 = 90°$ ✓R (co-int ∠ s supplementary) $\therefore PS \parallel QR$ (corr. ∠ s equal) ✓R (2)	or $\hat{A}_3 = \hat{Q}_2 = 90°$ (alt. ∠ s equal) ✓R
7.3.4	$\hat{A}_1 = \hat{Q}_2$ ✓S/R (corr. ∠ s ,lines ||) $\therefore \hat{Q}_2 = 90°$ ✓S $\therefore$ TR is a diameter. (chord sub. 90° at the circum.) ✓R /(converse ∠ in semi-circle) **OR** $\hat{S}_2 = \hat{Q}_1$ (∠ s in the same segment) ✓S/R $= 30°$ $\hat{S}_1 + \hat{S}_2 = 30° + 60°$ $= 90°$ ✓S $\therefore$ TR is a diameter. (chord sub. 90° at the circum.) ✓R /(converse ∠ in semi-circle) (3)	

Question 8		[13]

8.1

Const: Join MC and BN. (**or** shown on sketch) ✓M



$$\frac{\text{Area of } \Delta\ AMN}{\text{Area of } \Delta\ BMN} = \frac{\frac{1}{2}AM.h}{\frac{1}{2}MB.h} \quad ✓S \ ✓S$$ or same height

$$= \frac{AM}{MB} \quad ✓S$$

$$\frac{\text{Area of } \Delta\ AMN}{\text{Area of } \Delta\ CMN} = \frac{\frac{1}{2}AN.k}{\frac{1}{2}NC.k} \quad ✓S$$ or same height

$$= \frac{AN}{NC} \quad ✓S$$

✓S/R

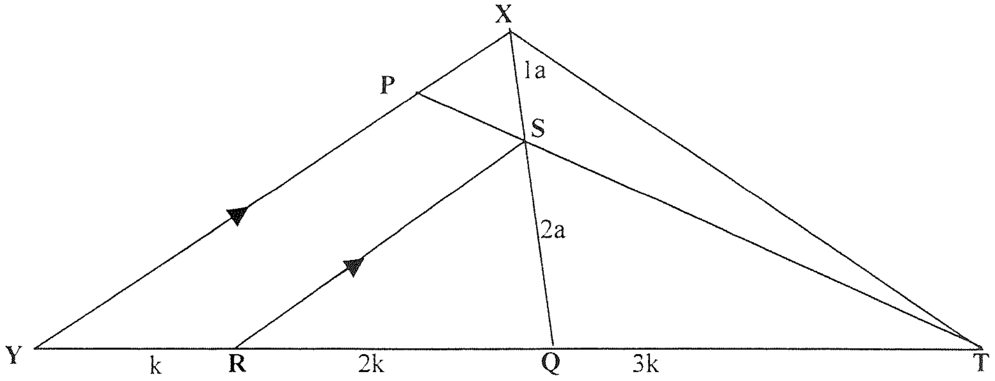
Area of Δ BMN = Area of Δ CMN
(same base, same height)

$$\therefore \frac{\text{Area of } \Delta\ AMN}{\text{Area of } \Delta\ BMN} = \frac{\text{Area of } \Delta\ AMN}{\text{Area of } \Delta\ CMN}$$

