Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2023

TECHNICAL MATHEMATICS P2 (DEAF LEARNERS)

MARKS: **150**

TIME: **3 hours**

This question has 17 pages, with a 2-page information sheet.

INSTRUCTIONS AND INFORMATION

Read the **instructions**.

1. This **question paper** has **TEN (10) questions**.

2. **Answer** ALL the **questions**.
   Use the **SPECIAL ANSWER BOOK**.

3. **Show ALL calculations, diagrams**, graphs, et cetera that you have **used** in **working out** your **answers.**

4. **Answers only** will **NOT always** be awarded **full marks**.

5. You **may use** a prescribed **calculator**.
   Some questions will **tell** you **NOT** to use a **calculator**.

6. **Round off** answers to **TWO decimal places**.
   Some questions will **tell** you **how to round off**.

7. **Diagrams** are **NOT** always drawn to **scale**.
   Some questions will **tell** you to **use the scale**.

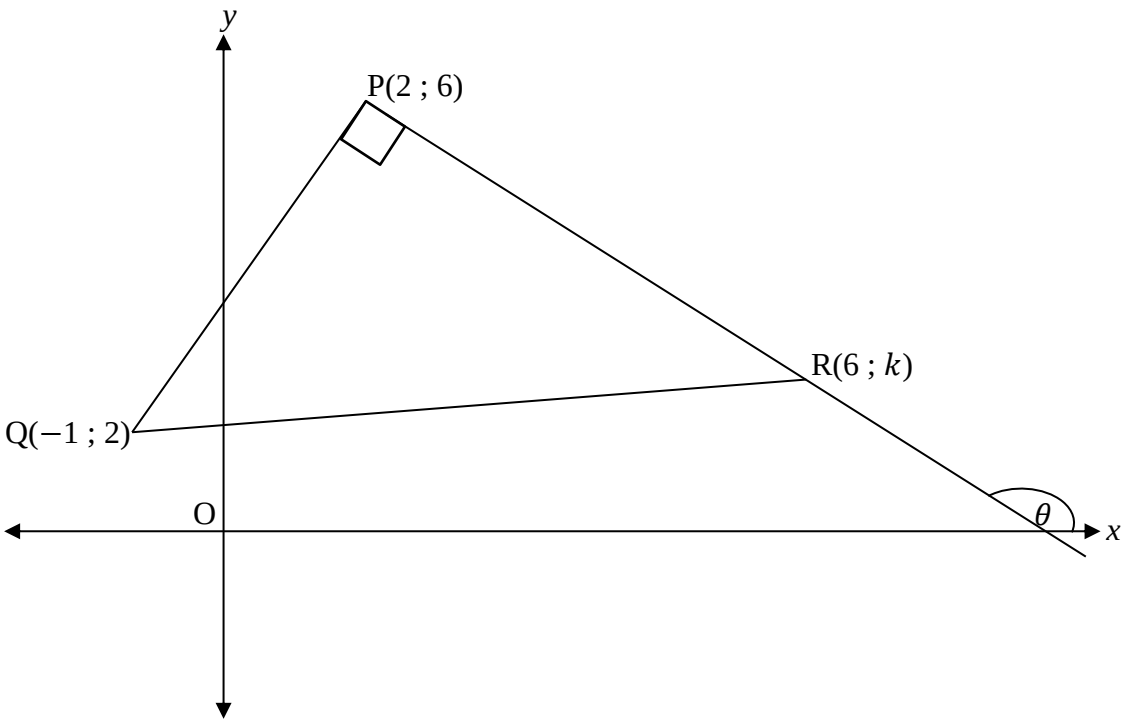
8. An **information sheet** with **formulae** is included at the **end** of the question paper.

9. Write **neatly**.
   Your **work** must be **easy** to **read**.

QUESTION 1

Diagram:

ΔPQR has a **right angle** at **P**.
The **coordinates** of the **vertice**s are **P**(**2** ; **6**); **Q**(**−1** ; **2**) and **R**(**6** ; ***k***).
θ is the **angle** of **inclination** of line **PR**.



