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Grade 12

Core Mathematics: Paper 2

September 2021

Time: 3 hours

Marks: 150

Please read the following instructions carefully:

1. This question paper consists of 20 pages and an Information sheet. Please check that your question paper is complete.
2. **Answer all the questions on the question paper.**
3. You may use an approved non-programmable and non-graphical calculator.
4. All necessary working details must be clearly shown.
5. Round off answers to **1 decimal place** where necessary, unless otherwise stated.
6. Ensure that your calculator is in **DEGREE** mode.
7. Diagrams may not be drawn to scale.
8. **A mark is not necessarily allocated to the correct answer** but rather the working. Show all working.

	SECTION A					SECTION B				
	Analytical Geom.	Analytical Geom.	Statistics	Geometry	Trigonometry	Statistics	Trigonometry	Geometry	Analytical Geom.	Trig/measure
Question	1	2	3	4	5	6	7	8	9	10
Mark	12	9	9	22	22	9	29	14	15	9
Total										
Total										
							150			
Percentage										
							100			

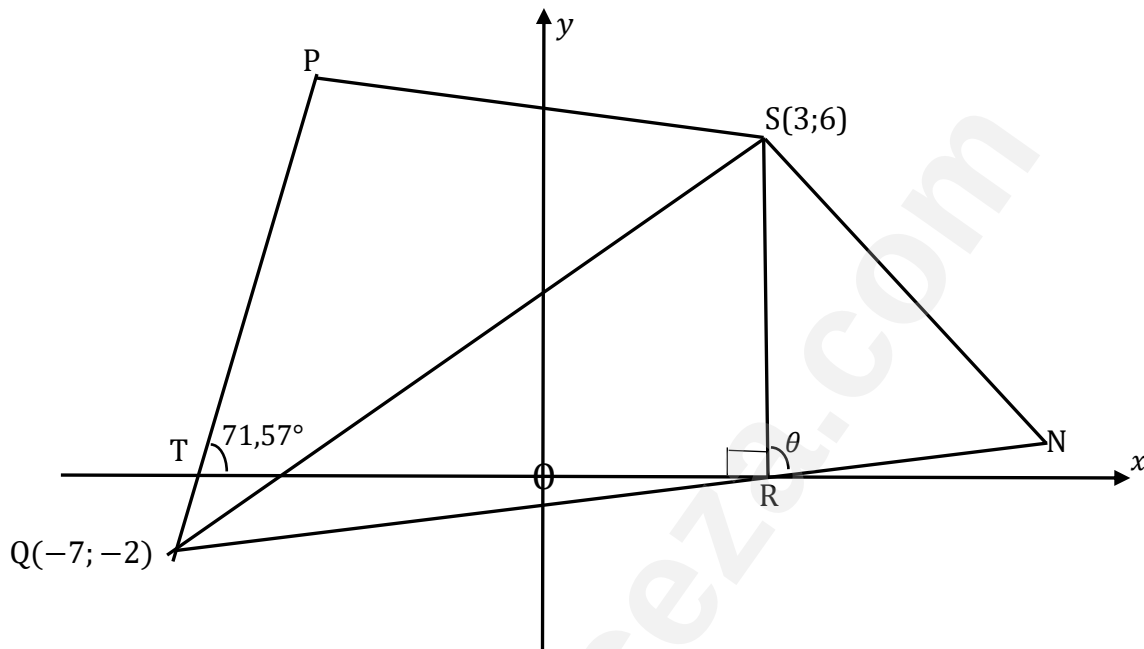
IEB exam number: _____

Name: _____

Teacher: _____

QUESTION 1

In the diagram, P, Q($-7; -2$), R and S($3; 6$) are vertices of a quadrilateral. R is a point on the x -axis. QR is produced to N. SN is drawn. $\widehat{PTO} = 71,57^\circ$ and $\widehat{SRN} = \theta$. SR is **perpendicular** to the x -axis.



Determine:

(a) the equation of SR.

