



Province of the
EASTERN CAPE
EDUCATION

Iphondo leMpuma Kapa: Isebe leMfundo
Provinsie van die Oos Kaap: Departement van Onderwys
Porafensie Ya Kapa Botjahabela: Lefapha la Thuto

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2024

TECHNICAL MATHEMATICS P1

MARKS: 150

TIME: 3 hours



★ I T M A T E 1 ★

This question paper consists of 13 pages including a 2-page information sheet and an answer sheet.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of EIGHT questions.
2. Answer ALL the questions.
3. Answer QUESTION 6.4 on the ANSWER SHEET provided. Write your name, surname and the school's name in the spaces provided on the ANSWER SHEET and hand in the ANSWER SHEET with your ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Clearly show ALL calculations, diagrams, graphs, etc. that you have used in determining your answers.
6. Answers only will NOT necessarily be awarded 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 and legibly.

QUESTION 1

1.1 Simplify the following WITHOUT using a calculator.

1.1.1 $x^2(2x - x^{-2})$ (3)

1.1.2 $\sqrt[4]{2^{12}\left(p^2 + \frac{1}{4}\right)^4}$ (3)

1.1.3 $\frac{\sqrt{15} + \sqrt{3}}{\sqrt{3}}$ (3)

1.1.4 $\frac{125^{x+1} + 5^{3x}}{25^{\frac{3}{2}x}}$ (4)

1.2 Prove that:

1.2.1 $\frac{\log 4 + \log 25}{\log 0,001} = -\frac{2}{3}$ (5)

1.2.2 $\frac{4x-12}{x^2-9} \div \frac{2}{x+3} = 2$ (4)

1.3 Consider the decimal number: $R = 1011_2$ and $S = 10_2$

1.3.1 Determine the binary value of $R \times S$. (2)

1.3.2 Hence, write the product in QUESTION 1.3.1 in decimal form. (2)

1.4 A grain of quartz sand has a spherical shape with a diameter of 0,4 mm.

1.4.1 Using the formula $V = \frac{3}{4}\pi r^3$, calculate the volume of the grain. (3)

1.4.2 Write the answer in QUESTION 1.4.1 in scientific notation. (1)

[30]

QUESTION 2

2.1 Solve for $x \in R$ WITHOUT using a calculator.

2.1.1 $x^3 = 125$ (2)

2.1.2 $(\sqrt{x} + 1)(\sqrt{x} - 1) = 0$ (3)

2.1.3 $\frac{3^{x-1} \cdot 9^x}{3^{-x}} = 81$ (5)

2.1.4 $\log_x 4(x + 3) = \log_2 4$ (6)

2.2 The magnitude of the force on a conductor inside a magnetic flux can be calculated using the formula:

$F = BIl \sin \theta$ F = Force exerted on the current carrying conductor in newtons (N).
 B = Magnetic flux density in teslas (T).
 I = Current flowing through the conductor in amperes (A).
 l = Length of the conductor in meters (m).
 θ = Angle that the conductor makes with the magnetic field.

2.2.1 Make θ the subject of the formula. (2)

2.2.2 Hence calculate the value of θ if: $F = 4,906 \text{ N}$; $B = 2,25 \text{ T}$; $I = 9,8 \text{ A}$ and $l = 275 \times 10^{-3} \text{ m}$. (2)
[20]

QUESTION 33.1 Solve for x :

