Reg. No. : ....

Name : ....

SY 627

SECOND YEAR HIGHER SECONDARY MODEL EXAMINATION, FEBRUARY 2025
Part – III
MATHEMATICS (SCIENCE)
Maximum : 60 Scores

Time : 2 Hours
Cool-off Time : 15 Minutes

General Instructions to Candidates :

- *There is a 'Cool off time' of 15 minutes in addition to the writing time.*
- *Use 'cool off time' to get familiar with questions and to plan your answers.*
- *Read questions carefully before answering.*
- *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 മിനിട്ട് 'കൂൾ ഓഫ് ടൈം' ഉണ്ടായിരിക്കും.
- 'കൂൾ ഓഫ് ടൈം' ചോദ്യങ്ങൾ പരിചയപ്പെടാനും ഉത്തരങ്ങൾ ആസൂത്രണം ചെയ്യാനും ഉപയോഗിക്കുക.
- ഉത്തരങ്ങൾ എഴുതുന്നതിന് മുമ്പ് ചോദ്യങ്ങൾ ശ്രദ്ധാപൂർവ്വം വായിക്കണം.
- കണക്ക് കൂട്ടലുകൾ, ചിത്രങ്ങൾ, ഗ്രാഫുകൾ, എന്നിവ ഉത്തരപേപ്പറിൽ തന്നെ ഉണ്ടായിരിക്കണം.
- ചോദ്യങ്ങൾ മലയാളത്തിലും നൽകിയിട്ടുണ്ട്.
- ആവശ്യമുള്ള സ്ഥലത്ത് സമവാക്യങ്ങൾ കൊടുക്കണം.
- പ്രോഗ്രാമുകൾ ചെയ്യാനാകാത്ത കാൽക്കുലേറ്ററുകൾ ഒഴികെയുള്ള ഒരു ഇലക്ട്രോണിക് ഉപകരണവും പരീക്ഷാഹാളിൽ ഉപയോഗിക്കുവാൻ പാടില്ല.

Score

Answer any 6 questions from 1 to 8. Each carries 3 scores. **(6×3=18)**

1. If $A = \{1, 2, 3, 4\}$ and R is a relation defined on A as

$R = \{(1, 2), (2, 2), (1, 1), (4, 4), (1, 3), (3, 3), (3, 2)\}$

i) Write the domain and range. **(1)**

ii) Is R is an equivalence relation ? Justify. **(2)**

2. i) The principal value of $\sin^{-1}\left(\frac{1}{\sqrt{2}}\right)$ is

A) $\frac{\pi}{4}$

B) $\frac{\pi}{2}$

C) π

D) $\frac{\pi}{6}$ **(1)**

ii) Prove that $2\sin^{-1}(x) = \sin^{-1}\left(2x\sqrt{1-x^2}\right), -\frac{1}{\sqrt{2}} \le x \le \frac{1}{\sqrt{2}}$. **(2)**

3. i) If a matrix has 7 elements, then what is the possible order of that matrix in the following ?

A) 7×2

B) 7×7

C) 2×7

D) 7×1 **(1)**

ii) Construct a 2×2 matrix $A = \left[a_{ij}\right]$ whose elements are given by $a_{ij} = \frac{(i+j)^2}{2}$. **(2)**

Score

4. i) $\frac{d}{dx}\left(2^x\right) =$ (1)

ii) If sinx + cosy = xy, find $\frac{dy}{dx}$. (2)

5. Find the absolute maximum and absolute minimum values of the function

$f(x) = 2x^2 - 8x + 5$ in [1, 5]. (3)

6. Evaluate $\int_0^{\frac{\pi}{2}} \frac{\sqrt{\sin x}}{\sqrt{\sin x}+\sqrt{\cos x}}\,dx$. (3)

7. If $\bar{a} = 2\hat{i}+3\hat{j}+2\hat{k}$ and $\bar{b} = \hat{i}+2\hat{j}+\hat{k}$, then find

i) $\bar{a}+\vec{b}$ (1)

ii) Projection of $\bar{a}$ on $\bar{b}$. (2)

