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HILTON COLLEGE
TRIAL EXAMINATIONS
SEPTEMBER 2023

MATHEMATICS PAPER 2

EXAMINATION NUMBER:

2	3	1	0	6	2	0	2	0			
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TIME: 3 Hours

MARKS: 150

Examiner: Mrs van Heeswijk

Moderator: Mathematics Department

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This Question paper consists of 26 pages as well as a yellow Information sheet of 2 pages.
2. This Question paper consists of 12 questions. Answer all of them.
3. You may use a non-programmable and non-graphical calculator unless a specific question prohibits the use of a calculator.
4. Round off your answers to **one decimal place**, where necessary, unless otherwise stated.
5. All necessary working details must be shown.
6. It is in your own interest to write legibly and present your work neatly.
7. Please note that diagrams are not drawn to scale.

	SECTION A						SECTION B						TOTAL
	1	2	3	4	5	6	7	8	9	10	11	12	
	12	13	12	20	15	6	14	9	17	10	8	14	
Mark													
Total													

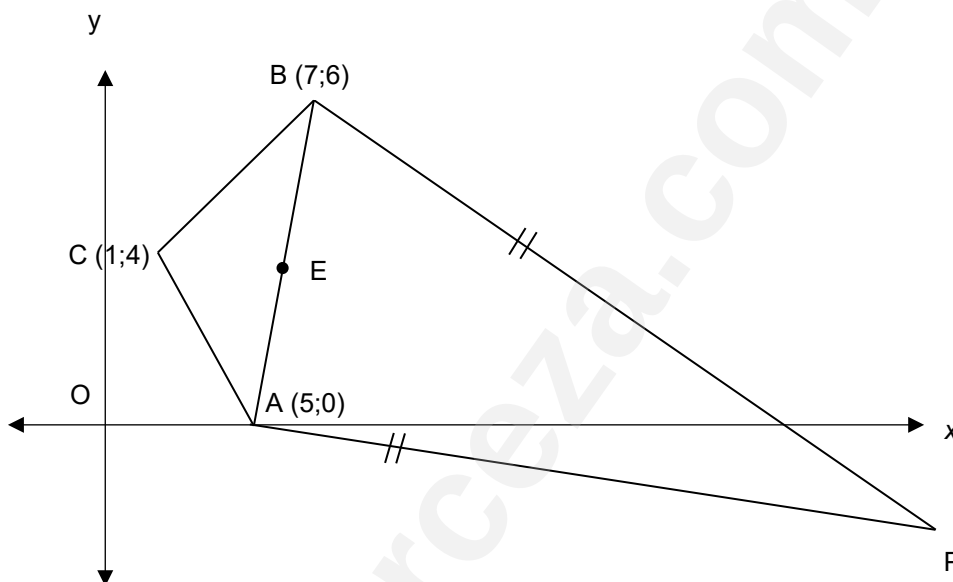
SECTION A

[78]

QUESTION 1

[12]

In the diagram below, which is not drawn to scale, points A (5;0), C (1;4), B (7;6) and P form a quadrilateral. $BP = AP$ and E is the midpoint of AB.



- (a) Determine the co-ordinates of E. (3)
- (b) Determine the gradient of AC. (2)
- (c) Hence, determine the equation of the line parallel to AC and passing through E. (3)

