Province of the EASTERN CAPE EDUCATION

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NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2024

TECHNICAL MATHEMATICS P2

MARKS: **150**

TIME: **3 hours**

This question paper consists of 14 pages, including a 1-page information sheet.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of TEN questions.

2. Answer ALL the questions in the SPECIAL ANSWER BOOK provided.

3. Clearly show ALL calculations, diagrams, graphs, et cetera which you have used in determining the answers.

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

5. You may use an approved scientific calculator (non-programmable and non-graphical) unless stated otherwise.

6. If necessary, round off your answers to TWO decimal places, unless stated otherwise.

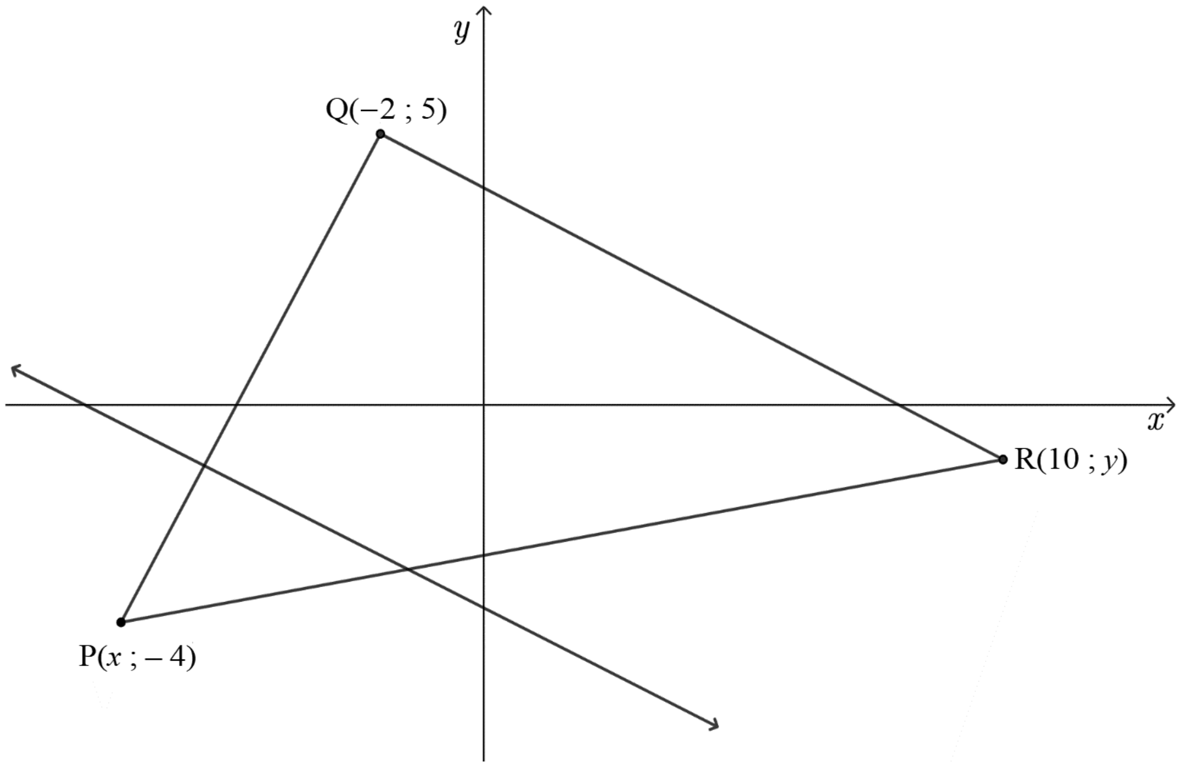
7. Diagrams are NOT necessarily drawn to scale.

8. An information sheet with formulae is included at the end of the question paper.

9. Write neatly and legibly.

QUESTION 1

In the diagram below P(x ; –4), Q(–2 ; 5) and R(10 ; y) are points on a cartesian plane. The line $2y + x + 5 = 0$ is drawn such that it is parallel to line segment QR.



