KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICS P1

PREPARATORY EXAMINATION

SEPTEMBER 2025

MARKS: 150

TIME: 3 hours

This question paper consists of 9 pages, an information sheet and an Answer Book of 18 pages.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 10 questions.

2. Answer ALL the questions.

3. Number the answers correctly according to the numbering system used in this question paper.

4. Clearly show ALL calculations, diagrams, graphs, etc. which you have used in determining your answers.

5. Answers only will NOT necessarily be awarded full marks.

6. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.

7. If necessary, round off answers correct to TWO decimal places, unless stated otherwise.

8. Write neatly and legibly.

QUESTION 1

1.1 Solve for x:

1.1.1 $x^2 - 11x + 30 = 0$ (3)

1.1.2 $3x^2 + 9x + 4 = 0$ (correct to TWO decimal places). (3)

1.1.3 $\left(\frac{1}{2}\right)^{-x}(3 - x) \leq 0$ (3)

1.1.4 $\sqrt{2 - 7x} + 2x = 0$ (5)

1.2 Evaluate: $\frac{2^{4025} + 2^{4023}}{4^{2011}}$ (3)

1.3 Solve simultaneously for x and y:

$y + 1 = 2x$
$(3x - y)(x + y) = 0$ (5)

1.4 Two integers have a sum of m and a product of n. Determine an expression for the sum of the squares of the two integers in terms of n and m. (3)

[25]

QUESTION 2

2.1 Consider the arithmetic sequence: $x-3\ ;\ 2x+1\ ;\ 4x-1\ldots$

2.1.1 Determine the value of x. (3)

2.1.2 Calculate the numerical value of the 7^{th} term. (3)

2.2 Consider the quadratic sequence: $2\ ;\ 7\ ;\ 16\ ;\ 29\ ;\ \ldots$

2.2.1 Determine the 5^{th} term of the sequence. (1)

2.2.2 Determine the n^{th} term of the quadratic sequence. (4)

2.2.3 Show that the sum of the first differences of the quadratic sequence can be given by: $S_n = 2n^2 + 3n$ (3)

2.2.4 If the sum of the first 40 first-differences in question 2.2.3 equals 3320 (that is $S_{40} = 3320$), which term in the quadratic sequence has a value of 3322? (2)

[16]

QUESTION 3

3.1 Determine the number of terms in the following geometric sequence:

$\frac{1}{2}\ ;\ \frac{\sqrt{3}}{2}\ ;\ \frac{3}{2}\ ;\ \ldots\ ;\frac{81\sqrt{3}}{2}$ (4)

3.2 Solve for p if $\sum_{k=0}^{\infty} 9p^k = \sum_{m=1}^{7} (-27)\left(-\frac{2}{3}\right)^m$ and $-1 < p < 1$. (6)

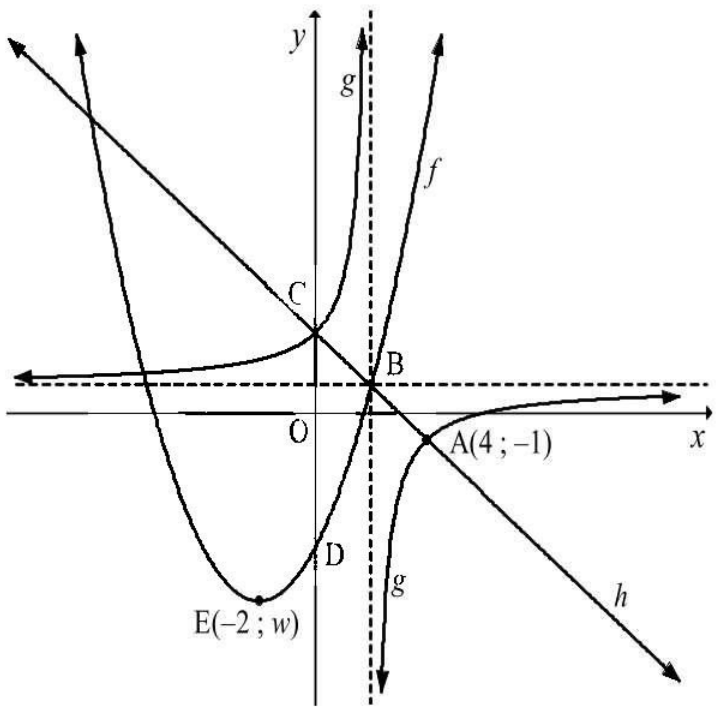
[10]

QUESTION 4

The graphs of $f(x)=\frac{1}{2}(x+p)^2+q$ and $g(x)=\frac{a}{x+r}+t$ are sketched below.