$$3.1.1 \quad 2x(x-7)-20=0 \quad (4)$$

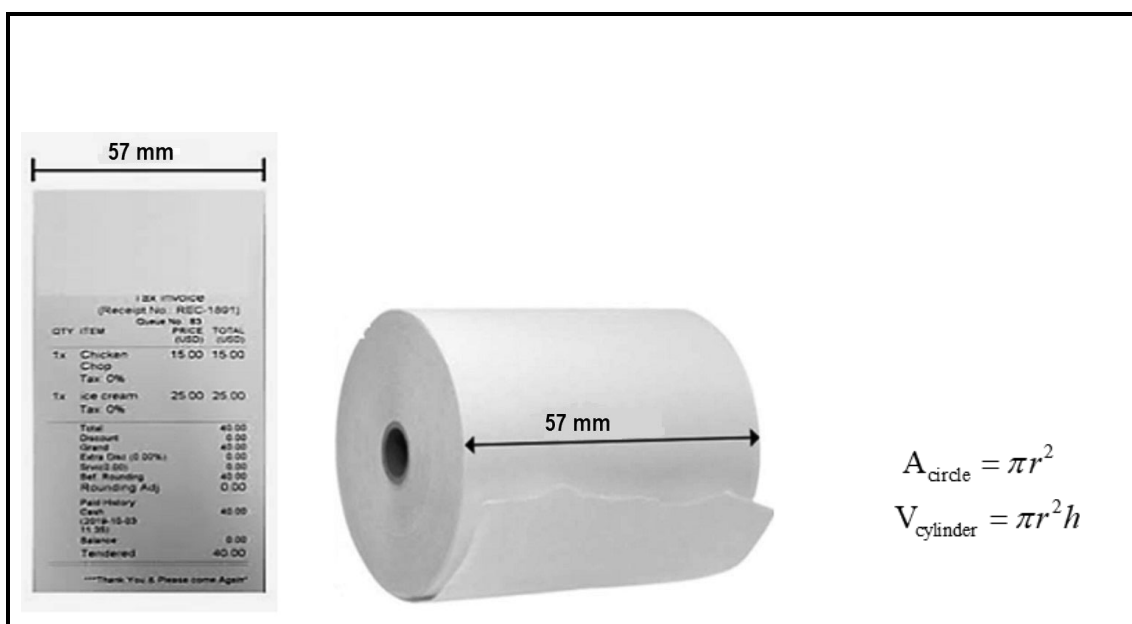
$$3.1.2 \quad -3x^2+4=-2x \quad (\text{Correct to TWO decimal places}) \quad (4)$$

$$3.1.3 \quad x(x+5) \geq 0 \quad (\text{Represent the solution on the NUMBER LINE}) \quad (4)$$

3.2 Solve for x and y simultaneously in the following equations.

$$2y-x-4=0 \quad \text{and} \quad y+6x=x^2+8 \quad (6)$$

3.3 A cylindrical thermal paper roll is given below. Its width is 57 mm and a diameter equal to x mm. The area of the circular faces is $625\pi \text{ mm}^2$.

3.3.1 Make r the subject of the formula. (2)

3.3.2 Hence, calculate the value of the diameter of the thermal paper roll. (3)

3.3.3 Calculate the area of a new thermal paper roll, with a radius that is half of the one in QUESTION 3.3.1. (3)

3.3.4 Determine $\text{Area}_{\text{original roll}} : \text{Area}_{\text{new roll}}$ (2)

[28]

QUESTION 4

4.1 Consider: $k(p) = \frac{1}{p} \pm \sqrt{\frac{2}{p+4}}$

Determine the values of p for which $k(p)$ will:

4.1.1 Be undefined (2)

4.1.2 Have non-real roots (2)

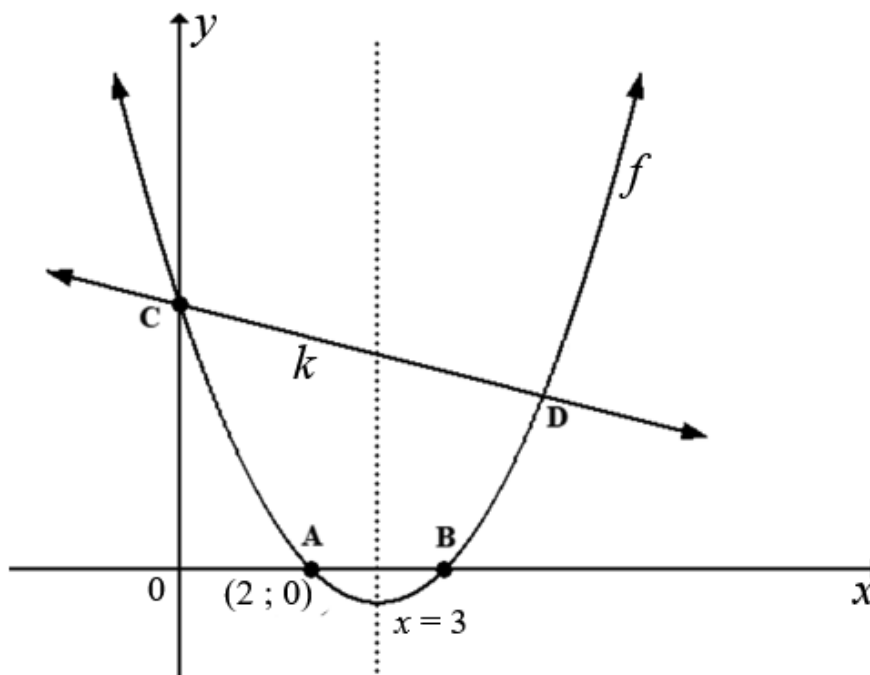
4.2 Determine, without solving the equation, the nature of roots of:
 $f(x) = x^2 - 5x + 1$. (3)