1.1 Determine the gradient of QR. (2)

1.2 Show that R is the point $(10; -1)$. (3)

1.3 Calculate the coordinates of M, the midpoint of QR. (2)

1.4 Determine the equation of the line passing through M, which is perpendicular to line QR. (5)

1.5 Given QP = QR.

1.5.1 What type of a triangle is ΔPQR? (1)

1.5.2 Determine the value of the x-coordinate of P, correct to the nearest whole number. (6)

1.5.3 Hence, calculate the length of PR to the nearest whole number. (3)

[22]

QUESTION 2

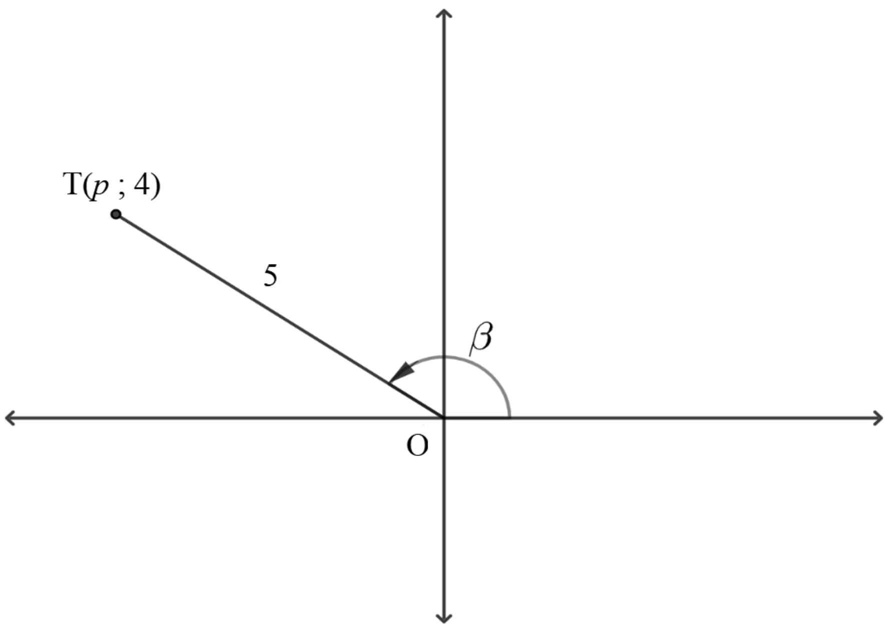
Given: $Y = 31{,}24°$ en $Z = 66{,}27°$

2.1 Evaluate the following:

2.1.1 $\sin Y + \cos Z$ (2)

2.1.2 $\dfrac{\cot Y + \tan^2 Z}{\sec Y \cdot \operatorname{cosec} Z}$ (3)

2.2 In the diagram below is T(p ; 4) a point on the cartesian plane. OQ and the x-axis form an obtuse angle β. OT = 5 units.



Determine the value of the following, WITHOUT the use of a calculator:

2.2.1 $\sin\beta$ (1)

2.2.2 p (4)

2.2.3 $\dfrac{\sec^2\beta}{\cot\beta}$ (3)

2.3 Solve for x, if it is given that $x \in [0°; 360°]$:
$3\tan x + 4 = 3$ (5)

[18]

QUESTION 3

3.1 Complete the following identities:

3.1.1 $\text{cosec}^2\alpha - 1 = \cdots$ (1)

3.1.2 $\cos^2\left(\frac{A}{2}\right) + \sin^2\left(\frac{A}{2}\right) = \ldots$ (1)

3.2 Simplify:

$$\frac{\tan^2(360° + x) \cdot \sin(180° + x) \cdot \cos(-x)}{\cos(180° + x) \cdot \sin(360° - x) \cdot \tan 315°}$$ (7)

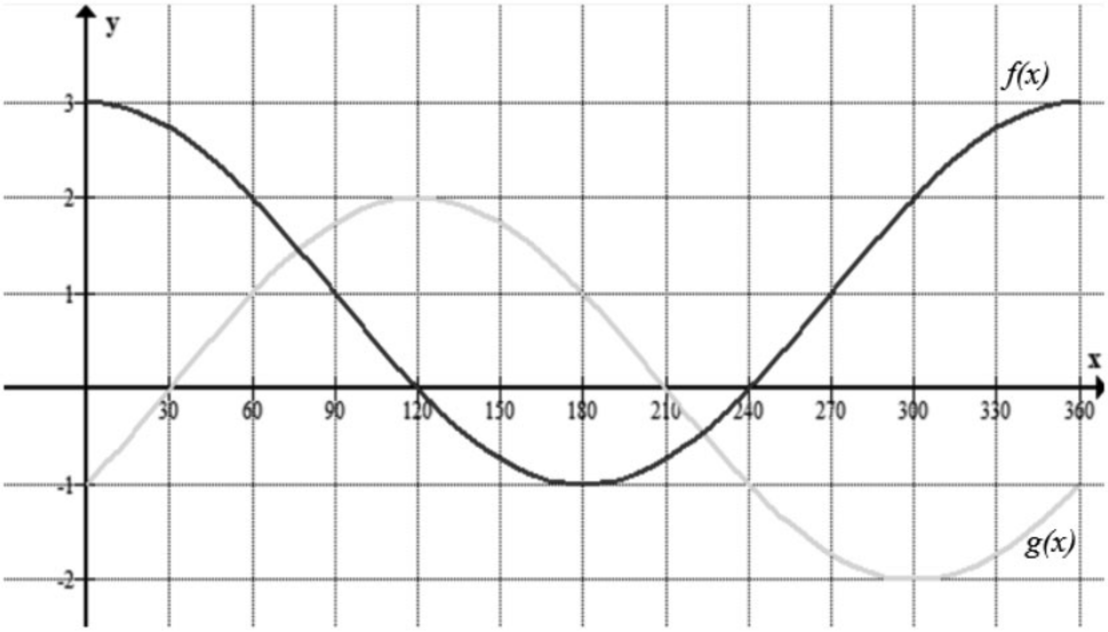
3.3 Prove the following identity:

$$\frac{\sin x}{1 - \cos x} - \frac{\sin x}{1 + \cos x} = 2\cot x$$ (5)

[14]

QUESTION 4

The diagram below shows the graphs of $f(x) = a \cos x + q$ and $g(x) = b \sin (x - 30°)$ for $x \in [0^\circ; 360^\circ]$.



4.1 Write down the numerical values of a, b and q. (3)

4.2 What is the period of f? (1)

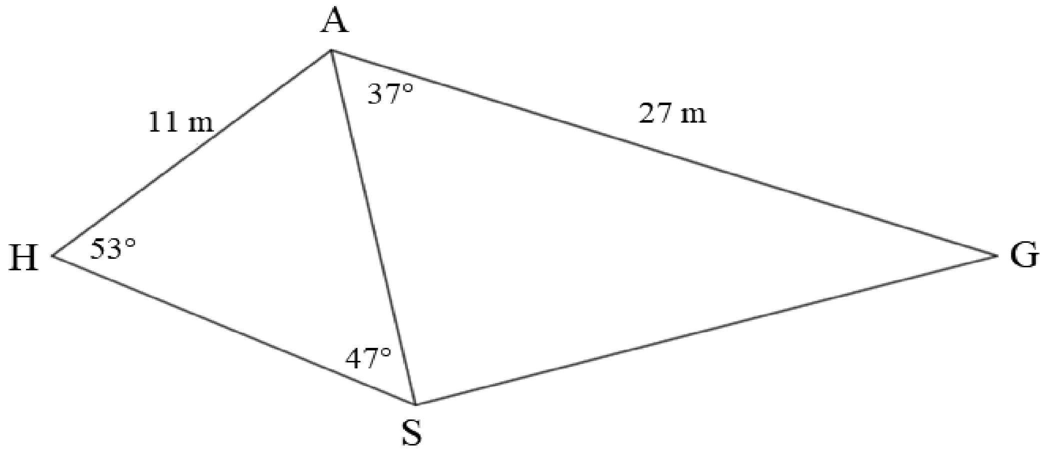
4.3 Write down the amplitude of g. (1)

4.4 Use the graph to determine the values of x for which $f(x) - g(x) = 4$. (3)

[8]

QUESTION 5

Pep Guardiola, a Manchester City coach, has a new formation that he will use to weaken the opponent's defence to win the league. Making use of his three forwards Alvarez (A), Haaland (H) and Silva (S), the ball is played between them. The plan is shown in the diagram below with G being the goal post.



5.1 What is the name of the shape formed by Pep Guardiola's plan? (1)

5.2 What is the distance between player **A** and player **S**, to the nearest metre? (3)

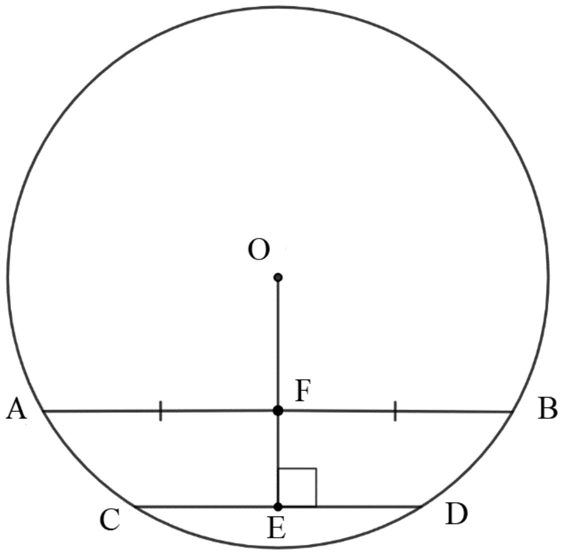
5.3 What will the distance between the goal post (**G**) and player **S** be? (***Hint***: *distance SG*) (4)