8. A fair die is thrown twice. A and B are two events obtained as follows

A : 4 appeared at least once

B : Sum is 5

Find :

i) P(A) (1)

ii) P(B) (1)

iii) P(A/B) (1)

Score

Answer any 6 questions from 9 to 16. Each carries 4 scores. (6×4=24)

9. i) Show that the function $f : \mathbb{R} \to \mathbb{R}$ given by $f(x) = x^3$ is injective. (2)

ii) Let A and B are two sets and $f : A \times B \to B \times A$ defined as $f(a, b) = (b, a)$. Show that f is one-one and onto. (2)

10. Express the matrix $A = \begin{bmatrix} 3 & 3 & -1 \\ -2 & -2 & 1 \\ -4 & -5 & 2 \end{bmatrix}$ as the sum of a symmetric and skew symmetric matrices. (4)

11. i) The function $f(x) = \log x$ is __________

A) Increasing function

B) Decreasing function

C) Neither increasing nor decreasing function

D) None of these (1)

ii) A circular disc of radius 3 cm is being heated. Due to expansion its radius increases at the rate of 0.05 cm/sec. Find the rate at which its area is increasing when radius is 3.2 cm. (3)

12. i) Using integration, find the area of the region bounded by the ellipse $\frac{x^2}{25} + \frac{y^2}{16} = 1$. (3)

ii) Deduce the area of the circle $x^2 + y^2 = 25$. (1)

13. $\bar{a}$ and $\bar{b}$ are any two unit vectors and θ is angle between them. Find θ, if $\bar{a} + \bar{b}$ is a unit vector. (4)

Score

14. Find the shortest distance between two skew lines

$\vec{r} = \hat{i} + 2\hat{j} + \hat{k} + \lambda(\hat{i} - \hat{j} + \hat{k})$ and $\vec{r} = 2\hat{i} - \hat{j} - \hat{k} + \mu(2\hat{i} + \hat{j} + 2\hat{k})$. **(4)**

15. Bag I contains 3 red balls and 4 black balls. Bag II contains 5 red and 6 black balls. One ball is drawn at random from one of the bags and it is found to be black. Find the probability that it was drawn from Bag I. **(4)**

16. i) Write the order and degree of the differential equation

$$\left(\frac{d^3s}{dt^3}\right)^2 + \left(\frac{d^2s}{dt^2}\right)^3 + \left(\frac{ds}{dt}\right)^4 + s^5 = 0.$$ **(2)**

ii) Find the general solution of the differential equation $\frac{dy}{dx} = \frac{1+y^2}{1+x^2}$. **(2)**

Answer any 3 questions from 17 to 20. Each carries 6 scores. **(3×6=18)**

17. Consider the following system of equation.

$3x - 2y + 3z = 8$

$2x + y - z = 1$

$4x - 3y + 2z = 4$

i) Write the matrix form $AX = B$. **(1)**

ii) Find A^{-1}. **(2)**

iii) Solve the system by matrix method. **(3)**

Score

18. i) Prove that the function $f(x) = x - |x|$ is continuous at $x = 0$ in $\mathbb{R}$. (2)

ii) If $x = at^2$, $y = 2at$, then find $\frac{d^2y}{dx^2}$. (2)

iii) Find $\frac{dy}{dx}$, where $y = x^{\sin x}$. (2)

19. Integrate :

i) $\int \frac{1}{1+\frac{x^2}{4}} dx$ (2)

ii) $\int \frac{1}{(x-1)(x-2)} dx$ (2)

iii) $\int_0^{\frac{\pi}{2}} x \cos x \, dx$ (2)

20. Solve the following LPP graphically.

Maximise : $Z = 4x + y$

Subject to the constraints :

$x + y \leq 50$

$3x + y \leq 90;$

$x \geq 0, y \geq 0.$ (6)