4.3 Determine for which value(s) of c the equation $g(x) = -x^2 + x + c$ will have equal roots. (3)
[10]

QUESTION 5

The sketch below represents the graph of $k(x)$ and $f(x)$ defined by $k(x) = -\frac{x}{2} + 8$ and $f(x) = x^2 + bx + q$.

- A and B are x -intercepts of f .
- C and D are points of intersections.
- The equation for the axis of symmetry of f is $x = 3$.



- 5.1 Write down the coordinates of C, the common y -intercept of both graphs. (2)
- 5.2 Show that $b = -6$ and $q = 8$. (3)
- 5.3 Determine the coordinates of B. (3)
- 5.4 Determine the minimum value of f . (2)
- 5.5 Determine the values of x for which $f(x) = k(x)$. (5)
- 5.6 Write down the coordinates of the NEW turning point as a result of shifting $f(x)$ 3 units downwards. (2)

[17]

QUESTION 6

Consider the graphs of g and h defined by $g(x) = \sqrt{9 - x^2}$ and $h(x) = \left(\frac{1}{5}\right)^x - 1$.

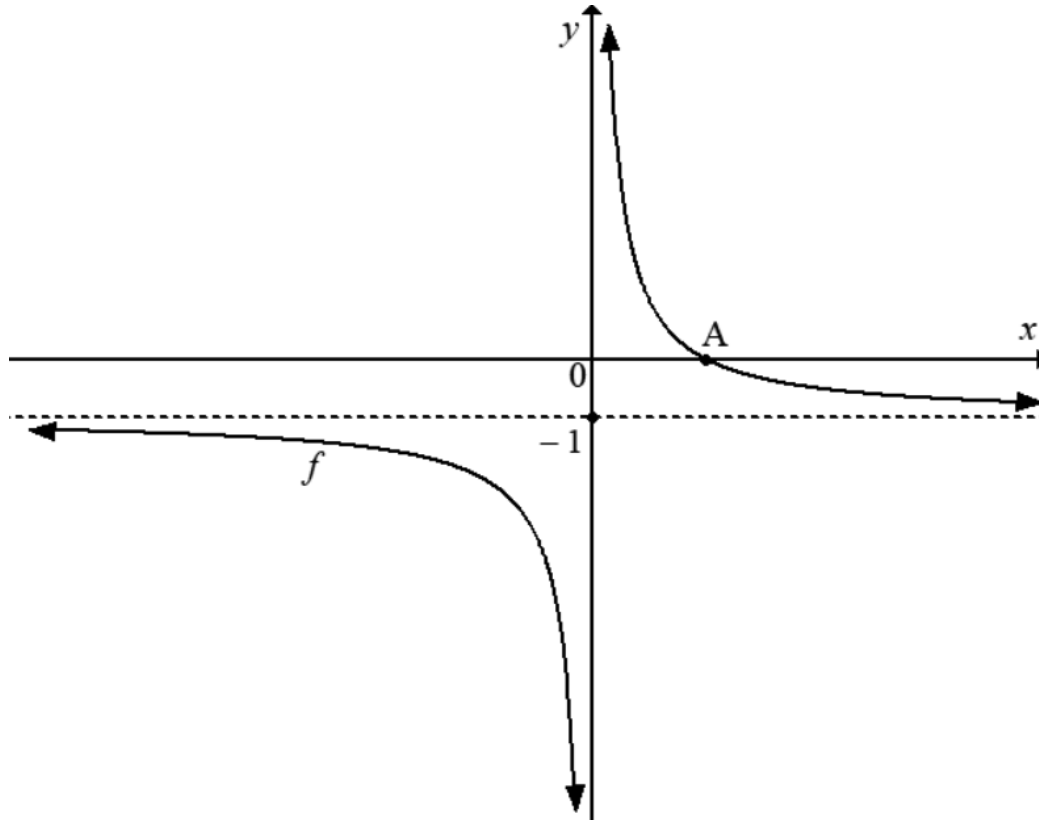
- 6.1 Determine the y -intercept of h . (2)
- 6.2 Write down the equation of the asymptote of h . (1)
- 6.3 Write down the coordinates of the y -intercept of g . (2)
- 6.4 Sketch the graph(s) of g and h on the same set of axis. Clearly label all the intercepts and asymptote(s). (5)
- 6.5 Use the graph to write the values of x for which $h(x) \geq 0$. (2)
- 6.6 Write down the range of g . (2)
- 6.7 Write down the equation of $k(x)$ resulted from reflecting $h(x)$ about the y -axis. (1)

