

SECTION A [10 MARKS]

Answer **all** questions

Question I

For each question, there are **FOUR** responses: A, B, C and D. Choose the corresponding letter of your response and **CIRCLE** it. If you change your answer, cross out the previous response clearly and circle your new answer. **NO** score will be awarded, if you circle more than **ONE** letter.

[10]

1. What is the value of $A \cap B$, if $A = \{1, 2, 3\}$ and $B = \{3, 4, 5\}$?

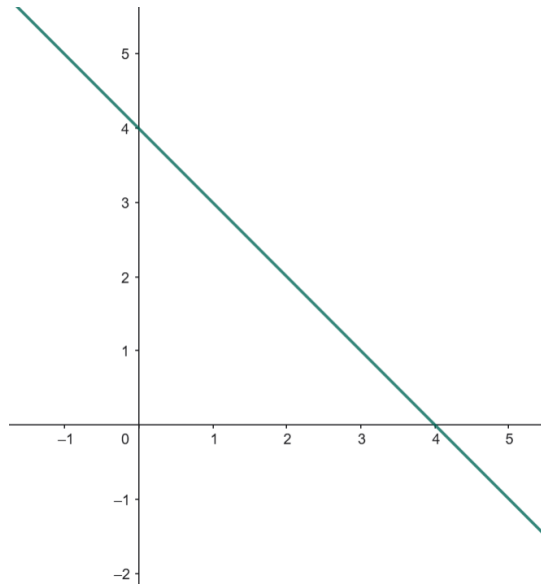
A $\{1, 2, 3, 4, 5\}$
B $\{4, 5\}$
C $\{1, 2\}$
D $\{3\}$
2. Which correctly describes the identity matrix of order 2?

A all ones.
B all zeros.
C zeros on diagonal.
D ones on diagonal, zeros elsewhere.
3. Which pattern is true for a quadratic sequence?

A A constant second difference
B A constant third difference
C A constant first difference
D No predictable pattern
4. If $M = 3^6 \times 5^a \times 11^3$, for which value of a will M be a perfect cube?

A 1
B 2
C 3
D 4

5. Why must bases be the same to apply exponent rules?
- A Exponent laws apply only when the bases in the expression are identical
 - B Different bases automatically cancel each other during simplification
 - C Bases always become equal after applying exponent operations
 - D Exponents always reduce to zero when bases are different
6. Which equation best represents the given graph?



- A $x - y - 4 = 0$
 - B $x + y - 4 = 0$
 - C $x - y + 4 = 0$
 - D $x + y + 4 = 0$
7. Consider the sequence A: 2, 5, 8, 11, 14, ...
- Which of the following follows the *same rule*?
- A 4, 7, 10, 13
 - B 2, 6, 12, 24, 48
 - C 3, 6, 12, 24, 48
 - D 5, 10, 20, 40, 80

8. A boy deposits money in a bank. The growth is shown below:

Year 1 $\rightarrow$ Nu 1000

Year 2 $\rightarrow$ Nu 1000 + interest on Nu 1000

Year 3 $\rightarrow$ Nu (previous total) + interest on new total

Which type of process is described in the situation?

- A Simple interest process
 - B Compound interest process
 - C Interest rate increases every year automatically
 - D Interest is added only at the end of the total time period
9. What is the value of $(5 \times 10^2) - 4^2 \div 2^2 + 2^{-1}$?
- A 496.0
 - B 495.5
 - C 496.5
 - D 497.5
10. A square has its side increased by 3 units, and the new area becomes 49 m². Which equation can be used to find the original side?
- A $x(x+3) = 49$
 - B $x^2 + 3 = 49$
 - C $x^2 + 49 = 3$
 - D $(x+3)^2 = 49$

SECTION B (50 MARKS)

Answer **all** questions

Question II

1. The line $y = 3x + 2$ is perpendicular to $y = -\frac{1}{3}x + 5$.

Verify whether the statement is correct. Justify your answer using gradients.

[2]

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2. A line has slope $m < 0$. Describe the direction of a straight-line graph and explain what happens to the value of y as x increases.

[2]

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3. A rectangular playground area is twice as long as it is wide. If you increase the length by 4 m and decrease the width by 3 m, the new area will be 532 m^2 . Determine the dimension of the original rectangle.

[3]

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4. Sketch the graph of function $f(x) = x^2 - 2x - 3$ and determine its x-intercepts.