1.1 **Complete** the **statement**:

"When **two lines** are **perpendicular** the … of the **gradients** must be **equal** to -1." (1)

Determine:

1.2 The **gradient** of **PQ** (3)

1.3 **Show** that the **value** of $k = 3$ (3)

1.4 The **coordinates** of the **midpoint** of QR (3)

1.5 The **coordinates** of S, so that **QPRS** is a **rectangle** (4)

1.6 The **equation** of PR (4)

1.7 θ, the **inclination angle** of **line PR** (3)

1.8 If the **length** of PQ = 5 units, **calculate** the **size** of $\widehat{Q}$ (5)

[26]

QUESTION 2

2.1 **Given**: $x = 30{,}5^\circ$ and $y = 130{,}5^\circ$

Determine:

2.1.1 $\tan(x + y)$ (2)

2.1.2 $\text{cosec}(y - x)$ (3)

2.2 If $\sin 36° = k$, **express** the **following** in **terms** of k .

2.2.1 $\cos 36°$ (4)

2.2.2 $\sin 216°$ (2)

2.3 **Solve** for θ, $\theta \in [0°; 360°]$ **rounded off** to **ONE decimal digit**:

$\tan\theta = 2 \sin 38{,}1°$ (4)

[15]

QUESTION 3

3.1 **Simplify:**

$$\frac{\cos(360° - \theta).\dfrac{1}{\cot(180° + \theta)}.\tan(360° + \theta)}{\cos(180° + \theta).\tan(180° - \theta)} \quad (6)$$

3.2 **Prove** that:

$$\left(tanx + \frac{1}{cosx}\right)^2 = \frac{1 + sinx}{1 - sinx} \quad (4)$$

[10]

QUESTION 4

Given $f(x) = \cos x$ **and** $g(x) = \sin x + 1; x \in (0°; 360°)$

4.1 **Use** the **grid** in the SPECIAL ANSWER BOOK.
On the same axes, draw the graphs of $f(x) = \cos x$ and $g(x) = \sin x + 1$.

Show ALL:
- The intercepts with the axes
- Turning points
- Endpoints (7)

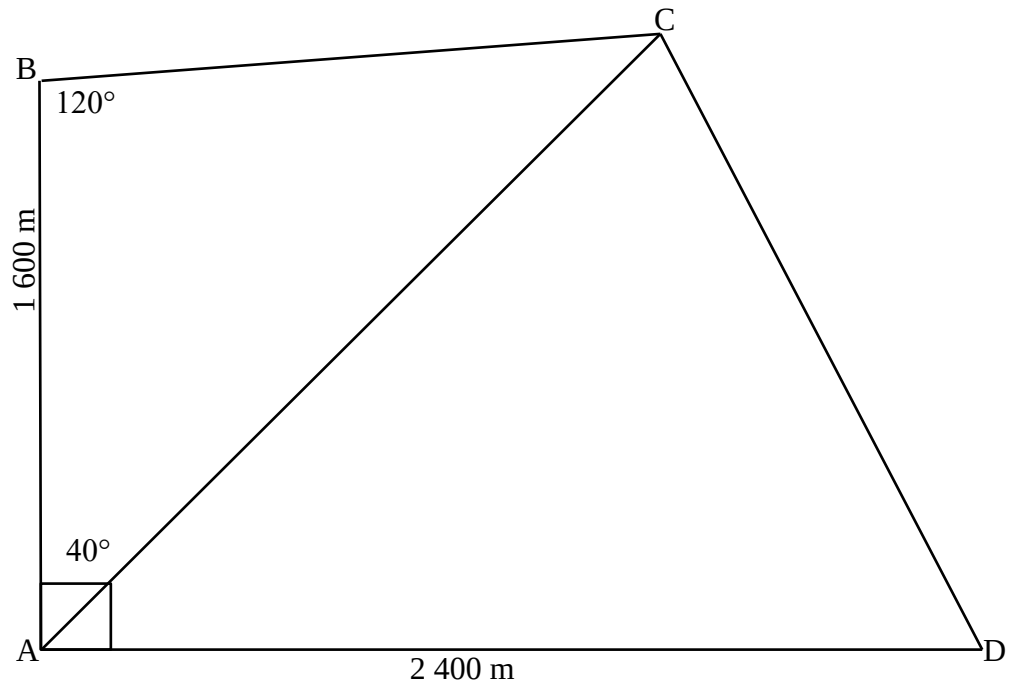
4.2 **Write** down the **range** of g. (2)

4.3 **Write** down the **period** of f. (1)

4.4 **Use** your **graphs**.
Determine for **which values** of x, is $f(x).g(x) \leq 0$. (2)
[12]

QUESTION 5

A **farm** has the **shape shown** in the **figure below**.
It has a **fence dividing** it into **two triangles**.
The **lengths** of **two adjacent(adjoining) sides** of the farm are **1 600 m** and **2 400 m**.
They **make** an **angle** of **90°**, with **one another** at **A**.
$B\widehat{A}C = 40°$ and $C\widehat{B}A = 120°$.



