Province of the
EASTERN CAPE
EDUCATION

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Porafensie Ya Kapa Botjahabela: Lefapha la Thuto

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2025

TECHNICAL MATHEMATICS P2

MARKS: 150

TIME: 3 hours

This question paper consists of 16 pages, including a 2-page information sheet.

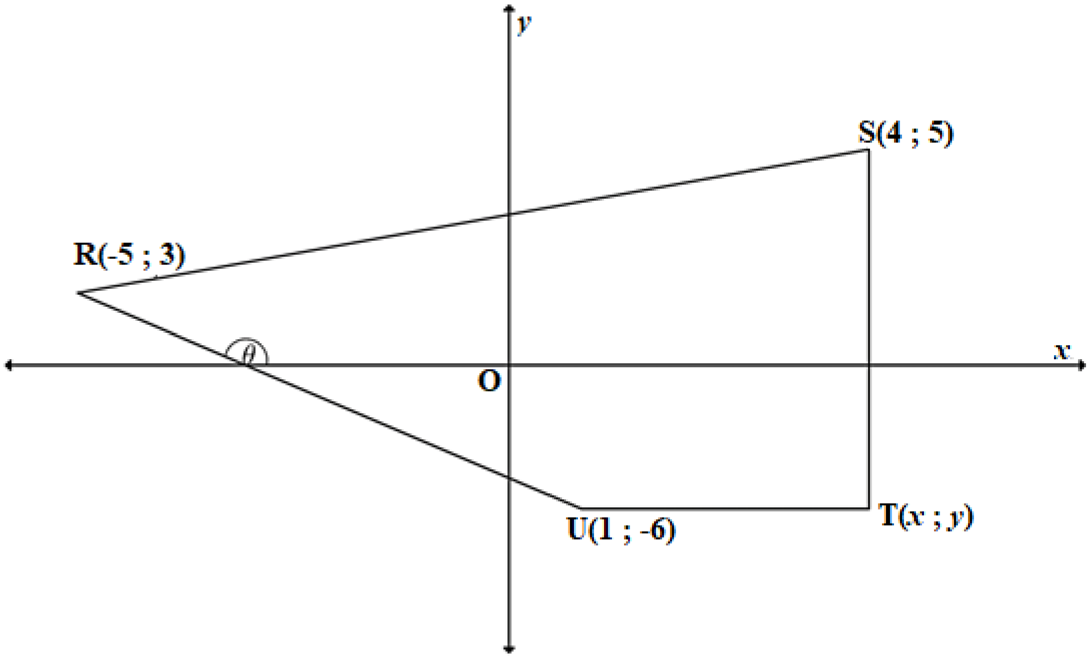
INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of ELEVEN 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

The diagram below has vertices $R(-5\ ;\ 3)$; $S(4\ ;\ 5), T(x\ ;\ y)$ and $U(1\ ;\ -6)$. Where θ is the angle of inclination of line RU with the x-axis.



1.1 Write the coordinates of T. (2)

1.2 Calculate the length of line RS. (3)

1.3 Calculate the midpoint M of RS. (2)

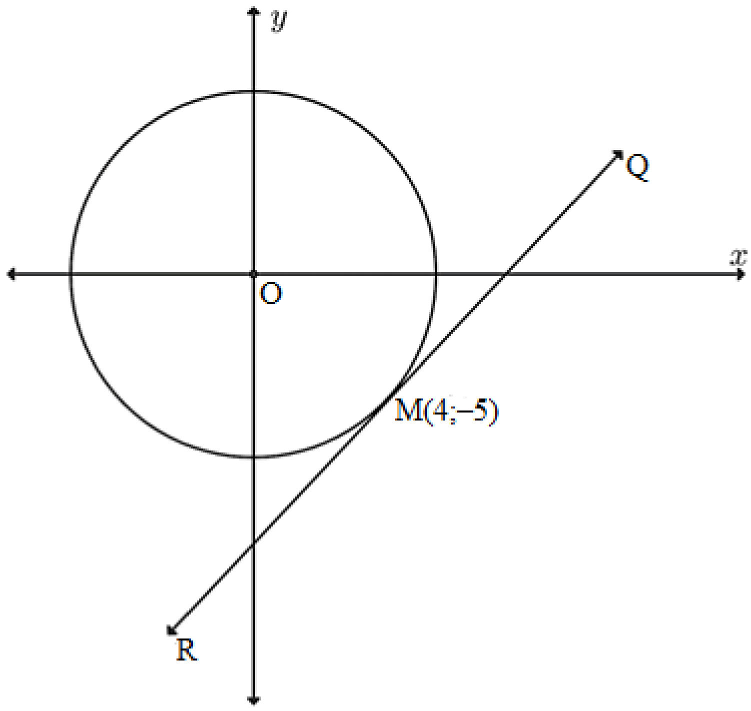
1.4 Determine the size of θ to two decimal places. (5)