[2]

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5. A school canteen sells sandwiches and juice.
Monday: 3 sandwiches and 2 juices cost Nu. 170.
Tuesday: 2 sandwiches and 3 juices cost Nu. 160.
A student claims that the price of a sandwich is Nu. 30 and a juice is Nu. 50.
Evaluate whether the student's claim is correct.
Solve the system of equations using an appropriate method and justify your answer. **[2]**

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Question III

1. Write the mapping notation for the following functions. **[1]**
a. $f(x) = 2x^2 - 0.5$

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- b. $f(x) = -3(x+1)^2 - 4$ **[1]**

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2. A function is given by

$$g(x) = 3x^2 + 2x - 7$$

The derivative $g'(x)$ represents the gradient of the tangent to the curve at any point on the graph. Explain what $g'(x)$ represents in this context and describe what $g'(1)$ tells us about the curve at $x = 1$, including what information would be needed to determine it from the graph.

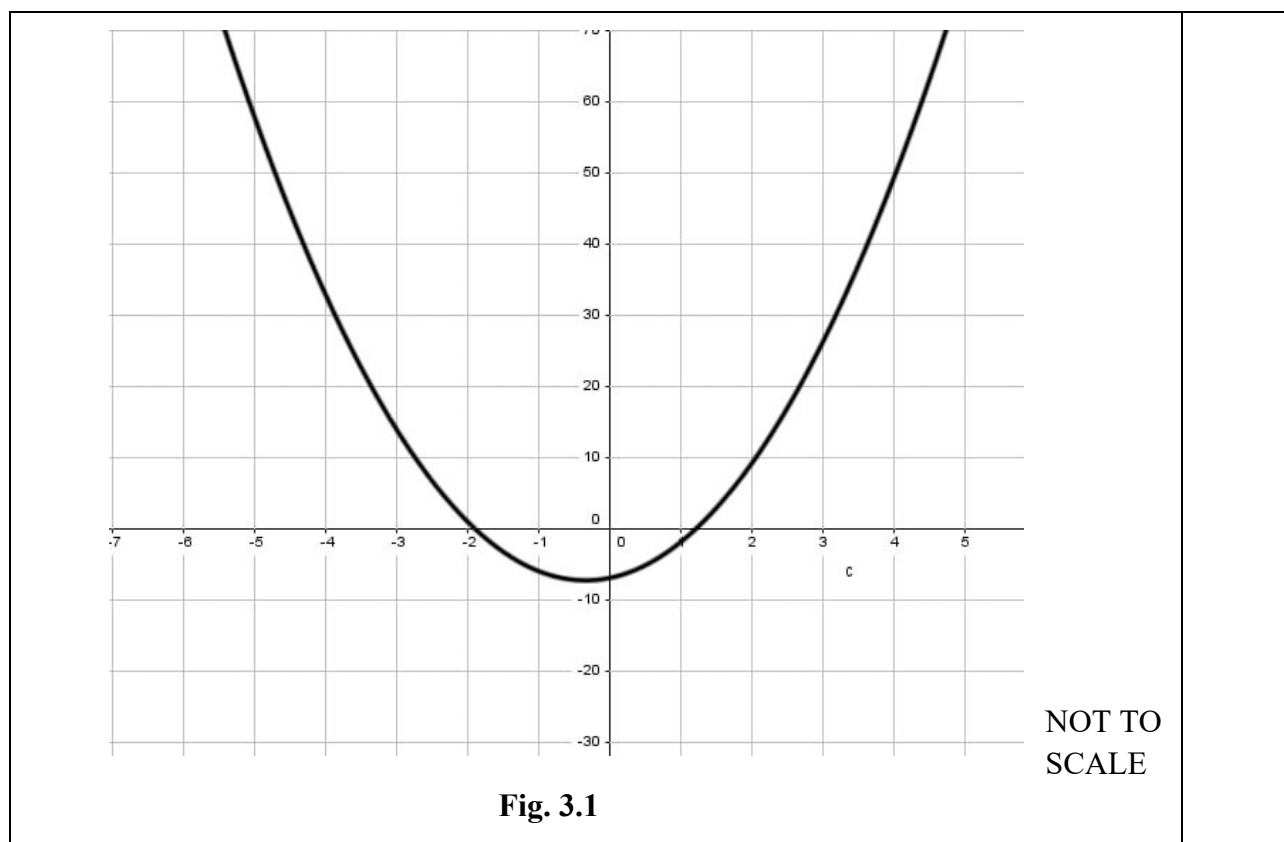
[3]

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3. Fig. 3.1 shows the curve of $g(x) = 3x^2 + 2x - 7$.

a. Draw a tangent to the curve at any point.

