Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 12

SEPTEMBER 2022

TECHNICAL MATHEMATICS P1 (DEAF)

MARKS: **150**

TIME: **3 hours**

This question paper has 12 pages, a 2-page information sheet and 2 answer sheets.

INSTRUCTIONS AND INFORMATION

Read the instructions.

1. This question paper has NINE questions.
2. Answer ALL the questions.
3. Answer QUESTIONS 4.2.7 and 7.4 on the ANSWER SHEETS **provided**$_{\text{(given)}}$**. Write** your **name** and the **school's name** in the spaces provided on the ANSWER SHEETS and hand in the ANSWER SHEETS with your ANSWER BOOK.
4. Number the answers correctly.
5. **Show** ALL **calculations**, **diagrams**, **graphs**, etc. that you have **used** in determining **(finding out)** your answers.
6. **Answers only** will NOT necessarily be **awarded** $_{\text{(given)}}$ full marks.
7. You may **use** an **approved scientific calculator** (non-programmable and non-graphical), unless stated otherwise.
8. If necessary, **round off** answers to TWO **decimal places**, unless stated otherwise.
9. Diagrams are NOT necessarily drawn to scale.
10. An **information sheet** with **formulae** is **included** at the end of the question paper.
11. Write neatly.

QUESTION 1

1.1 **Solve** for x:

1.1.1 $x(x + 7) + 10 = 0$ (3)

1.1.2 $2x - 1 = \frac{4}{x}$ (Correct to TWO decimal places) (3)

1.1.3 $x^2 + \frac{7x}{2} + 3 \leq 0$ (3)

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

$x - y - 1 = 0$ and $xy + y^2 = x$ (5)

1.3 The **following formula** for **Estimation** of **Blood Alcohol Content** (EBAC) is used for **programming** the **breathalyser**, an **instrument used** to **estimate** the **amount** of **alcohol** in someone's **blood**:

$$\text{EBAC} = \frac{(\text{BWb} \times \text{SD}) \times C}{\text{GBW} \times \text{BWt}} - \text{GMR} \times \text{DP}$$

Where,

- BWb is a constant for Body Water in the Blood stream.
- SD is a number of Standard Alcoholic Drinks taken.
- GBW is a Gender Body Water Constant.
- BWt is Body Mass of the person that drank SD (in kilograms, kg).
- C is a conversion factor.
- GMR is the Gender Metabolism Rate.
- DP is the Drinking Period (in hours, h)

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

1.3.2 A person, after a night shift work, consumed**(drank)** some alcoholic drinks at 2 am.

If the person's:

EBAC = 0,07
BWb = 1,806
GBW = 0,58
BWt = 140 kg
C = 3,2
GMR = 0,18

(a) Express**(show)** the person's EBAC in Scientific Notation. (1)

(b) **Determine(find out)** the **number** of **standard alcoholic** drinks (SD) the **person consumed(drank)** on the night, correct to a whole number. (2)

(c) If it is **punishable** by law to **consume(drink)** **more** than **4 alcoholic drinks** in **one night** in the person's country, determine the number of drinks the person exceeded according to the set limit. (1)

1.4 **Simplify**, WITHOUT **using** a **calculator**:

$1110_2 + 11_2$ (1)

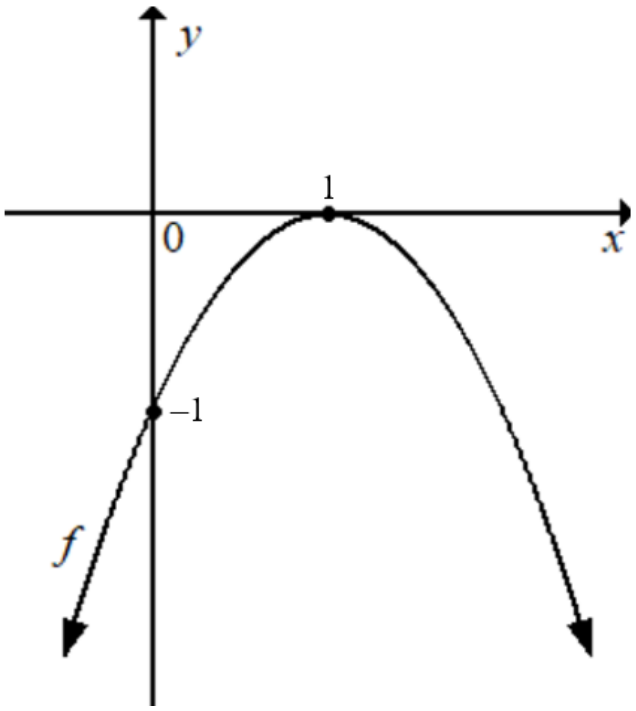
[21]

