Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2024

TECHNICAL MATHEMATICS P1 (DEAF)

MARKS: **150**

TIME: **3 hours**

This question paper has 15 pages, a 2-page formula sheet and 2 answer sheets.

INSTRUCTIONS AND INFORMATION

Read the **instructions**.

1. This **question paper** has **NINE questions**.
   Answer ALL the questions.

2. **Show** ALL **calculations**, **diagrams**, **graphs**, etc. that you have in your answers.

3. Answer **QUESTION 4.1.4 and QUESTION 7.5** on the **ANSWER SHEETS**.
   Write your **name** and **surname** on the **ANSWER SHEETS**.
   Hand in the **ANSWER SHEETS** with your **ANSWER BOOK**.

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

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

6. **Number** the **answers** the **same** as the numbers on the **question paper**.

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.

QUESTION 1

1.1 **Solve** for x:

1.1.1 $3x - \frac{x^2}{4} = 0$ (3)

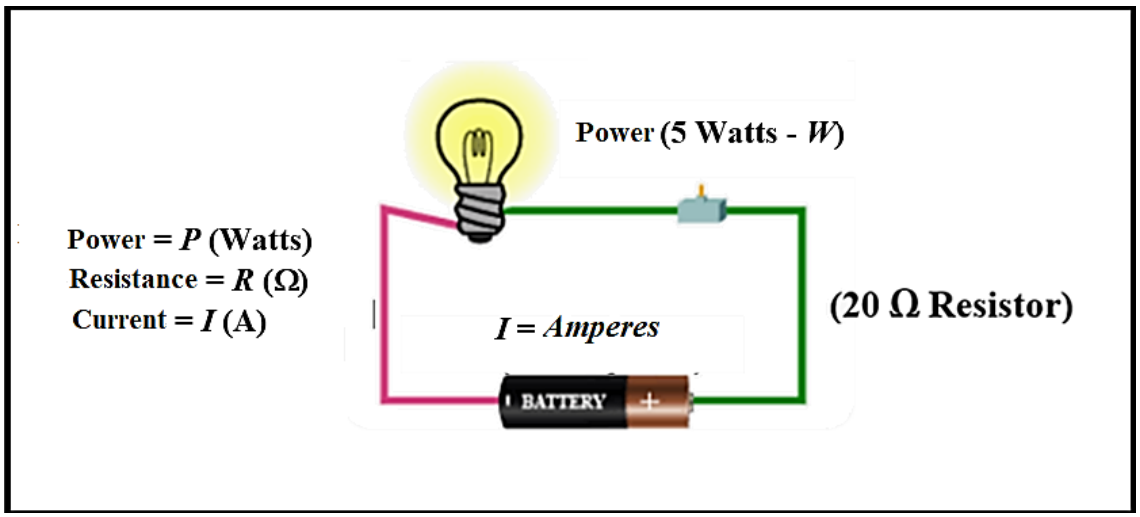
1.1.2 $x(x-3) = 13$ (round off to **TWO decimal places**) (4)

1.1.3 $-2x^2 - x + 10 \leq 0$ (Represent the solution set on a **NUMBER LINE**) (4)

1.2 **Solve** for x and y if:

$y - x = 2$ and $\frac{x^2}{y} = 1$ (6)

1.3 **Diagram**: It **shows** a **simple electric circuit** with a **light bulb**.
It is **connected** by a **conducting wire** to a **small battery**.



If $P = I^2R$:

1.3.1 **Make *I*** the **subject** of the formula. (2)

1.3.2 **Determine** the amount of current flowing through the circuit.
The **power** of the **light bulb** is **5 Watts**.
The **resistance** of the **conducting wire** = **20 Ω**. (2)

1.3.3 **Write** the **value** of the **current obtained**(found) in **QUESTION 1.3.2** in **Scientific Notation.** (1)

1.4 **Determine** the **value** of $A = 1010100_2 - 111011_2$ in **decimal form**. (3)
[25]

QUESTION 2

2.1 **Given**: $f(x)=1\pm\sqrt{\frac{x}{1-x^2}}$

2.1.1 **Write** down the **value of** x for **which** $f(x) = 1$. (1)

2.1.2 **Determine** the **values of** x for which the **roots** of $f(x)$ will be **undefined**. (3)

2.2 **Show** that the **roots** of $g(x) = 9x^2 - 12kx + 4k^2$ will **always** be **equal** for all **values of** k. (4)
[8]

