education

Department:
Education
PROVINCE OF KWAZULU-NATAL

NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICS P2

PREPARATORY EXAMINATION

SEPTEMBER 2019

MARKS: **150**

TIME: **3 hours**

This question paper consists of 13 pages, Information Sheet and an answer book with 20 pages.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 10 questions.

2. Answer **ALL** questions.

3. Clearly show **ALL** calculations, diagrams, graphs, et cetera that you have used in determining your answers.

4. Answers only will not necessarily be awarded full marks.

5. An approved scientific calculator (non-programmable and non-graphical) may be used, unless stated otherwise.

6. If necessary, answers should be rounded off to TWO decimal places, unless stated otherwise.

7. Diagrams are NOT necessarily drawn to scale.

8. Number the answers correctly according to the numbering system used in this question paper. Write neatly and legibly.

QUESTION 1

1. The following information represents the amount of maize exported to other countries over 11 years in 1000 tons.

39	42	48	54	62	68	78	78	82	91	93

1.1 Calculate the mean amount of maize exported over the 11 years. (2)

1.2 Calculate the standard deviation of the data. (2)

1.3 Calculate the number of years that are within one standard deviation of the mean. (2)

1.4 Draw a box and whisker diagram to represent the data. (4)

1.5 Comment on the skewness of the data. (1)

1.6 There was an error in the data. The mean amount of maize exported over the 11 years should increase by 1,25 thousands of tons. What impact will this error have on the:

1.6.1 yearly data provided in the above table? (1)

1.6.2 on the interquartile range of the given data above? (1)

[13]

QUESTION 2

The following information (in %) represent contributions made by the Agricultural and Mining industries in order to evaluate the GDP(GROSS DOMESTIC PRODUCT) of a certain country.

YEAR	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Agriculture (x)	4.2	3,4	3,1	2,7	2,9	3,0	2,9	3,0	2,6	2,5	2,6
Mining (y)	19,2	19,4	19,2	18,5	17,5	17,0	16,8	15,2	14,2	12,8	12,4

2.1 Determine the equation of the least squares regression line. (3)

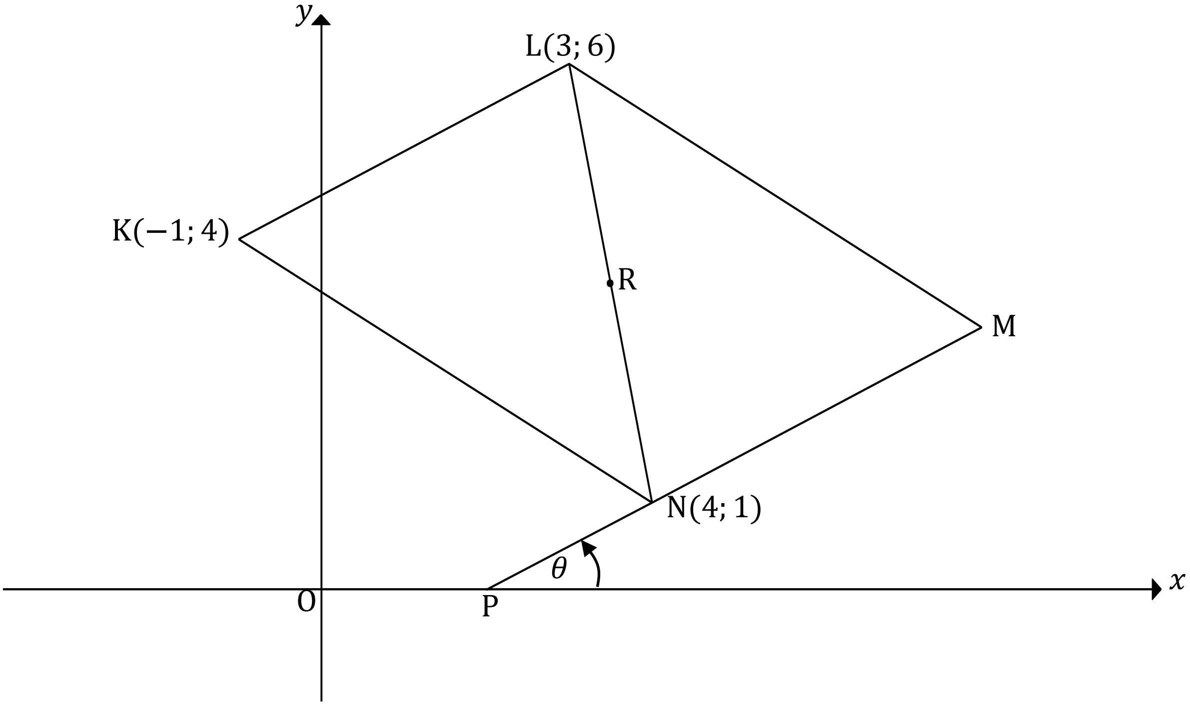
2.2 Estimate the percentage that the mining industry will contribute if the agriculture industry dropped to 1,2 %. (2)

2.3 Comment on the strength of the correlation between the contributions made by these two industries. Motivate your answer. (2)

[7]

QUESTION 3

In the diagram, K (–1 ; 4) ; L(3 ; 6); M and N(4 ; 1) are vertices of a parallelogram. R is the midpoint of LN. P is the x-intercept of the line MN produced.



3.1 Calculate the:

3.1.1 gradient of KL. (2)

3.1.2 coordinates of R. (3)

3.1.3 coordinates of M. (4)

3.2 Determine the equation of NM in the form $y = mx + c$. (3)

3.3 Calculate the:

3.3.1 coordinates of P. (2)

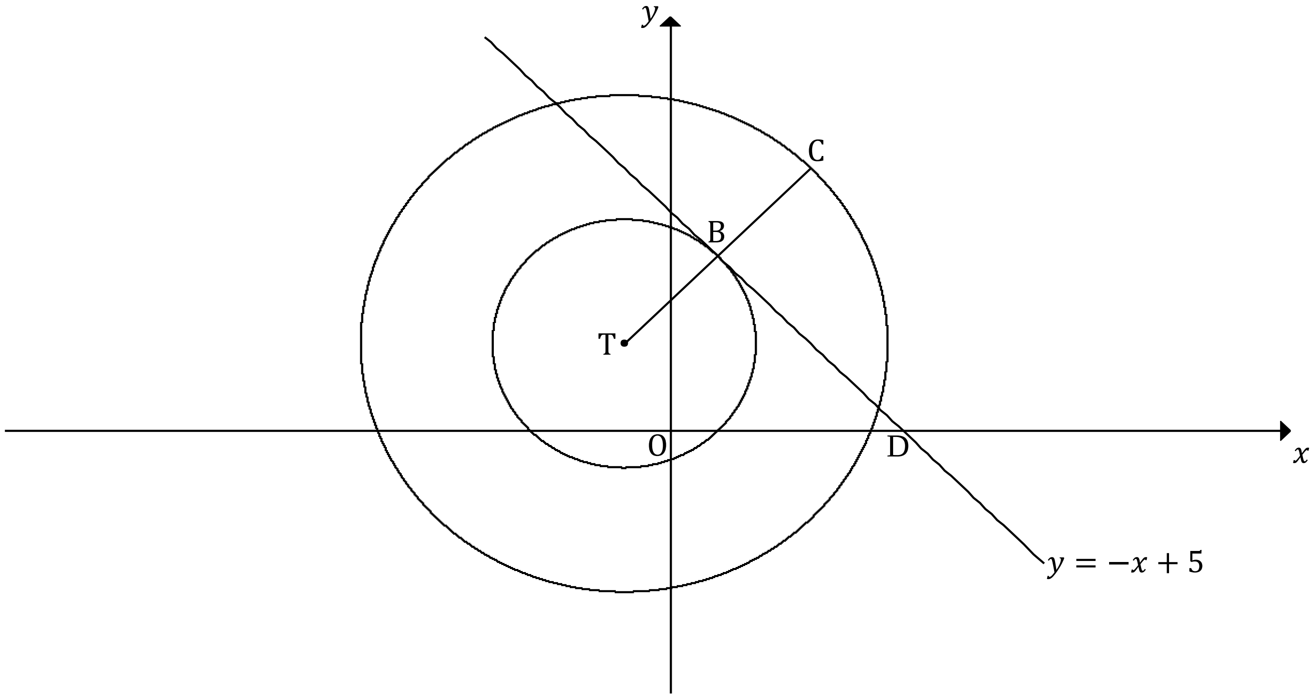
3.3.2 size of Θ , the inclination of PM. (2)