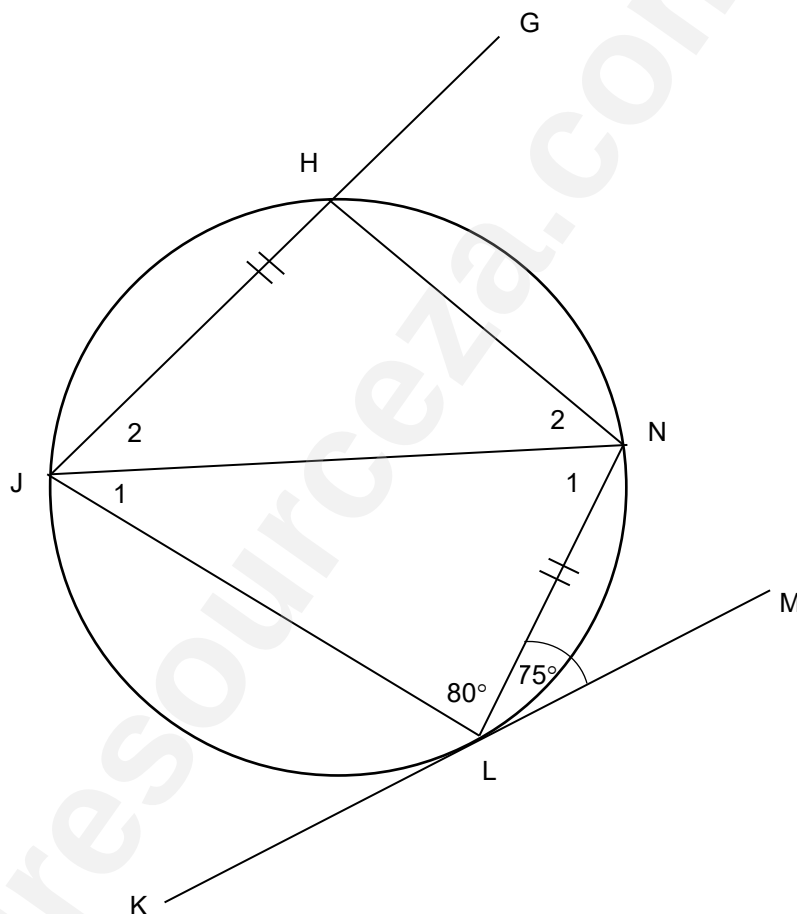
- (d) Given the length of AC is $4\sqrt{2}$, determine the length of BC and, hence state with reasons whether CBPA is a kite. (4)

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QUESTION 2

[13]

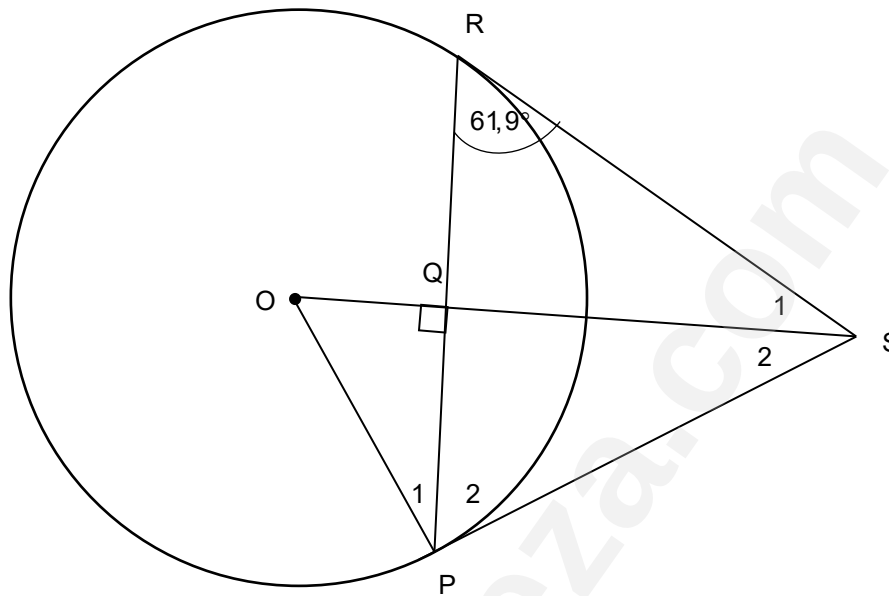
- (a) Complete the statement: The angle formed between a tangent to the circle and the chord drawn at the point of contact, is ... (1)
- (b) In the diagram, KLM is a tangent to the circle at L. $\angle NLM = 75^\circ$ and $\angle JLN = 80^\circ$. $JH = LN$.