[1]



b. On the tangent, draw a right-angled triangle to show how the gradient is calculated.

[1]

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c. State what the gradient of the tangent at point P represents.

[1]

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4. Show that Fig. 3.2 of a function showing a turning point.

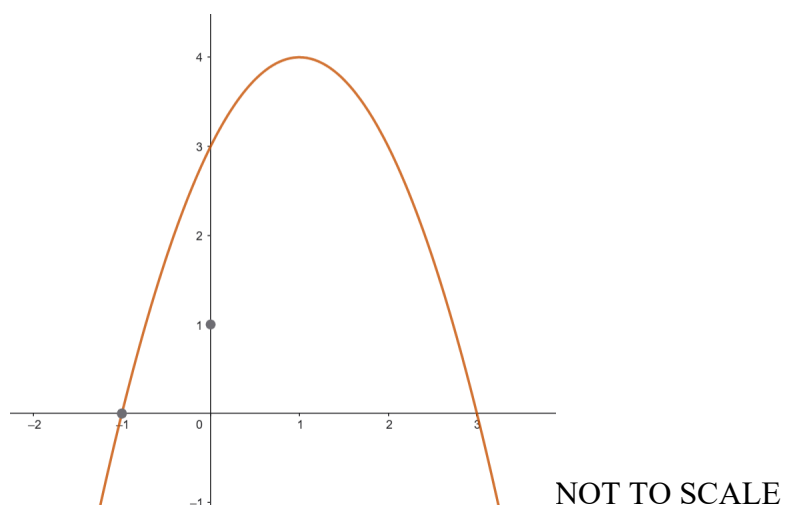


Fig. 3.2

Describe how the function behaves when x is slightly less than and slightly greater than 1. Hence, determine the nature of the turning point.

[2]

Question IV

1. Refer to the Fig. 4.1 of the inequality.

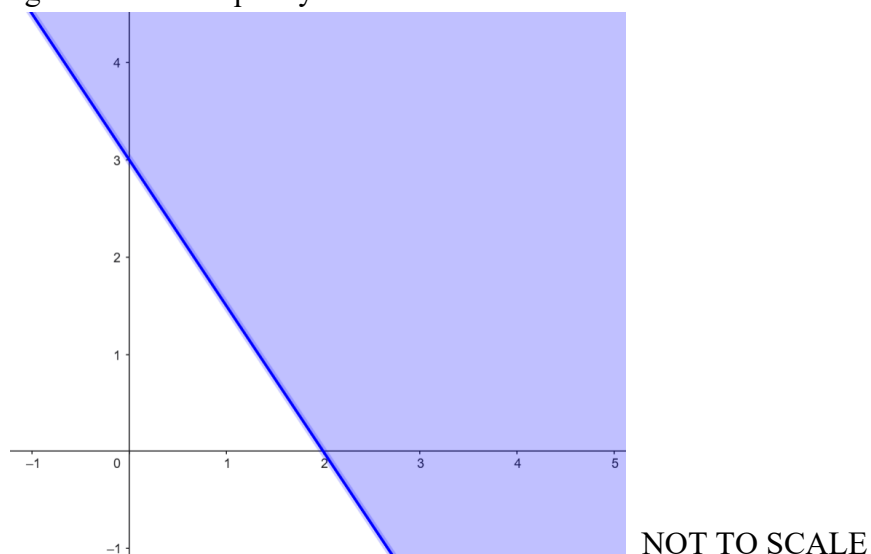


Fig. 4.1

- a. Write the inequality represented by the graph.

[1]

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- b. State whether the boundary line is included in the solution set. Give a reason.

[1]

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2. Transform the linear equation $\frac{5}{2}x - 6 = -y$ to slope and y-intercept form and sketch the graph of the resulting function. [2]

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3. The exchange rate is 1 US Dollar = 84.50 Bhutanese Ngultrum (BTN). A student exchanges 25.75 US dollars into Ngultrum. Calculate the amount in Ngultrum. Express your answer correct to two decimal places. [2]

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4. Given that

$$U = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$$

$$A = \{2, 4, 6, 8, 10\} \quad B = \{3, 6, 9\}$$

a. A student claims the set A and B are disjoint sets. Is he correct? Why?