QUESTION 2

2.1 Given: $g(x)=\dfrac{3-\sqrt{x}}{25-x^2}$

Determine(find out) the **values** of x for which g is **undefined**. (2)

2.2 **Consider** the following **sketch** of a **function defined** by $f(x) = -(x+1)^2$:



2.2.1 **Write** down the **value** of the **discriminant** of f. (1)

2.2.2 **Describe** the **nature** of **roots** of the **above function**. (2)

2.2.3 If $f(x) + k = 0$, determine(find out) the value(s) of k for which f will have two distinct real roots. (1)
[6]

QUESTION 3

3.1 **Simplify** the **following** WITHOUT **using** a **calculator**:

3.1.1 $\dfrac{5^{x+1}.2^{2x-3}}{20^{x}}$ (Leave the solution with a POSITIVE exponent) (3)

3.1.2 $\dfrac{\sqrt{405}-\sqrt{80}}{\sqrt{5}}$ (3)

3.2 Given: $\log_a 3x = \log_a\left(2x^2-9\right)$

3.2.1 **Show**, by means of **calculations**, that $x > \dfrac{3}{\sqrt{2}}$ (3)

3.2.2 **Solve** for the **exact value**(s) of x. (5)

3.3 Given the complex numbers $z_1 = 2-5i$ and $z_2 = 1+i$

Determine(**find out**):

3.3.1 The complex number P, if $P = \dfrac{z_1}{z_2}$ (4)

3.3.2 The modulus of P (2)

3.3.3 The size of θ, the angle of inclination of P (3)

3.3.4 **Express P** in **polar form** (where θ is in degrees) (1)

3.4 **Solve** for x and y if $x+2yi=-3$ (2)

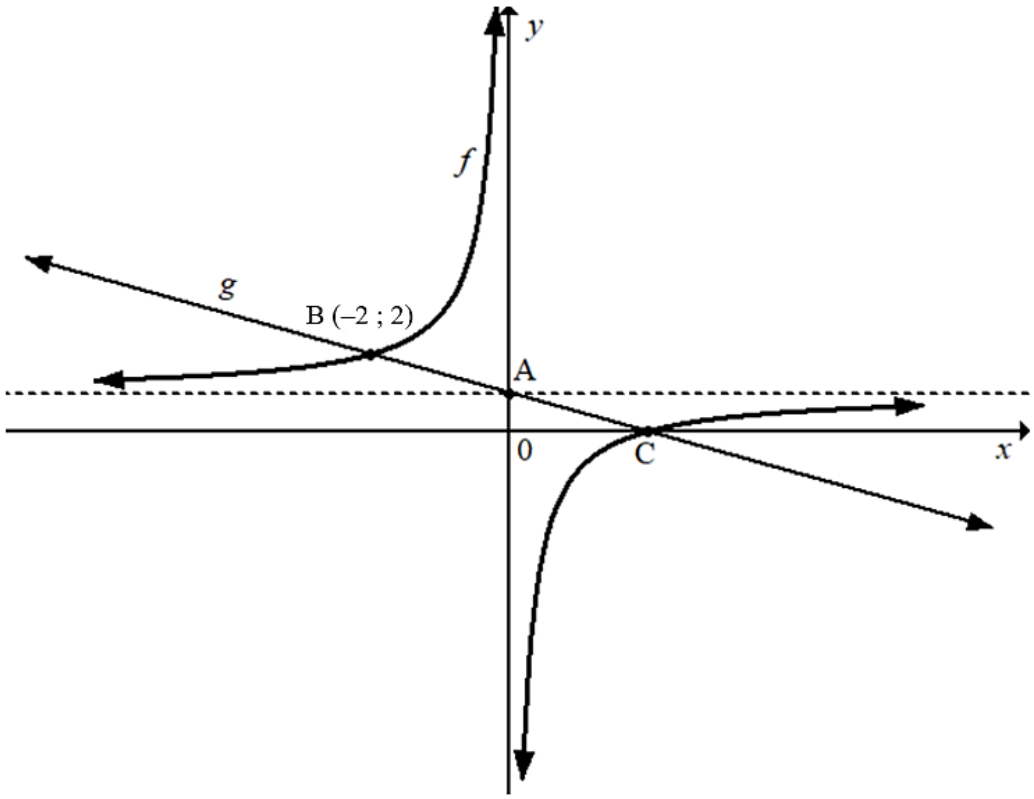
[26]

QUESTION 4

4.1 The **diagram below** shows **sketch graphs** of **functions** defined by $f(x)=-\frac{2}{x}+1$ and $g(x)=-\frac{x}{2}+1$

The two graphs cut each other at point B(–2 ; 2) and at C.