Determine, with reasons, the size of:

- (1) $\hat{J}_1$ (2)
- (2) $\hat{GHN}$ (2)
- (3) $\hat{N}_2$ (2)

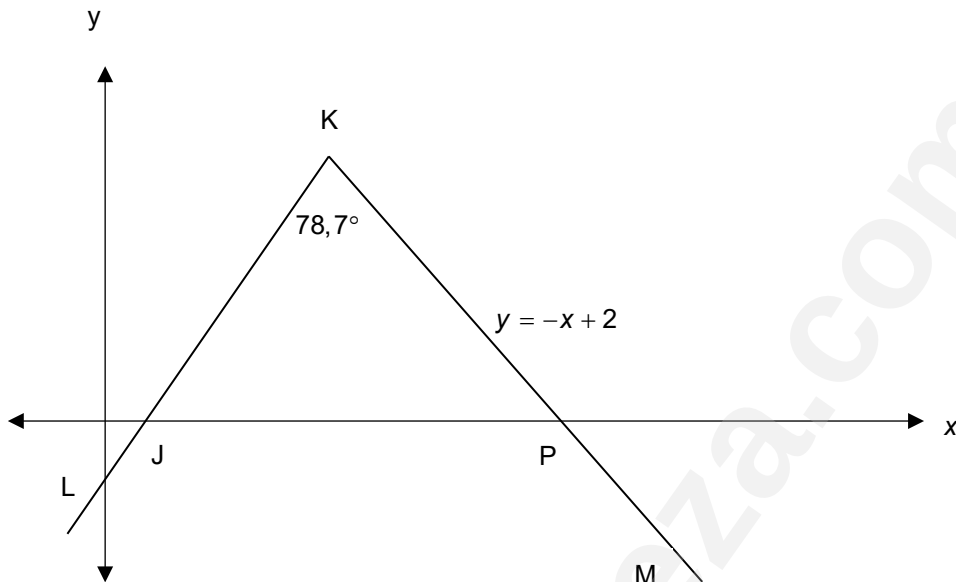
- (c) In the diagram below, SP and SR are tangents to the circle, centre O.
 $\angle PRS = 61,9^\circ$.



- (1) Give the reason why $SP = SR$. (1)
- (2) Prove that ORSP is a cyclic quad. (5)

QUESTION 3**[12]**

In the diagram, the equation of KM is $y = -x + 2$. $\hat{K} = 78,7^\circ$.



(a) Determine the gradient of KL.

(4)

(b) If L has a y – co-ordinate of -1 and $KL = LP$, determine the length of KL. Leave your answer in simplified surd form.

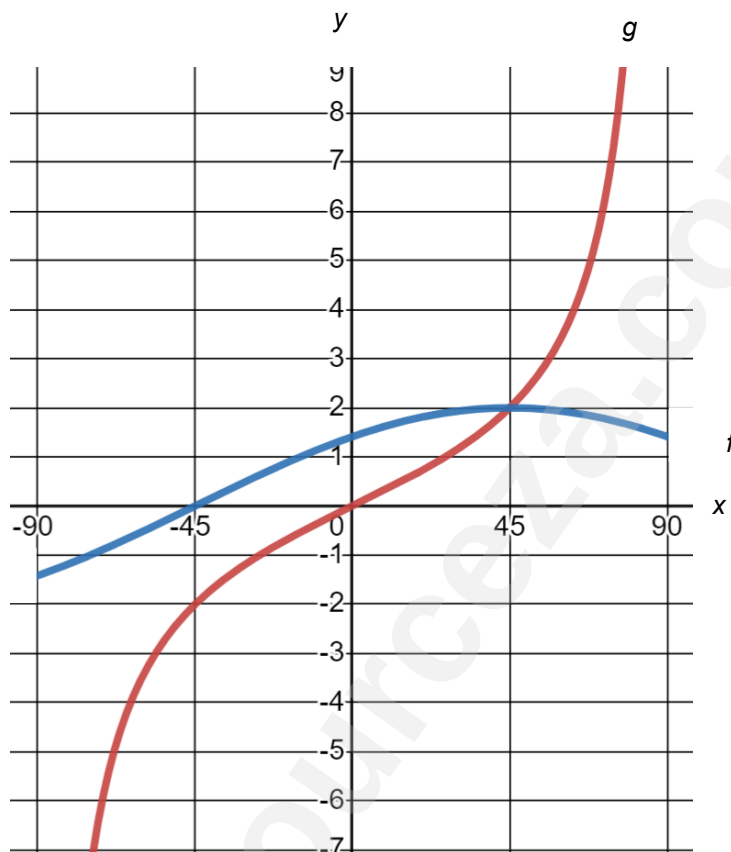
(4)

