MH Board Class 12 MATHEMATICS and STATISTICS 2025 Question Paper

Time Allowed : 3 Hours	Maximum Marks : 80	Total questions : 35

General Instructions

Important instructions ::

(1) Each activity has to be answered in a full sentence/s. One word answers will not be given complete credit. Just the correct activity number written in case of options will not be given credit.

(2) Web diagrams, flow charts, tables, etc. are to be presented exactly as they are with answers.

(3) In point 2 above, just words without the presentation of the activity format, will not be given credit. Use of colour pencils/pens etc. is not allowed. (Only blue/black pens are allowed.)

(4) Multiple answers to the same activity will be treated as wrong and will not be given any credit.

(5) Maintain the sequence of the Sections/Question Nos./Activities throughout the activity sheet.

Q. 1. Select and write the correct answer of the following multiple choice type questions:

(i) If $A = \{1, 2, 3, 4, 5\}$, then which of the following is not true?

(i) $\exists x \in A$ such that $x + 3 = 8$

(ii) $\exists x \in A$ such that $x + 2 < 9$

(iii) $\forall x \in A, x + 6 \geq 9$

(iv) $\exists x \in A$ such that $x + 6 < 10$

Q. ii. In $\triangle ABC$, $(a + b) \cdot \cos C + (b + c) \cdot \cos A + (c + a) \cdot \cos B$ is equal to ....

(i) $a - b + c$

(ii) $a + b - c$

(iii) $a + b + c$

(iv) $a - b - c$

Q. iii. If $|\vec{a}| = 5$, $|\vec{b}| = 13$, and $|\vec{a} \times \vec{b}| = 25$, then $|\vec{a} \cdot \vec{b}|$ is equal to ....

(i) 30

(ii) 60

(iii) 40

(iv) 45

Q. (iv) . The vector equation of the line passing through the point having position vector $4\hat{i} - \hat{j} + 2\hat{k}$ and parallel to vector $-2\hat{i} - \hat{j} + \hat{k}$ is given by ....

(i) $(4\hat{i} - \hat{j} + 2\hat{k}) + \lambda(-2\hat{i} - \hat{j} + \hat{k})$

(ii) $(4\hat{i} - \hat{j} + 2\hat{k}) + \lambda(2\hat{i} - \hat{j} + \hat{k})$

(iii) $(4\hat{i} - \hat{j} + 2\hat{k}) + \lambda(-2\hat{i} - \hat{j} - \hat{k})$

(iv) $(4\hat{i} - \hat{j} + 2\hat{k}) + \lambda(-2\hat{i} - \hat{j} + \hat{k})$

Q. v. Let $f(1) = 3$, $f'(1) = -\frac{1}{3}$, $g(1) = -4$, and $g'(1) = -\frac{8}{3}$. The derivative of $\sqrt{[f(x)]^2 + [g(x)]^2}$ w.r.t. x at $x = 1$ is ....

(i) $\frac{-29}{25}$

(ii) $\frac{7}{3}$

(iii) $\frac{31}{15}$

(iv) $\frac{29}{15}$

Q. vi. If the mean and variance of a binomial distribution are 18 and 12 respectively, then n is equal to ....

(i) 36

(ii) 54

(iii) 16

(iv) 27

Q. (vii). The value of $\int x^x(1 + \log x)\, dx$ is equal to ....

(i) $\frac{1}{2}(1 + \log x)^2 + c$

(ii) $x^{2x} + c$

(iii) $x^x \cdot \log x + c$

(iv) $x^x + c$

Q. viii. The area bounded by the line $y = x$, X-axis and the lines $x = -1$ and $x = 4$ is equal to .... (in square units).

(i) $\frac{2}{17}$

(ii) 8

(iii) $\frac{17}{2}$

(iv) $\frac{1}{2}$

Q. 2. Answer the following questions:

(i) Write the negation of the statement: $\exists n \in \mathbb{N}$ such that $n + 8 > 11$.

Q. ii. Write the unit vector in the opposite direction to $\vec{u} = 8\hat{i} + 3\hat{j} - \hat{k}$.

Q. iii. Write the order of the differential equation

$$\sqrt{1 + \left(\frac{dy}{dx}\right)^2} = \left(\frac{d^2y}{dx^2}\right)^{\frac{3}{2}}.$$

Q. iv. Write the condition for the function $f(x)$, to be strictly increasing, for all $x \in \mathbb{R}$.

Q. 3. Using truth table, prove that the statement patterns $p \leftrightarrow q$ and $(p \wedge q) \vee (\sim p \wedge \sim q)$ are logically equivalent.