The line $h(x)=-x+3$ is an axis of symmetry of g. C is the y-intercept of both g and h..

$E(-2\ ;\ w)$ is the turning point of *f*. B, a point on *f*, is the point of intersection of the asymptotes of g.

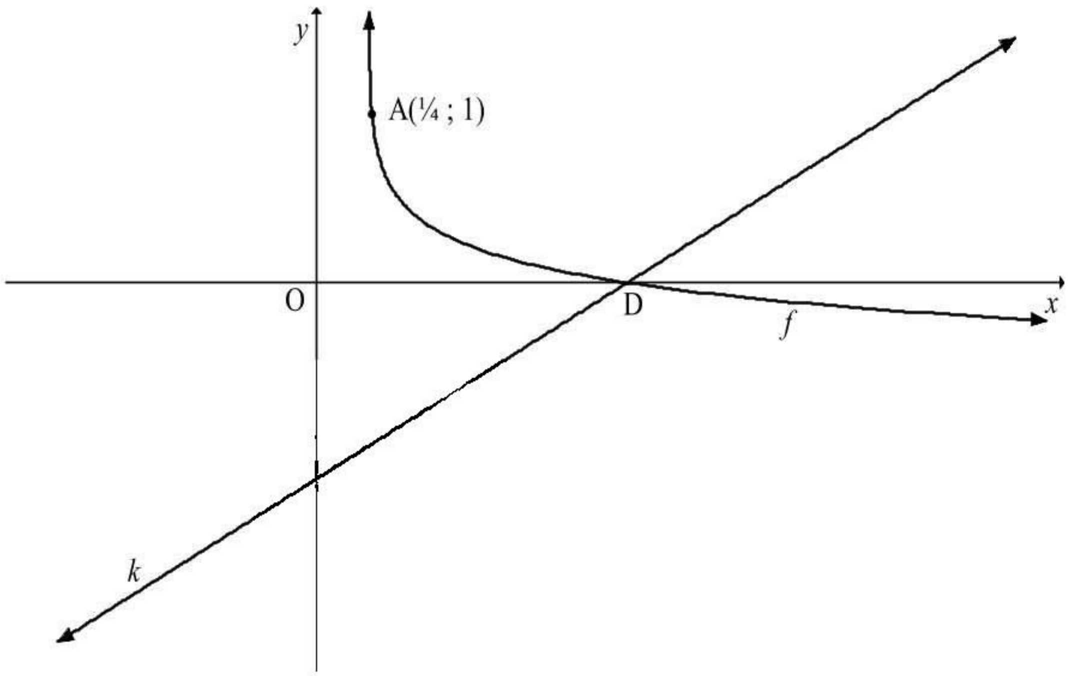


4.1	Write down the coordinates of C.	(1)
4.2	Show that the coordinates of B are $(2;1)$	(2)
4.3	Determine the values of a, r and t.	(4)
4.4	Determine the equations of the asymptotes of the graph of j if $j(x)=g(x+3)-1$.	(2)
4.5	Show that the equation of f is given by $f(x)=\frac{1}{2}x^2+2x-5$.	(3)
4.6	If $f(x)=k$, determine the values of k for $f(x)$ has TWO negative roots.	(3)
4.7	Determine the values of d such that $\frac{1}{2}(x+d)^2+2(x+d)-5=-(x+d)+3$ will have one positive and one negative root.	(4)

[19]

QUESTION 5

The graphs of $f(x)=\log_b x$ and $k(x)=mx-3$ are drawn below. $A\left(\frac{1}{4};1\right)$ is a point on f and D is the x-intercept of both f and k.



5.1 Write down the coordinates of D. (1)

5.2 Determine the value of b. (2)

5.3 Determine the value of m. (2)

5.4 Write down the domain of f. (1)

5.5 Determine the equation of f^{-1}, the inverse of f in the form of $y = ...$ (2)

5.6 Determine the values of x for which $\frac{1}{4} \leq f^{-1}(x) \leq 16$. (3)

5.7 Sketch the graphs of f^{-1} and k^{-1} on the same system of axes. Clearly indicate the intercepts with the axes. (4)

[15]

QUESTION 6

6.1 Johnson deposited an amount of R10 000 into a savings account that pays interest at 7,15% p.a., compounded quarterly.

6.1.1 Calculate the effective interest rate. (2)

6.1.2 How long will it take for this investment to grow to R17 628,78? (4)

6.2 Mr Simbine took out a home loan of R1 000 000 at an interest rate of 11,25% p.a., compounded monthly over 20 years. The loan is repaid via monthly instalments of R10 492,56.