QUESTION 3

3.1 Simplify **without using a calculator**:

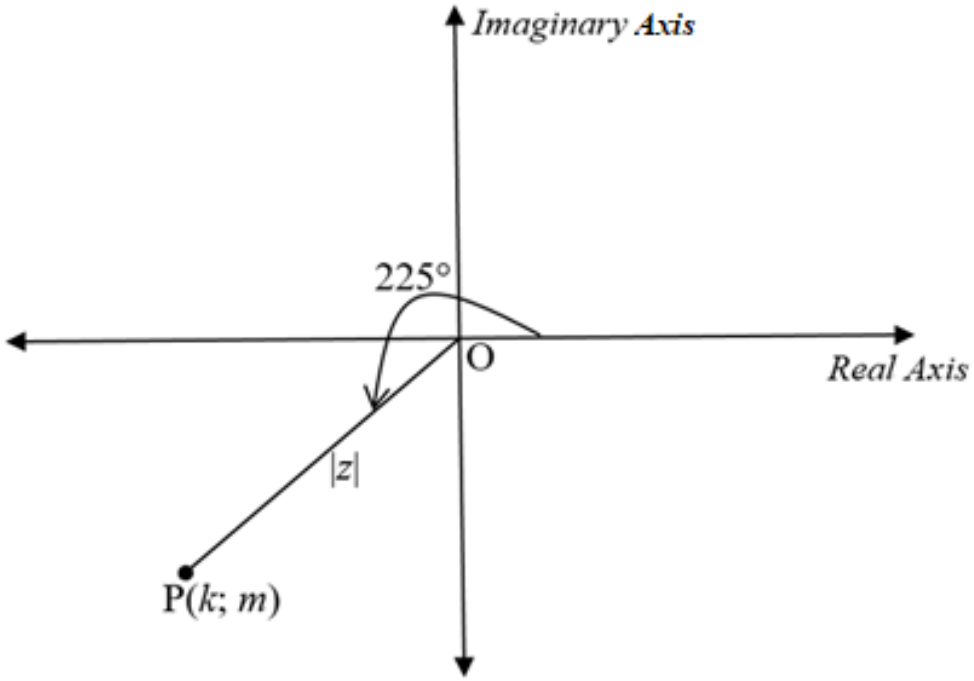
3.1.1 $\log_x x + \log_y 1$ (2)

3.1.2 $\frac{\sqrt{18}-\sqrt{128}}{5\sqrt{2}}$ (3)

3.2 **Solve** for x.
Do not use a **calculator**:

$7^{x-1} - 7^x = -\frac{2}{9}$ **HINT: $\log_7 27 = 1{,}69$** (7)

3.3 The **Argand diagram represents** the **complex**: $z = \sqrt{2}cis225°$.
P (k ; m) is a point on z.



3.3.1 **Write** down the **length** of the **modulus of** z. (1)

3.3.2 **Determine** the **length of** k and m. (2)

3.3.3 **Hence or otherwise**, write z in **rectangular form**. (1)

3.4 Solve for x and y if $x - iy = 0$. (2)

[18]

QUESTION 4

4.1 **Given** the **functions** ***f*** **and** ***g*** **defined** by $f(x) = 3^x + 1$ and $g(x) = 3x + 2$.

4.1.1 **Write** down the **asymptote of** ***f***. (1)

4.1.2 **Determine** the **coordinates** of the ***y*-intercept of** f. (2)

4.1.3 **Determine** the ***x* and *y*-intercepts of** g. (3)

4.1.4 **Sketch(Draw)** the **graph** of ***f* and *g*** on the ANSWER SHEET provided. **Clearly show** all the **intercepts** with the **axes** and the **asymptote** of the **graph**. (6)

