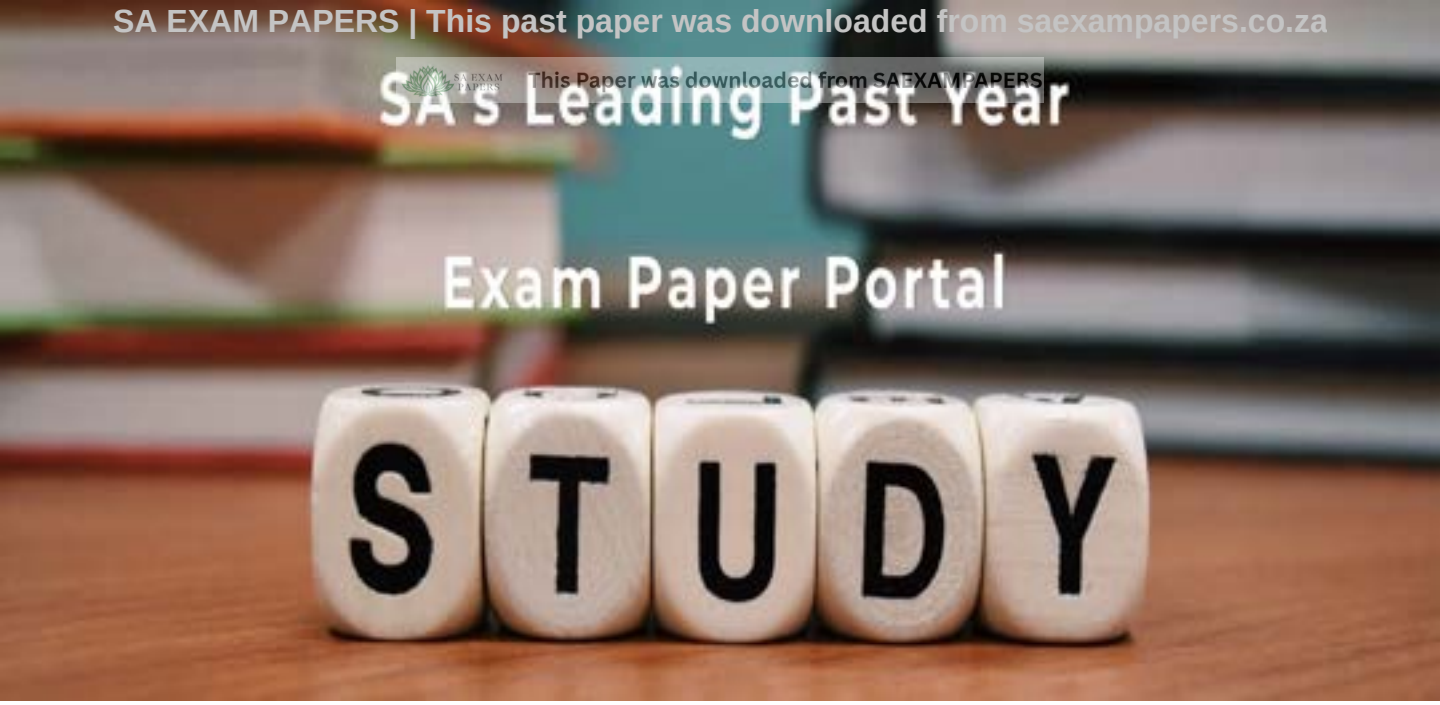


education

Department:
Education
North West Provincial Government
REPUBLIC OF SOUTH AFRICA

PROVINCIAL ASSESSMENT

GRADE 12

TECHNICAL MATHEMATICS P1

JUNE 2025

Marks: 150

Time: 3 hours

This question paper consists of 9 pages, a 2-page information 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.
2. Answer ALL the questions.
3. Answer QUESTION 3.3.2 and QUESTION 4.1.5 on the ANSWER SHEET provided. Write your name and surname in the spaces provided on the ANSWER SHEET and hand in the ANSWER SHEET with the 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. Answer 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 Solve for x.