(1)

(b) the gradient of QP correct to the nearest integer.

(2)

(c) the equation of QP in the form $y = mx + c$.

(2)

(d) the length of QR. Leave your answer in simplest surd form.

(2)

(e) (1) the angle of inclination of QN, β , correct to one decimal place.

(3)

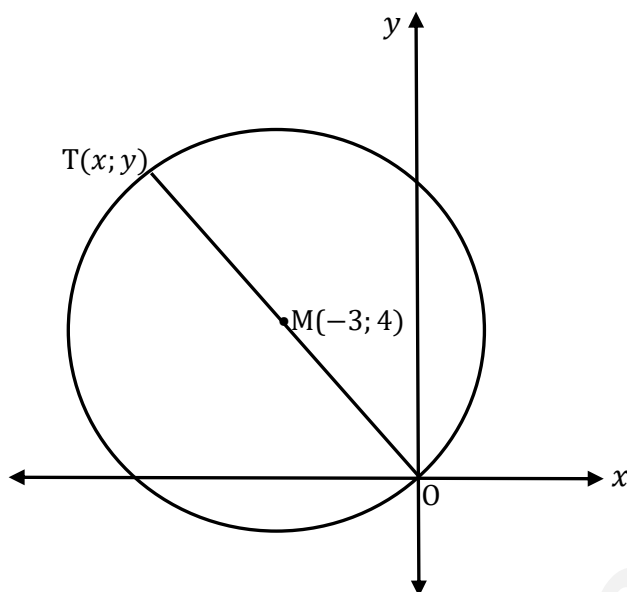
(2) Hence, determine the value of θ .

(2)

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QUESTION 2

In the diagram below, the circle has centre $M(-3; 4)$ and passes through the origin.



- (a) Determine the length of the radius of the circle. (1)

- (b) Write down the equation of the circle. (2)

- (c) Show that the coordinate of $T(x; y)$, the endpoint of diameter OT , is $(-6; 8)$. (2)

- (d) Determine the equation of the tangent to the circle at T . (4)

[9]

QUESTION 3

The following table shows the frequency distribution of the daily travelling time (in minutes) from home to work for the teachers at St. Annes.

Daily travelling time(x) in minutes	Number of teachers
$0 \leq x < 10$	20
$10 \leq x < 20$	35
$20 \leq x < 30$	30
$30 \leq x < 40$	10
$40 \leq x < 50$	5

(a) Circle the correct answer to the following questions:

(1) The estimated mean time, in minutes, taken by the teachers is:

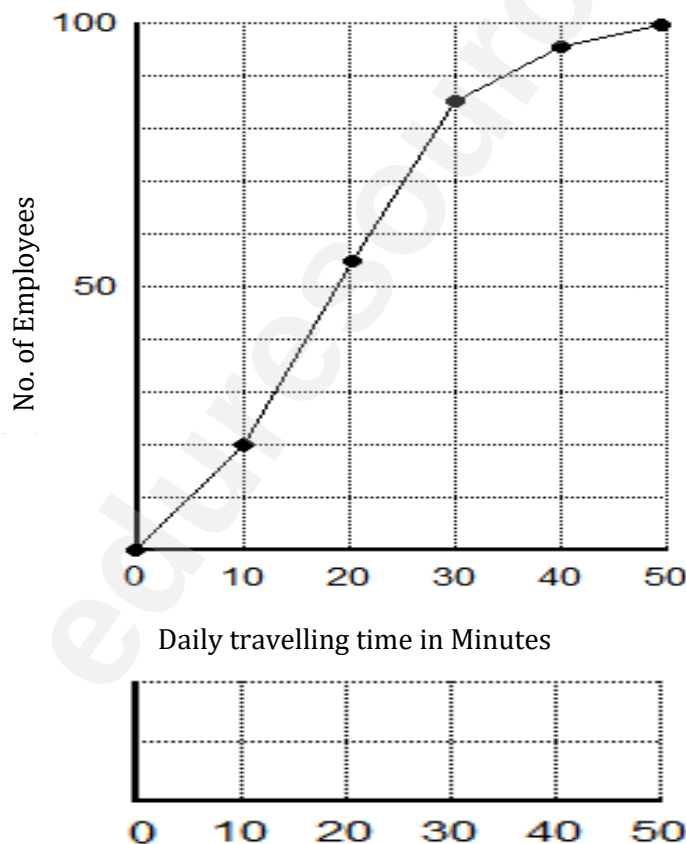
A: 14,5 B: 19,5 C: 16,7 D: 24,5 (2)