3.3.3 size of $K\hat{P}N$. (4)

[20]

QUESTION 4

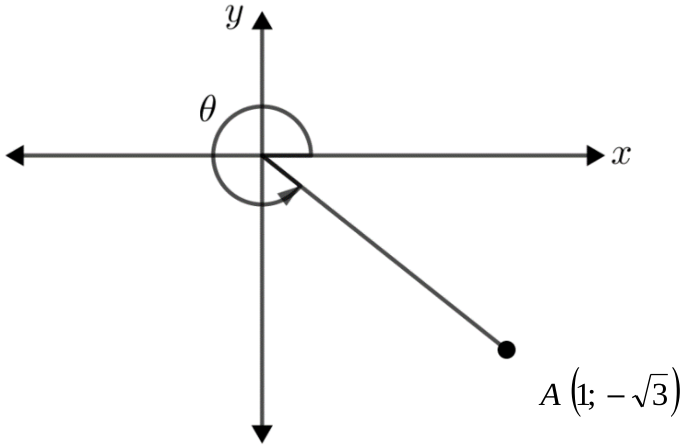
In the diagram, T is the centre of two concentric circles. The larger circle has equation $x^2 + y^2 - 4y + 2x - 27 = 0$. The smaller circle touches the straight line $y = -x + 5$ at point B. BD is a tangent to smaller circle T. D is the x- intercept of the straight line. C is a point on the larger circle such that TBC is a straight line.



4.1	Calculate the coordinates of T.	(4)
4.2	Show that equation of TB is given by $y = x + 3$.	(3)
4.3	Calculate the coordinates of B	(3)
4.4	Determine the equation of the smaller circle in the form $(x - a)^2 + (y - b)^2 = r^2$.	(3)
4.5	Calculate the area of quadrilateral OTBD.	(7)
		[20]

QUESTION 5

5.1 Use the diagram below to calculate, **without the use of a calculator,** the following



5.1.1 $\tan\theta$ (1)

5.1.2 $\sin(-\theta)$ (3)

5.1.3 $\sin(\theta - 60°)$ (4)

5.2 Determine the value of the following trigonometric expression:

$$\frac{\tan(180° - \theta)\sin(90° + \theta)}{\cos 300° \sin(\theta - 360°)}$$ (6)

5.3 Consider: $\frac{\cos 2x - 1}{\sin 2x} = -\tan x$

5.3.1 Prove the identity (3)

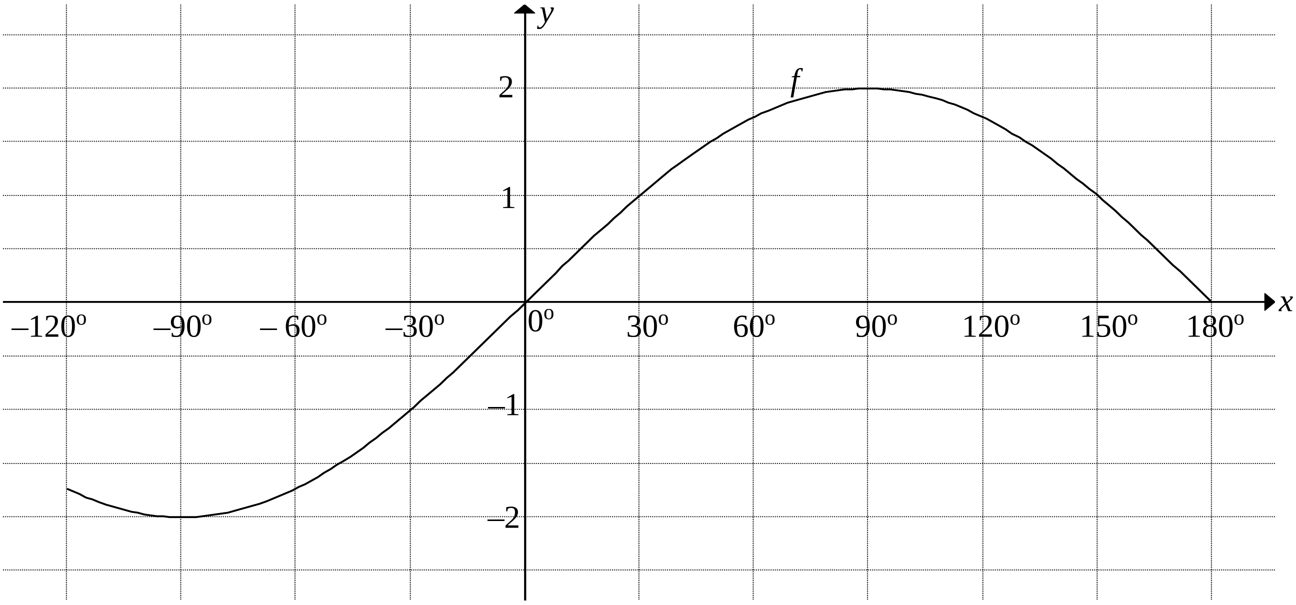
5.3.2 For which value(s) of x , $0° < x < 360°$, is this identity undefined? (3)

5.3.3 Hence or otherwise, find the general solution of $\frac{\sin 4x}{\cos 4x - 1} = 4$. (4)

[24]

QUESTION 6

In the diagram below, the graph of $f(x) = 2\sin x$ is drawn for the interval $x \in [-120° \,;\, 180°]$.



6.1 Draw on the same system of axes the graph of $g(x) = \cos(x + 30°)$, for the interval $x \in [-120° \,;\, 180°]$. Show all intercepts with the axes as well as the turning and end Points of the graph. (4)

6.2 Write down the period of *f*. (1)

6.3 For which values of *x* in the interval $x \in [-120° \,;\, 180°]$ is:

6.3.1 The graph of g decreasing? (2)

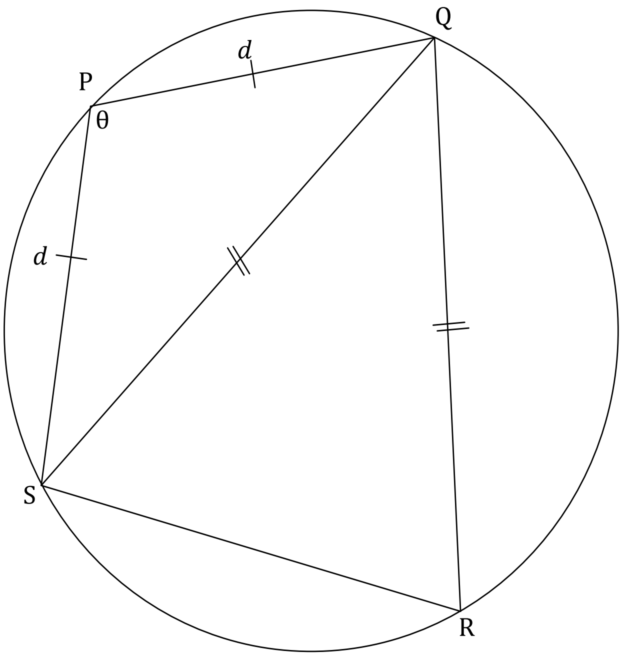
6.3.2 $f(x).\, g(x) > 0$? (2)

6.4 If the graph of *g* is moved 60° to the left, determine the equation of the new graph which is formed, in its simplest form. (2)

[11]

QUESTION 7

In the diagram, PQRS is a cyclic quadrilateral with QS = QR and PQ = PS = d units. $Q\hat{P}S = \theta$.