1.1.1 $(2-6x)3x=0$ (2)

1.1.2 $\frac{2}{x}=(3x-4)\,,x\neq 0$ (correct to TWO decimal places) (4)

1.1.3 $x^2+3x\geq 0$ (represent the solution on a number line) (4)

1.2 Solve for s and q if:

$s-q=1$ and $s^2+q^2=5$ (6)

1.3 The formula used to calculate the compound interest of an investment or savings is:

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

$A=F$inal amount

$P=$ Initial amount

$i=$ Interest rate

$n=$ Period/number of years

1.3.1 Make n the subject of the formula. (3)

1.3.2 Hence, calculate n (number of years) if $A=R50\ 000$, $P=R25\ 000$, $i=8{,}5\%$ and round off to ONE decimal place. (2)

1.4 Given: $A=11001_2$ and $B=101111_2$

1.4.1 Subtract A from B and leave your answer in binary form. (2)

1.4.2 Hence, convert the answer in QUESTION 1.4.1 to a decimal form. (2)

[25]

QUESTION 2

2.1 Given the roots: $x = \frac{-2 \pm 4\sqrt{k+3}}{3}$

Describe the nature of the roots if:

2.1.1 $k = -1$ (1)

2.1.2 $k = -3$ (1)

2.1.3 $k < -3$ (1)

2.2 Determine the numerical value of q, for which the equation $x^2 - x = -2 - q$ will have real and unequal roots. (4)

[7]

QUESTION 3

3.1 Simplify the following expressions **without the use of a calculator.**

3.1.1 $\sqrt{3}(\sqrt{27} + 2\sqrt{3})$ (2)

3.1.2 $\dfrac{3^{3x-2}}{3^{3x+1} \cdot 9^{x-3}}$ (3)

3.1.3 $\dfrac{\log 5 + \log 125}{\log 625 - \log 25}$ (4)

3.2 Solve for x: $\log_x 64 + \log_x 8 - \log_x 32 = \log_5 625$ (5)

3.3 Given the complex number: $z = -\sqrt{2} + 3i$

3.3.1 Write down the conjugate of z. (1)

3.3.2 Sketch the Argand diagram of $\bar{z}$ on the complex plane. (2)

3.3.3 Hence, determine the trigonometric form of $\bar{z}$ in the form of $z = r(cos\theta + i \cdot sin\theta)$. (5)

3.4 Solve for a and b if $a + bi = 2(3 - 2i) - (-5i)$ (3)

[25]

QUESTION 4

4.1 Given functions k and q defined by $k(x) = -x^2 + 2x + 15$ and $q(x) = \frac{3}{x} - 4$.

4.1.1 Write down the equation of the asymptote of q. (2)

4.1.2 Determine the x-intercept of q. (2)

4.1.3 Determine the coordinates of the x-intercept of k. (3)

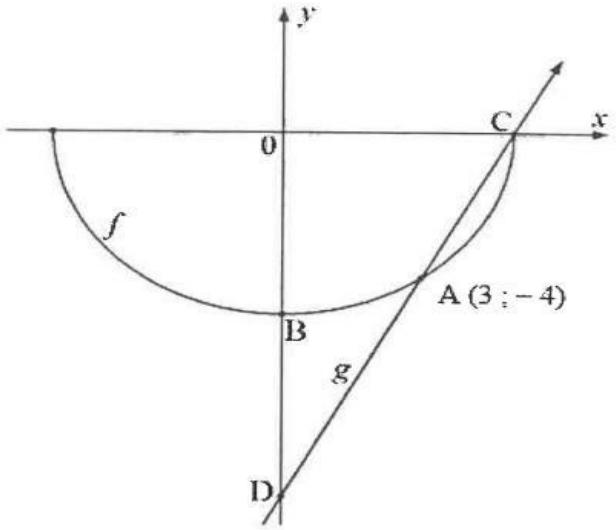
4.1.4 Calculate the coordinates of the turning point. (3)

4.1.5 Sketch the graphs of k and q on the same set of axes provided on the ANSWER SHEET provided. Clearly indicate ALL the intercepts with the axes, asymptotes and coordinates of the turning point. (6)

4.2 The graphs below represent functions of f and g defined by

$f(x) = -\sqrt{r^2 - x^2}$ and $g(x) = 2x - 10$.