- (c) Determine the value of x for which $R(x; -2)$, L and P are collinear. (4)

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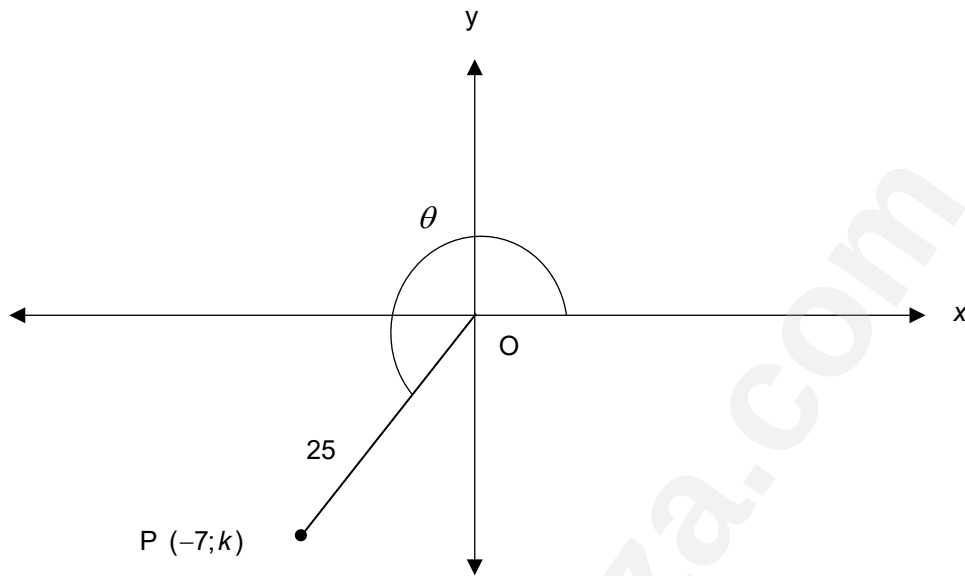
QUESTION 4**[20]**

- (a) The graphs of $g(x) = 2 \tan x$ and $f(x) = 2 \sin(x + 45^\circ)$ over the interval $x \in [-90^\circ; 90^\circ]$ are shown. Use the graph to answer the questions that follow.



- (1) What is the amplitude of f ? (1)
- (2) For which values of x is $f(x) \leq g(x)$ over the given interval? (2)
- (3) If $g(x)$ is translated 30° to the right and 2 units up to form $h(x)$, give the equation of h . (2)

- (b) In the diagram, $P(-7;k)$ is a point in the third quadrant such that $OP = 25$ units.



Determine the value of the following:

(1) k (1)

(2) $\sin(360^\circ - \theta)$ (2)

- (c) If $\sin 24^\circ = p$, express, **without using a calculator**, the following in terms of p :

(1) $\cos 24^\circ$ (2)

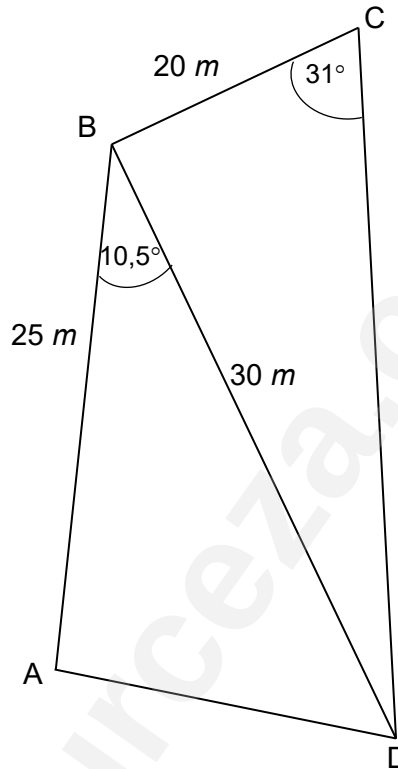
(2) $(\sin 168^\circ) \cdot (-\sin 78^\circ)$ (4)

- (d) Prove, **without the use of a calculator**, and showing all working: (6)

$$\frac{\sqrt{3} \sin x \cdot \sin^2 58^\circ + \sqrt{3} \sin^2 212^\circ \cdot \cos(x - 90^\circ)}{\tan 120^\circ \cdot \sin x} = -1$$

QUESTION 5**[15]**

- (a) In quadrilateral ABCD, $AB = 25$ metres, $BC = 20$ metres, $BD = 30$ metres, $\hat{ABD} = 10,5^\circ$ and $\hat{BCD} = 31^\circ$.