5.1 **Determine** the **size** of $B\widehat{C}A$.
State a r**eason**. (2)

5.2 **Determine** the **length** of **AC**, to the **nearest whole number**. (3)

5.3 **Determine** the **total area** of the **farm**, ABCD. (6)
[11]

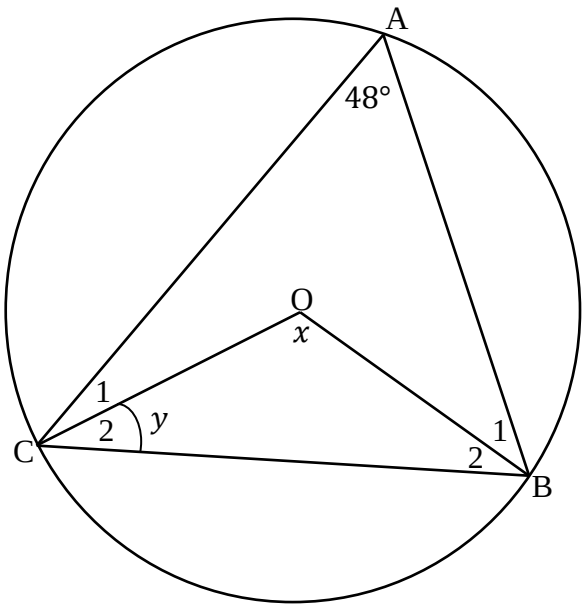
QUESTION 6

6.1 Fill in the **missing word(s)** in the **theorem** statement:

"The **angle subtended** by an **arc** at the **centre** of a **circle is** … the **size** of the **angle subtended** by the **same arc** at the **circumference** of the **circle**." (1)

6.2 **Diagram:**

O is the **centre** of the **circle passing through** A, B and C.
$C\hat{A}B = 48°, C\hat{O}B = x$, and $\hat{C}_2 = y$



Determine the **sizes** of the following.
Give reasons.

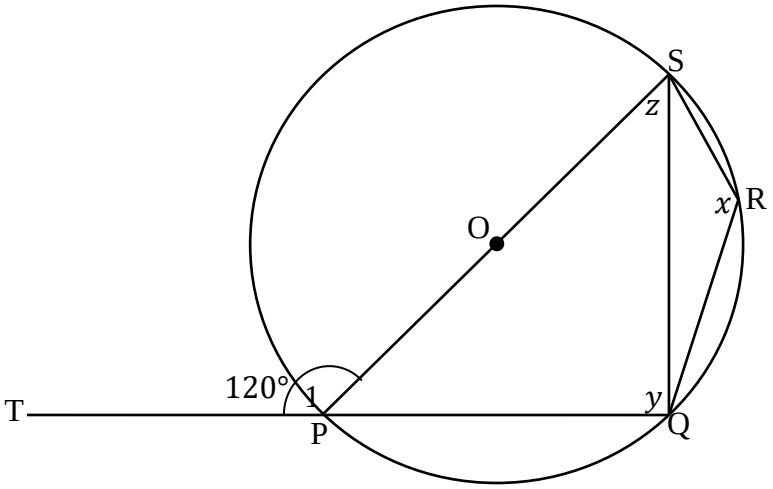
6.2.1 x (2)

6.2.2 y (2)

6.3 Fill in the **missing word(s)** in the **theorem** statement:

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

6.4 **O** is the **centre** of the **circle**, with **PS** as the **diameter**.
$T\hat{P}S = 120°$.



Determine the **sizes** of the **following**.
Give reasons.