6.2.1 Determine the outstanding balance after the 125th payment. (4)

6.2.2 Mr Simbine had financial difficulties and was unable to make the 126th, 127th, 128th, 129th and 130th payments. The bank agreed to restructure the loan so that it is paid off in the same amount of time. Determine the new monthly instalment. (5)

[15]

QUESTION 7

7.1 Determine $f'(x)$ from first principles if $f(x) = -5x^2$ (5)

7.2 Determine the following:

7.2.1 $\frac{dy}{dx}$ if $y = \frac{x^3 - 27}{x - 3}$ (3)

7.2.2 $D_x\left[x\left(4 - x^{-\frac{1}{2}}\right)\right]$ (3)

7.3 Given : $f(x) = ax^2$; $x > 0$, determine the value of a if $f'(4) = f^{-1}(1)$ (5)

[16]

QUESTION 8

Given: $f(x) = 2x^3 + x^2 - 13x + 6$

8.1 If one of the x-intercepts of f is 2, determine the other two x-intercepts. (3)

8.2 Determine the coordinates of the turning points of f. (4)

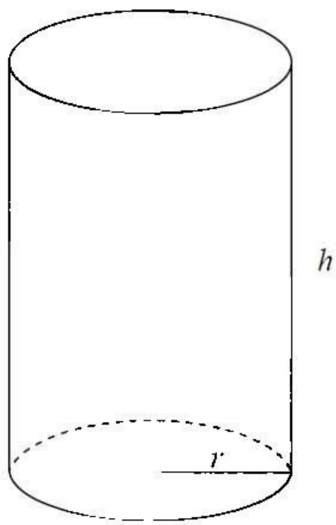
8.3 Draw a sketch graph of f. Clearly label all intercepts with the axes and any turning points. (3)

8.4 Determine the values of x for which $f'(x).f''(x) < 0$. (4)

[14]

QUESTION 9

A drinking glass, in the shape of a cylinder, must hold $300\,\text{cm}^3$ of liquid when full. The height of the glass is h cm and the radius of the base is r cm.



9.1 Show that the height of the glass, h, can be expressed as $h = \dfrac{300}{\pi r^2}$. (1)

9.2 Hence, determine the value of r for which the total surface area of the glass will be a minimum. (5)

[6]

QUESTION 10

10.1 Events A and B are independent. $P(A) = 0,3$ and $P(B) = 0,6$

10.1.1 Represent the given information on a Venn diagram. Indicate on the Venn diagram the probability associated with each region. (4)

10.1.2 Determine:

(a) $P(B \text{ only})$ (1)

(b) $P(B \text{ or NOT } A)$ (2)

10.2 The digits 0, 1, 2, 3, 4, 5, 6 and 7 are used to create four-digit codes.

10.2.1 How many different codes are possible if digits maybe be repeated? (1)

10.2.2 If digits may not be repeated:

(a) How many different codes are possible? (1)

(b) Calculate the probability that a code will be a number between 2000 and 6000 that are divisible by 5. (5)

[14]

TOTAL: 150

INFORMATION SHEET: MATHEMATICS

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

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

$T_n = a + (n-1)d$ $\quad S_n = \frac{n}{2}[2a + (n-1)d]$

$T_n = ar^{n-1}$ $\quad S_n = \frac{a(r^n - 1)}{r-1}$; $r \neq 1$ $\quad S_\infty = \frac{a}{1-r}$; $-1 < r < 1$

$F = \frac{x[(1+i)^n - 1]}{i}$ $\quad P = \frac{x[1-(1+i)^{-n}]}{i}$

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

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

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

$(x-a)^2 + (y-b)^2 = r^2$

InΔABC: $\quad \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

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

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

$\sin(\alpha + \beta) = \sin\alpha.\cos\beta + \cos\alpha.\sin\beta$ $\quad \sin(\alpha - \beta) = \sin\alpha.\cos\beta - \cos\alpha.\sin\beta$

$\cos(\alpha + \beta) = \cos\alpha.\cos\beta - \sin\alpha.\sin\beta$ $\quad \cos(\alpha - \beta) = \cos\alpha.\cos\beta + \sin\alpha.\sin\beta$

$$\cos 2\alpha = \begin{cases} \cos^2\alpha - \sin^2\alpha \\ 1 - 2\sin^2\alpha \\ 2\cos^2\alpha - 1 \end{cases}$$

$\sin 2\alpha = 2\sin\alpha.\cos\alpha$

$\bar{x} = \frac{\sum x}{n}$ $\quad \sigma^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n}$

$P(A) = \frac{n(A)}{n(S)}$ $\quad$ P(A or B) = P(A) + P(B) – P(A and B)

$\hat{y} = a + bx$ $\quad b = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sum(x-\bar{x})^2}$