Use the diagram to prove that:

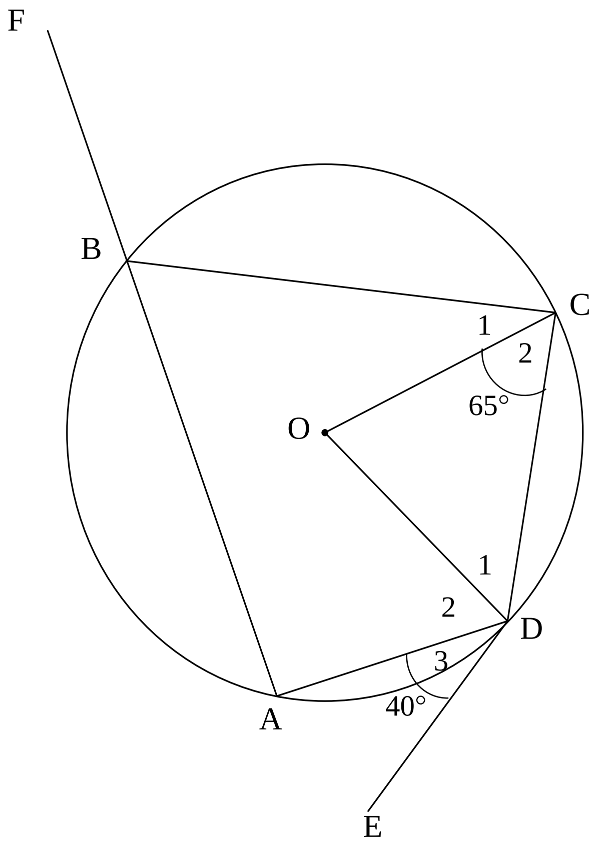
7.1. $QS = d\sqrt{2(1-\cos\theta)}$ (2)

7.2 The area of $\Delta QRS = -d^2 \sin 2\theta\,(1-\cos\theta)$ (3)

[5]

QUESTION 8

8.1 In the diagram, ABCD is a cyclic quadrilateral in the circle centered at O. ED is a tangent to the circle at D. Chord AB is produced to F. Radii OC and OD are drawn. $A\hat{D}E = 40°$ and $\hat{C}_2 = 65°$,

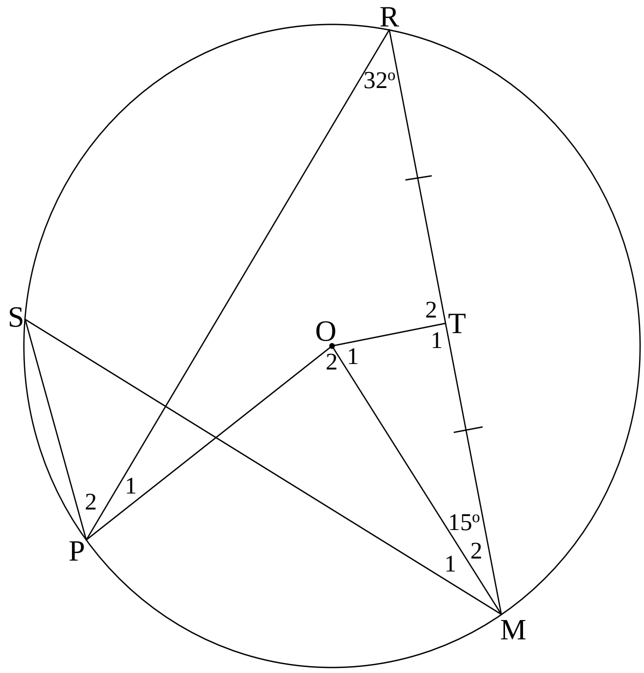


Determine, giving reasons, the size of each of the following angles:

8.1.1 $\hat{D}_2$ (3)

8.1.2 $F\hat{B}C$ (4)

8.2 In the diagram, O is the centre of the circle RMPS. OT bisects RM with T a point on RM. $P\hat{R}M = 32°$. SP, SM and radii OP and OM are drawn. $O\hat{M}T = 15°$.



Calculate, with reasons, the size of the angles:

8.2.1 $\hat{S}$ (2)

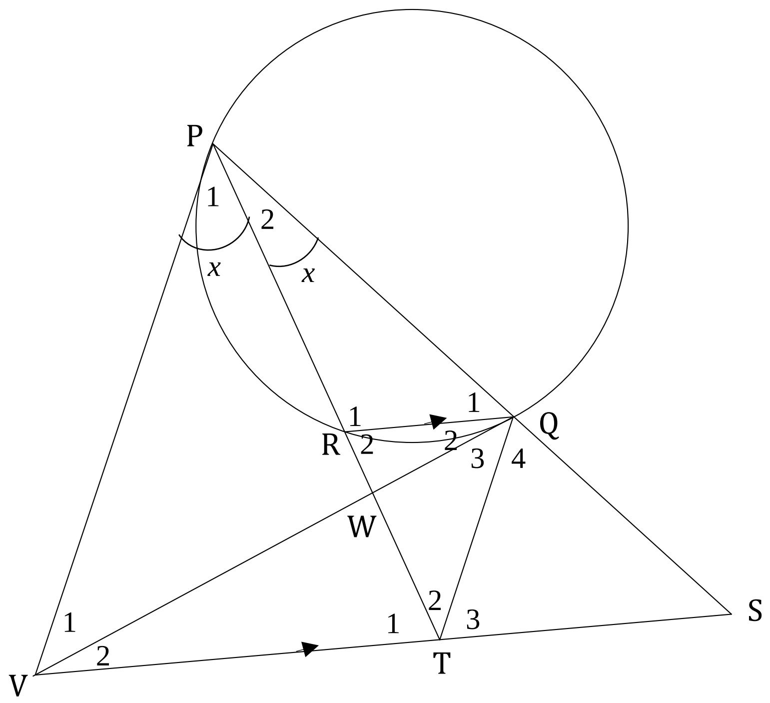
8.2.2 $\hat{O}_2$ (2)

8.2.3 $\hat{O}_1$ (3)

[14]

QUESTION 9

In the diagram, PV and VQ are tangents to the circle at P and Q. PQ is produced to S and chord PR is produced to T such that VTS || RQ. VQ and RT intersect at W. $\hat{P}_1 = \hat{P}_2 = x$.



Prove that:

9.1 $\hat{S} = x$ (4)

9.2 PQTV is a cyclic quadrilateral (5)

9.3 TQ is a tangent to the circle passing through Q, W and P (3)

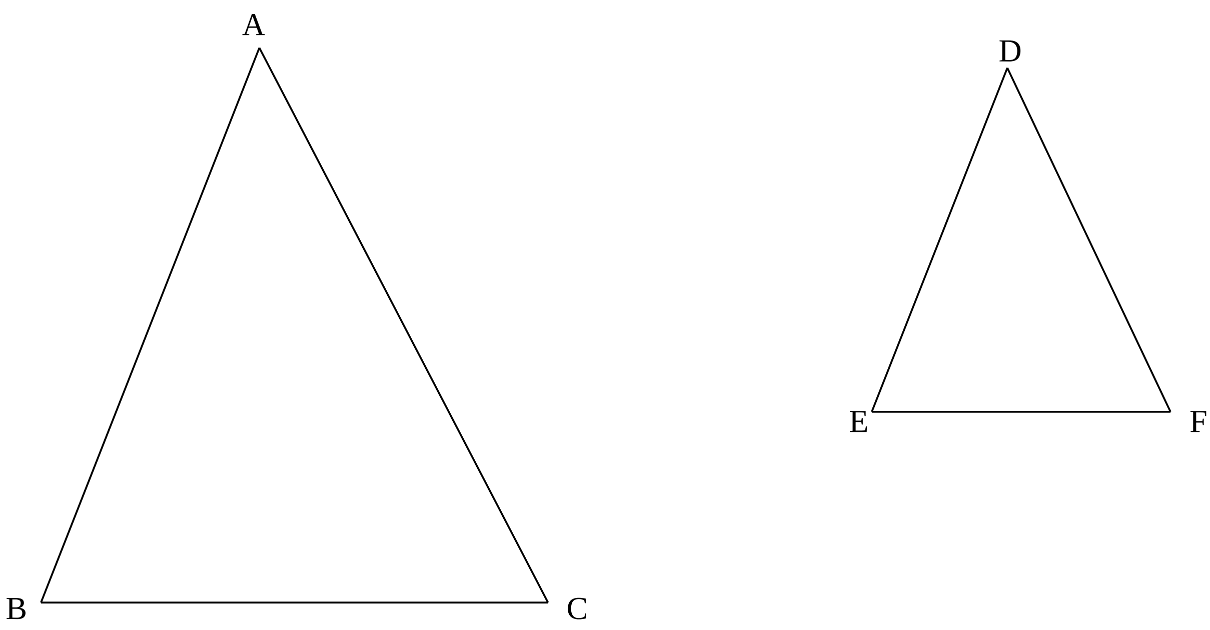
[12]

