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MATHEMATICS: PAPER 2
PRELIMINARY EXAMINATION 2024
30 August 2024

GRADE 12

Name & Surname: _____

Class: _____

Examination Number:

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Examiner: S. Colley

Time: 3 hours

Moderator: C. Pretorius

Total: 150 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 28 pages and an Information Sheet of 2 pages (i-ii). Please check that your question paper is complete.
2. Read the questions carefully.
3. **Answer ALL the questions on the question paper and hand it in at the end of the session. Remember to write your name and surname in the space provided.**
4. Diagrams are not necessarily drawn to scale.
5. You may use an approved non-programmable and non-graphical calculator.
6. Ensure that your calculator is in DEGREE mode.
7. Clearly show **ALL** calculations, diagrams, graphs, etc. that you have used in determining your answers. **Answers only will NOT necessarily be awarded full marks.**
8. Round off to **ONE DECIMAL PLACE**, unless otherwise stated.
9. It is in your own interest to write legibly and to present your work neatly.
10. **TWO** blank pages (page 27-28) are included at the end of the paper. If you run out of space for a question, use this page. Clearly indicate the question number of your answer should you use this extra space.

FOR OFFICE USE ONLY: MARKER TO ENTER MARKS

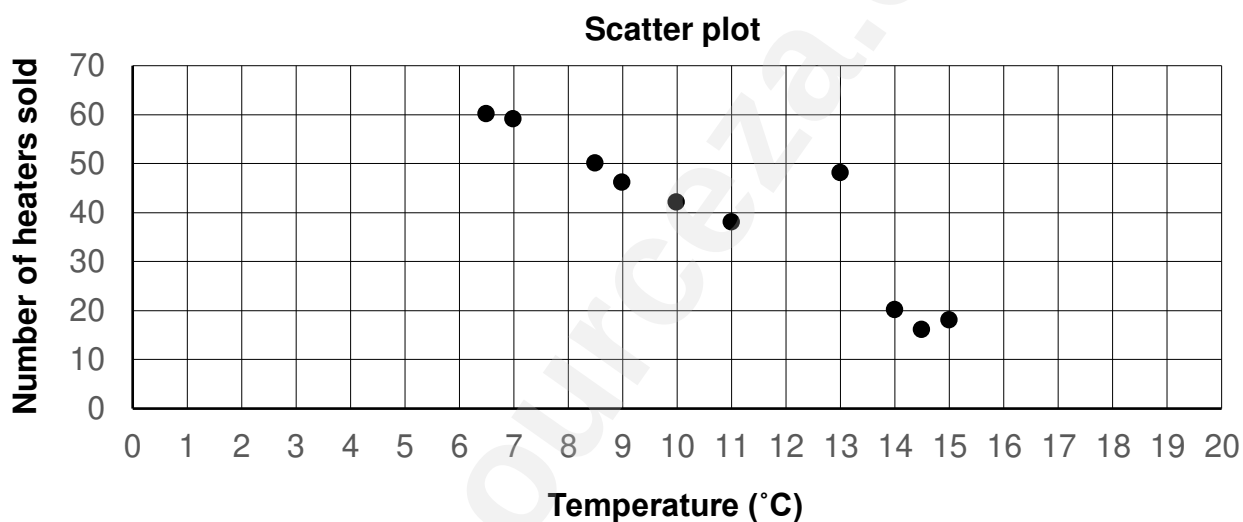
Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Total
21	22	17	18	12	12	9	8	7	13	11	150

SECTION A

QUESTION 1

- (a) A shop in Johannesburg recorded the number of heaters sold in a given day and the temperature at noon on that day. The results are shown in the table and scatter plot below.

Temperature at noon in $^{\circ}\text{C}$	9	8,5	10	14,5	11	15	13	14	6,5	7
Number of heaters sold	46	50	42	16	38	18	48	20	60	59



- (1) Calculate the correlation coefficient for the given set of data and use it to describe the relationship between the noon temperature and the number of heaters sold.

(3)

- (2) Determine the equation for the least squares regression line (line of best fit) for the given set of data. Round off your answers to **FOUR decimal places**.
- (2)
- (3) Hence, determine the number of heaters, correct to the nearest integer that should be sold if the noon temperature on a day is 12°C .
- (2)
- (4) The noon temperature on a certain day is 20°C . Can one use the equation above, obtained in number (2), to predict the number of heaters that will be sold? Motivate your answer.
- (2)
- (5) Identify a possible outlier in the given set of data and label it on the scatter plot with the letter T. Give a reason why this outlier might have occurred.