1.5 Determine the equation of the line passing through the midpoint M, of line RS and perpendicular to line RS. (5)

[17]

QUESTION 2

2.1 In the diagram below, $O(0\,;\,0)$ is the centre of the circle defined by $x^2 + y^2 = r^2$. QR is a straight line that intersect the circle at $M(4;-5)$.



2.1.1 What is the name given to line QR? (1)

2.1.2 Determine the equation of the circle. (2)

2.1.3 Determine the equation of line QR. (4)

2.2 Given the equation: $\frac{x^2}{32}+\frac{y^2}{81}=1$

2.2.1 Express the equation in the form: $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ (1)

2.2.2 Hence sketch the graph defined by $\frac{x^2}{32}+\frac{y^2}{81}=1$ on the grid provided, in the ANSWER BOOK. Clearly show ALL the intercepts with the axes. (3)

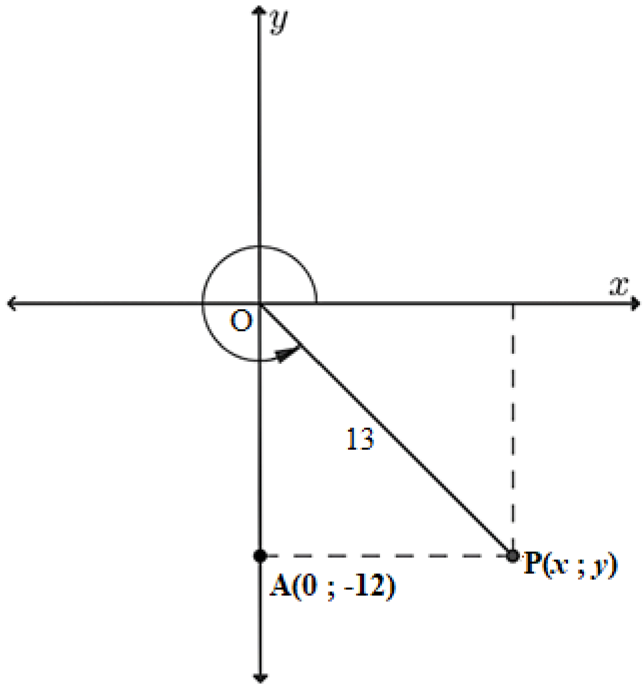
[11]

QUESTION 3

3.1 Given that: $x = 1{,}271$ rad

Determine the numerical value of: $\cot x + 11$ (3)

3.2 In the diagram below $\mathrm{P}(x\,;y)$, $\mathrm{OP} = 13$, $\mathrm{A}\,(0\,;-12)$ and θ is the given angle.



3.2.1 Determine the coordinates of P. (3)

3.2.2 Evaluate: $cos^2\theta - sec^2\theta$ (3)

3.2.3 Evaluate: $\dfrac{1}{\cos ec\theta} - \cot\theta$ (3)

3.3 Solve for β if $-7\tan\beta + 3 = 1$, where $\beta \in [0°\,;180°]$ (3)

[15]

QUESTION 4

4.1 Simplify the following:

$$\frac{cos^2(180° + x) + sin(360° + x).sinx + tan^2x}{cot(180° + x).tanx}$$ (6)

4.2 Prove that: $cosec\theta - cot\theta = \frac{sin\theta}{1+cos\theta}$ (5)

[11]

QUESTION 5

Given the functions $f(x) = \sin(x + 45°)$ and $g(x) = 3\cos x$ for $x \in [0° \ ; \ 360°]$.