QUESTION 10

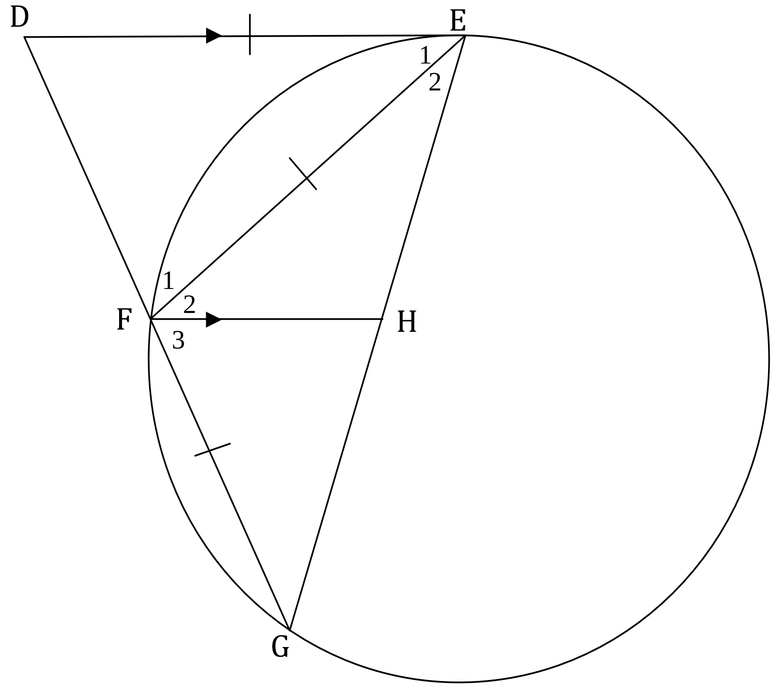
10.1 In the diagram below, ΔABC and ΔDEF are drawn with $\hat{A} = \hat{D}$, $\hat{B} = \hat{E}$ and $\hat{C} = \hat{F}$.

Prove the theorem that states that equiangular triangles are similar and therefore

$\frac{AB}{DE} = \frac{AC}{DF}$. (7)



10.2 In the diagram, DE is a tangent to the circle at E and DFG is a secant intersecting the circle at F and G. DE = EF = FG. H is a point on EG such that FH || DE.



10.2.1 Determine, giving reasons, 3 angles each equal to $D\hat{E}F$. (4)

10.2.2 Prove that:

a) $\Delta DEF \,|||\, \Delta DGE$ (3)

b) $\hat{D} = 72^0$. (5)

10.2.3 If it is further given that DF = *k* units and FG = 2 units, prove that $k^2 + 2k = 4$. (3)

10.2.4 Determine, giving reasons, the ratio of $\frac{GH}{GE}$ in terms of *k*. (2)

[24]

TOTAL MARKS: 150

INFORMATION SHEET

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$A = P(1+ni)$ $A = P(1-ni)$ $A = P(1-i)^n$ $A = P(1+i)^n$

$T_n = a + (n-1)d$ $S_n = \frac{n}{2}[2a + (n-1)d]$

$T_n = ar^{n-1}$ $S_n = \frac{a(r^n - 1)}{r-1}$; $r \neq 1$ $S_\infty = \frac{a}{1-r}$; $-1 < r < 1$

$F = \frac{x[(1+i)^n - 1]}{i}$ $P = \frac{x[1-(1+i)^{-n}]}{i}$

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ $M\left(\frac{x_1 + x_2}{2}; \frac{y_1 + y_2}{2}\right)$

$y = mx + c$ $y - y_1 = m(x - x_1)$ $m = \frac{y_2 - y_1}{x_2 - x_1}$ $m = \tan\theta$

$(x-a)^2 + (y-b)^2 = r^2$

InΔABC: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

$a^2 = b^2 + c^2 - 2bc.\cos A$

$area\Delta ABC = \frac{1}{2}ab.\sin C$

$\sin(\alpha + \beta) = \sin\alpha.\cos\beta + \cos\alpha.\sin\beta$ $\sin(\alpha - \beta) = \sin\alpha.\cos\beta - \cos\alpha.\sin\beta$

$\cos(\alpha + \beta) = \cos\alpha.\cos\beta - \sin\alpha.\sin\beta$ $\cos(\alpha - \beta) = \cos\alpha.\cos\beta + \sin\alpha.\sin\beta$

$$\cos 2\alpha = \begin{cases} \cos^2\alpha - \sin^2\alpha \\ 1 - 2\sin^2\alpha \\ 2\cos^2\alpha - 1 \end{cases}$$

$\sin 2\alpha = 2\sin\alpha.\cos\alpha$

$\bar{x} = \frac{\sum f.\ x}{n}$ $\sigma^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}$

$P(A) = \frac{n(A)}{n(S)}$ $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$ $\hat{y} = a + bx$

$$b = \frac{\sum(x - \bar{x})(y - \bar{y})}{\sum(x - \bar{x})^2}$$

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MARKING GUIDELINE

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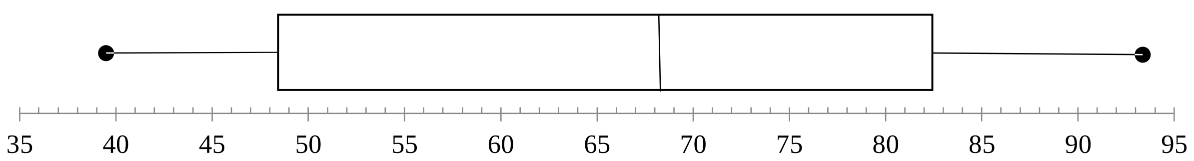
This memorandum consists 15 of pages.

QUESTION 1

39	42	48	54	62	68	78	78	82	91	93

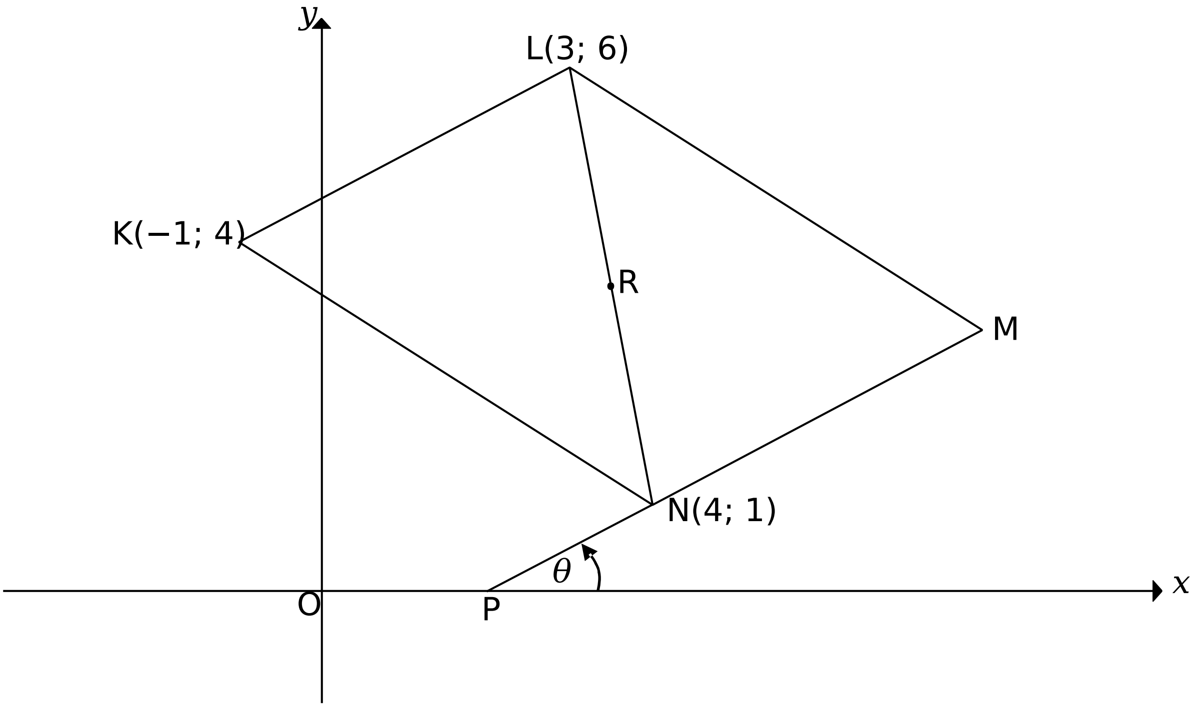
1.1	$\bar{x}$= 66,82 or 66,82 thousands	A ✓calculation CA ✓ answer	(2)
1.2	σ = 18,3	AA ✓✓answer If formula is used CA will apply.	(2)
1.3	($\bar{x}$ − σ; $\bar{x}$+ σ) = (48,52 ; 85,12) ∴ 6 countries	CA✓ substitution CA✓ answer	(2)
1.4	 A✓min & max values A✓quartile 1 value A✓median value & form A✓quartile 3 value		(4)
1.5	The data is skewed to the left/negatively skewed	CA✓answer	(1)
1.6.1	The sum of the data provided for the years must increase.	A✓answer	(1)
1.6.2	IQR will remain the same or change.	A✓answer (both same or change)	(1)
			[13]