(2)

(6) If the outlier was removed from the given set of data, how will this affect:

(i) the correlation coefficient?

(2)

(ii) the gradient of the line of best fit?

(2)

(b) For the box-and-whisker diagram below, invent a sample of data containing nine different integer values if the mean of the data is 68. Write the nine numbers in **ascending** order.



(6)

[21]

QUESTION 2

(a) If $x = 3 \sin \theta$ and $y = 3 \cos \theta$, determine the value of $x^2 + y^2$.

(b) Prove the identity: $\cos^2(180^\circ + x) + \tan(x - 180^\circ) \cdot \sin(720^\circ - x) \cdot \cos x = \cos 2x$ (2)

(5)

(c) Simplify without the use of a calculator: $\sin(-70^\circ) \cos(-20^\circ) - \cos^2 470^\circ$

(5)

(c) Determine the general solution of: $\tan x \cdot \sin x + \cos x \cdot \tan x = 0$

(5)

(d) Show that $\tan(x - 45) = \frac{\sin x - \cos x}{\sin x + \cos x}$

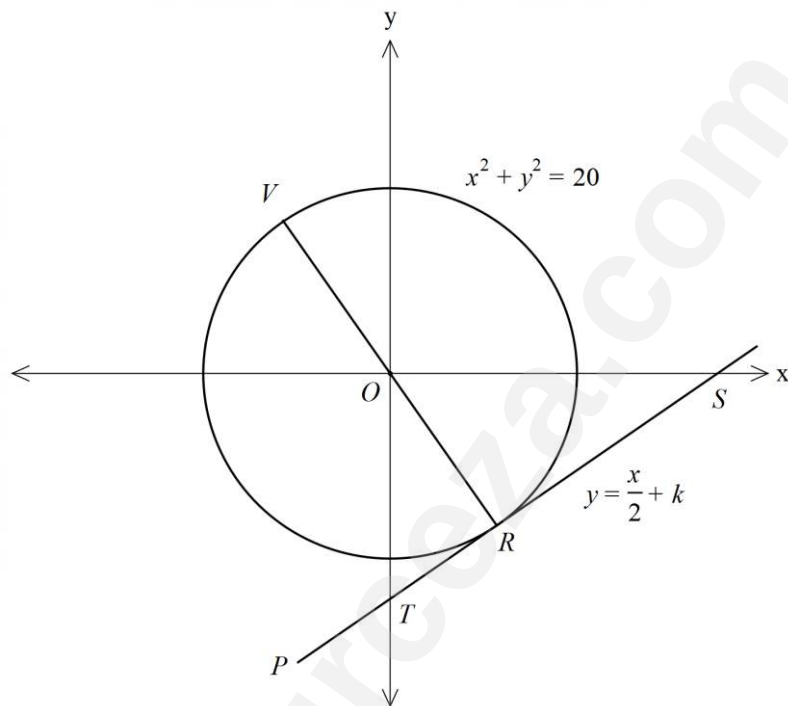
(5)
[22]

QUESTION 3

In the diagram below, the equation of the circle with centre O is $x^2 + y^2 = 20$.

The tangent PRS to the circle R has the equation $y = \frac{x}{2} + k$.

PRS cuts the y -axis at T and the x -axis at S .



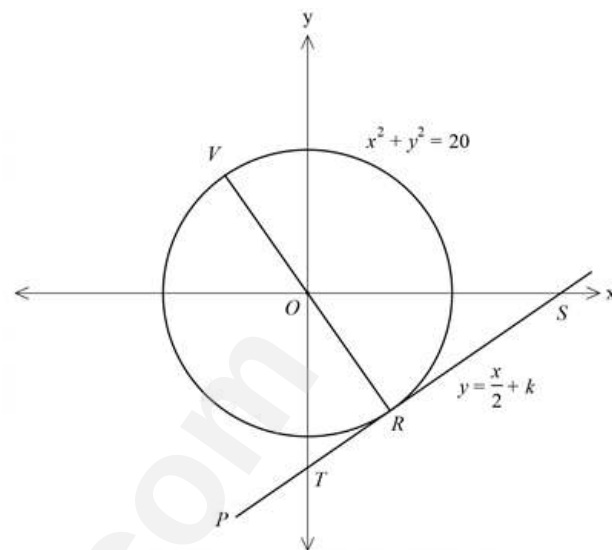
- (a) Determine, giving reasons, the equation of OR in the form $y = mx + c$.