5.1 Draw the sketch graphs of f and g on the same set of axes in the ANSWER BOOK provided. Clearly show all the turning points, starting and end points, and also intercepts with the axes. (6)

5.2 Write down the:

5.2.1 Period of f (1)

5.2.2 Amplitude of g (1)

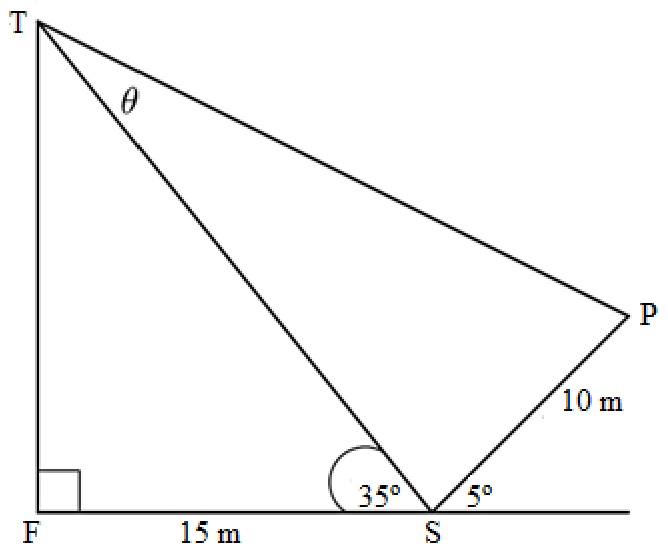
5.3 Use the graph to solve for x when $3\cos x = 3$. (2)

5.4 Determine the values of x for which $f(x) > g(x)$ for $y < 0$. (2)

[12]

QUESTION 6

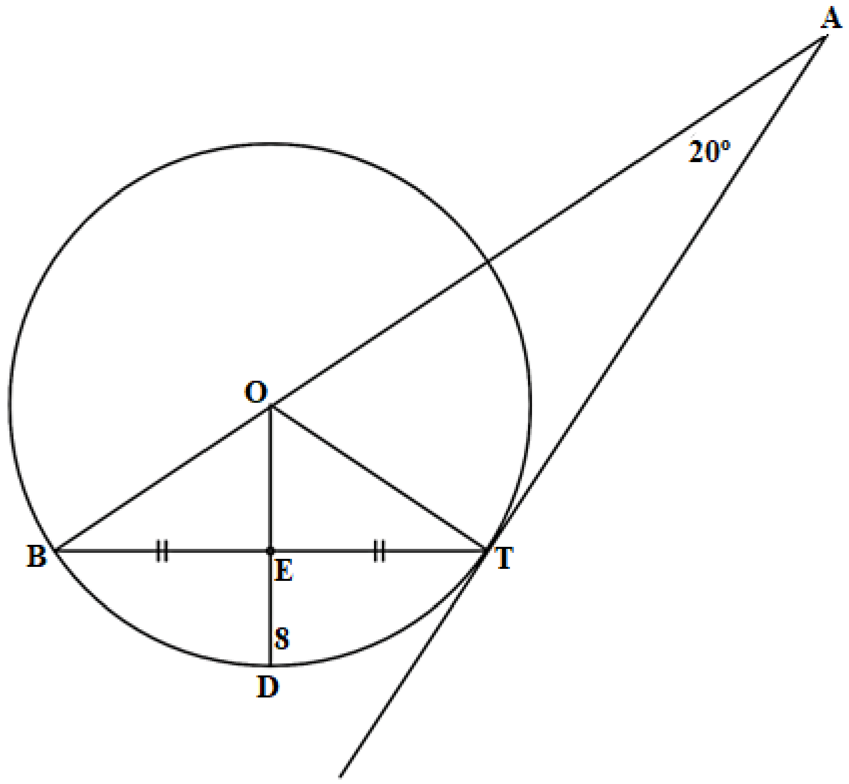
A sniper standing at point S looks up to the top, point T of a tree where his target, a bird is. Point F is the foot of the tree. The sniper is 15 m from the foot of the tree. The angle of elevation from S to T is 35°. He turns around and walks in the opposite direction from the tree to get a better shot at an inclination of 5° for 10 m to a point P. The diagram below is a sketch of the scenario. Angle $S\hat{T}P = \theta$.