(2) The estimated standard deviation for the time, in minutes, is:

A: 10,57 B:14,14 C: 114,75 D: 10,71 (2)

(b) An ogive was constructed from the given data.

(1) Construct a box-and-whisker plot on the scaled axes below the ogive to summarise the data. Show on the ogive (by means of dotted lines), where you have read off the data required for the box-and-whisker. (3)



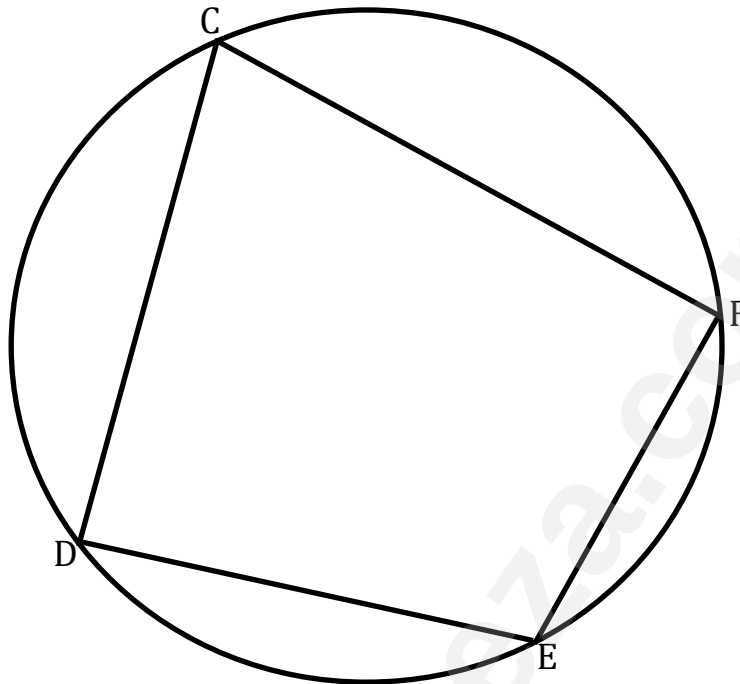
(2) State whether the following statements are TRUE or FALSE:

(i) The inter-quartile range for this data is 25. _____ (1)

(ii) Only 35 teachers take less than 20 minutes to travel to school _____ (1)

QUESTION 4

- (a) Prove the theorem that states “The opposite angles of a cyclic quadrilateral are supplementary”. (4)



RTP: $\hat{C} + \hat{E} = 180^\circ$

Construction: _____

Proof:

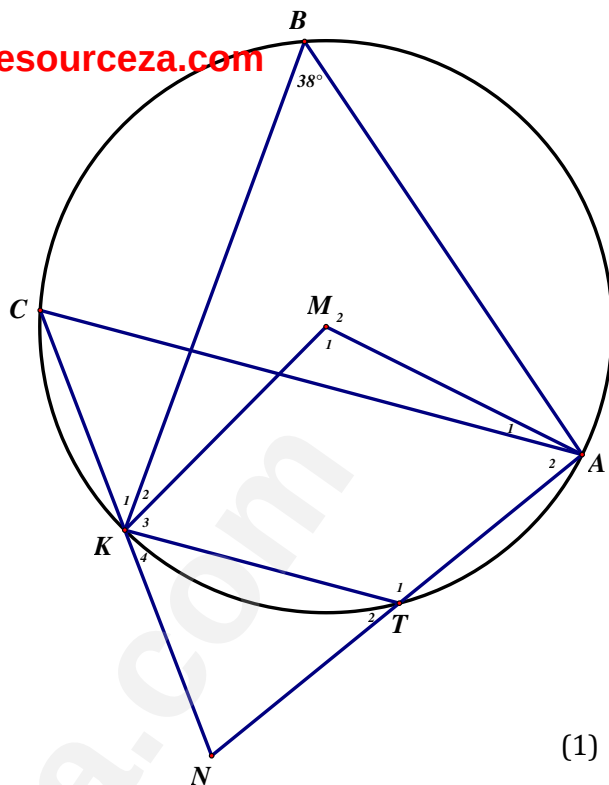
(b) Refer to the diagram (not drawn to scale):