(3)

- (b) Determine the coordinates of R .

(4)

- (c) Determine the area of $\triangle OTS$, given that $R(2; -4)$.



(6)

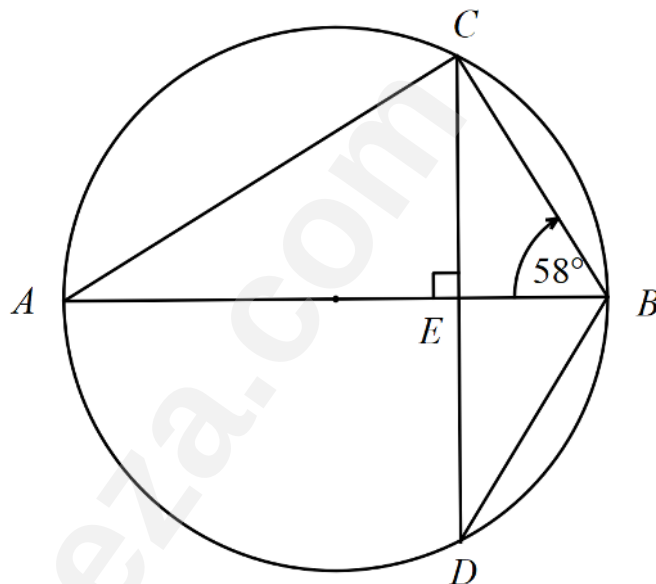
- (d) Calculate the length of VT .

(4)
[17]

QUESTION 4

(a) In the diagram below,

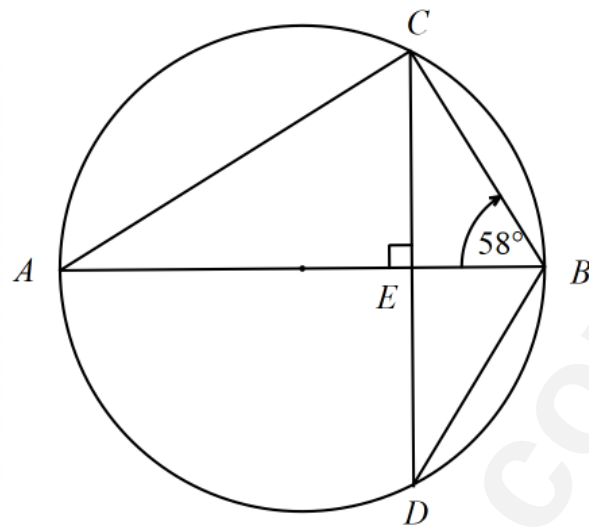
- AB is a diameter of the circle
- Chord CD is perpendicular to AB and cuts AB at E
- AC , CB and BD are drawn
- $\angle ABC = 58^\circ$



Prove that

(1) $\angle EBD = 58^\circ$

(4)