6.1	Show by calculations that ST is 18,3 m.	(2)
6.2	Calculate the length of TP to ONE decimal place.	(5)
6.3	Calculate the size of angle θ	(4)
6.4	Determine the area of ΔSTP.	(3)
		[14]

QUESTION 7

In the diagram below TA is a tangent to a circle with centre O. Points B, D and T are points on the circle. BE = ET; DE = 8; $T\hat{A}O = 20°$ and TA = 35.



7.1 Radius is … to the tangent. (1)

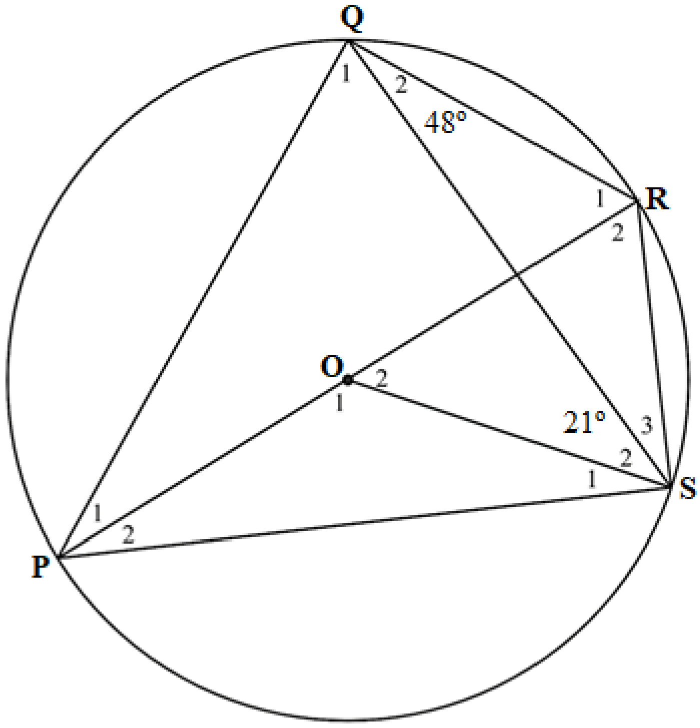
7.2 Calculate with reasons the length of BT. (5)

7.3 Determine with reasons the size $\hat{B}$. (5)

[11]

QUESTION 8

In the diagram below, circle PQRS with centre O is drawn. It is also given that $\hat{Q}_2 = 48°$ and $\hat{S}_2 = 21°$.



8.1 Complete the following theorem:

An angle subtended by a diameter is … (1)

8.2 Write, stating reasons, two more angles with the same size as $\hat{Q}_2$. (4)

8.3 Determine, stating reasons, the sizes of each of the following angles:

8.3.1 $\hat{O}_2$ (2)

8.3.2 $\hat{R}_2$ (4)

8.3.3 $\hat{S}_3$ (2)

8.3.4 $\hat{P}_1$ (2)