5.4 Calculate the area of ΔAGS. (3)

[11]

QUESTION 6

In the diagram below AB = 80 cm, CD = 48 cm and OF is 10 cm less than OE.
OF = x cm, AF = FB and OE$\perp$ CD.



6.1 Determine the following lengths in terms of x:

6.1.1 OE (2)

6.1.2 OC (3)

6.2 Determine the numerical value of x. (5)

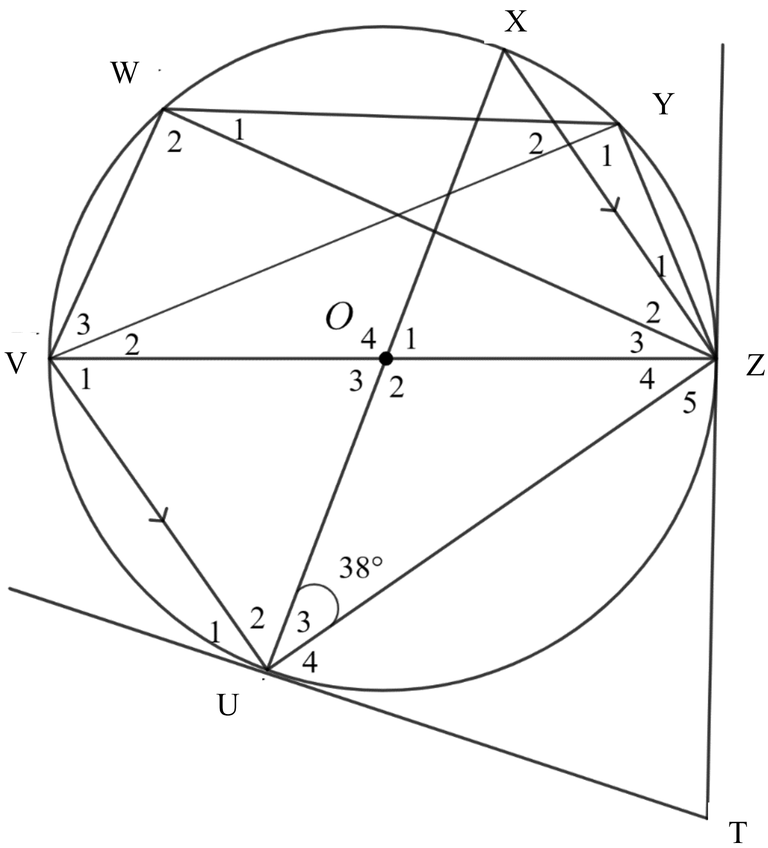
[10]

QUESTION 7

7.1 Complete the following statement:

"The angle subtended by the … at the circumference of a circle is $90°$*".* (1)

7.2 In the diagram below O is the centre of the circle, with U, V, W, X, Y and Z as points on the circumference of the circle. UT and ZT are tangents drawn such that they meet at T. $VU \parallel YZ$ and $\hat{U}_3 = 38°$.



7.2.1 List, with reasons, four angles equal to 90°. (4)

7.2.2 Calculate, with a reason, the size of angle $\hat{V}_1$ and then give, with reasons, three other angles that have the same size as $\hat{V}_1$. (8)