Determine:

- (1) the size of $\hat{BDC}$. (3)
- (2) the length of AD. (4)

(b) Given the identity: $\frac{\cos 2x + \cos x}{\sin 2x - \sin x} = \frac{\cos x + 1}{\sin x}$

(1) Prove the identity.

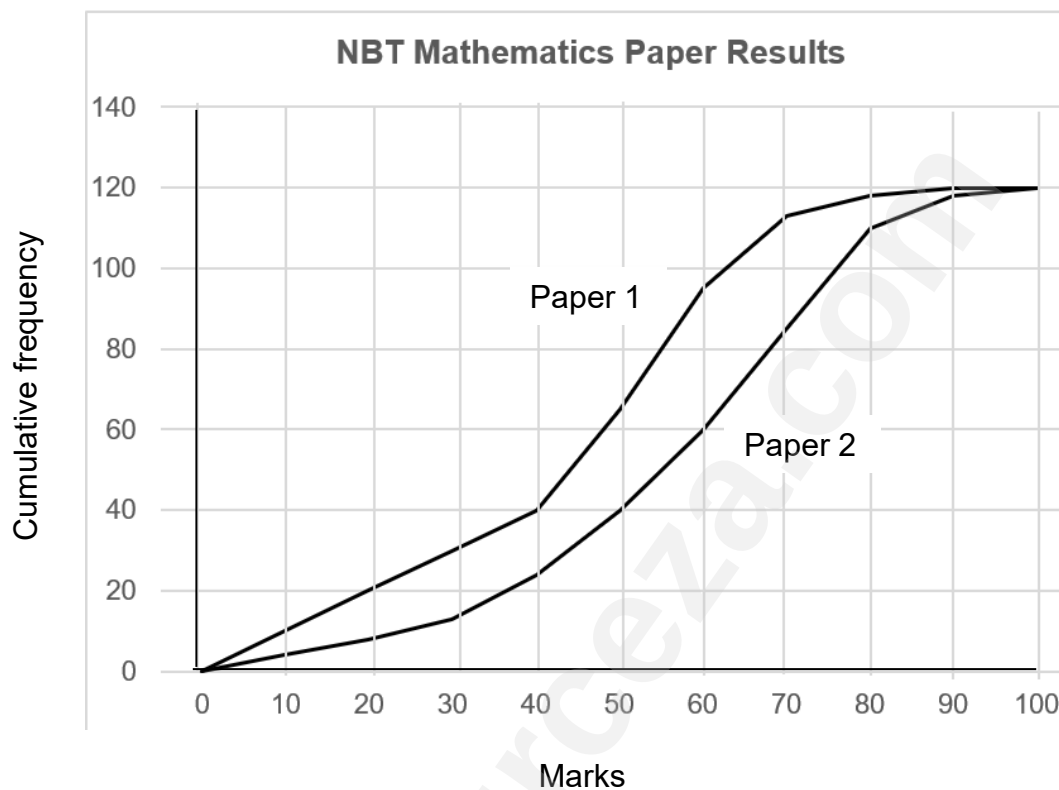
(5)

(2) For which value(s) of x is the identity undefined for $-90^\circ \leq x \leq 90^\circ$.

(3)

QUESTION 6**[6]**

A sample of marks from two benchmark tests is shown.