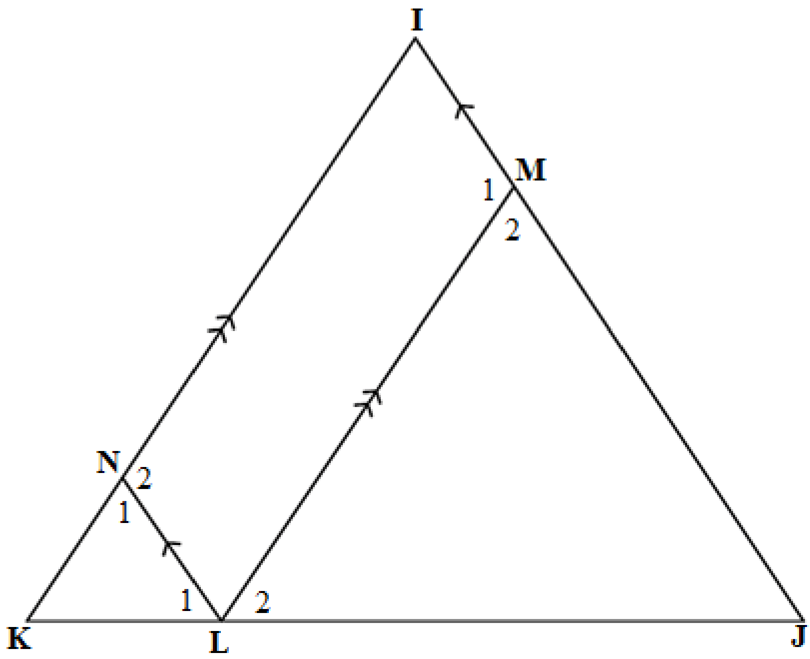
[15]

QUESTION 9

9.1 Complete the following statement:

"A line drawn … to one side of a triangle divide the other two sides proportionally." (1)

9.2 Given ΔIJK, LN || JI and LM || KI.



9.2.1 Prove, stating reasons, that $\Delta NKL \, ||| \, \Delta IKJ$. (4)

9.2.2 If $\frac{IK}{NK} = \frac{5}{2}$, find, with reasons, the value of:

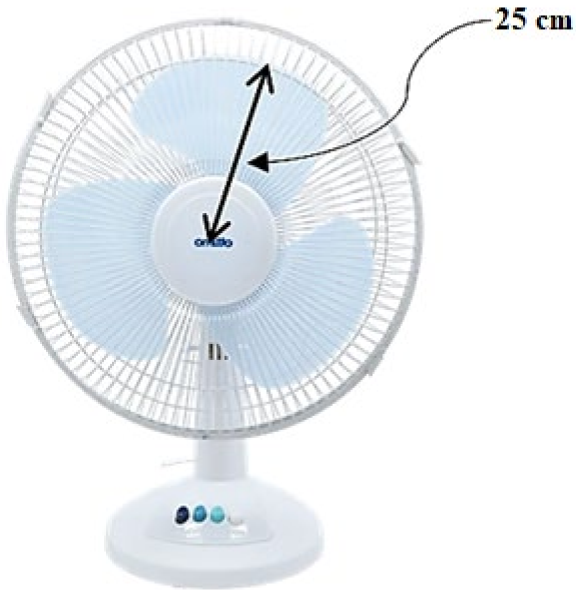
(a) $\frac{NL}{IJ}$ (2)

(b) $\frac{JM}{JI}$ (3)

[10]