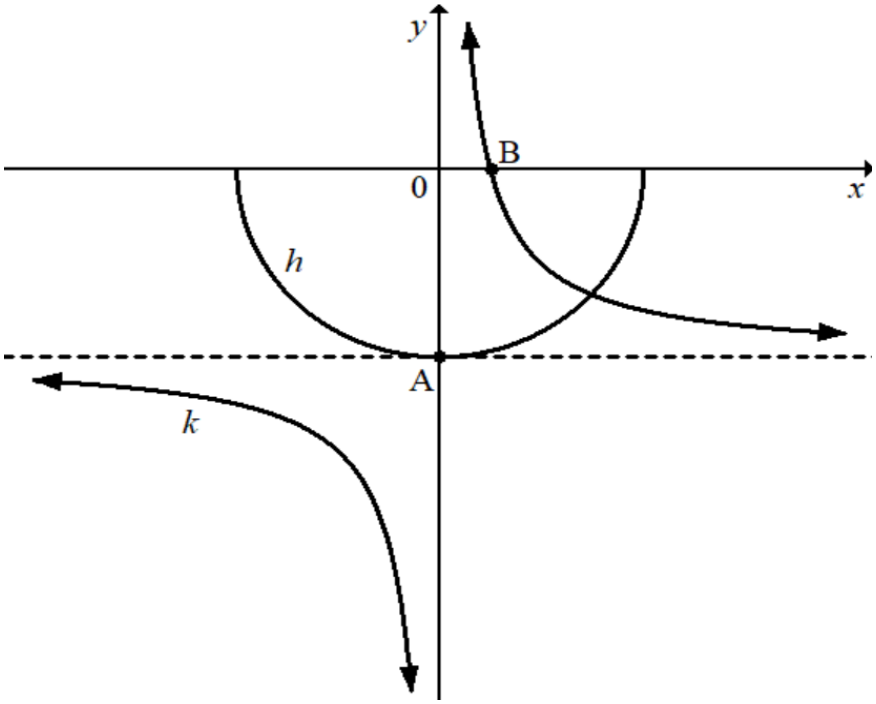
4.1.5 **Write** the **coordinates** of a **point** where the **graph of *g* cuts** the **asymptote of *f*.** (2)

4.1.6 **Determine** the values of x for which $g(x) <$ **asymptote of** f. (2)

4.2 **Diagram:** It **represents** the **graphs** of the **functions defined** by:

$$h(x) = -\sqrt{4 - x^2} \text{ and } k(x) = \frac{1}{x} + q$$

- The **asymptotes of *k* cut** the **graph of *h*** at **point A**, its y-intercept.
- **Point B** is the ***x*-intercept of *k***.



4.2.1 **Write** the ***y*-intercept** of ***h*.** (1)

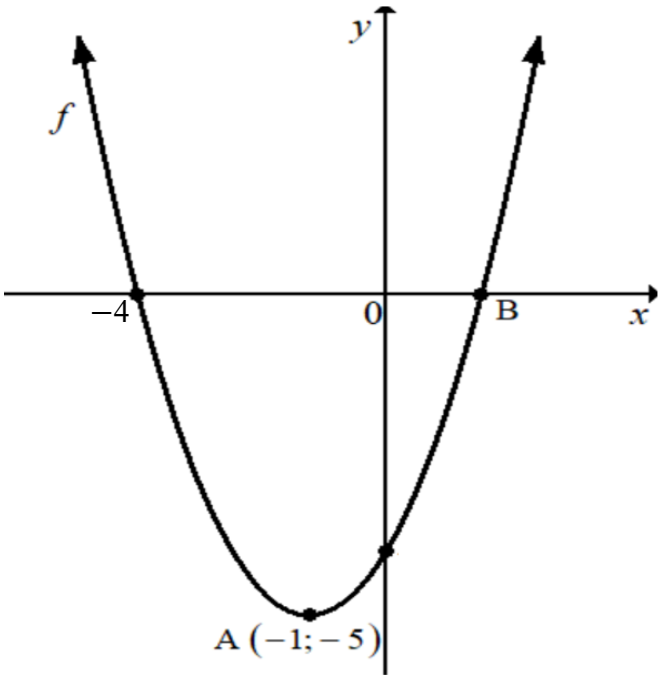
4.2.2 **Write** the **value** of ***q***. (1)

4.2.3 **Determine** the **coordinates** of **B**. (2)

4.2.4 **Write** down the **domain of *k***. (1)

4.2.5 **Determine** the **coordinates** of **two points on *k*** that are **closest** to **point A**. (4)

4.3 The **graph** of the **function defined** by: $y = a(x-p)^2 + q$ is drawn below.
x = -4 and B are the ***x*-intercepts of *f***.
A (−1 ; −5) is a **turning point of *f***.



4.3.1 **Write** the **equation** of the **axis** of **symmetry**. (1)

4.3.2 **Determine** the **values of *p* and *q***. (2)

4.3.3 **Calculate** the **coordinates of B**. (2)

4.3.4 **Determine** the **values of *x*** for which $f(x) \times f'(x) > 0$. (3)
[33]

QUESTION 5

5.1 November 2023 Black Friday rush dropped the price of a R7 300 stamper by 11%.

5.1.1 **Calculate** 11% of R7 300. (1)

5.1.2 **Determine** the **discounted price** of a **stamper**. (2)

5.2 **Rusting** of **metal** is an **exponential$_{(on\text{-}going)}$ process** if **not attended to**.
The **car** below started **rusting in 2 cm^2 area** some **years ago**.

