education

Department of Education
FREE STATE PROVINCE

# PREPARATORY EXAMINATION

Stanmorephysics.com

## GRADE 12

# MATHEMATICS P1

Stanmorephysics.com

## SEPTEMBER 2025

## TIME: 3 HOURS

## MARKS: 150

**This question paper consists of 8 pages, 1 information sheet and an answer book of 16 pages.**

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## 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 in the Special Answer Book provided.
3. Clearly show ALL calculations, diagrams, graphs, etc. that you have used in determining your answers.
4. Answers only will NOT necessarily be awarded full marks.
5. You may use an approved scientific calculator (non-programmable and non-graphical), unless stated otherwise.
6. If necessary, round off answers to TWO decimal places, unless stated otherwise.
7. Diagrams are NOT necessarily drawn to scale.
8. An information sheet with formulae is included at the end of this question paper.
9. Write neatly and legibly.

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## QUESTION 1

1.1 Solve for $x$:

1.1.1 $x(x+3)=28$ (3)

1.1.2 $2x^2+7x-1=0$ (correct to TWO decimal places) (3)

1.1.3 $(x+4)(5-x)\geq 0$ (3)

1.1.4 $2\sqrt{x+4}-3=x+1$ (5)

1.2 Solve simultaneously for $x$ and $y$:

$$y-x=-7$$
$$x^2+3xy=-27$$ (6)

1.3 Simplify the following expression fully without using a calculator:

$$\sqrt[n]{\frac{10^n+2^{n+2}}{5^{2n}+4.5^n}} \text{ where } n\neq 0$$ (4)

**[24]**

## QUESTION 2

The general term of a quadratic number pattern is $T_n=an^2+bn+c$ and its first term is 8. The general term of the first differences of the pattern is $T_k=4k-2$

2.1 Determine the next two terms of the number pattern $T_n$ (2)

2.2 Hence, or otherwise, show that the general term of the quadratic number pattern is given by $T_n=2n^2-4n+10$ (3)

2.3 Which term of the quadratic number pattern will be equal to 3050? (3)

**[8]**

**QUESTION 3**

3.1 Given the geometric sequence: $\frac{9}{2}; 9; 18; \ldots; 2304$

3.1.1 Determine the value of $r$, the common ratio. (1)

3.1.2 Does the sequence converge? Motivate your answer. (2)

3.1.3 How many terms are there in the sequence? (3)

3.1.4 Determine the sum of the first 10 terms of the sequence. (2)

3.2 If the first term of the arithmetic series is 18, the common difference is 3 and the last term is 99.

3.2.1 Write down the next two terms of the series. (2)

3.2.2 Calculate the sum of the series. (5)

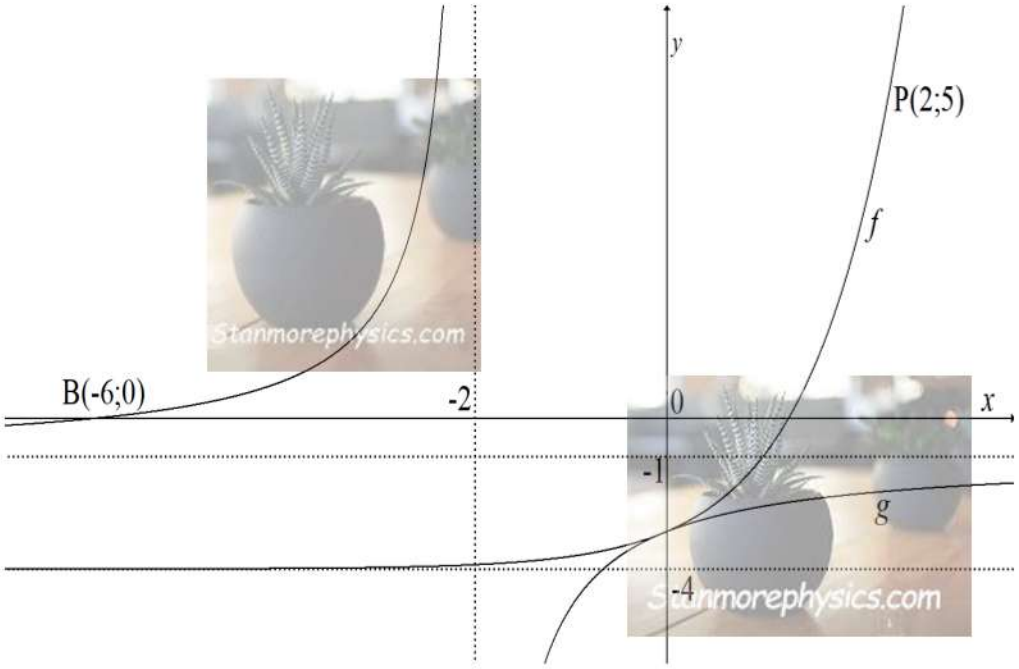
3.2.3 If the even numbers are removed from the series, calculate the sum of the remaining terms in the series. (5)

**[20]**

**QUESTION 4**

The diagram below shows the graphs of the functions of $f(x)=b^x+c$ and $g(x)=\frac{a}{x+p}+q$.

- $B(-6;0)$ is the $x$-intercept of $g$.
- The graphs of $f$ and $g$ have a common $y$-intercept.
- $P(2;5)$ is a point on $f$.