QUESTION 2

YEAR	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Agriculture (x)	4.2	3,4	3,1	2,7	2,9	3,0	2,9	3,0	2,6	2,5	2,6
Mining (y)	19,2	19,4	19,2	18,5	17,5	17,0	16,8	15,2	14,2	12,8	12,4

2.1	$a = 5,65$ and $b = 3,65$ $y = 5,65 + 3,65x$	A✓ a – value A✓ b – value CA✓ equation	(3)
2.2	$y = 5,65 + 3,65x$ $= 5,65 + 3,65(1,2)$ $= 10,03\%$	A✓ substitution of 1,2 CA✓ answer	(2)
2.3	strong positive correlation of the data r = 0,7	CA✓ strong positive A✓ value of correlation coefficient	(2)
			[7]

QUESTION 3



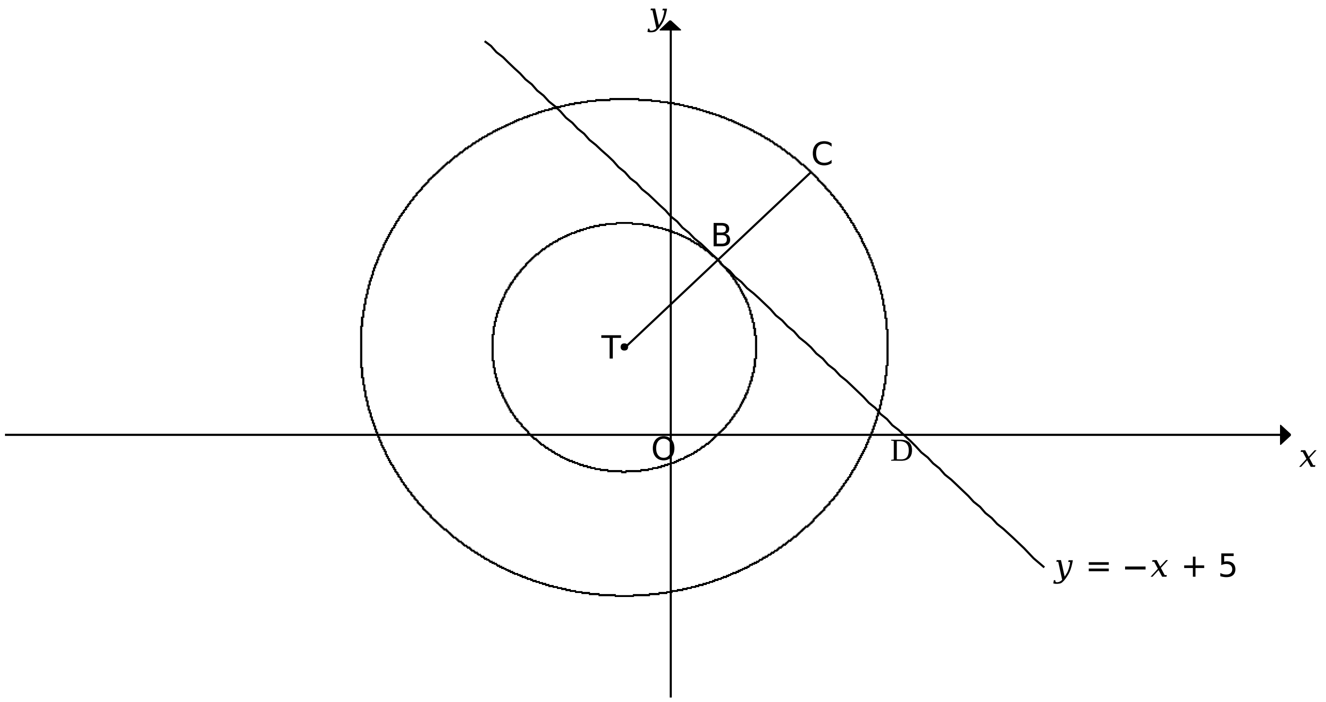
3.1

3.1.1	$m_{KL} = \frac{6-4}{3-(-1)}$ $= \frac{2}{4}$ or $\frac{1}{2}$ answer only: full marks	A✓ substitution in the correct formula CA✓ answer	(2)
3.1.2	midpoint of R : $\left(\frac{x_N + x_L}{2}; \frac{Y_N + Y_L}{2}\right)$: $\left(\frac{3+4}{2}; \frac{6+1}{2}\right)$ R $\left(\frac{7}{2}; \frac{7}{2}\right)$ answer only: full marks	A✓ substitution in the correct formula CA✓ x CA✓ y	(3)
3.1.3	co-ordinates of M: $\frac{x-1}{2} = \frac{7}{2}$ $x - 1 = 7 \quad \therefore x = 8$ $\frac{y+4}{2} = \frac{7}{2}$ answer only: full marks $y = 7 - 4 \quad \therefore y = 3$ $\therefore$ M $(8; 3)$	CA✓ $\frac{x-1}{2} = \frac{7}{2}$ CA✓ $\frac{y+4}{2} = \frac{7}{2}$ CA✓ x CA ✓y	(4)
3.2	The equation of NM $m_{NM} = \frac{1}{2}$ [NM ǁ KL] $y - y_1 = m(x - x_1)$ $y - 1 = \frac{1}{2}(x - 4)$ $y = \frac{1}{2}x - 2 + 1 \therefore y = \frac{1}{2}x - 1$	CA✓ gradient CA✓ correct subst. of m and N(4 ; 1) CA✓ equation	(3)

3.3

3.3.1	$0=\frac{1}{2}x-1$ $x=2$ $\therefore$ P (2; 0) answer only: full marks	A✓ y = 0 CA✓ x	(2)
3.3.2	$\tan\theta=\frac{1}{2}$ $\theta = 26{,}57^{o}$ answer only: full marks	CA✓ $\tan\theta=m$ CA✓ answer	(2)
3.3.3	$m_{KP}=\frac{0-4}{2-(-1)}=-\frac{4}{3}$ $\tan^{-1}\left(\frac{-4}{3}\right)=180^\circ-53{,}13^\circ=126{,}87^\circ$ $K\hat{P}N=126{,}87^\circ-26{,}57^\circ$ $=100{,}3^\circ$	CA✓ m_{KP} CA✓ inclination of KP A✓ method CA✓ answer	(4)
			[20]