A, B, C, K and T lie on the circle.

AT produced and CK produced meet in N.

M is the centre of the circle.

$\widehat{NA} = \widehat{NC}$ and $\widehat{B} = 38^\circ$.



(1) Calculate, with reasons, the size of the following angles:

(i) $\widehat{M}_1$ (1)

(ii) $\widehat{T}_2$

(iii) $\widehat{C}$ (1)

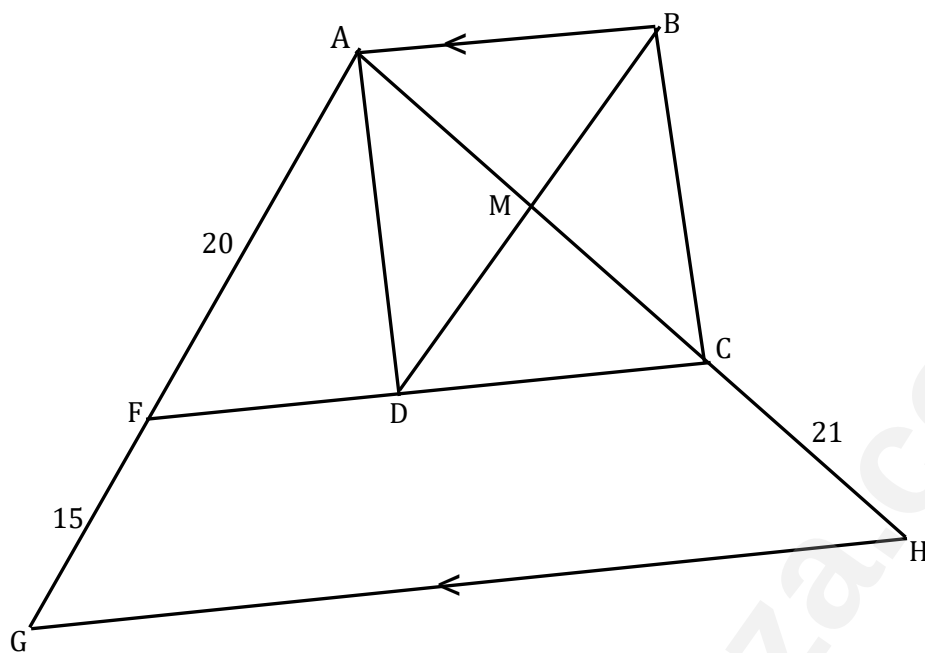
(iv) $\widehat{K}_4$ (2)

(2) Give a reason why $NK = NT$. (1)

(3) Give a reason why $KT \parallel AC$. (1)

(4) Prove that AMKN is a cyclic quadrilateral. (4)

- (c) In the diagram, $\triangle AGH$ is drawn. F and C are points on AG and AH respectively such that $AF = 20$ units, $FG = 15$ units and $CH = 21$ units. D is a point on FC such that ABCD is a rectangle. AB is parallel to GH. The diagonals, AC and BD, of ABCD intersect at M, a point on AH.



(1) Explain why $FC \parallel GH$.

