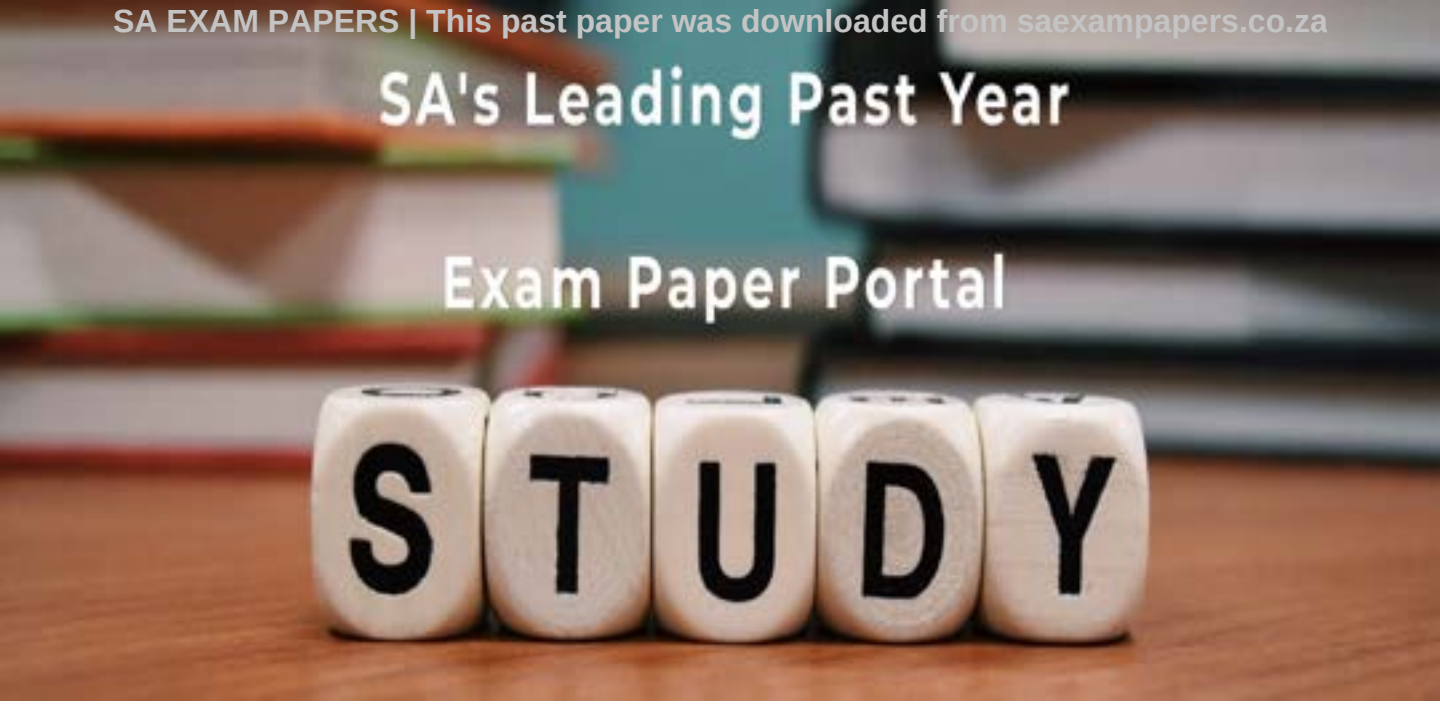

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NATIONAL SENIOR CERTIFICATE

GRADE 12

JUNE 2025

TECHNICAL MATHEMATICS P1

MARKS: **150**

TIME: **3 hours**

JTMATHE1

This question paper consists of 13 pages, including a 2-page formula sheet and 2 answer sheets.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of NINE questions. Answer ALL the questions.
2. Clearly show ALL calculations, diagrams, graphs, et cetera which you have used in determining your answers.
3. You may use an approved scientific calculator (non-programmable and non-graphical) unless stated otherwise.
4. If necessary, answers should be rounded off to TWO decimal places, unless stated otherwise.
5. Number the answers correctly according to the numbering system used in this question paper.
6. Diagrams are NOT necessarily drawn to scale.
7. An information sheet with formulae is included at the end of the question paper.
8. Write neatly and legibly.