7.3 Consider ΔUTZ:

7.3.1 Why would TU = TZ? (1)

7.3.2 Determine the size of $\hat{T}$. (2)

7.4 Show that ΔUXZ ≡ ΔZVU. (4)

7.5 Prove that the quadrilateral OUTZ is a cyclic quadrilateral. (4)

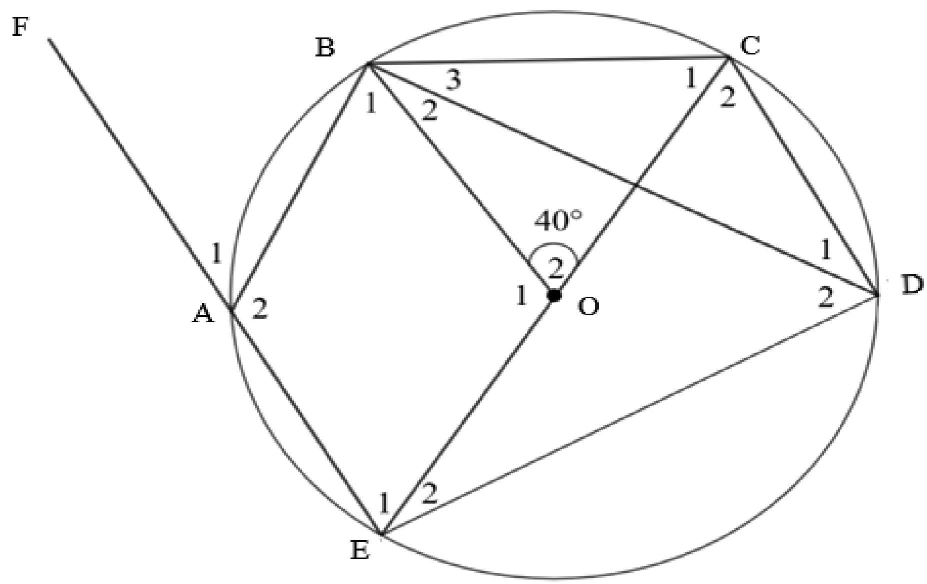
[24]

QUESTION 8

8.1 Complete the following statement:

"An exterior angle of a cyclic quadrilateral is ... to the interior opposite angle". (1)

8.2 In the diagram below O is the centre of the circle. A, B, C, D and E are points on the circle circumference. EA is produced to F and $\hat{O}_2 = 40°$.



Determine, with reasons, the sizes of the following angles:

8.2.1 $\hat{D}_2$ (3)

8.2.2 $\hat{A}_1$ (2)

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

[9]

QUESTION 9

9.1 Convert 271,314° to degrees, minutes and seconds. (2)

9.2 A circle with a diameter of 25 m has a sector with an arc length of 15 m.

9.2.1 Calculate the size of the central angle in radians. (4)

9.2.2 Calculate the area of the sector. (3)

9.3 A mini hand-held fan, in the picture below, has blades with a diameter of 50 mm which turn at 1 200 rpm.

9.3.1 Convert 1 200 rpm to rps. (1)

9.3.2 Calculate the angular velocity of the fan blades. (3)

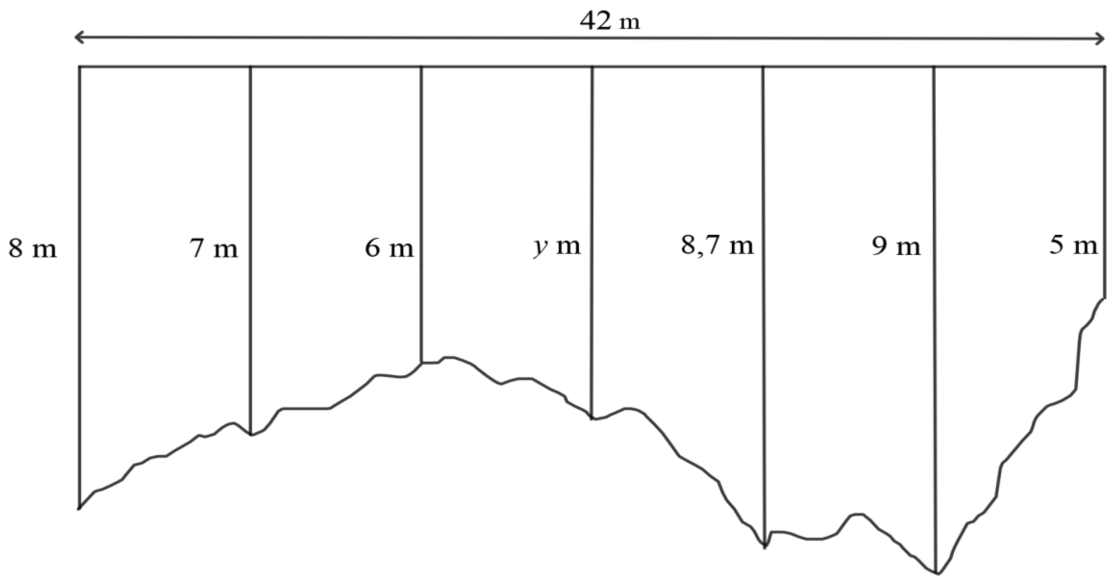
9.3.3 Calculate the circumferential velocity of the blades in m/s. (4)