(2) $\triangle ABC \parallel \triangle DBE$

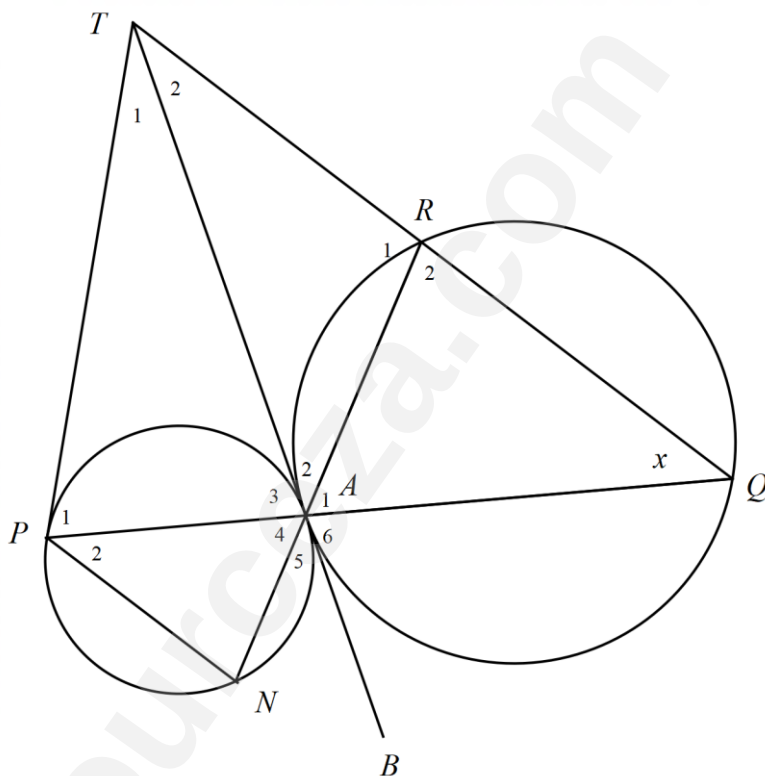
(3) $\frac{AC}{AB} = \frac{CE}{DB}$

(3)

(3)

(b) In the diagram below.

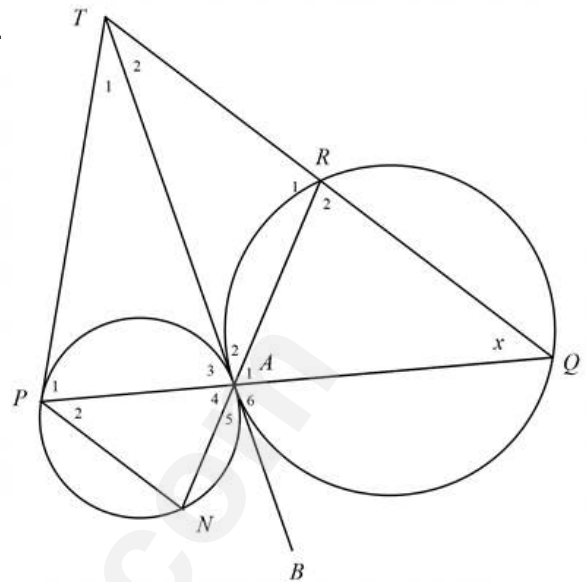
- The two circles have a common tangent TAB
- PT is a tangent to the smaller circle PAN
- QRT and NAR are straight lines
- $\hat{Q} = x$.



(1) Name with reasons THREE other angles equal to x .

(3)

(2) Prove that APTR is a cyclic quadrilateral.



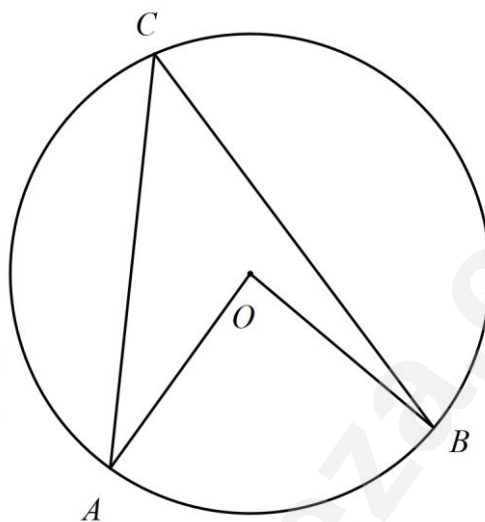
(5)
[18]

78 marks

SECTION B

QUESTION 5

- (a) Prove the theorem which states: "The angle which an arc of a circle subtends at the centre of a circle is twice the angle it subtends at the circumference of the circle."

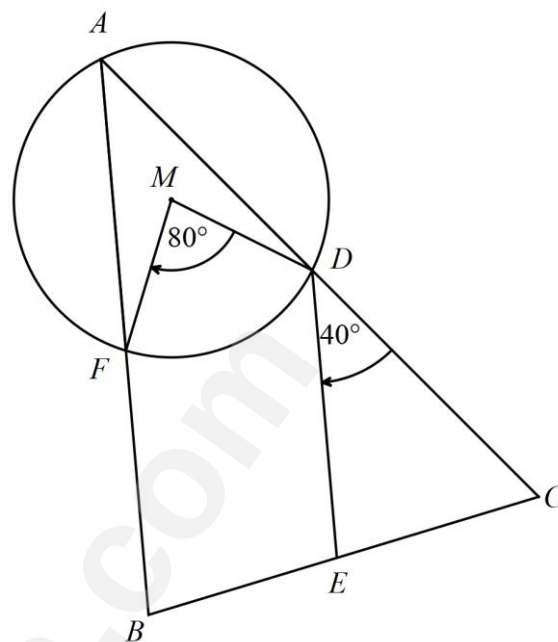


Required to prove: $\angle AOB = 2\angle ACB$

Construction:

Proof:

- (b) In the given figure, M is the centre of circle AFD. Chords AF and AD are produced to B and C respectively and BC is joined. $\angle EDC = 40^\circ$ and $\angle FMD = 80^\circ$.



