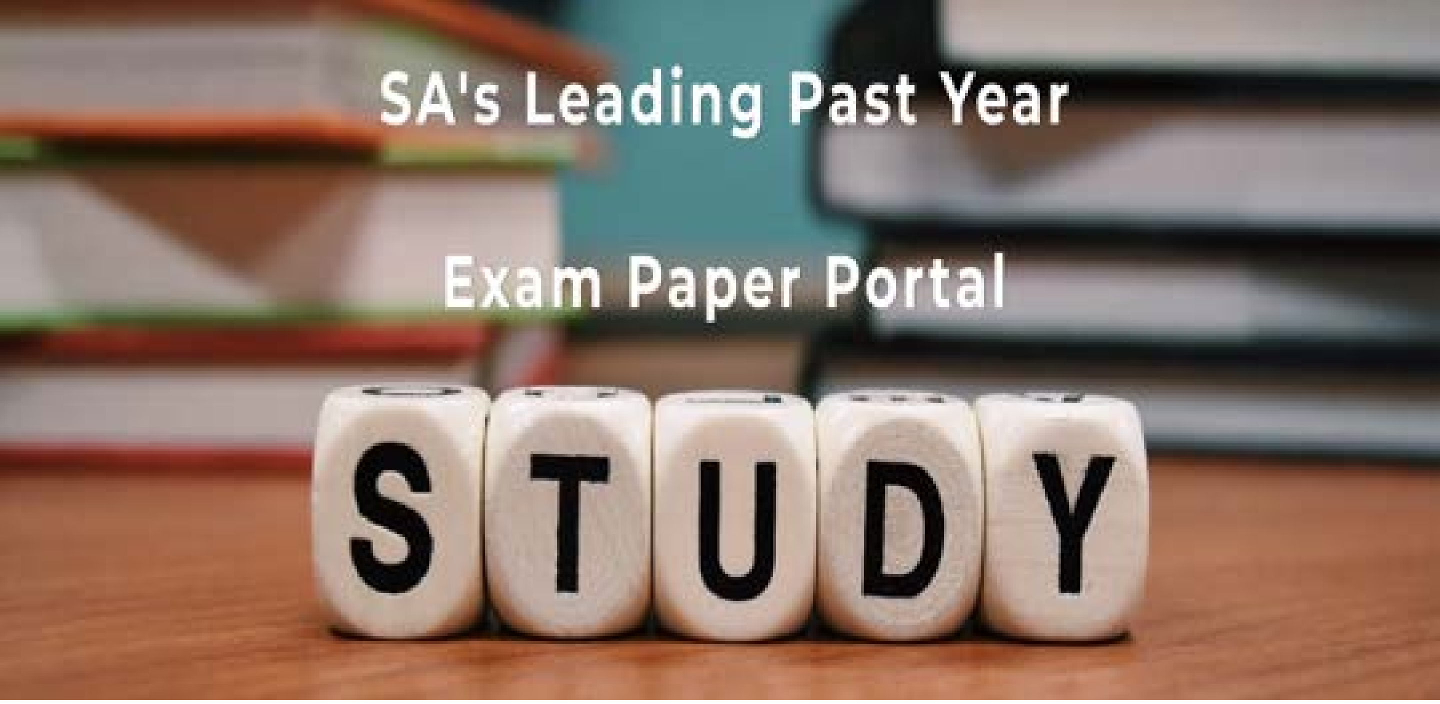
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STUDY

KWAZULU-NATAL PROVINCE

EDUCATION

REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

MATHEMATICS P1

SEPTEMBER 2021

PREPARATORY EXAMINATIONS

MARKS: 150

TIME: 3 hours

N.B. This question paper consists of 9 pages and an information sheet.

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions.

1. This question paper consists of 13 questions.
2. Answer **ALL** questions.
3. Clearly show **ALL** calculations, diagrams, graphs, et cetera that you have used in determining your answers.
4. Answers only will not necessarily be awarded full marks.
5. An approved scientific calculator (non-programmable and non-graphical) may be used, unless stated otherwise.
6. If necessary, answers should be rounded off to TWO decimal places, unless stated otherwise.
7. Diagrams are NOT necessarily drawn to scale.
8. Number the answers correctly according to the numbering system used in this question paper. Write neatly and legibly.

QUESTION 1

1.1 Solve for x:

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

1.1.2 $5x^2-4x=2$ (Rounded off to 2 decimal places) (4)

1.1.3 $\sqrt{7+3x}+2x=0$ (5)

1.1.4 $3^{x+2}+3^{2-x}=82$ (5)

1.2 For which values of x will $\sqrt{x^2-5x+4}$ be real? (4)

1.3 Solve for x and y simultaneously if:

$$xy=12 \quad \text{and} \quad x-4=y$$ (5)

[25]

QUESTION 2

The p^{th} term of the first differences of a quadratic sequence is given by $T_p=3p-2$.