QUESTION 10

10.1 A home fan with blade of length of 25 cm rotates its blades at 200 revolutions per min.



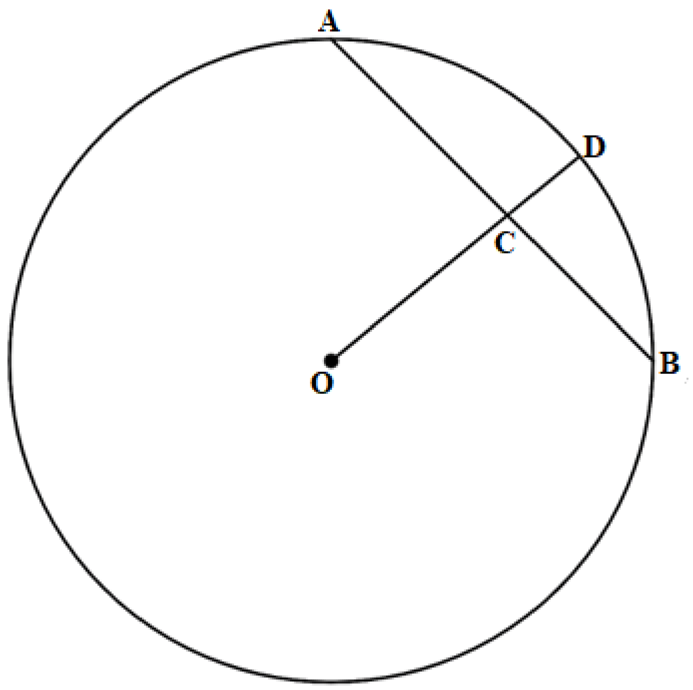
10.1.1 What is the diameter of the fan? (1)

10.1.2 Calculate the rotational frequency of the fan in revolutions per second. (2)

10.1.3 Determine the circumferential velocity in metres per second. (4)

10.1.4 Calculate its angular velocity. (3)

10.2 A circle with centre O, has a chord AB with centre C. Point D is on the circumference of the circle such that OD passes through C. It is given that $\mathrm{AB} = 60$ cm, $\mathrm{OD} = 80$ cm.



Calculate the length of CO. (5)

10.3 A sector with centre angle of $87°$ has a radius of 13 cm

10.3.1 Calculate the arc length. (4)

10.3.2 Determine the area of the sector. (3)

[22]

QUESTION 11

11.1 An irregular figure with one straight side of length 28 m is divided into seven equal parts. The lengths of the ordinates resulting from dividing the straight side are:
9 m; 8,25 m; 7 m; 6,25 m; 9,1 m; 7,5 m; 8 m, 6,52 m.

Calculate the area of the irregular shape to the nearest square metres. (5)

11.2 You have been asked to inflate three balls for your school's sports code. A soccer ball with radius 13 cm, volleyball with diameter 22 cm and a basketball with diameter 28 cm.

The following formulae may be used:

Surface area of a sphere $= 4\pi r^2$

Volume of a sphere $= \frac{4}{3}\pi r^3$

11.2.1 Calculate total volume of air inflated that the three balls can hold. (5)

11.2.2 Calculate the surface area of the inflated volleyball. (2)

[12]

TOTAL: 150

INFORMATION SHEET

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

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

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

$i_{eff} = \left(1 + \dfrac{i}{m}\right)^m - 1$

$f'(x) = \lim\limits_{h \to 0} \dfrac{f(x+h) - f(x)}{h}$

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

$\int \dfrac{1}{x} dx = \ln(x) + C, \quad x > 0$ $\qquad \int \dfrac{k}{x} dx = k \cdot \ln(x) + C, \quad x > 0$

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

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

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

$\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} = 1$

In ΔABC:

$\dfrac{a}{\sin \mathrm{A}} = \dfrac{b}{\sin \mathrm{B}} = \dfrac{c}{\sin \mathrm{C}}$ $\qquad a^2 = b^2 + c^2 - 2bc \cos \mathrm{A}$ $\qquad \text{Area} = \dfrac{1}{2} ab.\sin \mathrm{C}$

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

$\pi rad = 180°$

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

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

Circumferential velocity = $v = \pi Dn$ 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 r = radius and θ = central angle in radians

Area of a sector $= \dfrac{rs}{2}$ where r = radius and s = arc length

Area of a sector $= \dfrac{r^2\theta}{2}$ where r = radius and θ = central angle in radians

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

$A_T = a\left(m_1 + m_2 + m_3 + \ldots + m_{n-1}\right)$ where a = width of equal parts, $m_1 = \dfrac{o_1 + o_2}{2}$ and n = number of ordinates

OR

$A_T = a\left(\dfrac{o_1 + o_n}{2} + o_2 + o_3 + o_4 + \ldots + o_{n-1}\right)$ where a = width of equal parts, $o_i = i^{th}$ ordinate and n = number of ordinates