QUESTION 4



4.1.	$x^2 + 2x + y^2 - 4y = 27$ $x^2 + 2x + 1 + y^2 - 4y + 4 = 27 + 1 + 4$ $(x+1)^2 + (y-2)^2 = 32$ $\therefore$ T (–1; 2) **OR** $x = \frac{2}{-2} = -1$ $y = \frac{-4}{-2} = 2$	A✓ completing square LHS A✓ LHS CA✓ x CA✓ y AA✓✓ x AA✓✓ y	(4) (4)
4.2	$m_{TB} \times m_{BD} = -1$ [tangent ⊥ radius] $m_{TB} = 1$ $y = mx + c$ $2 = 1 . (-1) + c$ $\therefore c = 3$ $\therefore$ Equation of TB is $y = x + 3$	A✓ $m_{TB} = 1$ A✓ subst of m and T A✓ value of c	(3)
4.3	equating TB and BD: $x + 3 = -x + 5$ $2x = 2$ $x = 1$ $y = 1 + 3$ *or* $y = -1 + 5$ $\therefore$B(1 ; 4)	A✓equating CA✓ $x = 1$ CA✓ $y = 4$ CA provided first quadrant.	(3)

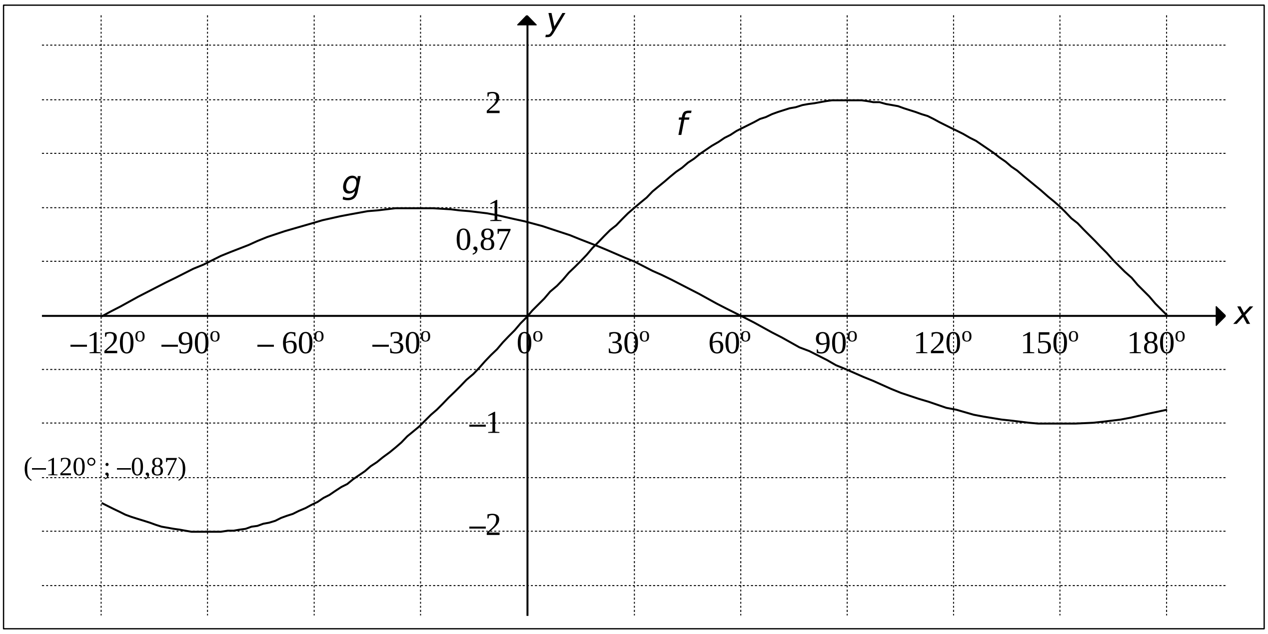
4.4	$(x+1)^2+(y-2)^2=r^2$ $(1+1)^2+(4-2)^2=r^2$ $8=r^2$ $(x+1)^2+(y-2)^2=8$	CA✓ subst T in circle eq CA ✓ subst B CA✓equation	(3)
4.5	Draw a horizontal line TE with E on BD: Point D(5 ; 0) and Point E: $2=-x+5$ $\therefore$ E(3 ; 2) $\text{Area of trap TEDO}=\frac{1}{2}(\text{TE}+\text{OD})\times\perp h$ $=\frac{1}{2}(4+5)\times 2$ $=9$ units $\text{Area of }\Delta\text{TBE}=\frac{1}{2}(\text{TB}\times\text{BE})$ $=\frac{1}{2}(\sqrt{8})(\sqrt{8})$ $=4$ units Area of OTBD = 9 + 4 = 13 units^2	A✓ coordinates of D CA✓coordinates of E CA✓ length of TE CA✓ subst in area of trap CA✓subst in correct area of Δ formula A✓ method CA✓ answer	(7)
			[20]

QUESTION 5

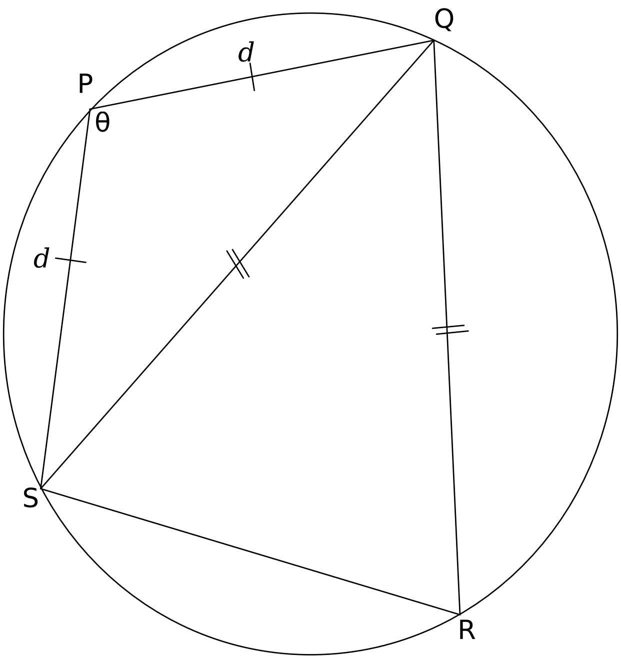
5.1.1	$\tan\theta = \frac{-\sqrt{3}}{1} = -\sqrt{3}$	A✓ answer	(1)
5.1.2	$r^2 = (1)^2 + (-\sqrt{3})^2$ Pyth $r^2 = 4$ $r = 2$ $\sin(-\theta) = -\sin\theta$ $= -\left(\frac{-\sqrt{3}}{2}\right)$ *or* $\frac{\sqrt{3}}{2}$	A✓ $r = 2$ A✓ reduction CA✓ answer	(3)
5.1.3	$\sin(\theta - 60^\circ)$ $= \sin\theta\cos 60^\circ - \cos\theta\sin 60^\circ$ $= \left(-\frac{\sqrt{3}}{2}\right)\left(\frac{1}{2}\right) - \left(\frac{1}{2}\right)\left(\frac{\sqrt{3}}{2}\right)$ $= \frac{-\sqrt{3}}{4} - \frac{\sqrt{3}}{4} = \frac{-2\sqrt{3}}{4} = \frac{-\sqrt{3}}{2}$	A✓ expansion CA✓ both special ratios CA✓ value of cos θ CA✓ answer	(4)
5.2	$\frac{\tan(180^\circ - \theta)\sin(90^\circ + \theta)}{\cos 300^\circ \sin(\theta - 360^\circ)}$ $= \frac{-\tan\theta \,.\, \cos\theta}{\cos 60^\circ \,.\, \sin\theta}$ $= \frac{-\frac{\sin\theta}{\cos\theta}.\cos\theta}{\frac{1}{2}.\sin\theta}$ $= -2$	A✓ $-\tan\theta$ A✓ $\cos\theta$ A✓ $\cos 60^\circ$ A✓ $\sin\theta$ A✓ identity CA✓ answer	(6)
5.3.1	$LHS = \frac{\cos 2x - 1}{\sin 2x}$ $= \frac{1 - 2\sin^2 x - 1}{2\sin x\cos x}$ $= -\frac{\sin x}{\cos x}$ $= -\tan x$ $= RHS$	A✓ $1 - 2\sin^2 x$ A✓ $2\sin x\cos x$ A✓ simplification	(3)
5.3.2	$x = 90^\circ\,;\ 180^\circ\,;\ 270^\circ$	A✓ 90° A✓ 180° A✓ 270°	(3)