The horizontal asymptote cuts the *y*-axis at A.



4.1.1 **Write** down the ***y*-coordinate** of **A**. (1)

4.1.2 **Determine**(find out) the **equation** of the **vertical asymptote** of *f*. (1)

4.1.3 **Write** down the ***x*-intercept of *f***. (1)

4.1.4 **Write** down the ***y*-intercept** of ***g***. (1)

4.1.5 **Determine**(find out) the **range** of ***f***. (2)

4.1.6 **Determine**(find out) the **value**(s) of ***x*** for which $f(x)<g(x)$ (3)

4.2 Given: $k(x) = 2x^2 - 7x + 3$ and $w(x) = \sqrt{9 - x^2}$

4.2.1 **Explain** why the **graph** of ***w*** is a **function**. (1)

4.2.2 **Write** down the ***y*-intercept** of ***k***. (1)

4.2.3 **Calculate** the ***y*-intercept** of ***w***. (1)

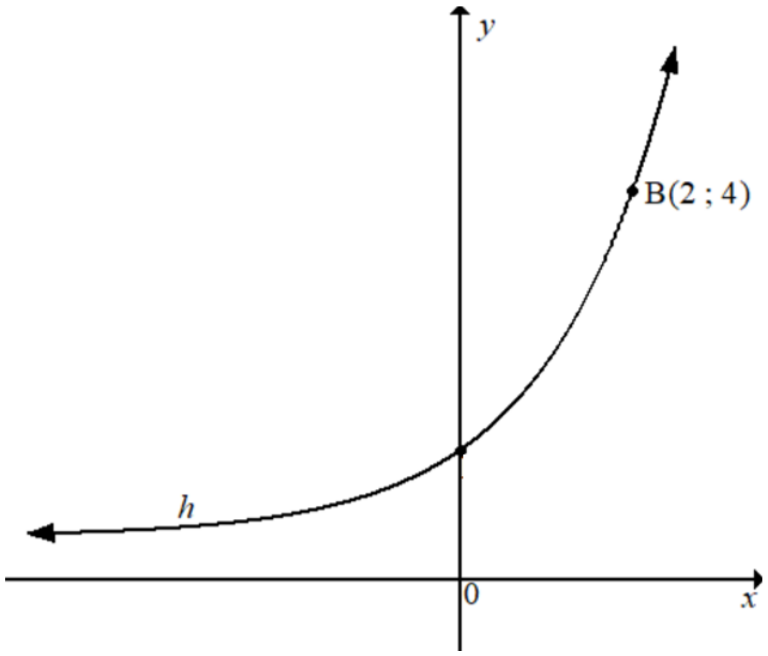
4.2.4 **Determine**$_{\text{(find out)}}$ the **coordinates** of the ***x*-intercepts** of ***k***. (2)

4.2.5 **Determine**$_{\text{(find out)}}$ the x-intercepts of w. (1)

4.2.6 **Determine**$_{\text{(find out)}}$ the **turning point** of ***k***. (4)

4.2.7 Sketch the **graph** of ***k*** and ***w*** on the **same set** of **axes** on the ANSWER SHEET provided$_{\text{(given)}}$. **Clearly show** the **intercepts** with the **axes** and all **asymptote**(s). (5)

4.3 Consider the sketch **graph** of a **function defined** by $h(x) = a^x$. The graph passes through point B(2;4).



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

4.3.2 **Determine**$_{\text{(find out)}}$ the **value** of ***a***. (3)

[28]

QUESTION 5

5.1 Melody buys her car radio which costs R2 960,00 on hire purchase and agrees to pay a deposit of R350 and a R145 monthly instalment for a period of 24 months.

Calculate:

5.1.1 **Melody's deposit**, as a **percentage** (1)

5.1.2 The **hire purchase value** after **paying** the **deposit** (1)

5.1.3 The **interest** rate **charged** on the **hire purchase** agreement (3)

5.2 Cype invests R20 000 for 7 years into an investment account that grows at 6 % interest rate per annum, compounded monthly for the first 3 years. The interest rates increased to 7,5% per annum on simple interest calculated quarterly p.a. for the remaining years.