- A$(3; -4)$ and C are points of intersection of f and g.
- B and D are the y-intercept of f and g.



Determine:

4.2.1 the equation of f (2)

4.2.2 the coordinates of B (1)

4.2.3 the domain and range of f (4)

4.2.4 the value(s) of x for which $g(x) \geq f(x)$ (2)

[25]

QUESTION 5

5.1 Calculate the effective annual interest rate if the nominal interest rate is 11,5% p.a compounded weekly. (3)

5.2 How long will it take a vehicle to depreciate to half of its original value if depreciation is calculated at 15% p.a on a straight-line basis? (4)

5.3 A small business invests R25 000 of their profit in an account with an interest rate of 7,5% p.a compounded monthly. Thirty months later the interest rate changes to 8% p.a compounded quarterly. Six months later they deposited R7 500 into the account. How much money will be in the account after 5 years? (6)
[13]

QUESTION 6

6.1 Given: : $f(x) = 5 - \frac{2}{3}x$

Determine $f'(x)$ using FIRST PRINCIPLES. (5)

6.2 Determine:

6.2.1 $\frac{dv}{dr}$ if $V = \frac{1}{3}\pi r^2 h$ (1)

6.2.2 $D_x[\sqrt[3]{x^4} + \frac{x^2 - \sqrt{3}x^6}{x^3}]$ (4)

6.3 The equation of a tangent to the curve defined by $g(x) = 3x^2 + x$ touches the curve at $x = 2$.

6.3.1 Calculate the gradient of the tangent. (3)

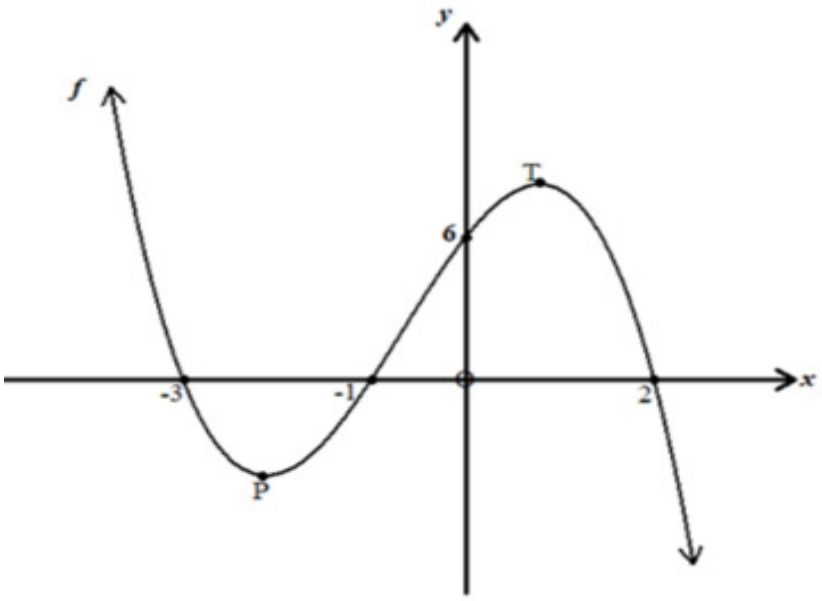
6.3.2 Hence, determine the equation of the tangent at the point where $x = 2$. (3)

6.3.3 Calculate the average gradient of g between the points where $x = 1$ and $x = 2$. (2)
[18]

QUESTION 7

7.1 The graph of function f, defined by $f(x) = ax^3 + bx^2 + cx + d$, is drawn below.

- P and T are the stationary points.
- x-intercepts are: $(-3;0)$, $(-1;0)$ and $(2;0)$.
- y-intercept: $(0;6)$.