- (1) Prove that $AB \parallel DE$.

- (2) If $\frac{BE}{EC} = \frac{7}{8}$ and $AC = 22.5\text{cm}$, calculate the length of AD.

(3)

(3)
[12]

QUESTION 6

Given the equation: $\sin(x + 60^\circ) + 2 \cos x = 0$

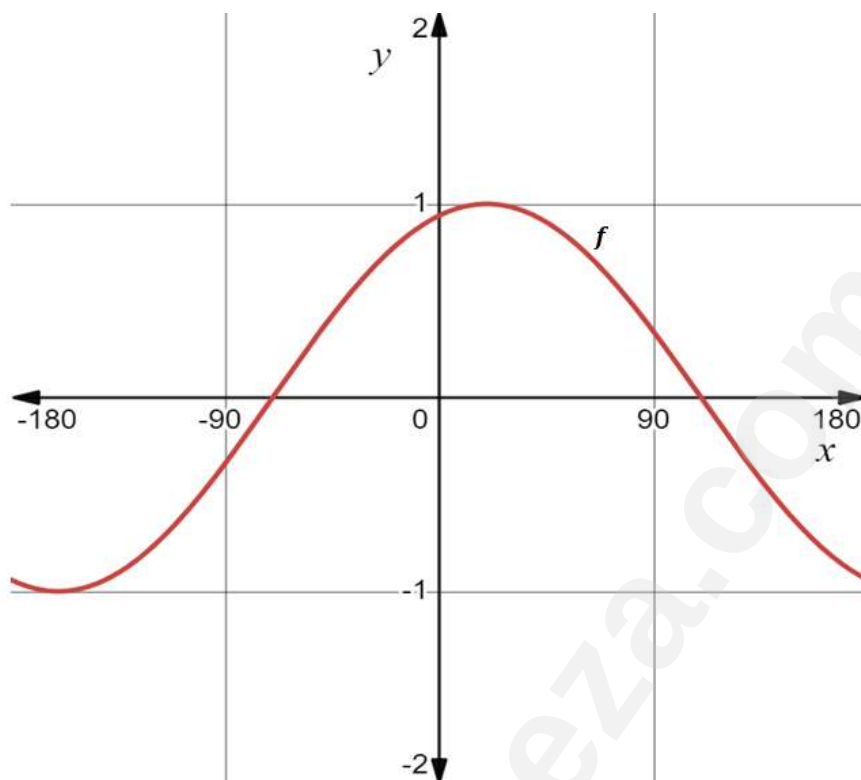
(a) Show that the equation can be written as $\tan x = -4 - \sqrt{3}$

(4)

(b) Hence determine the solutions to the equation $\sin(x + 60^\circ) + 2 \cos x = 0$ in the interval $-180^\circ \leq x \leq 180^\circ$.

(4)

(c) In the diagram below, the graph of $f(x) = \cos(x - 20^\circ)$ is drawn for $-180^\circ \leq x \leq 180^\circ$.



- (1) Draw the graph of $g(x) = -\sin 2x$ for $-180^\circ \leq x \leq 180^\circ$ on the same set of axes. Indicate the coordinates of all turning points, endpoints and intercepts of axes.

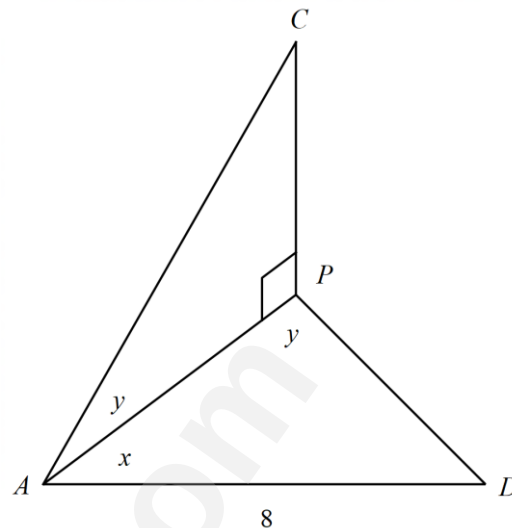
(4)
[12]

QUESTION 7

In the diagram below A, D and P are points in the same horizontal plane. CP is a vertical pole.