$$\therefore \frac{AM}{MB} = \frac{AN}{NC}$$

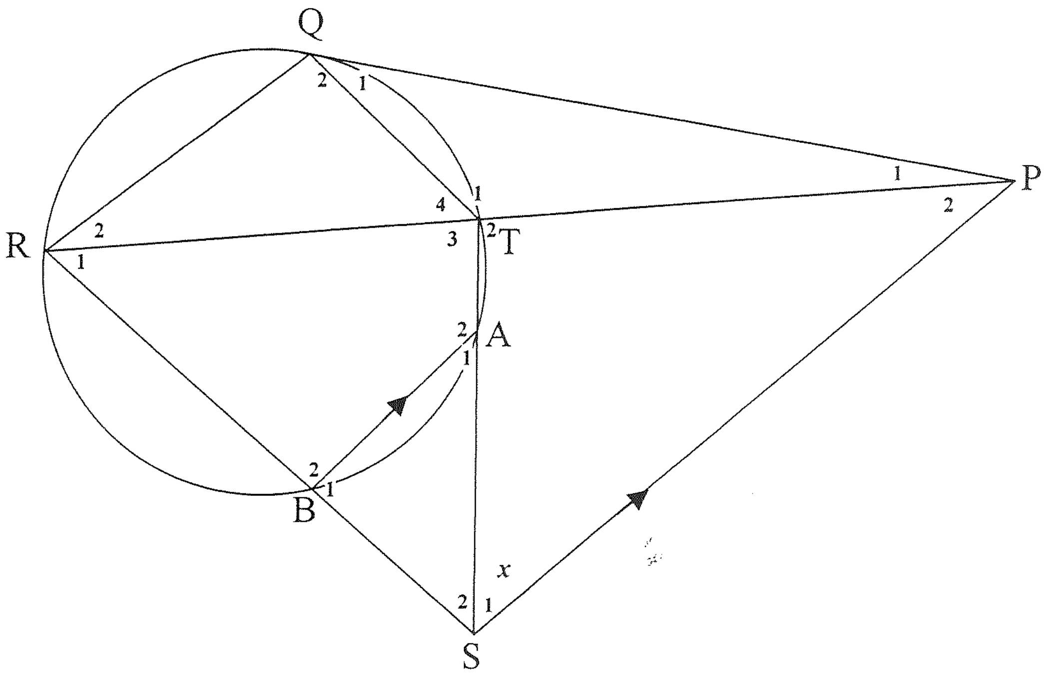
(7)

Area of can be omitted

8.2	

8.2.1	In Δ XYQ, RS ∥ YP $\frac{YR}{RQ} = \frac{XS}{SQ}$ ✓S (line ∥ to one side of a Δ) ✓R $= \frac{1}{2}$ ✓A (3)	Answer only 2/3
8.2.2	YR = k ; RQ = 2k $\therefore$ QT = 3k ✓S In Δ TYP, RS ∥ YP $\frac{TS}{TP} = \frac{TR}{TY}$ ✓S (line ∥ to one side of a Δ) ✓R $= \frac{5k}{6k} = \frac{5}{6}$ ✓CA **OR** $\frac{TS}{TP} = \frac{TR}{TY}$ ✓S (line ∥ to one side of a Δ) ✓R TR = 5k TY = 6k $\therefore \frac{TS}{TP} = \frac{5k}{6k} = \frac{5}{6}$ ✓S ✓CA (4)	Answer only 3/4

Question 9		[14]



9.1	$\hat{A}_1 = \hat{S}_1$ ✓S (alt ∠s, lines ‖) $= x$ $\hat{A}_1 = \hat{R}_1$ ✓S (ext ∠ of a cyclic quad) ✓R $= x$ (3)	
9.2	$\hat{P}_2 = \hat{P}_2$ ✓S (common) $\hat{S}_1 = \hat{R}_1$ ✓S (proved in 9.1) $\hat{T}_2 = \hat{S}_1 + \hat{S}_2$ (sum ∠s of a Δ) ∴ Δ PTS ||| Δ PSR (∠ ∠ ∠) ✓S/R **OR** $\hat{P}_2 = \hat{P}_2$ ✓S $\hat{T}_2 = \hat{B}_2$ (ext ∠ of a cyclic quad) } ✓S/R $= \hat{S}_1 + \hat{S}_2$ (corr. ∠s, lines ‖) $\hat{S}_1 = \hat{R}_1$ (sum ∠s of a Δ) ∴ Δ PTS ||| Δ PSR (∠ ∠ ∠) ✓S/R (3)	

9.3.1	$\hat{P}_1 = \hat{P}_1$ ✓S (Common) $\hat{Q}_1 = \hat{R}_2$ ✓S (tan-chord) ✓R $\hat{T}_1 = \hat{Q}_1 + \hat{Q}_2$ (sum ∠s of a Δ) $\therefore \Delta PQT \,\|\|\|\, \Delta PRQ$ (∠ ∠ ∠) ✓S/R (4)	
9.3.2	$\therefore \frac{PQ}{PR} = \frac{PT}{PQ}$ ✓S (Δs |||) $\therefore PQ^2 = PR \,.\, PT$............(1) (1)	
9.4	$\therefore \frac{PT}{PS} = \frac{PS}{PR}$ ✓S/R (Δs ||| from9.2) $\therefore PS^2 = PR \,.\, PT$ ✓S .... (2) From 1 and 2 $PQ^2 = PS^2$ ✓S $\therefore PQ = PS$ (3)	

TOTAL:150