Determine the **number of years** it has taken to **rust 60 cm^2 area**.
The **rate of rusting** is **5% per year**. (5)

5.3 Ludwe **invests R500 000 into** an **investment company**.
It pays **7% per annum** on **simple interest.**
At the **end** of the **5th year** Ludwe **deposits** a **further R77 000** into the **investment account.**
The **interest rates changed** to ***x*% per annum**, **compounded monthly**.

Determine the value of ***x*%** (interest rates), if at the **end** of **8 years** Ludwe gets a total of **R880 000** from his **investment account**. (6)
[14]

QUESTION 6

6.1 **Determine** the **derivative** of $f(x)=3ax+5$ by using **FIRST PRINCIPLES.** (5)

6.2 **Determine:**

6.2.1 $\frac{dy}{dx}$ if $xy=\sqrt{x}$ (4)

6.2.2 $D_x\left[\frac{3}{2x}\right]$ (2)

6.3 Determine the **average gradient** between **points** A(3 ; 5) and B (−2 ; −1). (3)
[14]

QUESTION 7

Consider: $f(x) = (x - 1)(x + 2)(x + 3)$

7.1 **Write** the **coordinates** of the ***x*-intercept of** f. (1)

7.2 **Determine** the ***y*-intercept of** f. (1)

7.3 **Determine** the **coordinates** of the **turning point of** f. (5)

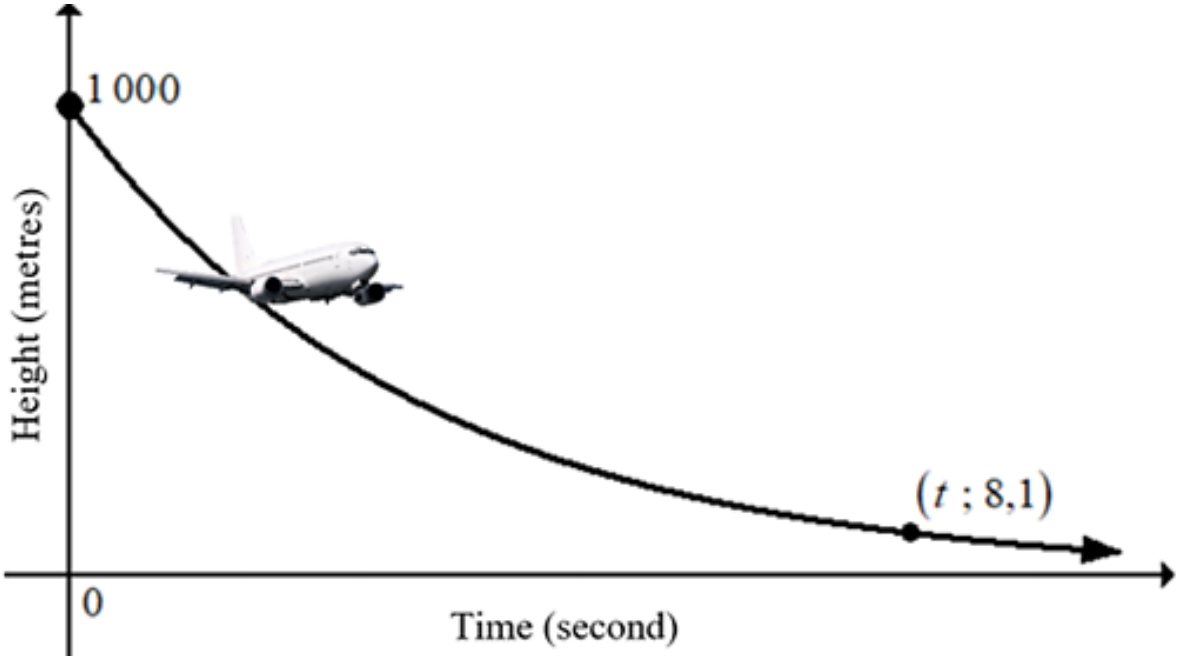
7.4 **Sketch(Draw)** the graph of f on the ANSWER SHEET.
Clearly indicate(show) your **turning points.**
Show the **intercepts** with the **axes**. (4)

7.5 **Write** the **values of** x for which $f(x) < 0$. (2)
[13]

QUESTION 8

Graph: Shows the **path** of a Boeing **plane** that is **landing** after **experiencing** hydraulics **problems**.