5.2.1 **Calculate** the **amount Cype got** at the **end** of the **7th year investment period**. (4)

5.2.2 **Determine(find out)** the **amount** Cype **would** have **withdrawn** at the **end** of the **3rd year** in order **to get R30 000 paid** to **her** at the **end** of the investment **period**. (4)

[13]

QUESTION 6

6.1 **Determine(find out)** $f'(x)$ by using FIRST **PRINCIPLES** if $f(x) = -1 - 2x$. (5)

6.2 **Determine(find out)**:

6.2.1 $D_x\left(x^2 + x - 2\right)$ (2)

6.2.2 $\frac{dy}{dx}$ if $xy = x\sqrt{x} - 9x^2 - 1$ (5)

6.3 **Determine(find out)** the **average gradient** of a **function between** the points $(-3\ ;\ 0)$ and $(2\ ;\ 5)$. (2)

[14]

QUESTION 7

Given: $f(x) = x^3 - 7x + 6$

7.1 **Write** down the ***y*-intercept** of ***f***. (1)

7.2 **Determine**$_{\text{(find out)}}$ the x-intercepts of f. (5)

7.3 **Determine**$_{\text{(find out)}}$ the **coordinates** of the **turning point** of f. (5)

7.4 **Sketch** the graph of ***f*** on the ANSWER SHEET **provided**$_{\text{(given)}}$**.** Clearly **show** all the **coordinates** of the **turning points** and **intercepts** with the **axis**. (4)

7.5 **Determine**$_{\text{(find out)}}$ the **equation** of a **tangent** to the **curve** of f at $x = -2$ (4)
[19]

QUESTION 8

A certain state is applying strict tax laws to control the private selling of **indigenous**(home-grown) products by increasing the tax for more items sold. The following is an Objective Profit function that is used by the state to control the sale of this indigenous item:

$P(x) = -x^2 + 5x$, in thousand dollars, where x is the number of the indigenous items sold.

8.1 **Write** 1,5 thousand as a whole number. (1)

8.2 **Determine**(find out) the **number** of **items** that **generate**(make) no **profit when sold**. (4)

8.3 **Calculate**, how much **profit**, in thousand **dollars**, does a **single indigenous item sold**, **generate**(make). (2)

8.4 **Determine**(find out) the **maximum** number of **indigenous** items that should be sold to **generate** the **maximum profit**. (2)

8.5 **Calculate** the **maximum profit**, in **thousand dollars**, that can be **made** in **sales**. (2)
[11]

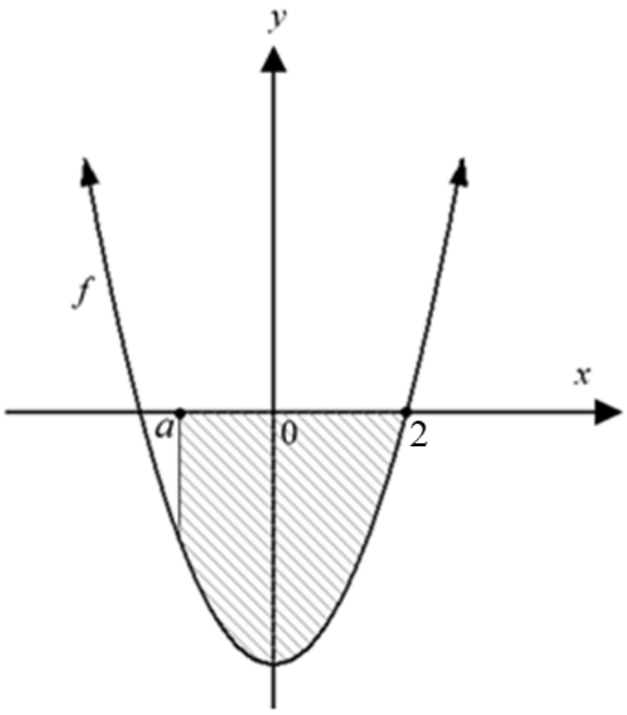
QUESTION 9

9.1 **Determine**(find out) the following **integrals**:

9.1.1 $\int x^{\frac{1}{2}}\,dx$ (2)

9.1.2 $\int\left(x^{-2}-\frac{\pi}{x}\right)dx$ (2)

9.2 The **sketch** below **represents** the **shaded area** bounded by the **function** defined by $f(x)=5x^2-20x$ and the x-axis from $x=a$ to $x=2$



Determine(find out) the **value** of a if the **shaded area** is 45 **square units**. (8)
[12]