(2)

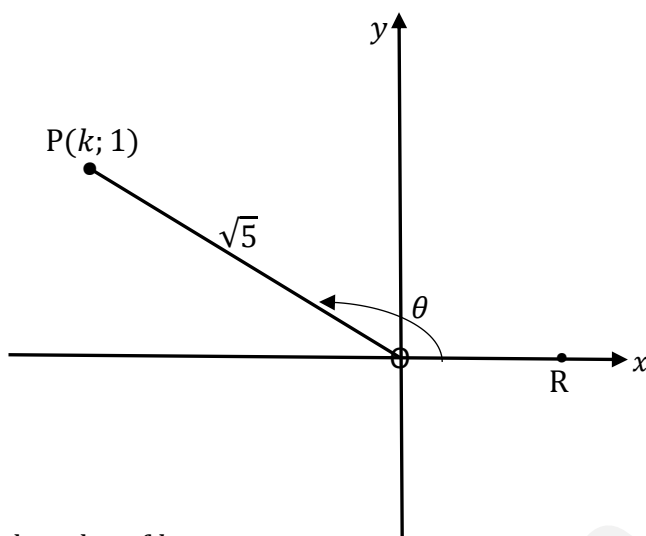
(2) Calculate, with reasons, the length of DM.

(5)

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QUESTION 5

- (a) In the diagram, $P(k; 1)$ is a point in the 2nd quadrant and is $\sqrt{5}$ units from the origin.
R is a point on the positive x -axis and obtuse $\widehat{ROP} = \theta$.



(1) Calculate the value of k .

(2)

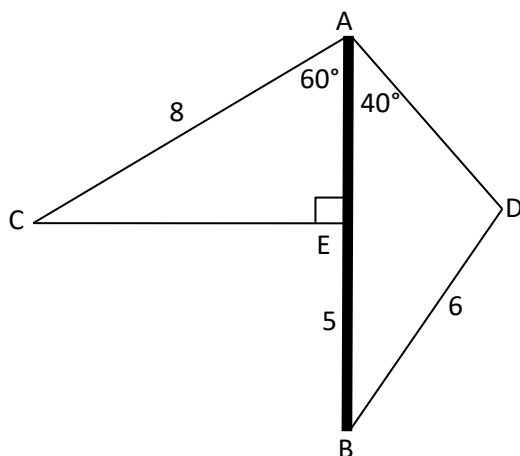
(2) Without using a calculator, find the value of :

(i) $\tan \theta$

(1)

(ii) $\sin(\theta + 60^\circ)$

(3)



(1) Show that the total height of the mast is 9 metres.

(3)

(5)

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. A faint, light gray watermark is visible diagonally across the center of the page, containing the word "edure". There are no other markings or text on the page.

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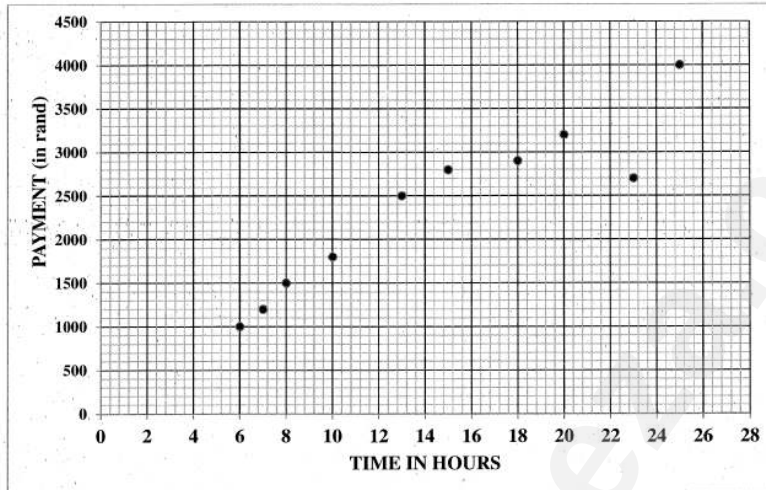
(3)

74 marks for SECTION A

QUESTION 6

A group of students did some part-time work for a company. The number of hours that the students worked and the payment (in rand) received for the work done is shown in the table below. The scatter plot is drawn for the data.