The process of its **landing** is **observed** from a **certain height**, in metres, over time, in seconds.



The **landing path** in terms of time (t) is: $h(t) = h_0(0{,}09)^t$.

$h(t)$ = Final height of descend, in metres.

h_0 = Initial height of observation, in metres.

t = Time of observation, in seconds.

8.1 **Write** the **height** of the **plane**, in **metres**, at the **start** of its **landing observation**. (1)

8.2 **Determine** the **height** of the **plane** after **1 second**. (1)

8.3 **Determine** the **time** the **plane took to drop** to a **height** of **8,1 metres**. (4)

8.4 **Calculate** the **plane's average speed** of **descend(going down) between 1 000 m to 8,1 m**. (2)

8.5 If the **maximum landing speed** of a **plane** is **290 km/h, indicate(show)** whether this **plane's landing speed** in QUESTION 8.4 was a **normal speed or not**. (**Show calculations.**) (2)

[10]

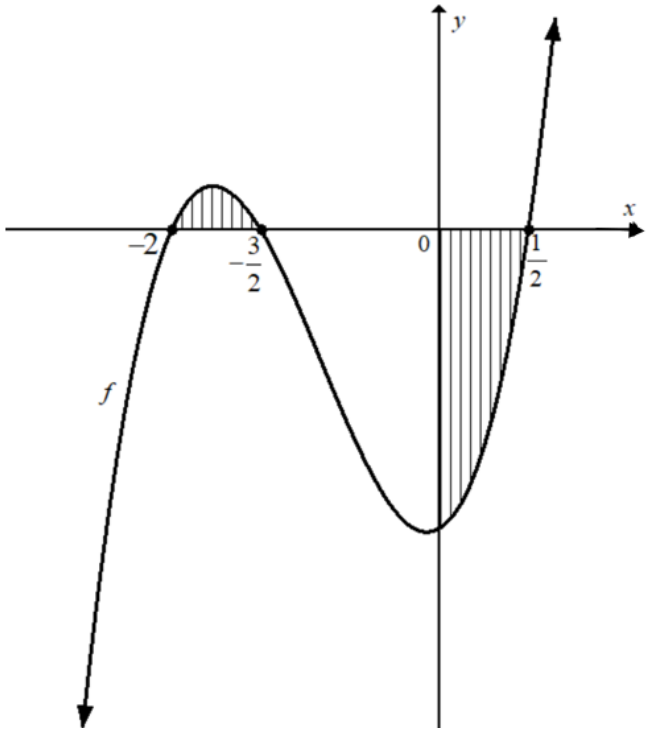
QUESTION 9

9.1 **Determine** the **integrals:**

9.1.1 $\int (-3x^2 + 2x^{-1})\,dx$ (3)

9.1.2 $\int (x-3)(x-5)\,dx$ (4)

9.2 The **sketch(drawing)** shows the **shaded area bounded by** the **function** ***g*** **defined** by: $g(x) = x^3 + 3x^2 + \frac{5}{4}x - \frac{3}{2}$ and the **axis between the points** where $x = -2$ and $x = -1,5$ together with $x = 0$ and $x = 0,5$.



Determine the **area** of the **shaded region** of the **graph** of g **bounded by the graph** and **the *x*-axis**, between $x = -2$ and $x = -1,5$ and $x = 0$ and $x = 0,5$. (8)

[15]

TOTAL: 150

INFORMATION SHEET: TECHNICAL MATHEMATICS

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

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

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

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

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

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

$$\int \frac{1}{x} dx = \ln x + C, \quad x > 0 \qquad \int \frac{k}{x} dx = k.\ln x + C, \quad x > 0$$

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

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

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

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

In ΔABC: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ $\qquad a^2 = b^2 + c^2 - 2bc.\cos A$

$$\text{area of } \Delta ABC = \frac{1}{2}ab.\sin C$$

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

$$\pi \, rad = 180°$$

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

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

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

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

Area of a sector $= \frac{r^2\theta}{2}$ where r = radius, s = arc length 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

$A_T = a(m_1 + m_2 + m_3 + ... + m_n)$ where a = equal parts, $m_1 = \frac{o_1 + o_2}{2}$
and n = number of ordinates