2.1 Determine between which two consecutive terms of the quadratic sequence the first difference is equal to 1450. (3)

2.2 The 40$^{\text{th}}$ term of the quadratic sequence is 2290 and $T_n=an^2+bn+c$ is the n^{th} term of the quadratic sequence. Calculate the value of c. (4)

[7]

QUESTION 3

3.1 The first four terms of an arithmetic sequence are:

$65\ ;\ 73\ ;\ 81\ ;\ 89\ ;\ ...$

3.1.1 Determine an expression for the n^{th} term. (2)

3.1.2 Calculate value of the term in the 1000^{th} position. (2)

3.1.3 Calculate the sum of the first 1000 terms. (2)

3.2 An arithmetic and geometric sequence have the same first term, 5. The common difference and common ratio have the same value. The 5^{th} term of the geometric sequence is 80. Determine the first three terms of the arithmetic sequence(s). (5)

[11]

QUESTION 4

Calculate the value of y if

$$\sum_{p=1}^{5}(4y+3p)+\sum_{k=4}^{7}3.(2)^{k-1}=\sum_{j=1}^{\infty}\left(\frac{1}{3}\right)^{j-1}$$

[7]

QUESTION 5

Given $g(x)=-\frac{4}{x-1}+2$

5.1 Write down the equations of the asymptotes of g. (2)

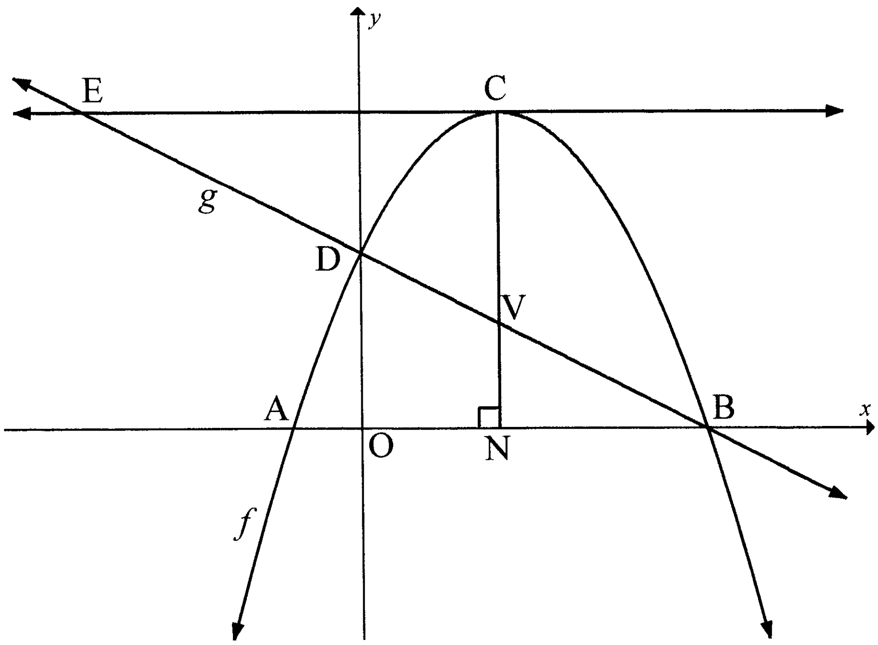
5.2 Determine the intercepts of the graph of g with the axes. (3)

5.3 Sketch the graph of g. Show all intercepts with the axes as well as the asymptotes of the graph. (3)

[8]

QUESTION 6

Sketched below are the graphs of $f(x) = -x^2 + 4x + 5$ and $g(x) = mx + c$.
f and g intersect at B and D. B and D are the x– and y – intercepts of g, respectively. C is the turning point of f. V is a point on g and N is a point on the x – axis such that CVN ⊥ x – axis. E is a point on g such that CE || x – axis. A and B are the x – intercepts of f.