The angle of elevation of C from A is y .

$\hat{P}AD = x$, $\hat{D}PA = y$ and $AD = 8$ metres.



(a) Show that $CP = \frac{8 \sin(x+y)}{\cos y}$

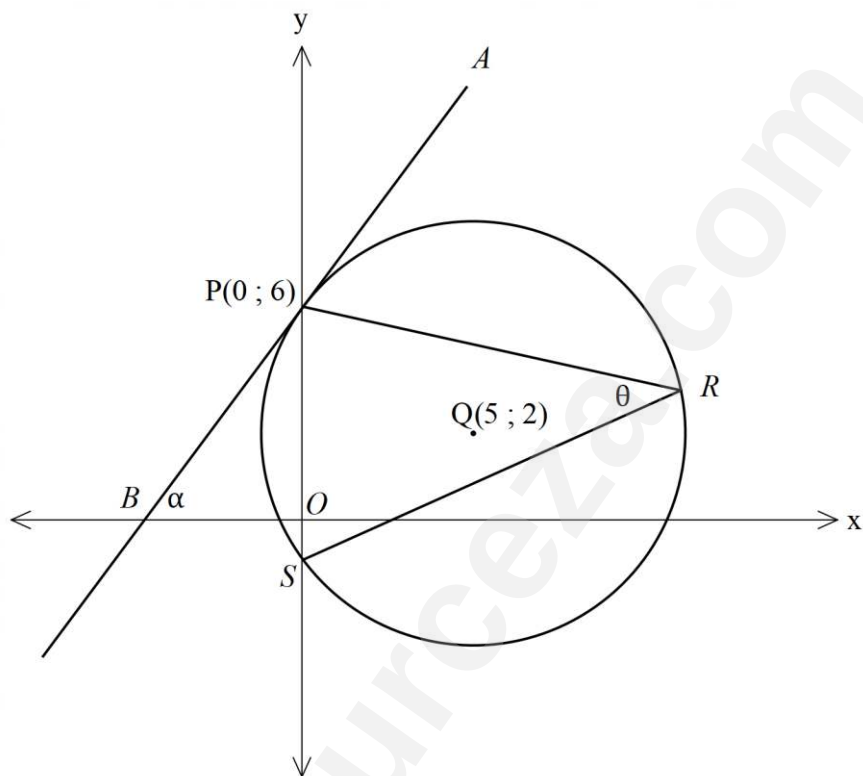
(b) If $x = y$, what are the possible values of CP?

(5)

(4)
[9]

QUESTION 8

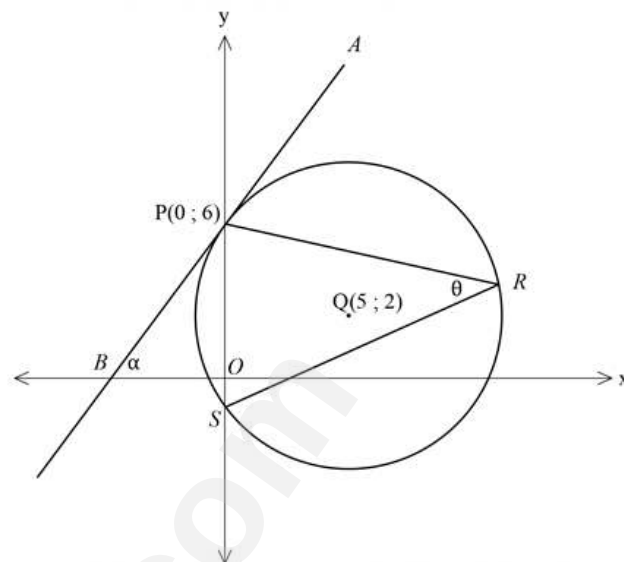
In the diagram below, $Q(5 ; 2)$ is the center of a circle that intersects the y -axis at $P(0 ; 6)$ and S . The tangent APB at P intersects the x -axis at B and makes the angle α with the positive x -axis. R is a point on the circle and $\widehat{PRS} = \theta$.



- (a) Determine the equation of the circle in the form $(x - a)^2 + (y - b)^2 = r^2$.

(3)

(b) Calculate the size of α .