OR

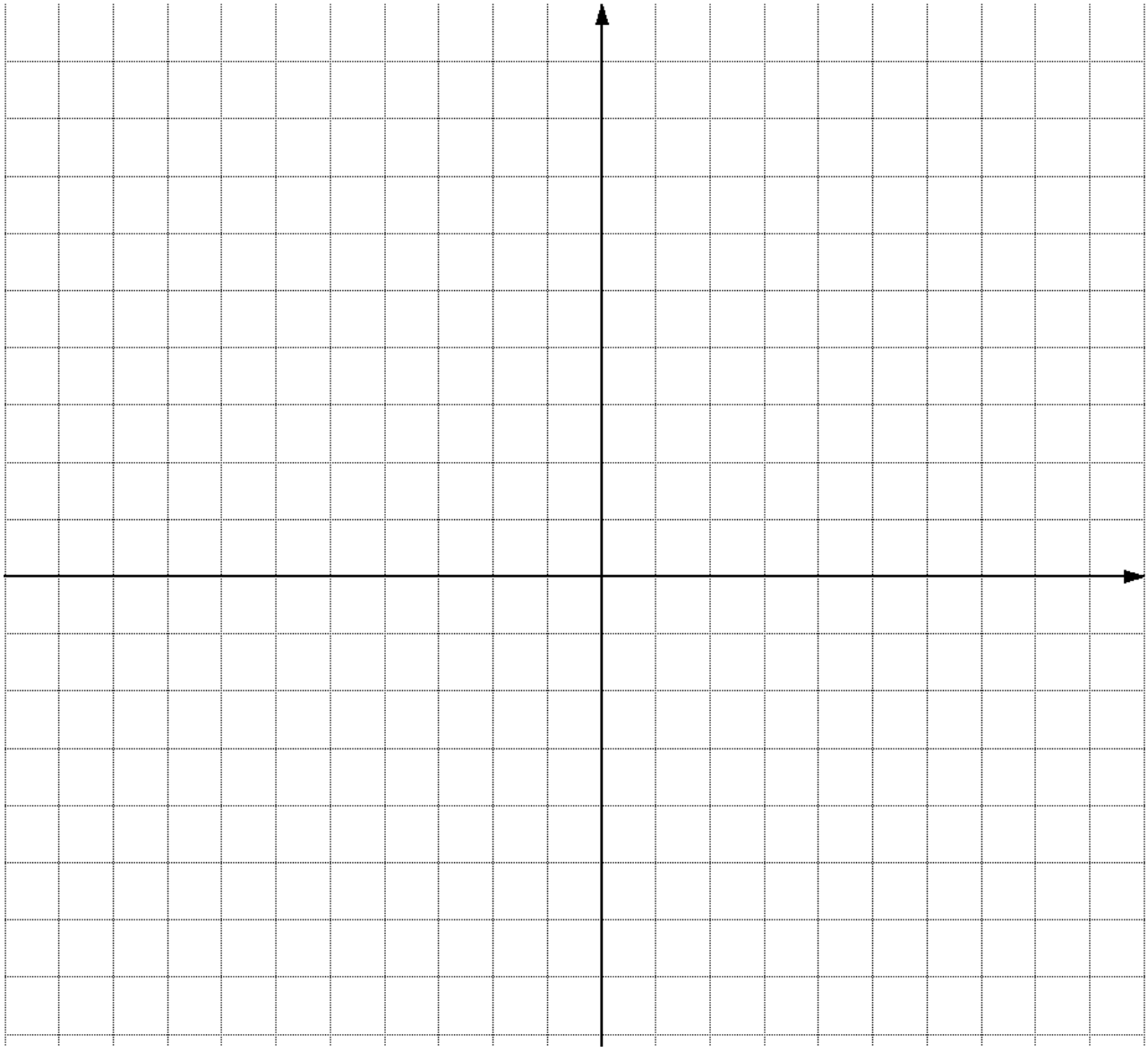
$A_T = a\left(\frac{o_1 + o_n}{2} + o_2 + o_3 + ... + o_{n-1}\right)$ where a = equal parts, $o_i = i^{th}$ ordinate
and n = number of ordinates

ANSWER SHEET

Learner Name: …….. Class: ……..

School Name: ……

QUESTION 4.1.4



ANSWER SHEET

Learner Name: …….. Class: ……..

School Name: ……

QUESTION 7.4