TOTAL: 150

INFORMATION SHEET: TECHNICAL MATHEMATICS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$1 + \cot^2\theta = \text{cosec}^2\theta$$

$\pi\, rad = 180°$

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 = $v = 2\pi rn$ where r = radius and = rotation frequency

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

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

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

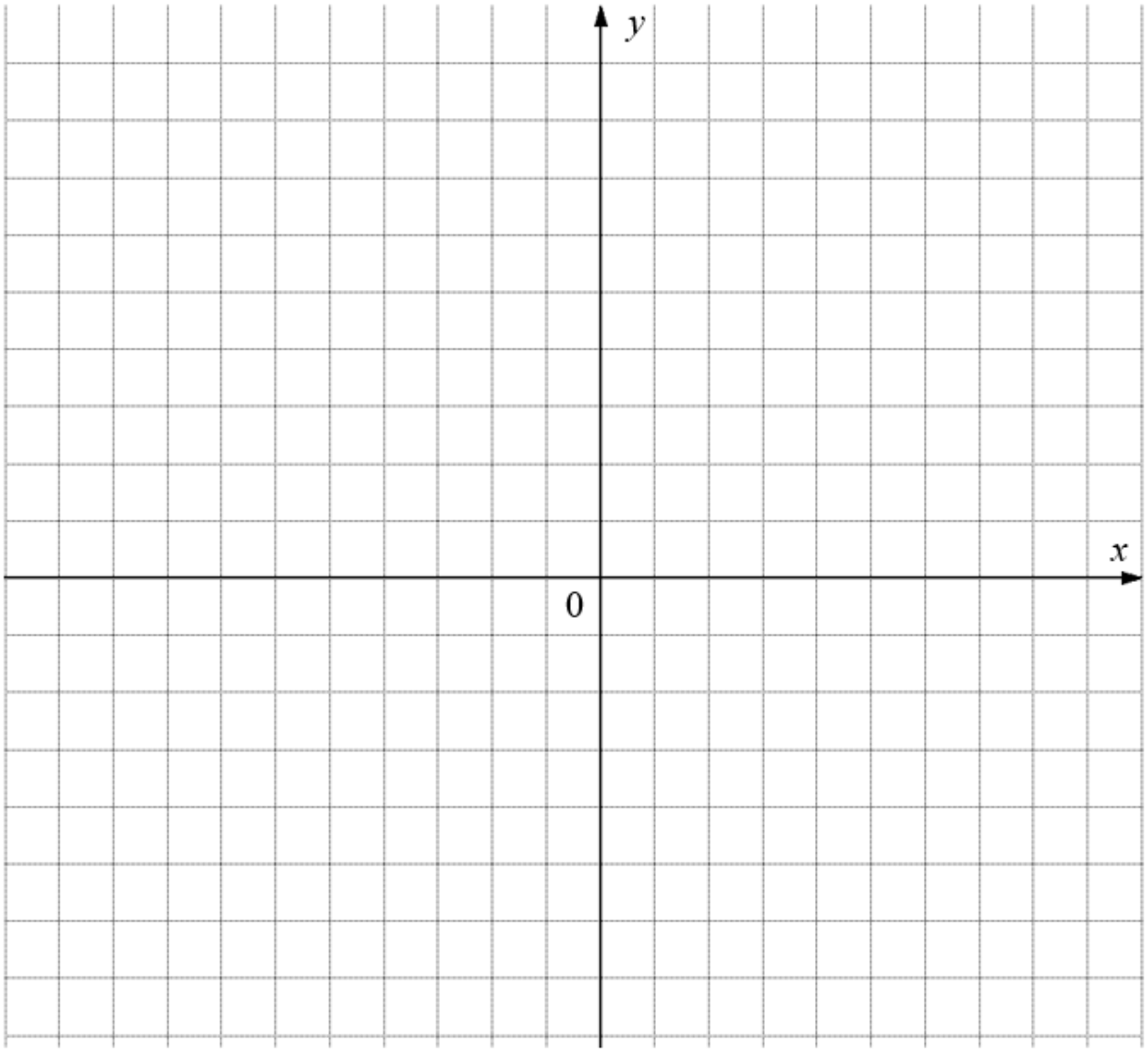
$4h^2 - 4dh + x^2 = 0$ where h = height of segment, d = diameter of circle and x = length of chord

$A_T = a\left(m_1 + m_2 + m_3 + ... + m_n\right)$ 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

QUESTION 4.2.7



QUESTION 7.4