7.1.1 Calculate the value of $a; b; c$ and d. (6)

7.1.2 Hence, determine the coordinates of P and T. (5)

7.2 Determine:

7.2.1 the value(s) of x for which $f(x) \leq 0$ (4)

7.2.2 the value(s) of x for which $f(x)$ is increasing (2)
[17]

QUESTION 8

An open cardboard box has the shape of a rectangular prism. The total surface area of the box is:

$S.A(x) = 4x + \frac{960}{x} + 240.$

8.1 Determine the value of x for which the surface area is a minimum and round off to the nearest integer. (4)

8.2 Determine the minimum surface area of the box. (2)
[6]

QUESTION 9

9.1 Determine the following integrals:

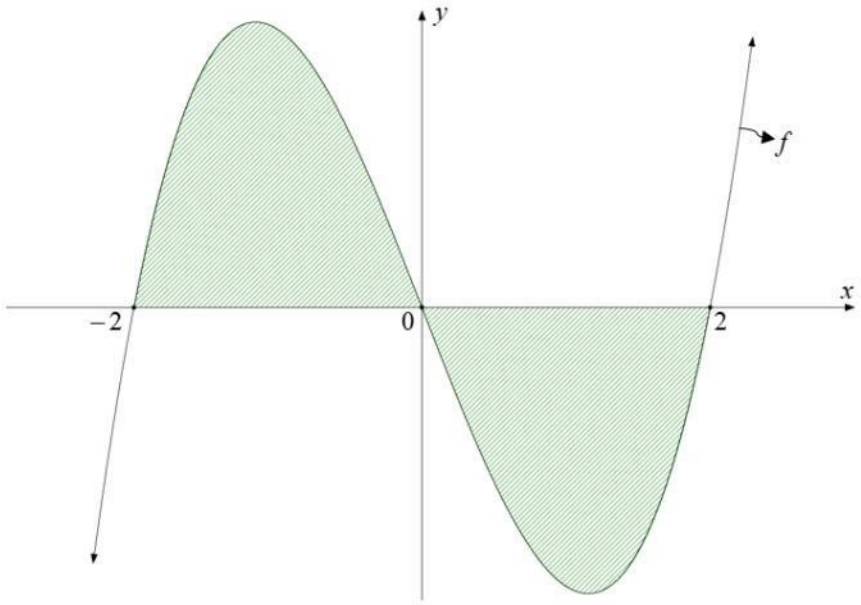
9.1.1 $\int (\sqrt[3]{x} + \left(\frac{1}{5}\right)^{4x})d_x$ (4)

9.1.2 $-3\int (x^{-1} - x)d_x$ (3)

9.2 The sketch below shows function f defined by

$f(x) = x^3 - 5x^2 + 8x + 12.$

- The shaded area represents the bounded area of the curve.



Determine (showing ALL calculations) the shaded area bounded by the curve and the x-axis between the points where $x = -2$ and $x = 2$. (7)

[14]

TOTAL: 150

INFORMATION SHEET: TECHNICAL MATHEMATICS

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

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

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

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

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

$$\int x^n dx = \frac{x^{n+1}}{n+1} + C \ , \quad n \neq -1 \qquad \int kx^n dx = k.\frac{x^{n+1}}{n+1} + C \ , \ n \neq -1 \text{ and } k \neq 0$$

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

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

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

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

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

$$\text{In } \Delta ABC: \frac{a}{SinA} = \frac{b}{SinB} = \frac{c}{SinC} \qquad a^2 = b^2 + c^2 - 2bc.CosA$$

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

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

π rad $= 180^\circ$

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

Angular velocity $= \omega = 360^\circ n$ where n = rotational frequency

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

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

Arc length $= s = r\theta$ where r = radius , s = arc length

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

Area of sector $= \dfrac{r^2\theta}{2}$ 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

$A_T = a(m_1 + m_2 + m_3 + ... + m_n)$ where a = width of equal parts, $m_1 = \dfrac{o_1 + o_2}{2}$