6.4.1 x (2)

6.4.2 y (2)

6.4.3 z (2)
[12]

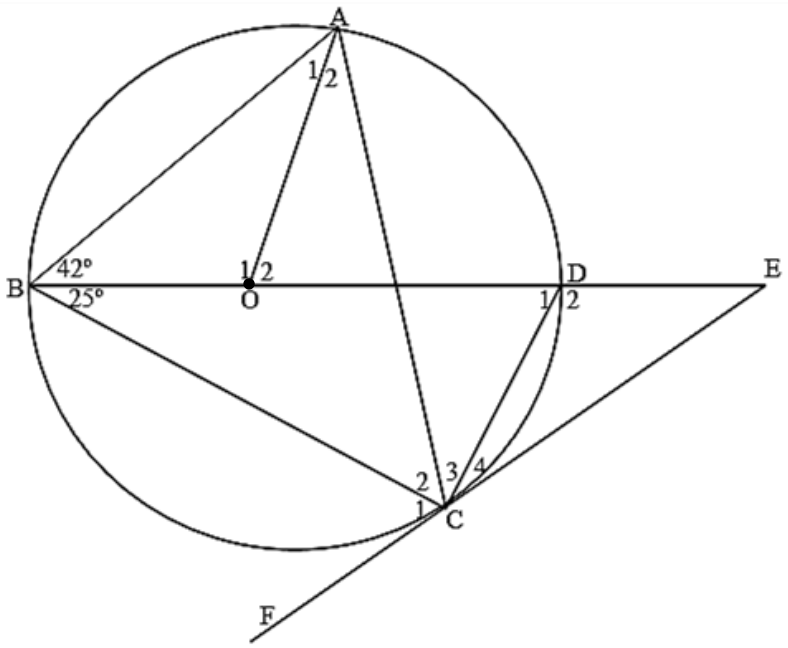
QUESTION 7

7.1 Fill in the **missing word(s)** in the **theorem** statement:

"The **angle** between the **tangent** to a **circle** and the **chord drawn** from the **point** of **contact** is … to the **angle** in the **alternate segment**." (1)

7.2 **Diagram:**

O is the **centre** of the **circle**.
Tangent FC touches the **circle** at **C**.
Diameter BD extended meets tangent FC in **E**.
$A\widehat{B}O = 42°$ and $O\widehat{B}C = 25°$



Determine the **sizes** of the **following**.
Give reasons.

7.2.1 $\hat{C}_4$ (2)

7.2.2 $\hat{C}_3$ (2)

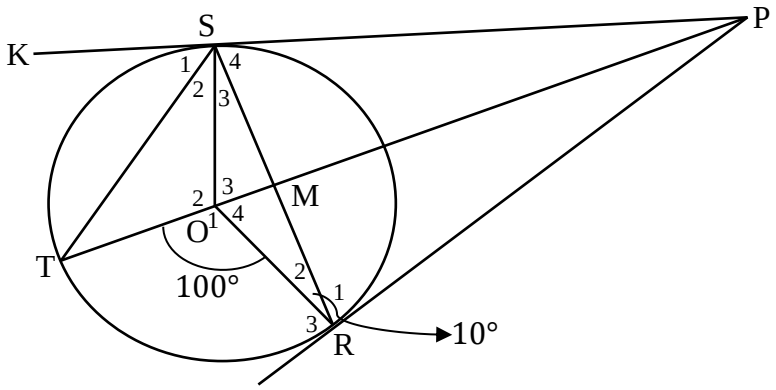
7.2.3 $\hat{D}_1$ (4)

7.3 Fill in the **missing word(s)** in the **theorem** statement:

"**Two tangents drawn** to a **circle** from the **same point** … the **circle are equal** in **length**." (1)

7.4 **Diagram:**

PS and **PR** are **tangents**.
O is the **centre** of the **cirle**.
POT is a straight line.
$\hat{O}_1 = 100°$ and $\hat{R}_2 = 10°$.



Determine the **sizes** of the **following**.
Give reasons.