- (a) In which paper were the results more favourable? Explain your reasoning. (2)
- (b) Draw a box and whisker plot under the graph using the cumulative frequency graph of Paper 1. The lowest mark was 10%. Using your plot, comment on the distribution of the results for this paper. (4)

SECTION B

[72]

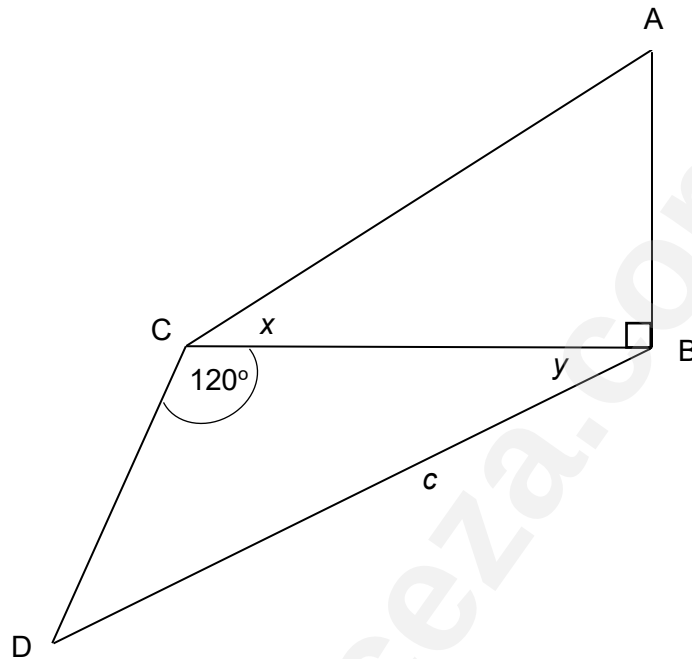
QUESTION 7

[14]

- (a) **Without the use of a calculator**, and showing all working, determine the values of α and β if: (7)

- $\sin(\alpha - \beta) = \frac{1}{2}$
- $\sin(\alpha + \beta) = -1$
- α and β are both positive
- $\sin \alpha < 0$
- $\beta < 90^\circ$

- (b) In the diagram below, AB is a building. B, the foot of the building, and the points C and D are in the same horizontal plane. From C, the angle of elevation to the top of the building is x . $\angle BCD = 120^\circ$ and $\angle CBD = y$, and the distance between B and D is c metres.

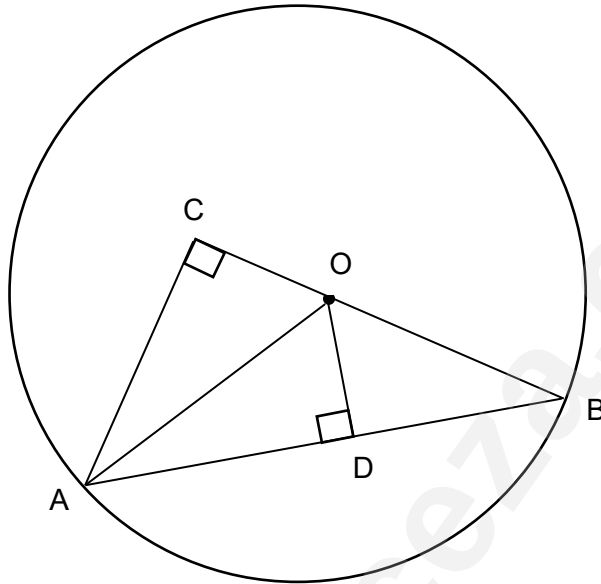


Prove, **without the use of a calculator** and showing all working, that (7)

$$AB = \frac{2c \tan x \cdot \sin(60^\circ - y)}{\sqrt{3}}$$

QUESTION 8**[9]**

In the diagram, O is the centre of the circle. $AC \perp CB$ and $OD \perp DA$.



(a) Prove $\triangle ODB \parallel \triangle ACB$.