5.3.3	$-\tan 2x = \frac{1}{4}$ $\tan 2x = -\frac{1}{4}$ $2x = 165{,}96^\circ + k.180^\circ$ $x = 82{,}98^\circ + k.90^\circ \; ; k \in Z$	A✓ $\tan 2x = -\frac{1}{4}$ A✓ $165{,}96^\circ$ CA✓ $82{,}98^\circ$ A✓ $k \in Z$	(4)
			[24]

QUESTION 6

6.1	 A✓ x-intercepts A✓ shape A✓ (–30° ; 1) & (150° ; -1) A✓ (–120° ; 0) & (180° ; -0,87)	(4)
6.2	Period = 360º	A✓ answer (1)
6.3.1	– 30º < x < 150º	CA✓ endpoints A✓ correct interval (2)
6.3.2	$x \in (0^o ; 60^o)$	CA✓ endpoints A✓ correct interval (2)
6.4	$y = \cos\left(x + 30^o + 60^o\right)$ $y = \cos\,(x + 90^o)$ $y = -\sin x$	A✓ $\cos\,(x + 90^o)$ CA✓ answer (2)
		[11]

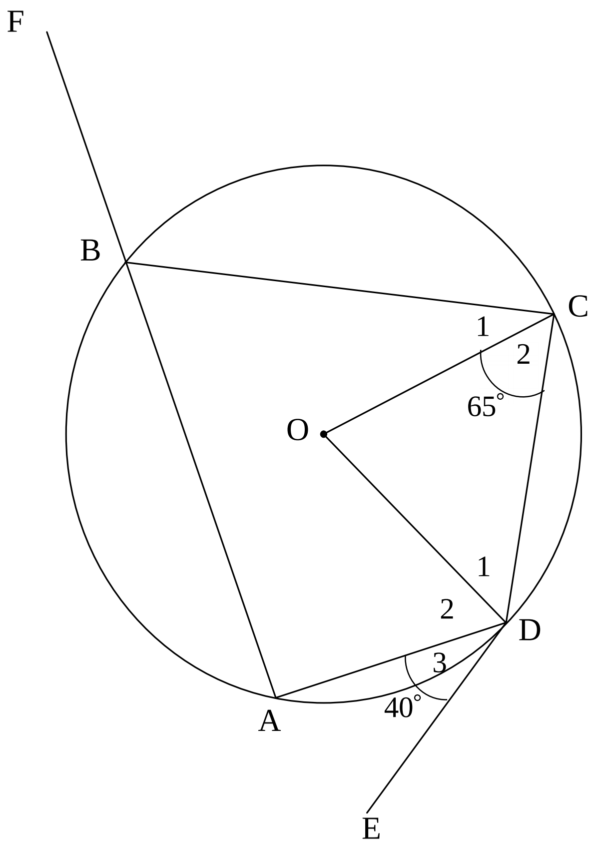
QUESTION 7



7.1	$QS^2 = d^2 + d^2 - 2d.d.\cos\theta$ $QS^2 = 2d^2 - 2d^2.\cos\theta$ $QS^2 = 2d^2(1-\cos\theta)$ $QS = d\sqrt{2(1-\cos\theta)}$	A✓ subst into cos-rule A✓ common factor	(2)
7.2	$\hat{R} = 180° - \theta$ opp. $\angle^s$ cyclic quad suppl $= Q\hat{S}R$ equal sides, equal angles $S\hat{Q}R = 2\theta - 180°$ sum $\angle^s \Delta$ $\Delta QRS = \frac{1}{2}.QS.QR\sin R\hat{S}Q$ $= \frac{1}{2}d\sqrt{2(1-\cos\theta)}.d\sqrt{2(1-\cos\theta)}\sin(2\theta-180°)$ $= \frac{1}{2}d^2.2(1-\cos\theta)(-\sin 2\theta)$ $= -d^2(1-\cos\theta)\sin 2\theta$	A✓ $S\hat{Q}R$ A✓ subst into area rule A✓ simplify & reduction	(3)
			[5]

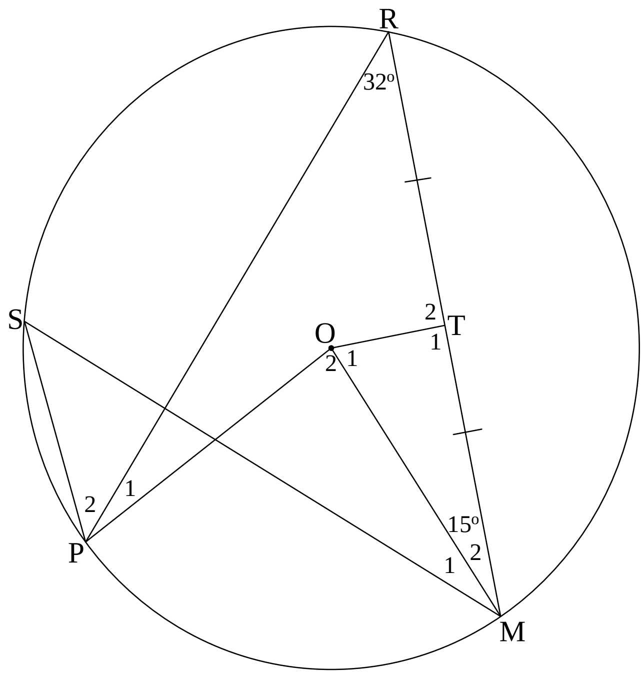
QUESTION 8

8.1



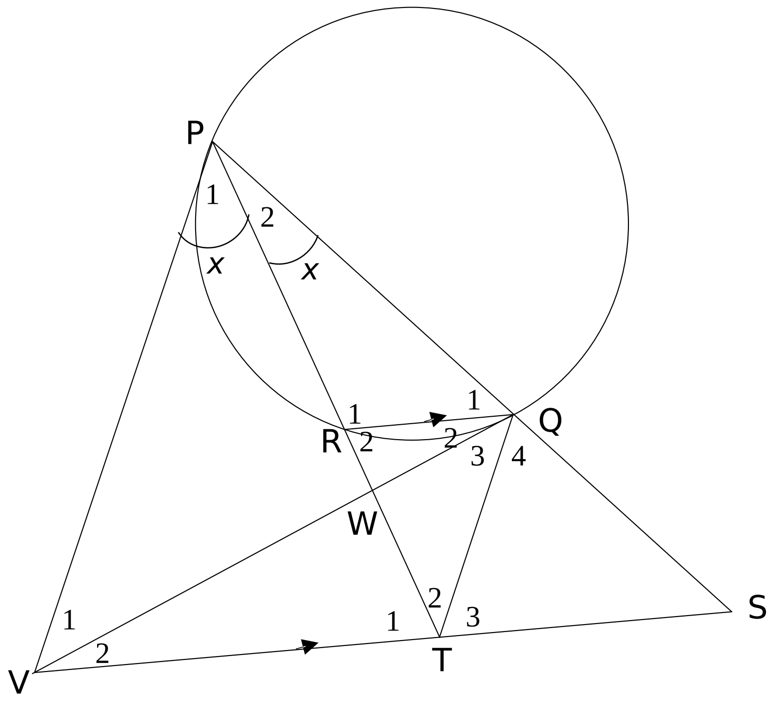
8.1.1	$\hat{D}_2 + \hat{D}_3 = 90^O$ (tan $\perp$ radius) $\therefore\ \hat{D}_2 = 90^o - 40^o = 50^o$	A✓S A✓R A ✓answer	(3)
8.1.2	$\hat{D}_1 = \hat{C}_2 = 65^o$ (angles opposite equal sides) $\hat{D}_1 + \hat{D}_2 = F\hat{B}C$ (ext angle of a cyclic quad) $65^o + 50^o = F\hat{B}C$ $\therefore F\hat{B}C = 115^o$	A✓S/R A✓S A✓R CA✓answer	(4)