QUESTION 1

1.1 Solve for x:

1.1.1 $x(x + 5) = 0$ (2)

1.1.2 $(x + 1)(x - 3) = 2x$ (Round off your answer to ONE decimal place) (4)

1.1.3 $2x^2 - x - 3 < 0$ (3)

1.2 Solve simultaneously for x and y:

$3y - 2 + x = 0$ and $y^2 - y = xy - x$ (6)

1.3 The quadratic formula $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ is used to solve quadratic equations in which a, b and c are parameters of the quadratic equation. c is the constant parameter of the equation.

1.3.1 Make c the subject of the formula. (4)

1.3.2 Calculate the value of c if $a = 3$, $b = -2$ and $x = 1$. (2)

1.4 Consider the following numbers: A = 11111_2 and B = 1010_2

1.4.1 Express A as a decimal digit. (1)

1.4.2 Determine the value of A – B, in binary. (Show your working) (2)

[24]

QUESTION 2

2.1 Given the function: $f(x) = 4x^2 - 3x - 7$

2.1.1 Write down the values of a, b and c from the given function. (1)

2.1.2 Calculate the value of $b^2 - 4ac$ of f. (2)

2.1.3 Discuss the nature of roots of f. (1)

2.2 Consider: $g(x) = mx^2 - 3x + 2$

Determine the values of m for which roots of g will be imaginary. (3)

[7]

QUESTION 3

3.1 Simplify the following, WITHOUT using a calculator:

3.1.1 $\left(\frac{7x}{25}-10\right)^0$ (1)

3.1.2 $\frac{2^{x-4}-5.2^{x-1}}{2^{x-2}}$ (4)

3.1.3 $\frac{\sqrt{45}-\sqrt{20}}{2\sqrt{5}}$ (3)

3.2 Show that:

$$\log_a a.\log_x\left(\frac{x}{y}\right)+\log_x y=1$$ (4)

3.3 Consider the complex: $z = 2 - 3i$

3.3.1 Write down the conjugate of z. (2)

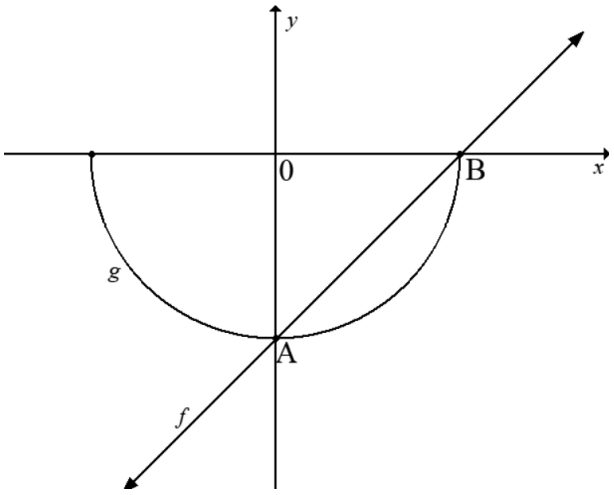
3.3.2 Express z in polar form. (5)

3.4 Solve for x and y if: $x + 2i = 3 - iy$ (2)

[21]

QUESTION 4

4.1 Consider two functions defined by $f(x) = x - 3$ and $g(x) = -\sqrt{9 - x^2}$.
Points A and B are the y- and x-intercepts of both f and g, as shown below.



4.1.1 Determine the coordinates of A and B. (2)

4.1.2 Calculate the distance between point A and B. (3)

4.1.3 Write down the range of g. (2)

4.1.4 Determine the values of x for which $g(x) < f(x)$. (2)

4.2 Given the functions $h(x) = 2(x - 1)(x + 3)$ and $k(x) = 2^x - 8$.

4.2.1 Write down the equation of the asymptote of k. (1)

4.2.2 Determine the coordinates of the x-intercept of k. (2)

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

4.2.4 Calculate the x-intercepts of h. (3)

4.2.5 Sketch the graphs of h and k on the same system of axis. Use the ANSWER SHEET 4.2.5 provided to sketch the two graphs. Clearly show all the critical points, turning points and the intercepts with the axes. (5)

4.2.6 Write down the equation of the axis of symmetry of h. (1)

4.2.7 Determine the values of x for which $k(x) > 0$. (2)

4.3 Consider the function: $m(x) = \frac{a}{x} + b$

- The equations of axis of symmetry are $y = \pm x + 5$.
- x-intercept is $x = \frac{2}{5}$

4.3.1 Write the domain of m. (1)

4.3.2 Determine the equation of m. (3)

[28]

