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FURTHER EDUCATION AND TRAINING

GRADE 12

MATHEMATICS

PRE TRIAL EXAMINATION

AUGUST 2024

MARKS: 150

TIME: 3 HOURS

This paper consists of 10 pages including a formula sheet

INSTRUCTIONS AND INFORMATION

Read the following instructions carefully before answering the questions:

1. This question paper consists of 10 questions. Answer **ALL** the questions.
2. Clearly show **ALL** the calculations, reasoning, diagrams, graphs, etc., that you have used in determining your answers.
3. An approved calculator (non-programmable and non-graphical) may be used, unless stated otherwise.
4. If necessary, answers should be rounded off to **TWO** decimal places, unless stated otherwise.
5. Number the answers **EXACTLY** as the questions are numbered.
6. Diagrams are not drawn to scale.
7. It is in your own interest to write legibly and to present the work neatly.

1.1 Solve for x , correct to TWO decimal places, where necessary:

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

1.1.2 $2x^2 + 3x - 7 = 0$ (4)

1.1.3 $2^x - 8 = 2 \cdot 2^{\frac{x}{2}}$ (4)

1.1.4 $7x^2 + 18x - 9 > 0$ (4)

1.2 Solve for x and y if

Given: $4y - x = 4$ and $xy = 8$

1.2.1 Solve for x and y simultaneously. (6)

1.2.2 Write down both lines of symmetry of the graph $xy = 8$. (2)

1.3 The solutions of a quadratic equation are given by $x = \frac{-2 \pm \sqrt{36 - 4k}}{2k}$ for which value(s) of k will this equation:

1.3.1 Have Non-real roots (2)

1.3.2 Be undefined (1)

[25]

QUESTION 2

2.1 The first term of a quadratic sequence, $T_n = n^2 + an + b$, is 9 and the term of the first difference is 11.

2.1.1 Determine the a and b , hence the general term. (3)

2.1.2 What is the value of the first term of the sequence that is greater than 240 (4)

2.2 Given the arithmetic sequence: 3; -1; -5;...-85; -89

2.2.1 Calculate the number of terms in the sequence. (3)

2.2.2 Calculate the sum of all negative terms in this sequence (3)

2.2.3 Consider the sequence: 3; -1; -5...-85; -89...; -389 (4)

Determine the number of terms in this sequence that will be exactly divisible by 3.

[17]**QUESTION 3**

The first 3 terms of a geometric series are $3 + 2 + \frac{4}{3} + \frac{8}{9} + \dots$

3.1 Explain why the series converges (1)

3.2 Calculate the sum to infinity of the series (2)

3.2 Express $s_\infty - s_n$ in the form ab^n (5)

[8]**QUESTION 4**

Consider the function $f(x) = \frac{-2x+5}{x-1}$

4.1 Show, using necessary calculations, that f can be written in the form (4)

$$f(x) = \frac{a}{x+p} + q$$

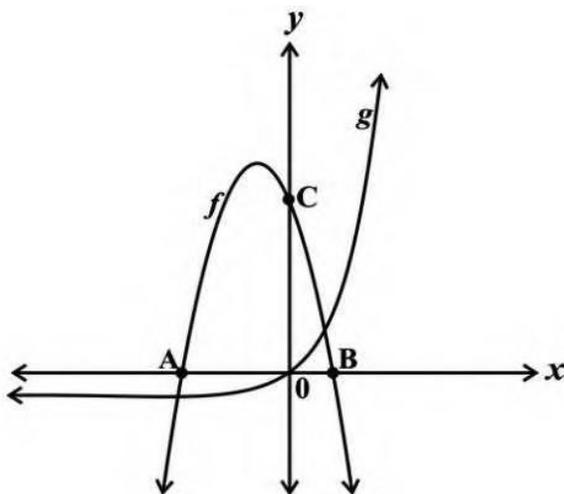
4.2 write down the equations of the asymptotes of f , If $f(x) = \frac{3}{x-1} - 2$. (2)

4.3 Calculate the intercepts of the graph of f with the axes. (3)

- 4.4 Sketch the graph of f . (3)
- 4.5 Write down the range of $y = -f(x)$. (1)
- 4.6 Describe, in words, the transformation of f to g if $g(x) = \frac{-3}{x+1} - 2$ (2)

[15]**QUESTION 5**

Sketched below is the graph of the functions $f(x) = ax^2 + bx + c$ and $g(x) = d^x + q$.
A(-3;0) and B(1;0) are the x -intercepts, and C(0;6) is the y -intercept of f . The graph of g passes through the origin and point (1;2)



- 5.1 Use the graphs to determine the values of x where $f'(x) \cdot g(x) < 0$ (4)
- 5.2 Determine d and q . (4)
- 5.3 Determine g^{-1} , the inverse of g , in the form $y = \dots$ (3)
- 5.4 State the domain of g^{-1} . (2)
- 5.5 Determine a, b and c . (4)
- 5.6 Draw the graph of f^{-1} , the inverse of f . Show the turning point and the intercepts with the axes. (4)
- 5.7 Determine the values of k for which $f(x) + k = g(x)$ has two roots that are opposite in sign. (2)

[23]

QUESTION 6

- 6.1 Alec invests a lump sum of R5000 in a savings account for exactly 2 years. The investment earns interest at 10% p.a, compounded quarterly.
- 6.1.1 What is the quarterly interest rate for Alec's investment? (1)
- 6.1.2 Calculate the amount in Alec's savings account at the end of the 2 years. (3)
- 6.2. A school issued new laptops to each of its 110 employees at the beginning of the year. The school was advised to set up a sinking fund to ensure that there would be enough money to replace them at the end of the 5th year.