7.4.1 $\hat{S}_2$ (4)

7.4.2 $\hat{S}_4$ (2)

7.4.3 $\hat{P}$ (4)
[20]

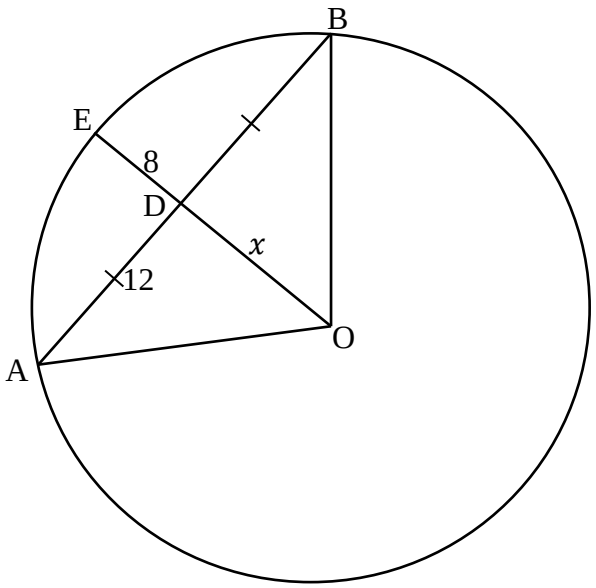
QUESTION 8

8.1 Fill in the **missing word(s)** in the **theorem** statement:

"The **line drawn** from the **centre** of a **circle** to the **midpoint** of a **chord** is … to the **chord**." (1)

8.2 **Diagram:**

AB is a **chord** of a **circle** with **centre O**.
OE bisects AB.
AD = 12 cm.
ED = 8 cm
OD = x.



8.2.1 **Determine** the **length** of **OE**, **in terms** of x. (1)

8.2.2 **Complete** the **statement.**
Give a **reason**.

$OA^2 = 12^2 + \ldots$ and **determine** the **length** of **OA**, in **terms of** x. (3)

8.2.3 **Determine** the **length** of x. (4)

8.2.4 **Determine** the **length** of the **radius**. (1)
[10]

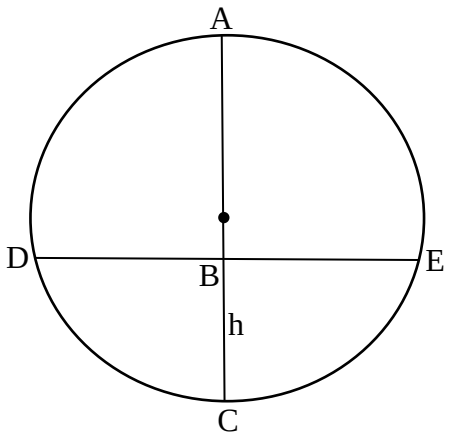
QUESTION 9

9.1 A **wheel rotates** at **12 revolutions per second**.
Determine the **angular velocity** of the **wheel.** (3)

9.2 The **radius** of a **circular spinning toy** is **40 mm**.
It **rotates** at **20 revolutions per minute**.
Determine the **circumferential velocity** of the **toy**. (4)

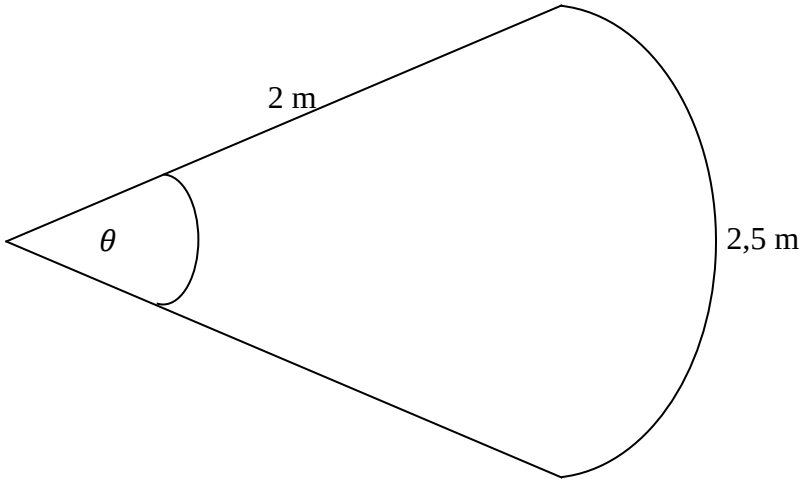
9.3 **Diagram:**

The **circle** with **centre O**, has a **chord**, **DE**, with a **length** of **500 mm**.
The **diameter, AC**, is **56,6 cm**.
Chord, **DE**, **divides** the **circle** into **two segments**.



Calculate the **height** of the **minor segment**, **h (BC)**, in **cm**. (6)

9.4 A **metal plate** is **cut** into the **shape** of a **sector** of a **circle**.
The **radius** of the circle is 2 m and the arc length is 2,5 m.