6.1 Determine the co-ordinates of C, the turning point of f. (3)

6.2 Write down the range of f. (1)

6.3 Calculate the length of AB. (4)

6.4 Determine the equation of g. (2)

6.5 T is a point on f such that D and T are reflections of each other over CVN. Write down the coordinates of T. (2)

6.6 The line EC is a tangent to f at C.

6.6.1 Write down the gradient of this tangent. (1)

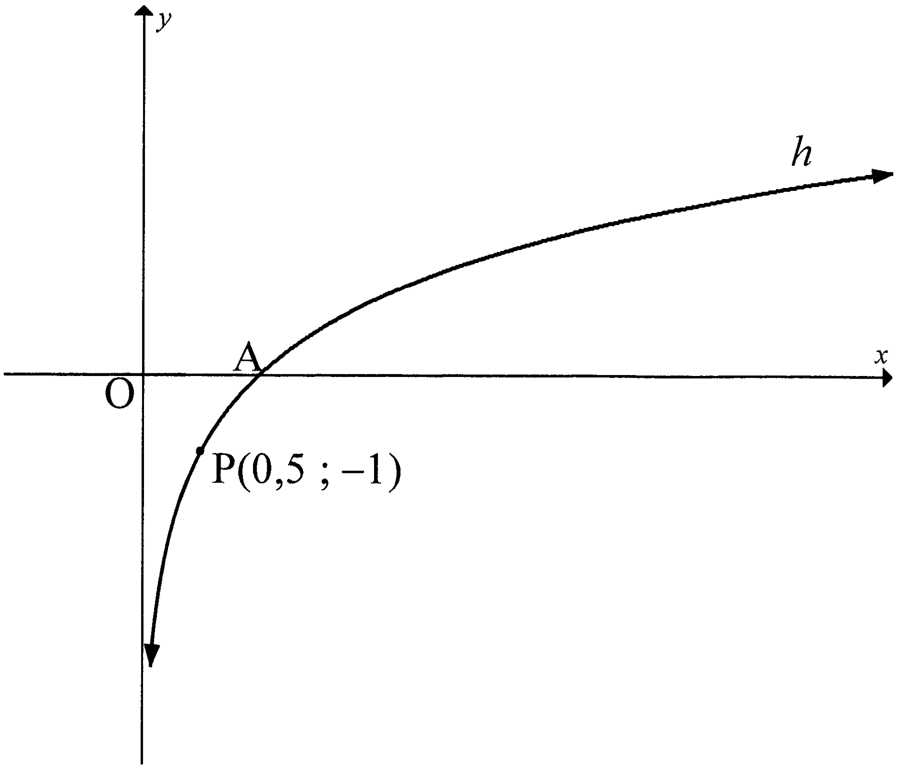
6.6.2 Determine the coordinates of E. (2)

6.7 Determine the value of k for which $y = -x + k$ is a tangent to f. (5)

[20]

QUESTION 7

In the diagram, the graph $h(x) = \log_a x$ is drawn. P(0,5 ; – 1) lies on h.



7.1 Calculate the value of a. (3)

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

7.3 Write down the domain of h^{-1}. (1)

7.4 Determine the values of x if $h(x) \leq -1$. (2)

[8]

QUESTION 8

8.1 ABC traders purchased a truck for R500 000. The truck depreciates at 8,5 % p.a. on a reducing balance. Determine the value of the truck after 12 years (to the nearest rand). (3)

8.2 Sipho takes a bank loan to pay for his new car. He repays the loan by means of monthly payments of R3300 for a period of 5 years. The repayments start one month after the loan is granted. The interest rate is 16 % p.a. compounded monthly.

8.2.1 Calculate the purchase price of the car if Sipho is granted a loan for the full purchase price of the car. (4)

8.2.2 If the trade in value of his old car is R10 000 and he decides to use this amount as deposit, determine the new monthly instalments that Sipho will now make. (3)

8.2.3 Calculate the savings he will make if he pays the deposit of R10 000. (4)

[14]