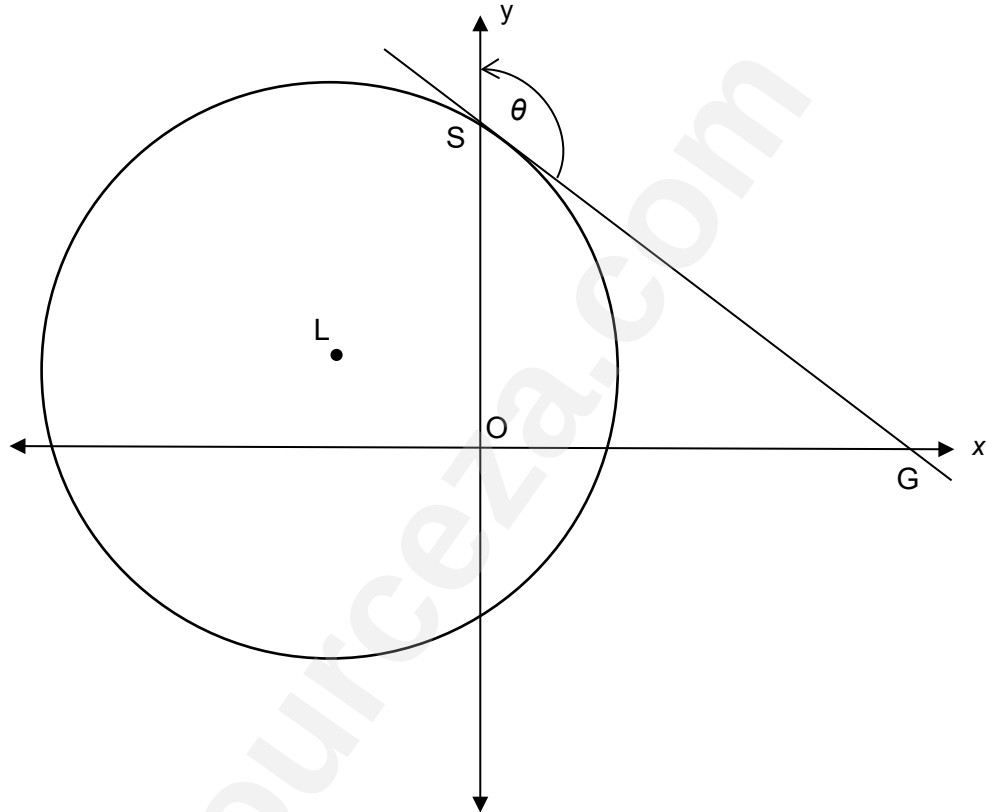
(3)

(b) Hence, prove that $AD = \sqrt{\frac{OA \cdot BC}{2}}$

(6)

QUESTION 9**[17]**

- (a) The circle sketched below has centre L and equation $x^2 + y^2 + 6x - 4y - 12 = 0$. The circle cuts the y -axis at point S. GS is a tangent to the circle with G on the x -axis and the angle θ lies between the y -axis and GS.



- (1) Determine the co-ordinates of L and the length of the radius of the circle. (5)

(2) Determine the co-ordinates of point S. (4)

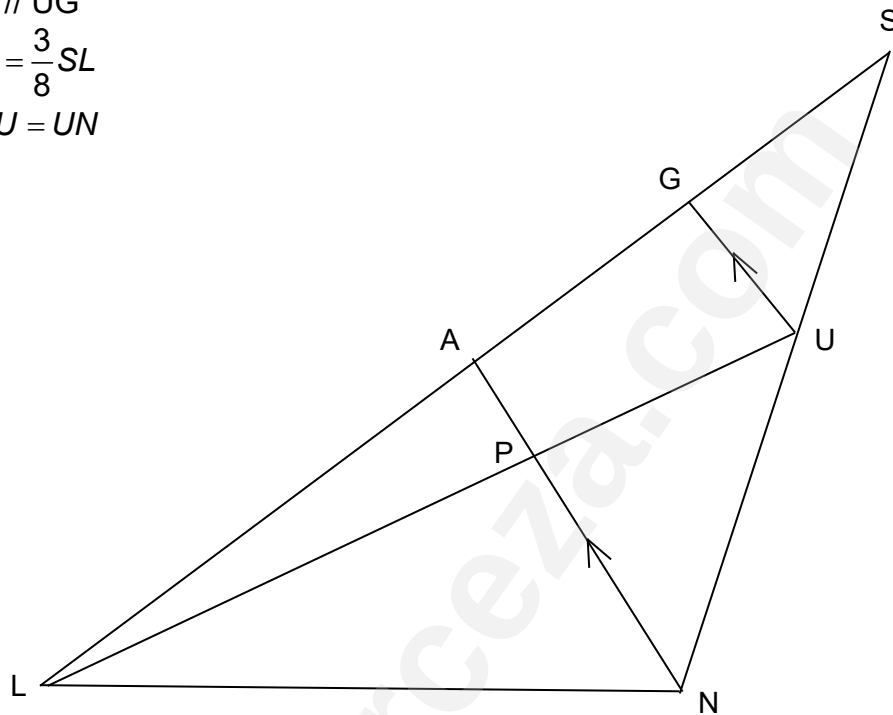
(3) If it is given that the gradient of the radius LS is $\frac{4}{3}$, calculate the size of θ . (5)