9.3.4 The battery of the fan lasts 30 minutes before needing to be recharged. How many revolutions will the fan complete before the battery dies out? (3)

[20]

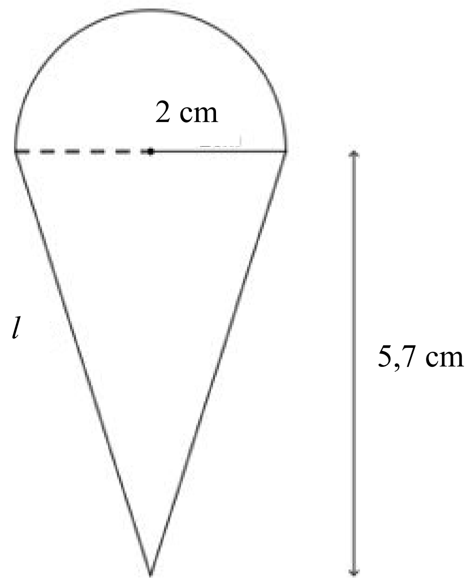
QUESTION 10

10.1 Consider the irregular figure below, with area $306{,}60\ m^2$, the length of the flat side as $42\ m$ and with ordinates of length 8 m, 7 m, 6 m, y m, 8,7 m, 9 m and 5 m.



Calculate the height of the ordinate represented by *y*. (5)

10.2 An ice cream man makes very nice ice cream cones, as shown in the picture below. Next to the picture is a cross section of the ice cream cone. The ice cream scoop is a semi-sphere with a radius of 2 cm. The bottom part of the ice cream cone has a height of 5,7 cm and a slant height of l.



Volume of cone = $\boldsymbol{\frac{1}{3}\pi r^2 h}$
Surface area of cone = $\boldsymbol{\pi r^2 + \pi r l}$

Volume of sphere = $\boldsymbol{\frac{4}{3}\pi r^3}$
Surface area of sphere = $\boldsymbol{4\pi r^2}$

10.2.1 Calculate the slant height (l) of the conical base. (2)

10.2.2 Hence, calculate the surface area of the ice cream. (3)

10.2.3 Determine the volume of the ice cream in litres. (4)
[14]

TOTAL: 150

INFORMATION SHEET

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

$a^x = b \Leftrightarrow x = \log_a b$, $\quad a > 0,\ a \neq 1$ and $b > 0$

$$A = P(1 + ni) \qquad A = P(1 - ni)$$

$$A = P(1 + i)^n \qquad A = P(1 - i)^n \qquad i_{eff} = \left(1 + \frac{i^m}{m}\right)^m - 1$$

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

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

$$m = tan\theta \qquad \frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

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

$$\int k x^n \, dx = k \cdot \frac{x^{n+1}}{n+1} + C \quad , n \neq -1$$

$$\int \frac{k}{x} dx = k \cdot \ln x + C, \quad x > 0$$

$$\int k a^{nx} \, dx = k \cdot \frac{a^{nx}}{n \ln a} + C \quad , a > 0$$

$$\pi rad = 180°$$

Angular velocity $= \omega = 2\pi n = 360°n$ where n = rotation frequency

Circumferential velocity $= v = \pi D n$ where D = diameter and n = rotation frequency

Circumferential velocity $= v = \omega r$ where ω = angular velocity and r = radius

Arc length $= s = r\theta$ where = radius and θ = central angle in radians

$4h^2 - 4dh + x^2 = 0$ where h = height of segment, d = diameter of circle and x = length of chord

Area of a sector $= \frac{rs}{2} = \frac{r^2\theta}{2}$ where r = radius, s = arc length and θ = central angle in radians

In ΔABC: $\quad \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} \qquad a^2 = b^2 + c^2 - 2bc.cosA \qquad Area = \frac{1}{2}ab.sinC$

$$sin^2\theta + cos^2\theta = 1 \qquad 1 + tan^2\theta = sec^2\theta \qquad cot^2\theta + 1 = cosec^2\theta$$

$$A_T = a\left(\frac{O_1 + O_n}{2} + O_2 + O_3 + O_4 + \ldots + O_{n-1}\right)$$

where a = width of equal parts, O_i = i^{th} ordinate and n = number of ordinates

OR

$$A_T = a(m_1 + m_2 + m_3 + \ldots + m_{n-1})$$

where a = width of equal parts, $m_i = \frac{O_i + O_{i+1}}{2}$ and n = number of ordinates; i = 1;2;3; …;n-1