[15]

QUESTION 7

The sketch below represents a graph of f defined by: $f(x) = \frac{m}{x} + q$.

- The domain of f is $x \in R, x \neq 0$.
- The graph intersects the axis at A(1 ; 0) .
- The asymptotes intersect at point (0 ; -1).



- 7.1 Write down the equations of the asymptotes. (2)
- 7.2 Determine the value of m and write the equation of f . (3)
- 7.3 Hence, determine the equations of the axis of symmetry of f . (2)
- 7.4 Write down the range of f . (2)
- 7.5 Determine the values of x for which $f(x) < 0$. (2)
- 7.6 The graph f is reflected about the y -axis, write the new coordinates of point A after reflection. (2)

[13]

QUESTION 8

- 8.1 Determine the effective interest of 9,8% per annum compounded daily. (3)
- 8.2 An iPhone 12 that was bought for R28 000 in 2021 was sold at 35,71% of its original price in 2023 in order to buy the newly released iPhone 14 pro max at R30 000.
- 8.2.1 Calculate 35,71% of R28 000. (1)
- 8.2.2 Determine how much money the seller has to raise in order to pay for the iPhone 14 pro max. (2)
- 8.3 Millions of chickens died due to Avian flu and the price of eggs is estimated to increase to double its original price in 7 years. Calculate the rate of appreciation on a straight-line appreciation. (3)
- 8.4 An amount of R75 000 is invested into an account with an interest rate of 6,2% per annum compounded quarterly. 12 months later, R6 000 is deposited into the account and the interest rate changes to 8% per annum compounded monthly. 2 years later from the second deposit, R10 000 is withdrawn from the account. Calculate the amount of money in the account after 6 years. (8)
- [17]**

TOTAL: 150

INFORMATION SHEET: TECHNICAL MATHEMATICS

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

$$x = -\frac{b}{2a}$$

$$y = \frac{4ac - b^2}{4a}$$

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

$$A = P(1 + ni)$$

$$A = P(1 - ni)$$

$$A = P(1 + i)^n$$

$$A = P(1 - i)^n$$

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

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

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

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

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

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$M\left(\frac{x_2 + x_1}{2}; \frac{y_2 + y_1}{2}\right)$$

$$y = mx + c$$

$$y - y_1 = m(x - x_1)$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$\tan \theta = m$$

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

$$\text{In } \triangle ABC: \quad \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cdot \cos A$$

$$\text{area of } \triangle ABC = \frac{1}{2} ab \cdot \sin C$$

$$\sin^2 \theta + \cos^2 \theta = 1$$

$$1 + \tan^2 \theta = \sec^2 \theta$$

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

$$\pi \text{ rad} = 180^\circ$$

$$\text{Angular velocity} = \omega = 2\pi n \quad \text{where } n = \text{rotation frequency}$$

$$\text{Angular velocity} = \omega = 360^\circ n \quad \text{where } n = \text{rotation frequency}$$

$$\text{Circumferential velocity} = v = \pi D n \quad \text{where } D = \text{diameter and } n = \text{rotation frequency}$$

$$\text{Circumferential velocity} = \vec{v} = \omega r \quad \text{where } \omega = \text{angular velocity and } r = \text{radius}$$

$$\text{Arc length} = s = r\theta \quad \text{where } r = \text{radius and } \theta = \text{central angle in radians}$$

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

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

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

$$A_T = a(m_1 + m_2 + m_3 + \dots + m_n) \quad \text{where } a = \text{width of equal parts, } m_1 = \frac{o_1 + o_2}{2} \\ o_n = n^{\text{th}} \text{ ordinate and } n = \text{number of ordinates}$$

OR

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

ANSWER SHEET

NAME AND SURNAME:

SCHOOL:

QUESTION 6.4