4.1 Write down the values of $p$ and $q$. (2)

4.2 Determine the equation of $g$. (3)

4.3 Determine the equation of the inverse of the axis of symmetry of $g$ for $m<0$. (4)

4.4 Write down the equation of the asymptote of $f$. (1)

4.5 Determine the equation of $f$. (3)

4.6 Determine the equation of $h$ if $h(x)=f(x)+4$ (2)

4.7 Determine the equation of $h^{-1}$, the inverse of $h$, in the form $y=\ldots$ (2)

4.8 For which values of $x$ is $f(x)\geq g(x)$? (2)

**[19]**

## QUESTION 5

Given $f(x)=x^2-2x-3$ and $g(x)=x+3$

5.1 Write down the $y$-intercepts of both graphs. (2)

5.2 Sketch the graphs of $f(x)=x^2-2x-3$ and $g^{-1}$ on the same set of axes, indicating the turning point and all intercepts with the axes. (5)

5.3 Determine the values of $k$ for which $f(x)=k$ will have two unequal positive real roots. (3)

5.4 For which values of $x$ will $f'(x).f''(x)\geq 0$? (3)
**[13]**

## QUESTION 6

6.1 How long must R50 000 be invested to double at an interest rate of 8.5% p.a. on the straight-line method? (Give your answer in years and months). (3)

6.2 On 1 June 2024, a bank granted Thabiso a loan of R250 000 at an interest rate of 15% p.a. compounded monthly to buy a car. Thabiso agreed to repay the loan in monthly instalments commencing on 1 July 2024 and ending four (4) years later on 1 June 2028. However, Thabiso was unable to make the first two instalments and only commenced with monthly instalments on 1 September 2024.

6.2.1 Calculate the amount Thabiso owed the bank on 1 August 2024, a month before he paid his first monthly instalment. (2)

6.2.2 Having paid his first monthly instalment on 1 September 2024, Thabiso will still pay his last monthly instalment on 1 June 2028. Calculate his monthly instalment. (4)

6.3 R$x$ ($x$ Rands) is invested into a new account at an interest rate of 12% p.a. compounded monthly. Three years later, R$2x$ is deposited into the same account. After seven years, there is R276 558,75 in the account. Determine how much money was invested at the beginning. (That is the value of $x$.) (6)
**[15]**

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## QUESTION 7

7.1 Determine $f'(x)$ from first principles if it is given that $f(x)=-\frac{1}{x}$. (5)

7.2 Determine:

7.2.1 $D_x\left[(4x+3)(2x-5)\right]$ (3)

7.2.2 $\frac{dy}{dx}$ if $y=\frac{\sqrt[4]{x^{-5}}+2x^{-3}-x}{x^{-3}}$ (6)

7.3 Given: $f(x)=2x^3-2x^2+4x-1$.
Determine the interval for which $f$ is concave up. (4)
**[18]**

## QUESTION 8

The equation of the cubic function $f$ is given as $f(x)=(x-1)(x^2-4x+4)$
$=x^3-5x^2+8x-4$

8.1 Calculate the coordinates of the turning points of $f$. (5)

8.2 Sketch the graph of $f$ clearly, indicating the intercepts with the axes and the turning points. (4)

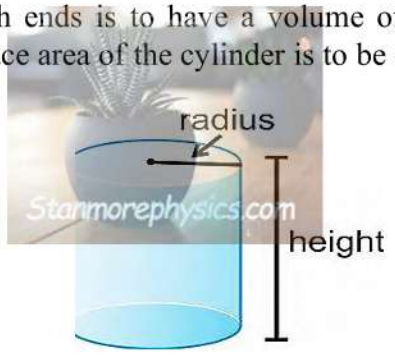
8.3 For which value(s) of $x$ is:

8.3.1 $f'(x)>0$ ? (2)

8.3.2 $x.f'(x)<0$ ? (2)
**[13]**

## QUESTION 9

A cylinder closed at both ends is to have a volume of $2000\pi\ m^3$. What should its dimensions be if the surface area of the cylinder is to be as small as possible?




**[7]**

**QUESTION 10**

10.1 A survey was conducted among 100 grade 12 learners at Lenakeng Technical High School regarding their preferences for the following subjects: Mathematics (M), Physical Sciences (P), and Life Sciences (L). The following was revealed from the survey:

- Eight (8) prefer all three
- 12 prefer Mathematics and Physical Sciences
- Five (5) prefer Physical Sciences and Life Sciences, but not Mathematics
- $x$ prefer Mathematics and Life Sciences, but not Physical Sciences
- 61 prefer Mathematics
- 19 prefer Physical Sciences
- 73 prefer Life Sciences
- 14 prefer none of the three subjects

10.1.1 Draw a Venn diagram to illustrate the information above. (4)

10.1.2 Calculate the value of $x$. (2)

10.1.3 Calculate the probability that a learner, chosen randomly, prefers only one of the subjects. (2)

10.2 Consider the letters of the word MATHEMATICIAN. The letters that are the same are treated as being identical. If the letters are arranged in any order without repetition, what is the probability that the word arrangement formed will end with the letter M? (5)

**[13]**

**TOTAL: 150**

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# INFORMATION SHEET: MATHEMATICS

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

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

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

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

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

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

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

$y - y_1 = m(x - x_1) \qquad m = \frac{y_2 - y_1}{x_2 - x_1} \qquad m = \tan\theta \qquad (x-a)^2 + (y-b)^2 = r^2$

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

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

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

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

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

$\bar{x} = \frac{\sum x}{n} \qquad \sigma^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n} \qquad P(A) = \frac{n(A)}{n(S)}$ P(A or B) = P(A) + P(B) – P(A and B)

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

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