Number of hours worked	6	7	8	10	13	15	18	20	23	25
Payment (in rand)	1000	1200	1500	1800	2500	2800	2900	3200	2700	4000



(a) Using all the data in the table:

(1) calculate the standard deviation of the hours worked.

(1)

(2) determine the minimum number of hours that a student needed to work (to the nearest whole number) in order to receive a payment that was more than one standard deviation above the mean.

(2)

(3) determine the equation of the line of best fit of the data (correct to 3 decimal places).

(2)

(b) Jo, who worked for 11,5 hours, was omitted from the original data. Calculate the possible amount that the company had to pay Jo.

(2)

(c) Identify an outlier and describe what effect this would have on the gradient of the line of best fit if it were omitted from the data set.

(2)

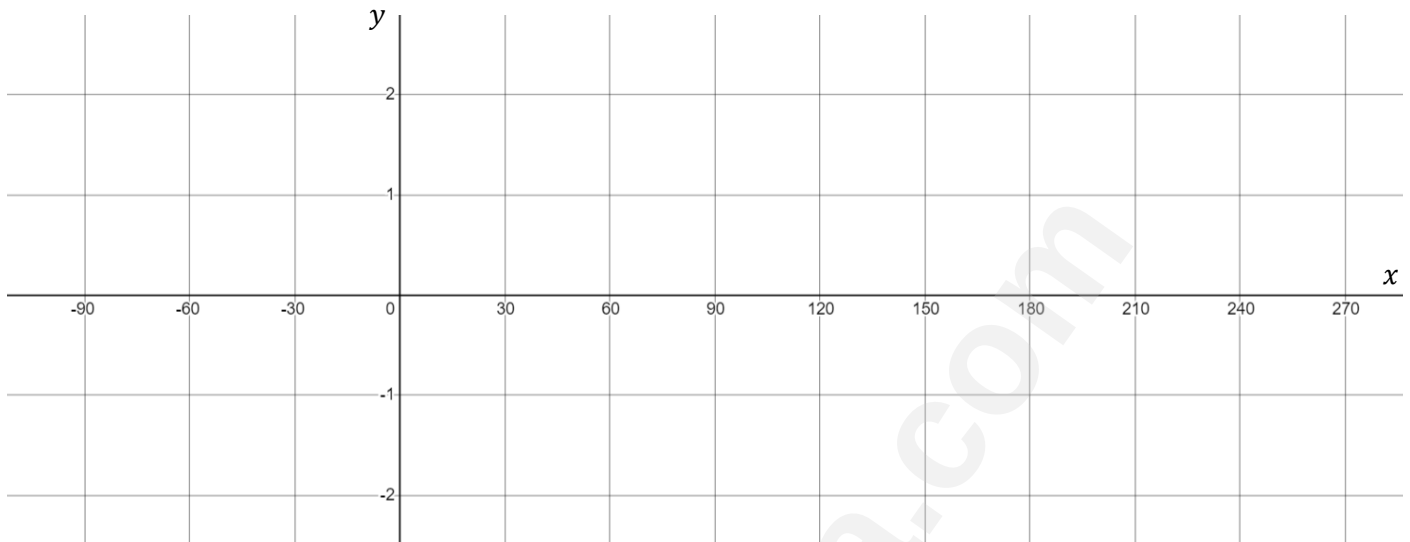
QUESTION 7

(a) Given $f(x) = 2 \sin x$ and $g(x) = \cos(x + 30^\circ)$

(1) Show that the equation $2 \sin x = \cos(x + 30^\circ)$ can also be expressed as $\tan x = \frac{\sqrt{3}}{5}$ (4)

(2) Hence, determine the value(s) of $x \in [0^\circ; 270^\circ]$, rounded to one decimal digit, where $f(x) = g(x)$. (4)

- (3) (i) Draw sketch graphs of the curves of f and g for $x \in [-90^\circ; 270^\circ]$, clearly showing all intercepts, turning points and endpoints. (6)



- (ii) For which values of x is $f(x)$ increasing and negative? (1)

- (iii) For which values of x is $f(x) > g(x)$? (2)

- (b) If $\sin 22^\circ = a$, express the following in terms of a :

$$\cos(-26^\circ) \cdot \sin 318^\circ + \cos 402^\circ \cdot \sin(-154^\circ)$$

(5)

(c) Given: $\cos \theta = y$

(1) For what values of y is $\cos \theta$ defined?