QUESTION 5

5.1 Calculate the value of 9,5% of R500. (1)

5.2 A student invests R500 into a student account for 15 months. The account accumulates interest of 9,5%, compounded monthly. Determine how much will the student get from the proceeds of the investment after 15 months. (4)

5.3 The diagram below shows a tyre of a car that is losing its air pressure because it has been punched by a nail.

Determine how long it would take (in minutes) for the tyre to be deflated to 50% of its air pressure if it started leaking from 250 kPA at 3% leak per minute on a straight line deflation. (4)

5.4 A company invests R600 000 into an investment account that offers 6,5% per annum simple interest rate for the first 3 years of investment. After 3 years the interest rate changed to 6% per annum, compounded monthly. Determine the amount that would be accumulated by the investment after 5 years. (6)

[15]

QUESTION 6

6.1 Find $f'(x)$ from the FIRST PRINCIPLES if $f(x) = 2x - 3$. (5)

6.2 Determine:

6.2.1 $f'(x)$ if $f(x) = 3\pi$ (1)

6.2.2 $D_x(2x+1)(x-2)$ (4)

6.2.3 $\frac{dy}{dx}$ if $xy = 1 - \sqrt{x}$ (4)

6.3 Determine the average gradient between $x = 2$ and $x = -3$ for the function defined by: $f(x) = x^2 - 1$ (3)

[17]

QUESTION 7

Given: $g(x) = -(2x+1)(x-1)(x+1)$

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

7.2 Determine the x-intercepts of g. (3)

7.3 Determine the turning point of g. (5)

7.4 Sketch the graph of $g(x)$ on the ANSWER SHEET provided. (4)

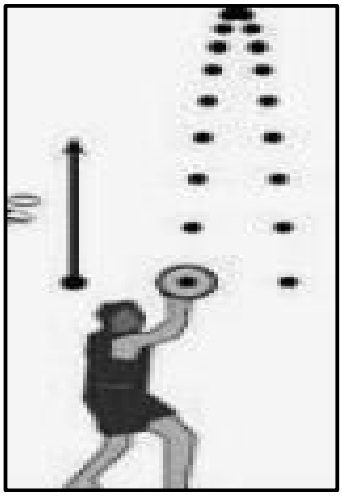
7.5 Show whether point A $(-3 ; 11)$ lies on the graph of g or not. (2)

[15]

QUESTION 8

A ball is thrown from a hand upwards and falls back to the hand that threw it.

$H(t) = t^2 - 10t$ is the relationship of the path of the ball leaving and coming back to the hand.



8.1 Calculate the height of the ball from the start of the throw. (1)

8.2 Determine the time the ball took to reach maximum height. (3)

8.3 How high was the ball after 3 seconds? (2)

8.4 Calculate the gradient of the ball at the maximum point. (2)
[8]

QUESTION 9

9.1 Simplify:

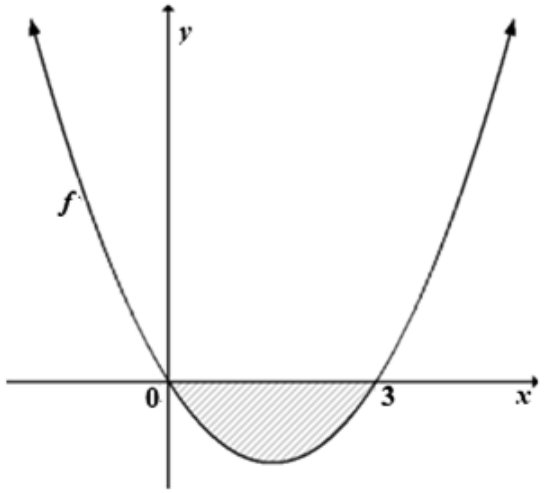
9.1.1 $\int (1)\,dx$ (2)

9.1.2 $\int \left(\sqrt{x} - \frac{1}{x^2} + \pi\right) dx$ (5)

9.2 Calculate the value of :

$$\int_{-1}^{0} (x)\ dx$$ (3)

9.3 Determine the striped area bounded by the graph of a function defined by $f(x) = x(x - 3)$ and the x-axis between $x = 0$ and $x = 3$.