The following applies:

- They paid R6000.00 for each laptop.
- The laptops depreciate at 15% p.a on reducing balance basis.
- Inflation is estimated to be 6% p.a over the 5-year period.
- A sinking fund is set up such that all payments will receive 12% interest p.a compounded monthly.

- 6.2.1 Determine the amount of money required at the end of 5 years to replace the laptops (5)
- 6.2.2 Determine the monthly payments that should be made to into the sinking fund to ensure that all 110 laptops can be replaced at the end of 5-years. (4)

[13]

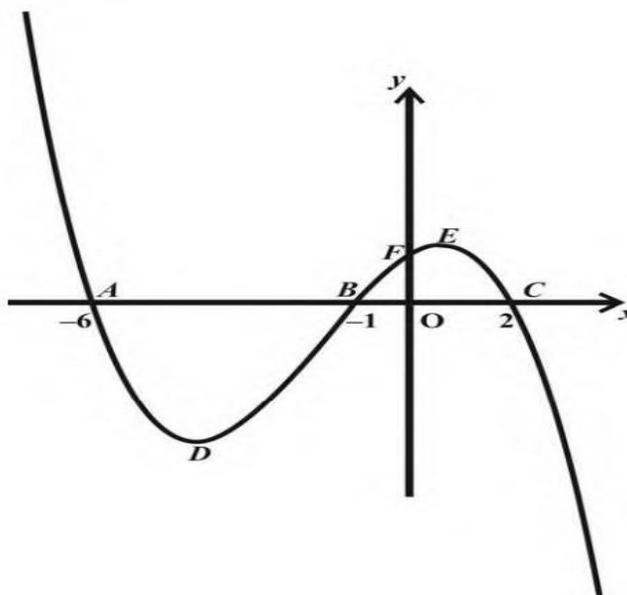
QUESTION 7

- 7.1 Differentiate f from first principle if $f(x) = 3 - 2x^2$ (5)
- 7.2 Evaluate:
- 7.2.1 $\frac{dy}{dx}$ if $y = -\frac{1}{x} + \sqrt{x}$ (3)
- 7.2.2 $D_x \left[\frac{8 - 3x^6}{8x^5} \right]$ (3)

[11]

QUESTION 8

Sketched below is a graph of a cubic function $f(x) = ax^3 + bx^2 + cx + d$. A(-6; 0), B(-1; 0), C(2; 0) and F(0; 24) are intercepts with the axes, with D and E as turning points.

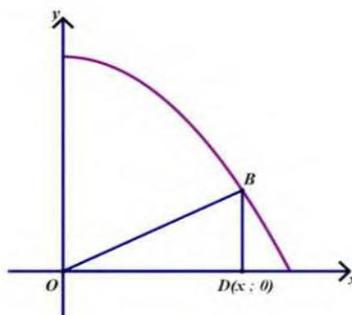


- 8.1 Show that $a = -2$, $b = -10$, $c = 16$ and $d = 24$ (5)
- 8.2 Determine the coordinates of D (4)
- 8.3 Write down the value of p and q if the graph is translated in such a way that the point D is moved to the origin. That is, the new graph has equation $y = f(x - p) + q$, where p and q are constants. (2)
- 8.4 For which values of x will $f''(x) \cdot f(x) > 0$ (3)
- 8.5 For which values k will $f(x) + k = 0$ have two negative and one positive roots. (3)

[17]

QUESTION 9

Refer to the figure showing the parabola given by $f(x) = 4 - \frac{x^2}{4}$ with $0 \leq x \leq 4$. D is the point $(x; 0)$ and DB is parallel to the y -axis, with B on the graph of f .



- 9.1 Write down the coordinates of B in terms of x . (2)
- 9.2 Show that the area, A, of $\triangle OBD$ is given by: $A = 2x - \frac{x^2}{8}$. (3)
- 9.3 Determine how far D should be from O in order that the area of $\triangle OBD$ is as large as possible. (4)

[9]**QUESTION 10**

In a survey 1530 skydivers were asked if they had broken a limb. The results of the survey were as follows:

	Broken a limb	Not broken a limb	Total
Male	463	b	782
Female	a	c	d
TOTAL	913	617	1 530

- 10.1.1 Calculate the values of a , b , c and d . (4)
- 10.1.2 Calculate the probability of choosing at random in the survey, a female skydiver who has not broken a limb. (2)

10.1.3. Determine whether the events being female and having broken a limb are independent. (3)

10.2 Given the word HAMMERHEAD.

10.2.1 How many unique ten-letter words can be formed using the letters in the word above. (3)

10.2.2 Find the probability of ten-letter words formed such that the letters R and D are next to each other. (3)

[15]

TOTAL:150

INFORMATION SHEET

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

$$A = P(1 + in)$$

$$A = P(1 - in)$$

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

$$T_n = a + (n - 1)d$$

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

$$S_n = \frac{a(r^n - 1)}{r - 1}; r \neq 1$$

$$S_\infty = \frac{a}{1 - r}; -1 < r < 1$$

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

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

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

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$M\left(\frac{x_1 + x_2}{2}; \frac{y_1 + y_2}{2}\right)$$

$$y = mx + c$$

$$y - y_1 = m(x - x_1) \quad m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \tan \theta \quad (x - a)^2 + (y - b)^2 = r^2$$

$$\text{In } \triangle ABC: \frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

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

$$\sin(\alpha + \beta) = \sin \alpha \cos \beta + \cos \alpha \sin \beta$$

$$\sin(\alpha - \beta) = \sin \alpha \cos \beta - \cos \alpha \sin \beta$$

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

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

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

$$\sin 2A = 2 \sin A \cos A \quad P(A) = \frac{n(A)}{n(S)}$$

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$\bar{x} = \frac{\sum x}{n}$$

$$\hat{y} = a + bx$$