(1)

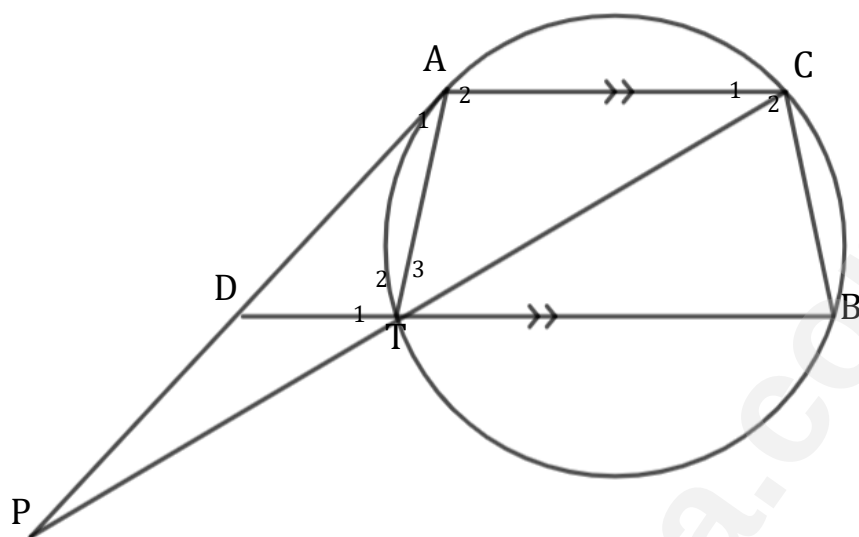
(2) Determine the general solution for θ if $\cos \theta = \frac{1}{\cos \theta} + \frac{5}{6}$

(6)

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QUESTION 8

- (a) In the diagram below, ACBT is a cyclic quadrilateral having $AC \parallel TB$.
CT is produced to P such that tangent PA meets the circle at A. BT produced meets PA at D.



- (1) Prove that $\triangle PAT \sim \triangle PCA$.

(3)

- (2) If $PA = 6$, $TC = 5$ and $PT = x$,

- (i) Show that $PT = 4$.

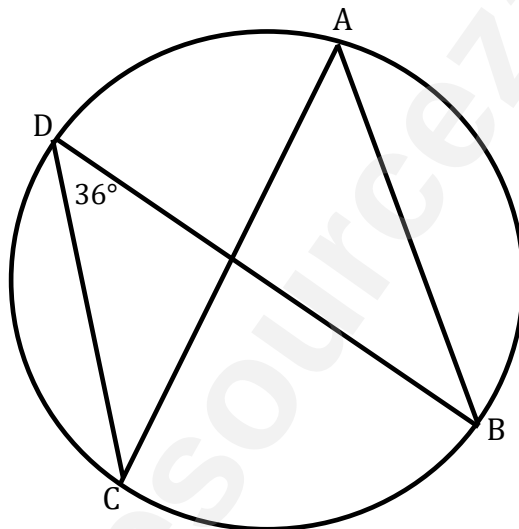
(4)

(i) Calculate the length of PD.

(2)

(b) In the figure below, BD is the diameter of the circle ABCD. If $AB = AC$ and $\widehat{D} = 36^\circ$, determine the size of $\widehat{ABD}$.