QUESTION 9

9.1 Determine $f'(x)$ from first principles given $f(x) = x^2 + 5x - 6$. (5)

9.2 Determine:

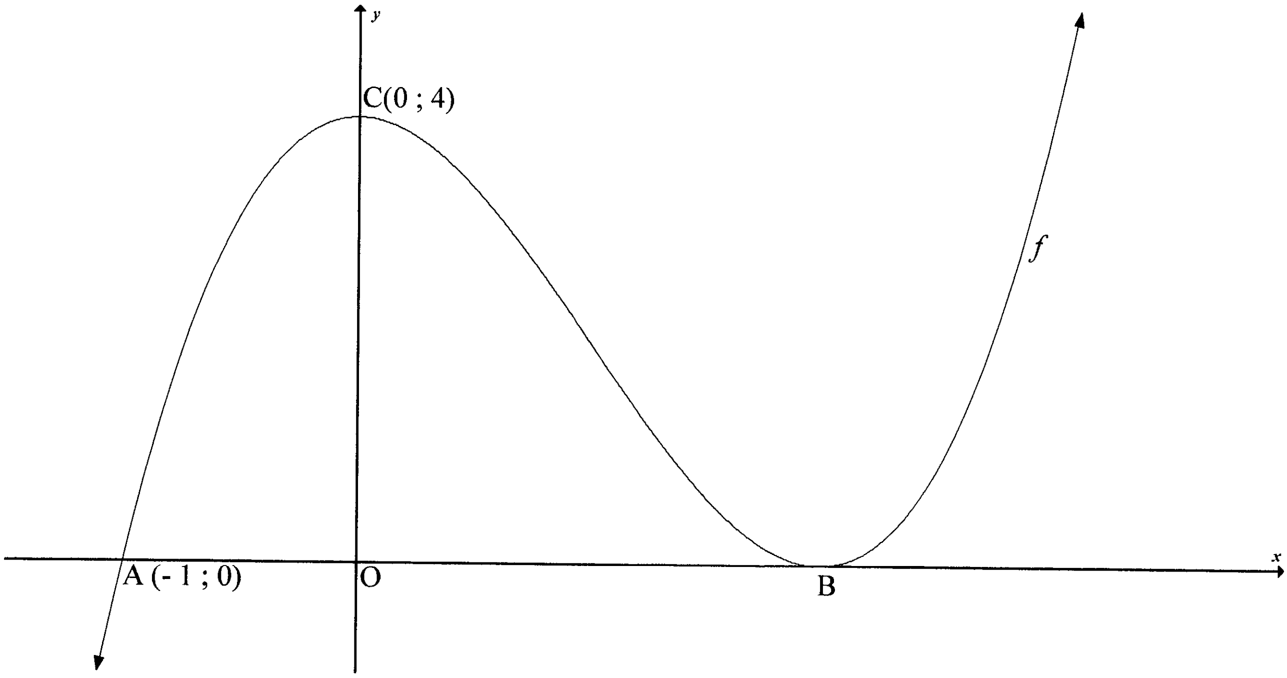
9.2.1 $f'(x)$ if $f(x) = 3x\left(\sqrt{x} - 4\right)$ (3)

9.2.2 $\frac{dy}{dx}$ if $y = \frac{x^3 - 4x}{2 - x}$ (4)

[12]

QUESTION 10

The graph of $f(x) = x^3 + bx^2 + cx + d\ ;\ a\ \neq 0$ is sketched below.
A(–1; 0) is an x – intercept. C(0 ; 4) is a turning point and B is both a local minimum and x – intercept of f.



10.1 Write down the value of d. (1)

10.2 Show that $b = -3$ and $c = 0$. (4)

10.3 Determine the equation of the tangent to f at $x = 5$. (4)

10.4 For which values of k will $f(x) = k$ have 2 unequal positive roots and 1 negative root simultaneously. (2)

10.5 Determine the coordinates of the local minimum of g if $g(x) = f(-x) + 3$. (4)

[15]

QUESTION 11

11.1 Use the information below to draw a graph of the function defined by
$f(x) = ax^3 + bx^2 + cx + d$.
Indicate the intercepts with the axes as well as the coordinates of the turning points.

- $f(0) = 3$ *and* $f(-3) = 0$
- $f'(-2) = f'(1) = 0$
- $f(-2) = 5$ *and* $f(1) = 1$ (5)

11.2 Use the graph to answer the questions below:

11.2.1 Determine the values of x for which $x.f(x) < 0$. (2)

11.2.2 If $g(x) = -f(x)$, write down the coordinates of the local minimum point of g. (2)
[9]

QUESTION 12

The word **PANDEMIC** is an important word used in the COVID – 19 crises in the world today. The letters of this word are randomly arranged to form new arrangements of the letters.

12.1 How many unique arrangements of the letters can be made? (2)

12.2 Determine the number of unique arrangements of the letters that are possible if each arrangement must start with the letter P and end with the letter C. (3)

12.3 Calculate the probability that randomly chosen unique arrangements of the letters will start with the letter P and end with the letter C. (2)
[7]

QUESTION 13

Each passenger on ABC Airways flight chose exactly one beverage from tea, coffee or fruit juice. The results are shown in the table below.

	MALE	**FEMALE**	**TOTAL**
Tea	**20**	**40**	**60**
Coffee	***b***	***c***	**80**
Fruit Juice	***d***	***e***	**20**
TOTAL	**60**	**100**	***a***

13.1 Write down the value of a. (1)

13.2 Determine the probability that a randomly selected passenger is male. (2)

13.3 Given that the event of a passenger choosing coffee is independent of being a male, calculate the value of b. (4)

[7]

Total Marks: 150

INFORMATION SHEET: MATHEMATICS

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

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

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

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

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

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

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

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

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

In ΔABC: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ $\quad a^2 = b^2 + c^2 - 2bc.\cos A$ $\quad \text{area } \Delta ABC = \frac{1}{2}ab.\sin C$

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

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

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

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

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

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