$o_n = n^{th}$ ordinate and n = number of ordinates

OR

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

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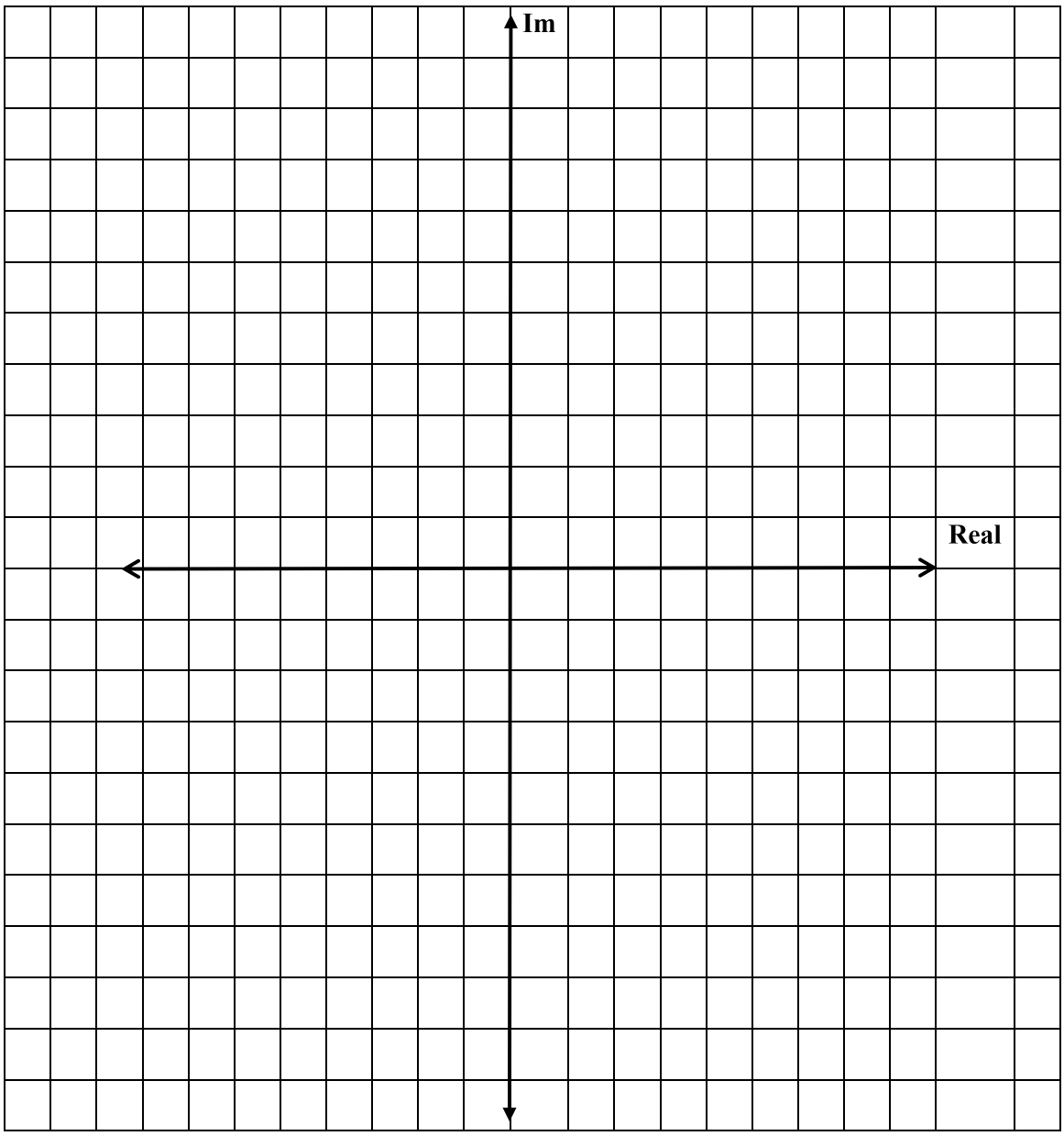
QUESTION 3.3.2



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QUESTION 4.1.5