(b) Consider the circle with equation $(x - 2 + t)^2 + (y + t^2 - 4) = 25^2$ where t is any real number. Determine the value(s) of t for which the circle has its centre on the x-axis but not on the y-axis. (3)

QUESTION 10**[10]**

In the diagram below:

- LAGS and SUN are two straight lines.
- $NA \parallel UG$
- $SA = \frac{3}{8}SL$
- $2SU = UN$



(a) Determine $\frac{GA}{SG}$.

(2)

(b) Determine $\frac{UP}{UL}$.

(3)

(c) $\frac{\text{Area}\triangle SGU}{\text{Area}\triangle SLN}$ (5)

QUESTION 11**[8]**

- (a) The following information is given:

$$\sum_{k=1}^{20} (x_k - \bar{x})^2 = 156$$

$$\sum_{k=1}^{20} x_k = 1220$$

Determine:

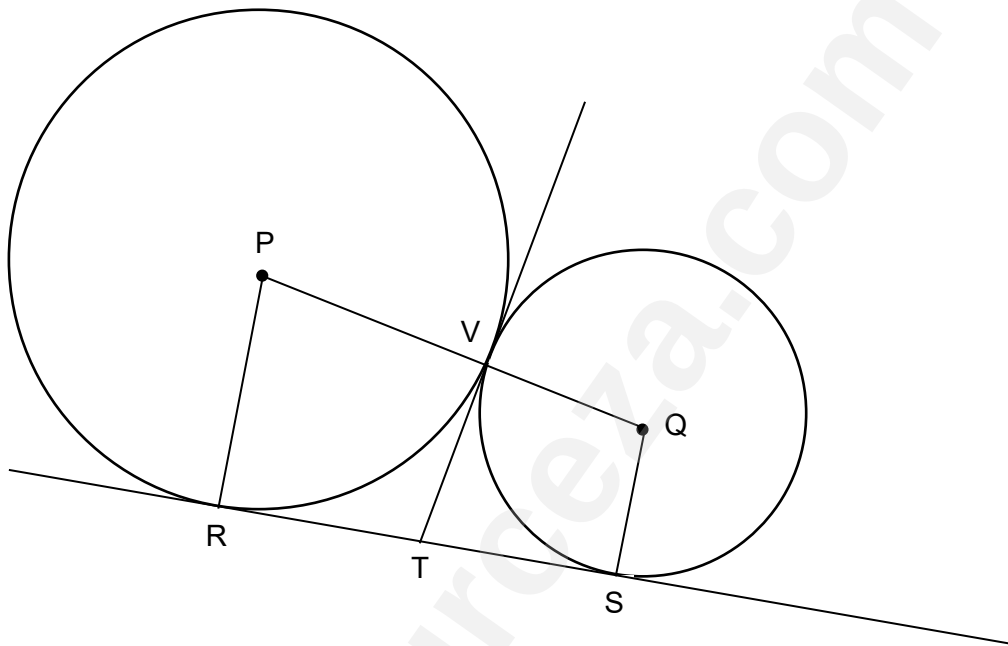
- (1) the number of pupils in the class. (1)
- (2) the mean mark of the data. (1)
- (3) the standard deviation. (2)

- (b) Suppose the data set a, b, c, d and e has a mean of 8. (4)
Find the mean of $10 - a$; $10 - b$; $20 - c$; $20 - d$ and $50 - e$.

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QUESTION 12**[14]**

- (a) A circle with centre P and radius 9 cm is a tangent to a smaller circle with centre Q and radius 4 cm. Common tangents VT and RS are drawn to the circles making points of contact at V, R and S. (7)



Determine the length of VT.

- (b) Determine the maximum radius of the circle with equation $x^2 + y^2 - 2x \cos \theta - 4y \cos \theta = -2$ for any value of θ . (7)

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ADDITIONAL WORKING SPACE. INDICATE AT THE QUESTION IF THIS SPACE HAS BEEN UTILISED.

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