(5)

[15]

TOTAL: 150

INFORMATION SHEET: TECHNICAL MATHEMATICS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\pi rad = 180°$$

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 $= \nu = \omega r$ 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 $= \frac{r\,s}{2}$ 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

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

OR

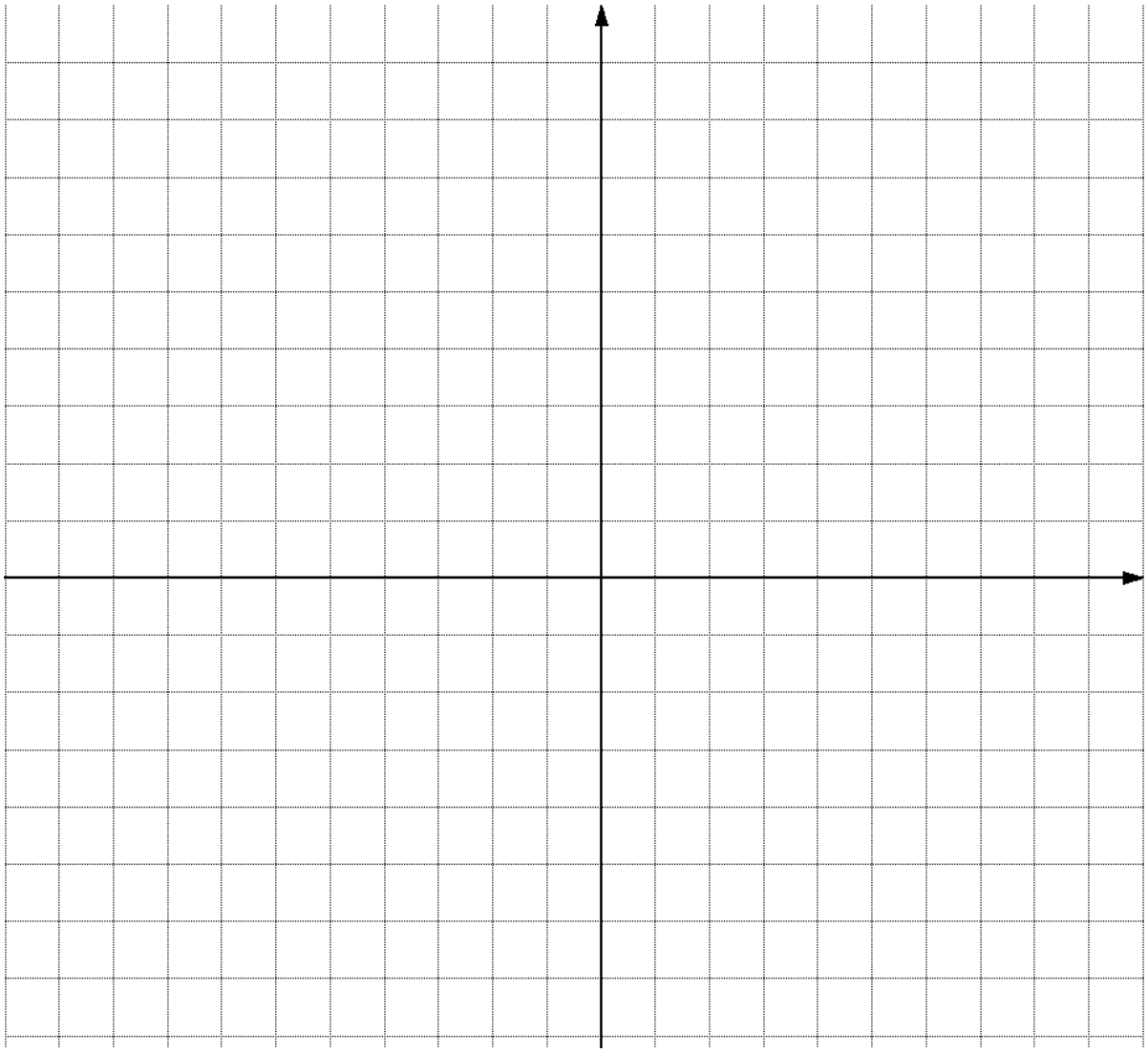
$A_T = a\left(\frac{o_1 + o_n}{2} + o_2 + o_3 + ... + o_{n-1}\right)$ where a = equal parts, $o_i = i^{th}$ ordinate
and n = number of ordinates

ANSWER SHEET

Learner Name: …….. Class: ……..

School Name: ……

QUESTION 4.2.5



ANSWER SHEET

Learner Name: …….. Class: ……..

School Name: ……

QUESTION 7.4