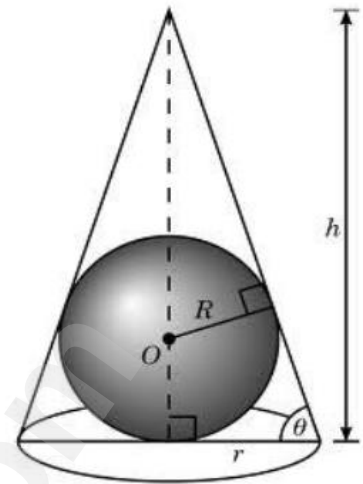
(c) Calculate, with reasons the size of θ .

(3)

(2)
[8]

QUESTION 9

- (a) The diagram below shows a sphere placed inside a cone which has a radius (r) of 7 cm. The total surface area of the sphere is $100\pi \text{ cm}^2$ and the height (h) of the cone is three and a half times the length of the radius of the sphere (R).



$$SA = \pi r^2 + \pi rs$$

$$V = \frac{1}{3} \pi r^2 h$$

$$SA = 4\pi r^2$$

$$V = \frac{4}{3} \pi r^3$$

Calculate the volume of the empty space in the cone, to one decimal.

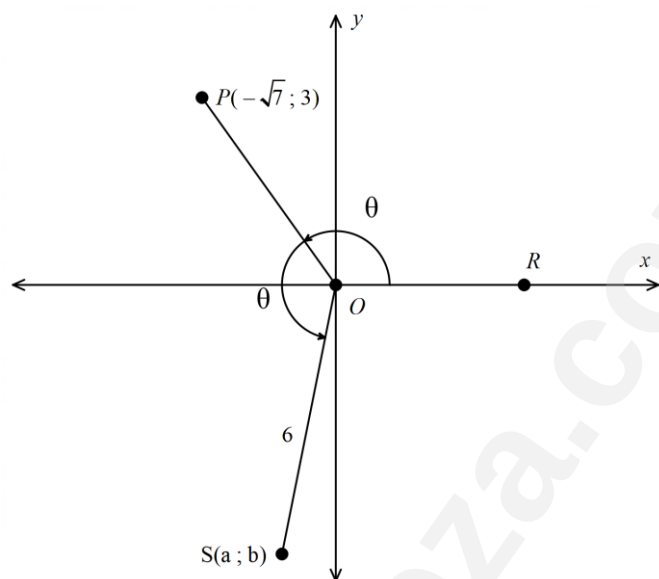
(5)

- (b) Nandi has two spheres in her office, a small marble and a large bowling ball. If the bowling ball has a volume which is 2744 times the volume of the marble, how many times larger is the radius of the bowling ball than the radius of the marble? Show all working.

(2)
[7]

QUESTION 10

- (a) $P(-\sqrt{7}; 3)$ and $S(a; b)$ are points on the Cartesian plane, as shown below
 $\widehat{POR} = \widehat{POS} = \theta$ and $OS = 6$ units.



Determine, without a calculator, the value of a .

(5)

- (b) Determine the value of $\lim_{x \rightarrow 0} \frac{\sin 2x}{\sin x}$.

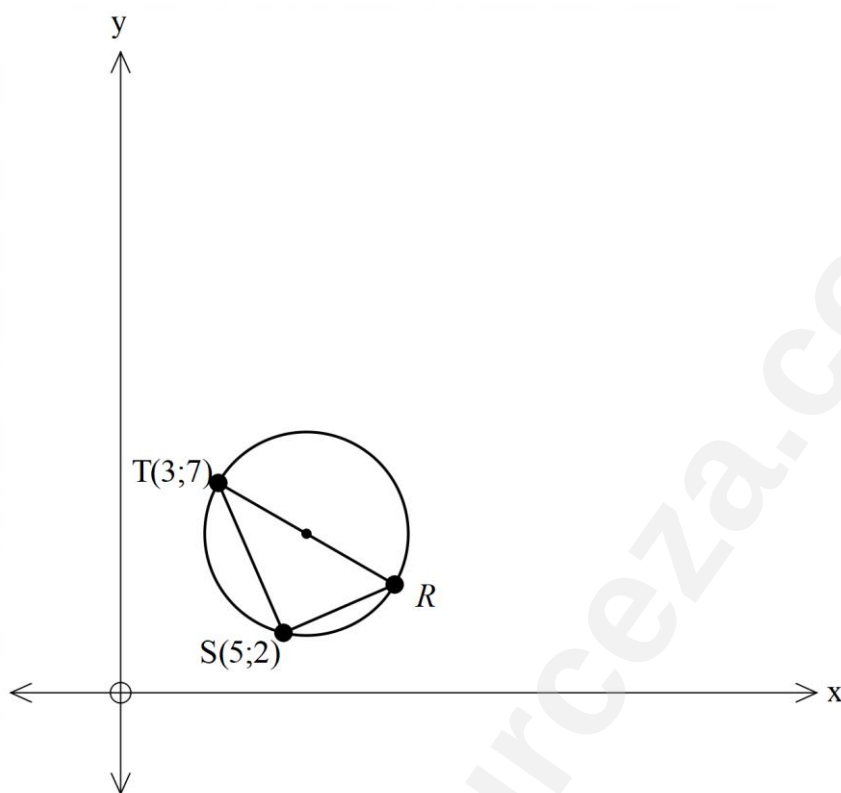
(3)

