SY-227

Reg. No.

Name : .

SECOND YEAR HIGHER SECONDARY EXAMINATION, MARCH 2026

Part – III

Time : 2 Hours

MATHEMATICS (SCIENCE)

Cool-off time : 15 Minutes

Maximum : 60 Scores

General Instructions to Candidates :

- There is a 'Cool-off time' of 15 minutes in addition to the writing time.
- Use the 'Cool-off time' to get familiar with questions and to plan your answers.
- Read questions carefully before answering.
- Read the instructions carefully.
- Calculations, figures and graphs should be shown in the answer sheet itself.
- Malayalam version of the questions is also provided.
- Give equations wherever necessary.
- Electronic devices except non-programmable calculators are not allowed in the Examination Hall.

വിദ്യാർത്ഥികൾക്കുള്ള പൊതുനിർദ്ദേശങ്ങൾ :

- നിർദ്ദിഷ്ട സമയത്തിന് പുറമെ 15 മിനിറ്റ് 'കൂൾ ഓഫ് ടൈം' ഉണ്ടായിരിക്കും.
- ചോദ്യങ്ങൾ പരിചയപ്പെടാനും ഉത്തരങ്ങൾ ആസൂത്രണം ചെയ്യാനും 'കൂൾ ഓഫ് ടൈം' ഉപയോഗിക്കുക.
- ഉത്തരങ്ങൾ എഴുതുന്നതിനു മുമ്പ് ചോദ്യങ്ങൾ ശ്രദ്ധാപൂർവം വായിക്കണം.
- നിർദ്ദേശങ്ങൾ മുഴുവനും ശ്രദ്ധാപൂർവം വായിക്കണം.
- കണക്ക് കൂട്ടലുകൾ, ചിത്രങ്ങൾ, ഗ്രാഫുകൾ, എന്നിവ ഉത്തരപേപ്പറിൽ തന്നെ ഉണ്ടായിരിക്കണം.
- ചോദ്യങ്ങൾ മലയാളത്തിലും നല്കിയിട്ടുണ്ട്.
- ആവശ്യമുള്ള സ്ഥലത്ത് സമവാക്യങ്ങൾ കൊടുക്കണം.
- പ്രോഗ്രാമുകൾ ചെയ്യാനാകാത്ത കാൽക്കുലേറ്ററുകൾ ഒഴികെയുള്ള ഒരു ഇലക്ട്രോണിക് ഉപകരണവും പരീക്ഷാഹാളിൽ ഉപയോഗിക്കുവാൻ പാടില്ല.

Questions from 1 to 8 carry 3 scores each. Answer any 6 questions. **(6 × 3 = 18)**

1. Consider the matrices $P = \begin{bmatrix} 3 & -1 & 2 \\ -2 & 1 & 4 \end{bmatrix}$, $Q = \begin{bmatrix} 4 & -2 & 1 \\ -5 & 3 & 1 \end{bmatrix}$ and $R = \begin{bmatrix} 3 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 3 \end{bmatrix}$

   (i) The order of the matrix PR is ...... **(1)**

   (ii) Show that PR = 3P **(1)**

   (iii) Find 3P + Q. **(1)**

2. Consider the relation $R = \{(x, y) : x, y \in A, x = y\}$ defined on the set $A = \{1, 2, 3, 4\}$

   (i) Show that R is an equivalence relation. **(2)**

   (ii) Hence write the equivalence classes. **(1)**

3. (i) Evaluate $\int_0^{\pi} \sin x \, dx$ **(2)**

   (ii) Hence find the area formed by the curve $y = \sin x$ between $x = 0$ and $x = 2\pi$. **(1)**

4. Let P(3, –1, 2) and Q(3, 6, 4) be two points in space.

   (i) Find the vector $\overrightarrow{PQ}$. **(1)**

   (ii) Which of the following is perpendicular to $\overrightarrow{PQ}$? **(1)**

   (a) $5\hat{j}$ (b) $\hat{i}$

   (c) $\hat{i} - \hat{j}$ (d) $\hat{j} + \hat{k}$

   (iii) Hence find the angle between vector $\overrightarrow{PQ}$ and the vector $3\hat{i} + 4\hat{j}$. **(1)**

5. (i) Find the principle value of $\cos^{-1}\left(-\frac{1}{2}\right)$. (1)

(ii) Express $\tan^{-1}\left(\frac{\cos x}{1-\sin x}\right)$ in the simplest form. (2)

6. (i) Check the continuity of the function $f(x) = \begin{cases} x^2, & x < 2 \\ 4, & x > 2 \end{cases}$ (2)

(ii) Find the $\frac{dy}{dx}$ if $y = \sqrt{\sin(2x+1)}$ (1)

7. Consider the function $f(x) = \begin{cases} x, & x \leq 2 \\ x-1, & x > 2 \end{cases}$ defined on set of natural numbers $\mathbb{N}$. Check whether $f(x)$ is one-one and onto. (3)

8. A fair coin and an unbiased die are tossed together. Let A : "Head appears on the coin" and B : "3 appears on the die" be two events. Check whether A and B are independent events. (3)

Questions from 9 to 16 carry 4 scores each. Answer any 6 questions. (6 × 4 = 24)

9. Consider the matrix $A = \begin{bmatrix} 2 & -3 & 1 \\ 4 & -2 & 1 \\ 5 & 1 & 3 \end{bmatrix}$.

(i) Find the cofactors C_{31}, C_{32}, C_{33} of the elements 5, 1, 3. (1)