8.2



8.2.1	$\hat{S} = 32^o$ (∠s in the same segment)	A✓S A✓R	(2)
8.2.2	$\hat{O}_2 = 64^o$ (∠ at centre = 2 × ∠ at circumference)	A✓S A✓R	(2)
8.2.3	$\hat{T}_1 = 90^o$ (line from centre to midpoint of chord) $\hat{O}_1 + \hat{T}_1 + \hat{M}_2 = 180^O$ (sum of angles of Δ) $\hat{O}_1 + 90^\circ + 15^\circ = 180^\circ$ $\hat{O}_1 = 75^\circ$	A✓S/R A✓Method A✓answer	(3)
			[14]

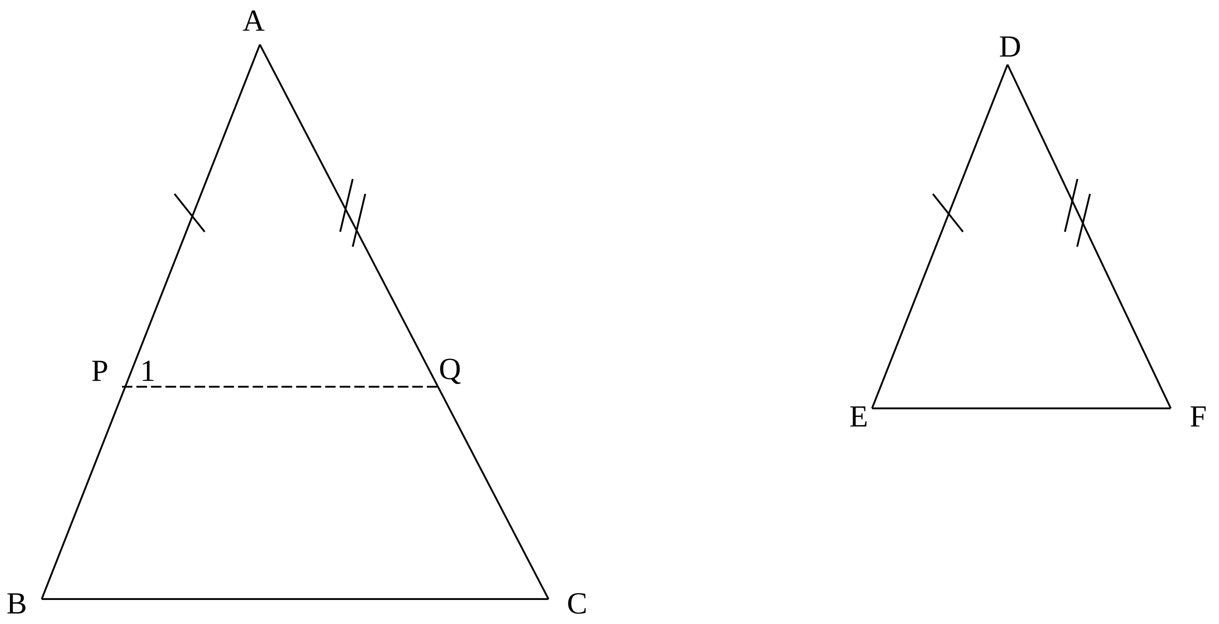
QUESTION 9



9.1	$\hat{P}_1 = \hat{Q}_1 = x$ (tan chord theorem) $\hat{Q}_1 = S = x$ (corresp $\angle$'s (PQ//VS) $\hat{S} = x$	A□S A □R A□ S A□R	(4)
9.2	$\hat{P}_2 = \hat{Q}_2$ (tan chord theorem) $\hat{Q}_2 = \hat{V}_2$ (alt$\angle$'s (PQ//VS) $\therefore \hat{P}_2 = \hat{V}_2$ $\therefore$ PQTV is a cyclic quadrilateral (converse of angles in the same seg.)	A□ S A□R A□ S A□R A□ R	(5)
9.3	$\hat{Q}_3 = \hat{P}_1$ ($\angle$'s in the same segment) $\therefore \hat{Q}_3 = \hat{P}_2$ $\therefore$ TQ is a tangent (converse: tan chord theorem)	A□ S A□R A□ R	(3)
			[12]

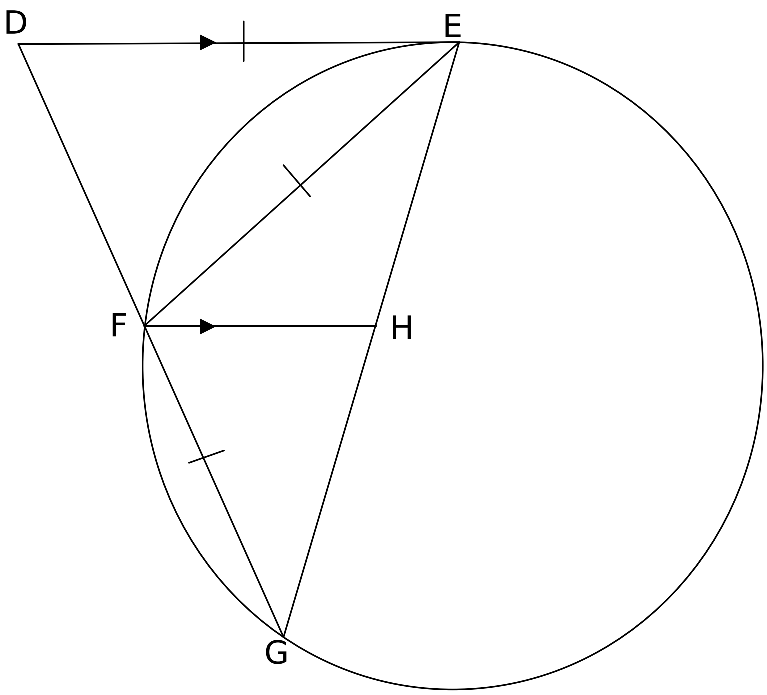
QUESTION 10

10.1



Construct AP = DE and AQ = DF and draw PQ	A✓ construction	
In Δ APQ and ΔDEF:		
AP = DE		
AQ = DF		
$\hat{A} = \hat{D}$		
$\therefore \Delta APQ \equiv \Delta DEF$ (SAS)	A✓ $\Delta APQ \equiv \Delta DEF$ A✓ SAS	
$\hat{P}_1 = \hat{E}$, But $\hat{B} = \hat{E} \ldots$ (given)		
$\hat{P}_1 = \hat{B}$		
PQ ∥ BC (corresponding angles =)	A✓S A✓R	
$\therefore \frac{AB}{AP} = \frac{AC}{AQ}$ (proportionality theorem; PQ ∥ BC)	A✓S A✓R	
$\therefore \frac{AB}{DE} = \frac{AC}{DF}$ (construction)		(7)

10.2



10.2.1	$\hat{G}$ (tan chord theorem) $E\hat{F}H$ (alt $\angle$'s, DE||FH) $F\hat{E}H = \hat{G}$ ($\angle$'s opposite = sides)	A✓ S/R A✓ S ✓R A✓ S/R	(4)
10.2.2(a)	In Δ's DEF and DGE: 1) $\hat{D}$ is common 2) $D\hat{E}F = \hat{G}$ (proven) 3) $D\hat{F}E = D\hat{E}G$ (sum of angles in triangle) ΔDEF ||| ΔDGE ($\angle\angle\angle$)	A✓ S A✓ S A✓ R	(3)
10.2.2(b)	Let $D\hat{E}F = x$: $E\hat{F}D = 2x$ (ext . angle of Δ) $\hat{D} = 2x$ ($\angle$s opposite = sides) $\therefore 2x + 2x + x = 180^\circ$ $x = 36^\circ$ $\therefore \hat{D} = 2x = 72^o$	A✓ S A✓ R A✓ S A✓ Equation A✓ value of x	(5)

10.2.3	$\frac{DE}{DG}=\frac{DF}{DE}$ (ΔDEF ||| ΔDGE) $\frac{FG}{DG}=\frac{DF}{FG}$ (DE = FG) $\frac{2}{k+2}=\frac{k}{2}$ $k^2+2k=4$	A S A S A substitution	(3)
10.2.4	$\frac{GH}{GE}=\frac{GF}{GD}=\frac{2}{k+2}$ (Prop. Intercept theorem DE//FH)	A S A R	(2)
			[24]

TOTAL: 150