(5)



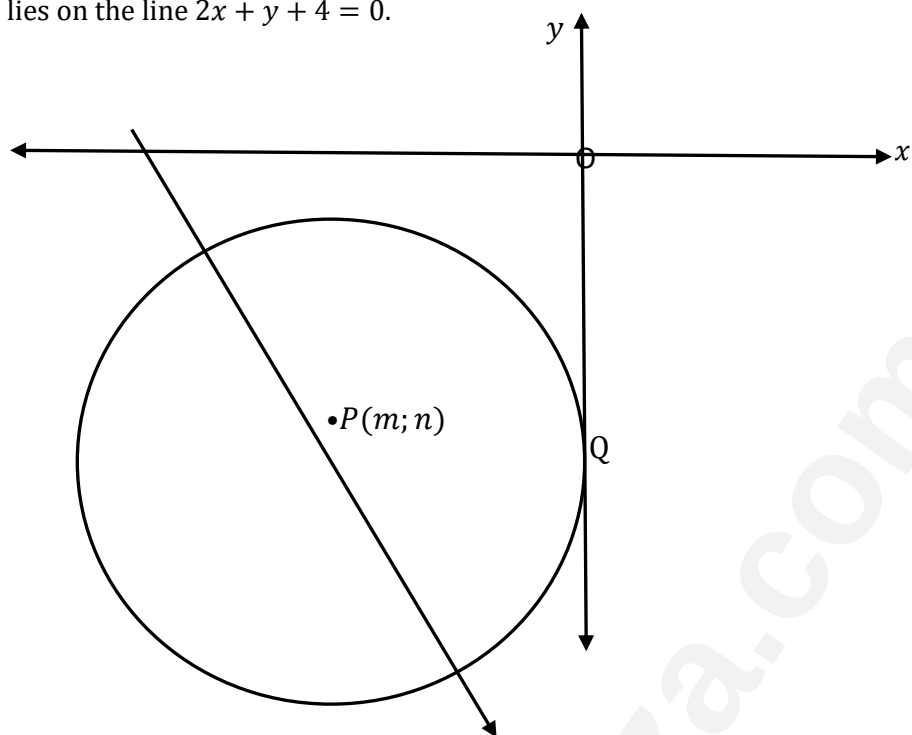
[14]

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- A coordinate plane with x and y axes. A large circle is centered at the origin, labeled 'A'. A smaller circle is tangent to the large circle at the point (1, 0) on the x-axis. The center of the smaller circle is labeled 'B'.

- (1)

- (6)

- (b) A circle with centre $P(m, n)$ touches the y -axis at point Q and passes through the point $R(-1; -1)$. Point P lies on the line $2x + y + 4 = 0$.



(1) Show that $n = -2m - 4$.

(1)

(2) Write down the coordinates of Q , in terms of n .

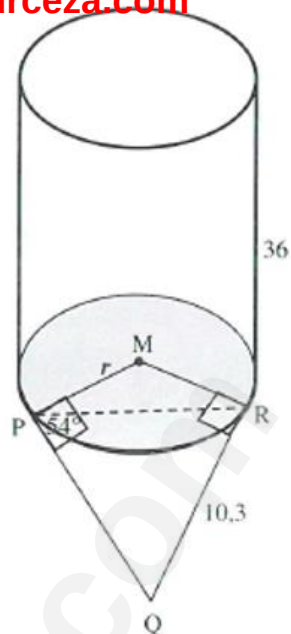
(1)

(3) Determine the coordinates of point P .

(6)

QUESTION 10

The diagram below represents a right cylindrical silo.
 M is the centre of the circular base.
 PQ and RQ are tangents to the base at P and R.
 M, P, Q and R lie in the same horizontal plane.
 The vertical height of the cylinder is 36 metres.
 $QR = 10,3$ m and $\widehat{RPQ} = 54^\circ$.



- (a) Show that $\widehat{Q} = 72^\circ$. (2)

- (b) Calculate the length of PR. (2)

- (c) Calculate the volume of the cylindrical section of the silo. (5)

[9]

76 MARKS FOR SECTION B