(ii) Which of the following is the value of $5 \times C_{31} + 1 \times C_{32} + 3 \times C_{33}$? (1)

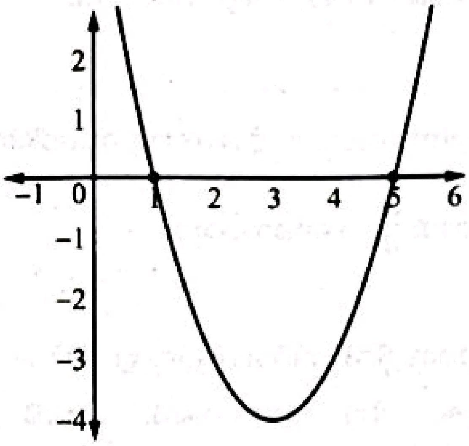
(a) 0 (b) 1

(c) $|A|$ (d) $2|A|$

(iii) Find a symmetric matrix using A. (2)

10. Find $\int \frac{3x+1}{(x-1)(x^2+1)} dx$ (4)

11. (i) Observe the graph of $f'(x)$ (derivative of the function $f(x)$) given below and answer the following questions.



(a) Write the interval in which the function $f(x)$ is decreasing. **(1)**

(b) Find the local maximum and local minimum points of the function $f(x)$. **(1)**

(ii) Find the absolute maximum and absolute minimum value of the function

$g(x) = |x| + 2$, in the interval $[-2, 4]$. **(2)**

12. (i) The length x of a rectangle is decreasing at the rate of 4 cm/s and the width y is increasing at the rate of 3 cm/s. Find the rate of change of perimeter. **(1)**

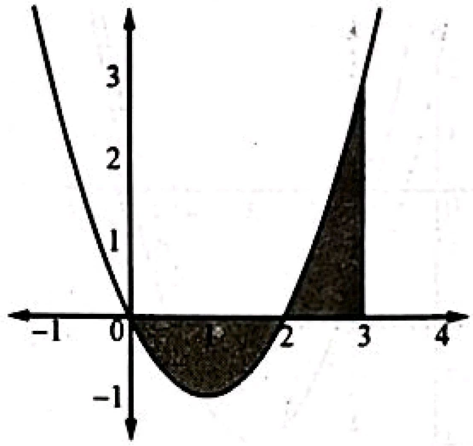
(ii) Prove that the radius of the right circular cylinder of greatest curved surface area which can be inscribed in a given cone is half of that of the cone. **(3)**

13. (i) If $A(x) = \int_0^x x^2\,dx$ is the area function, then $A'(2)$ is **(1)**

(a) 4 (b) 2

(c) 0 (d) 1

(ii) The figure given below represents the curve $y = (x-1)^2 - 1$. Find the area of the shaded region. (3)



14. (i) If a directed line has direction ratios $l = \frac{1}{2}$, $m = \frac{\sqrt{3}}{2}$, then which of the following is its direction angle with the positive direction of z-axis ? (1)

(a) 30° (b) 45°

(c) 60° (d) 90°

(ii) The adjacent sides of a parallelogram are $\vec{a} = 3\hat{i} - \hat{j} + 2\hat{k}$, $\vec{b} = 4\hat{i} + 2\hat{j} + 6\hat{k}$.

(a) Write a vector parallel to its diagonal. (1)

(b) Find the area of the parallelogram. (2)

15. Find the shortest distance between the skew lines $\frac{x+1}{3} = \frac{y-1}{2} = \frac{z-9}{1}$ and $\frac{x-2}{2} = \frac{y+1}{1} = \frac{z+1}{1}$. (4)

16. A person has undertaken a construction job. The probabilities are 0.65 that there will be strike, 0.80 that the construction job will be completed on time if there is no strike, and 0.32 that the construction job will be completed on time if there is a strike. Determine the probability that the construction job will be completed on time. (4)

Question from 17 to 20 carry 6 scores each. Answer any 3 questions. **$(3 \times 6 = 18)$**

17. Solve system of linear equations, using matrix method : **(6)**

$$x + y + 3z = 16$$

$$3x + 2y - 5z = 6$$

$$2x + y + 2z = 10$$

18. (i) Find $\frac{dy}{dx}$ if $x = a(\theta - \sin\theta)$, $y = a(1 + \sin\theta)$ **(1)**

(ii) If $e^y(x + 1) = 1$, show that $\frac{d^2y}{dx^2} = \left(\frac{dy}{dx}\right)^2$ **(2)**

(iii) Find $\int_0^{\pi} \frac{x}{1 + \sin x} dx$ **(3)**

19. Consider the linear programming problem :

Objective function : $Z = 2x + 3y$

Subject to the constraints :

$$x + 2y \leq 10,$$

$$x + y \leq 8,$$

$$x \geq 0, y \geq 0$$

(i) Mark the feasible region. **(2)**

(ii) Write the corner points. **(2)**

(iii) Find the maximum value of objective function Z. **(2)**

20. (i) Solve the differential equation $\frac{dy}{dx} = xy$. **(3)**

(ii) Find the equation of a curve passing through (1, 2), given that the slope of the tangent to the curve at any point (x, y) is $\frac{x}{y^2}$. **(3)**