[1]

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b. Which elements of set B should be removed to make set A and set B disjoint?

[1]

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c. Use Venn diagram to show the relationship among the three sets given.

[1]

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Question V

1. The prime factorizations of the multiples of 3 from 6 to 18 are given below:

$$6 = 2 \times 3$$

$$9 = 3^2$$

$$12 = 2^2 \times 3$$

$$15 = 3 \times 5$$

$$18 = 2 \times 3^2$$

Using the prime factors 2, 3, and 5 as columns, construct a matrix that shows how many times each prime factor appears in each number.

[2]

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2. The following adjacency matrix represents a road network between four villages A, B, C, and D.

$$\begin{bmatrix} 0 & 1 & 1 & 0 \\ 1 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{bmatrix}$$

- a. Using the given adjacency matrix, state whether Village A is directly connected to Village D.

[1]

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- b. Write down the number of direct connections village B has. [1]

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3. Given the matrices:

$$A = \begin{bmatrix} 1 & 0 \\ 1 & 0 \end{bmatrix}, B = \begin{bmatrix} 1 \\ 0 \end{bmatrix}, C = \begin{bmatrix} 1 & 2 \end{bmatrix}, D = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}, E = \begin{bmatrix} 2 & 0 \\ 0 & 3 \end{bmatrix}, F = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 0 \end{bmatrix}$$

Identify which pairs of matrices can be

- a. added or subtracted, and [1]

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- b. multiplied [1]

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4. Given a 3×3 matrix, explain why each element must have a unique position and describe what would happen if row and column positions were interchanged while locating elements. [2]

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5. Two travel networks between cities A,B,C are given:

$$\begin{array}{ccc}
 & A & B & C \\
 \begin{array}{l} A \\ P=B \\ C \end{array} & \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix} & \begin{array}{ccc}
 & A & B & C \\
 A & \begin{bmatrix} 0 & 1 & 1 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}
 \end{array}
 \end{array}$$

Evaluate which matrix allows a one-stop (two-step) trip from A to C. Justify your answer by comparing the travel routes in both matrices. [2]

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Question VI

1. Find the missing value.

$$\sqrt{36x^m} \times \sqrt{48} = 24x^7 \sqrt{3x}$$

[2]

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2. Explain how you would compare two radical expressions like $5\sqrt{2}$ and 13 without using exact calculation.

[2]

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3. A student says: “ $\sqrt{a^2} = a$ for all real numbers.”

Do you agree? Explain your answer with a suitable reason or counter example.

[2]

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4. Sangla invests Nu 20,000 for 2 years at 10% p.a. in two schemes:

Scheme A: Compounded annually

Scheme B: Compounded half-yearly.

Calculate the maturity amount for both schemes and hence analyze which scheme is more beneficial for Sangla, giving a reason for your conclusion.

[2]

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5. A company offers two investment options:

Option A: Buy shares of Company X at Nu 100 each with 8% annual dividend.

Option B: Buy shares of Company Y at Nu 80 each with 6% annual dividend.

Rita wants to invest Nu 10,000, analyze which option is better for Rita and justify your answer with reasons.

[2]

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FORMULAE

Class X

Strand A : Numbers and Operations

$$SI = prt \text{ or } \frac{PRT}{100}$$

$$A = p \left(1 + \frac{r}{n} \right)^{nt} \text{ or } p \left(1 + \frac{r}{n \times 100} \right)^{nt}$$

Strand B : Patterns and Algebra

$$f(x) = ax^2 + bx + c$$

Factorising

$$f(x) = a(x-p)(x-q)$$

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

$$f(x) = a(x-h)^2 + v$$

Derivative

$$\frac{d}{dx}(x^n) = nx^{n-1}$$

Class IX

Strand A : Numbers and Operations

$$SI = prt \text{ or } \frac{PRT}{100}$$

$$\text{Mark up} = SP - CP$$

$$\text{Mark down} = CP - SP$$

$$\text{Mark up}\% = \frac{\text{mark up}}{CP} \times 100\%$$

$$\text{Mark down}\% = \frac{\text{mark down}}{CP} \times 100\%$$

Strand B : Patterns and Algebra

$$a_n = a_1 + (n-1)d$$

$$S_n = \frac{n}{2}(2a_1 + (n-1)d)$$

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