- (c) For which values in the interval $0^\circ \leq x \leq 180^\circ$ will the geometric sequence $\sin x ; \sin 2x ; \dots$ converge?

(5)
[13]

QUESTION 11

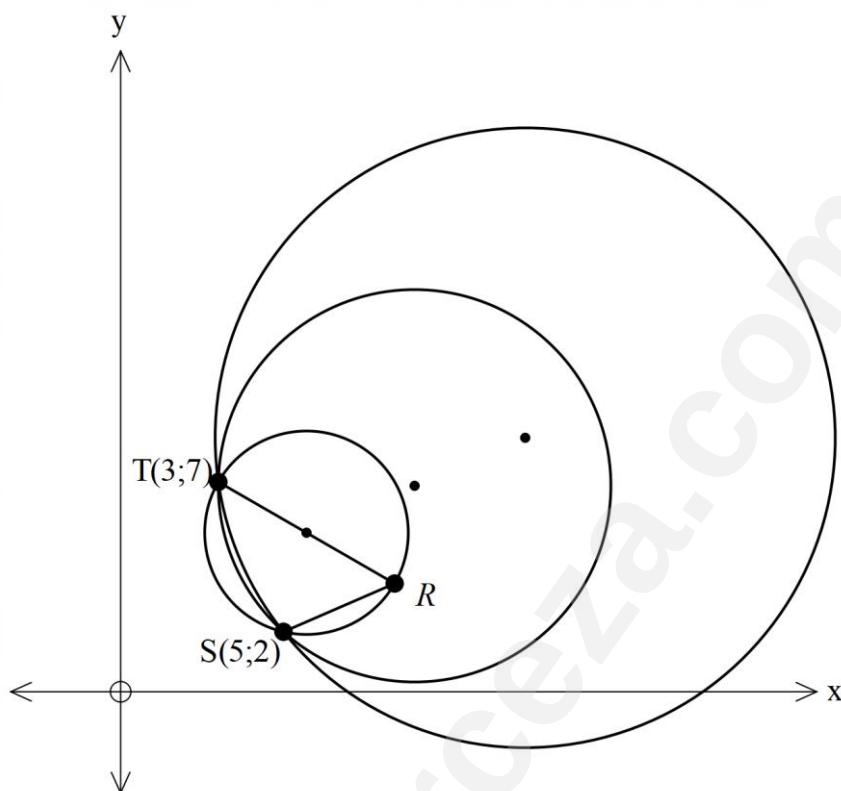
In the diagram is a small circle which passes through $T(3;7)$, $S(5;2)$ and R . RT is a diameter of the circle.



- (a) Show that the equation of SR is $y = \frac{2}{5}x$.

(4)

- (b) This small circle now begins to grow but at the same time continues to pass through the fixed positions of $T(3;7)$ and $S(5;2)$. RT remains the diameter of the growing circle.



Determine the new coordinates of R if:

- (1) TR becomes parallel to the x -axis.

(3)

(2) the equation of the circle becomes $(x - 9)^2 + \left(y - \frac{13}{2}\right)^2 = \frac{145}{4}$.

(4)
[11]

72 marks

Total: 150 marks

ADDITIONAL SPACE (ALL questions)

**REMEMBER TO CLEARLY INDICATE AT THE QUESTION THAT YOU USED THE
ADDITIONAL SPACE TO ENSURE THAT ALL ANSWERS ARE MARKED.**

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