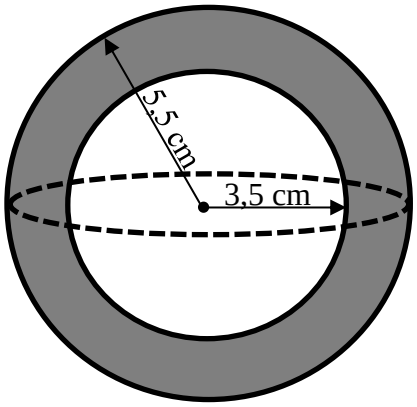
9.4.1 **Determine** the **central angle** of the **sector** in **radians**. (3)

9.4.2 **Determine** the **area** of the **sector**. (3)

9.4.3 The **sector** is **bent** into a **cone**.
Determine the **perpendicular height** of the **cone**. (5)

9.5 **Diagram:**

A toymaker wants to **make** a **toy** in the **shape** of a **hollow sphere**.
The **hollow sphere** has an **internal radius** of **3,5 cm** and an **external radius** of **5,5 cm**.
One cubic centimetre of **metal weighs 30 grams**.
$V = \frac{4}{3}\pi r^3$



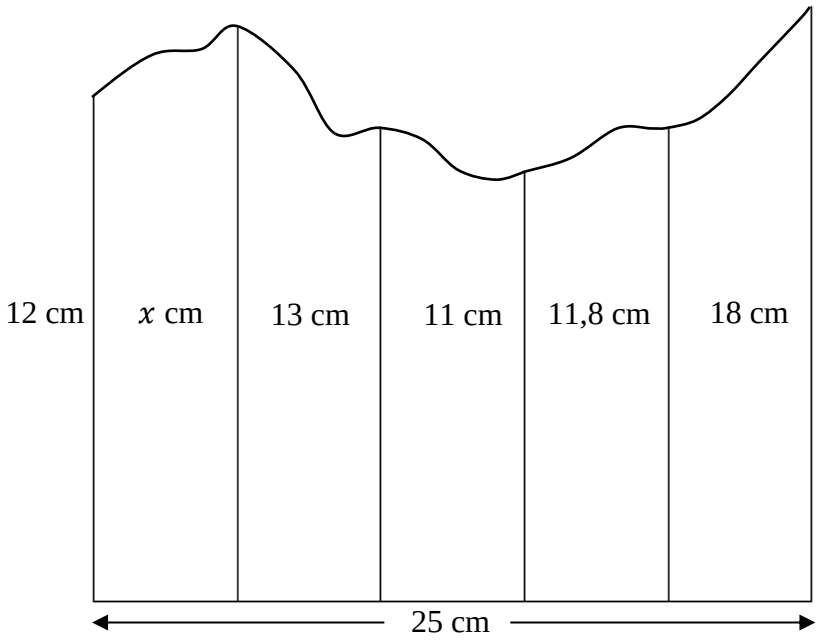
Determine the **mass** of the **toy**. (5)

[29]

QUESTION 10

Diagram:

The **irregular shape** below has an **area** of **329 cm²**.
The **horizontal side** is **25 cm** in **length**.
It is **divided** into **five equal parts**.
The **ordinates** are **12 cm**, ***x*** **cm**, **13 cm**, **11 cm**, **11,8 cm** and **18 cm**.



Determine, **using** the **mid-ordinate rule**, the **value** of x. (5)
[5]

TOTAL: 150

INFORMATION SHEET

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

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

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

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

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

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

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

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

$\int kx^n dx = \frac{kx^{n+1}}{n+1} + C \text{ , } n, k \in \mathbb{R} \text{ with } n \neq -1 \text{ and } k \neq 0$

$\int \frac{k}{x} dx = k \ln(x) + C, x > 0 \; and \; k \in \mathbb{R}; k \neq 0$

$\int ka^{nx} dx = \frac{ka^{nx}}{nlna} + C, a > 0; a \neq 1 \; and \; k, a \; \in \mathbb{R}; k \neq 0$

$\pi rad = 180°$

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

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

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

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

In ΔABC:

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

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

$A_T = a\left(\frac{O_1 + O_n}{2} + O_2 + O_3 + O_4 + \ldots + O_{n-1}\right)$ 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; $i = 1;2;3; \ldots; n\text{-}1$