Q. 4. Find the adjoint of the matrix $\begin{bmatrix} 2 & -2 \\ 4 & 3 \end{bmatrix}$.

Q. 5. Find the general solution of $\tan^2 \theta = 1$.

Q. 6. Find the coordinates of the points of intersection of the lines represented by $x^2 - y^2 - 2x + 1 = 0$.

Q. 7. A line makes angles of measure $45°$ and $60°$ with the positive directions of the Y and Z axes respectively. Find the angle made by the line with the positive direction of the X-axis.

Q. 8. Find the vector equation of the plane passing through the point having position vector $2\hat{i} + 3\hat{j} + 4\hat{k}$ and perpendicular to the vector $2\hat{i} + \hat{j} - 2\hat{k}$.

Q. 9. Divide the number 20 into two parts such that the sum of their squares is minimum.

Q. 10. Evaluate: $\int x^9 \cdot \sec^2(x^{10})\, dx$.

Q. 11. Evaluate: $\int \frac{1}{25-9x^2}\, dx$

Q. 12. Evaluate: $\int_{\frac{\pi}{4}}^{\frac{\pi}{2}} \frac{1}{1-\sin x}\, dx$

Q. 13. Find the area of the region bounded by the parabola $y^2 = 16x$ and its latus rectum.

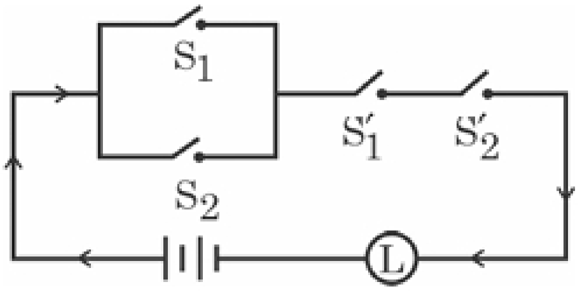
Q. 14. Suppose that X is the waiting time in minutes for a bus and its p.d.f. is given by:

$$f(x) = \frac{1}{5}, \quad \text{for } 0 \leq x \leq 5, \quad \text{and} \quad f(x) = 0, \quad \text{otherwise.}$$

Find the probability that:

(i) waiting time is between 1 to 3 minutes. (ii) waiting time is more than 4 minutes.

Q. 15. Express the following switching circuit in the symbolic form of logic. Construct the switching table and interpret it.



Q. 16. Prove that: $2\tan^{-1}\left(\frac{1}{3}\right) + \cos^{-1}\left(\frac{3}{5}\right) = \frac{\pi}{2}$.

Q. 17. In $\triangle ABC$, if $a = 13$, $b = 14$, and $c = 15$, then find the values of:

(i) $\sec A$

(ii) $\csc \frac{A}{2}$

Q. 18. A line passes through the points $(6, -7, -1)$ and $(2, -3, 1)$. Find the direction ratios and the direction cosines of the line. Show that the line does not pass through the origin.

Q. 19. Find the cartesian and vector equations of the line passing through $A(1, 2, 3)$ and having direction ratios $2, 3, 7$.

Q. 20. Find the vector equation of the plane passing through points $A(1, 1, 2)$, $B(0, 2, 3)$, and $C(4, 5, 6)$.

Q. 21. Find the nth order derivative of $\log x$.

Q. 22. The displacement of a particle at time t is given by $s = 2t^3 - 5t^2 + 4t - 3$. Find the velocity and displacement at the time when the acceleration is $14\,\text{ft/sec}^2$.

Q. 23. Find the equations of the tangent and normal to the curve $y = 2x^3 - x^2 + 2$ at the point $\left(\frac{1}{2}, 2\right)$.

Q. 24. Three coins are tossed simultaneously, X is the number of heads. Find the expected value and variance of X.

Q. 25. Solve the differential equation: $x\frac{dy}{dx} = x \cdot \tan\left(\frac{y}{x}\right) + y$.

Q. 26. Five cards are drawn successively with replacement from a well-shuffled deck of 52 cards. Find the probability that:

(i) all the five cards are spades.

(ii) none is spade.

Q. 27. Find the inverse of the matrix

$$\begin{pmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

by elementary row transformations.

Q. 28. Prove that the homogeneous equation of degree two in x and y, $ax^2 + 2hxy + by^2 = 0$, represents a pair of lines passing through the origin if $h^2 - ab \geq 0$. Hence, show that the equation $x^2 + y^2 = 0$ does not represent a pair of lines.

Q. 29. Let $\vec{a}$ and $\vec{b}$ be non-collinear vectors. If vector $\vec{r}$ is coplanar with $\vec{a}$ and $\vec{b}$, then show that there exist unique scalars t_1 and t_2 such that $\vec{r} = t_1\vec{a} + t_2\vec{b}$. For $\vec{r} = 2\hat{i} + 7\hat{j} + 9\hat{k}$, $\vec{a} = \hat{i} + 2\hat{j}$, $\vec{b} = \hat{j} + 3\hat{k}$, find t_1, t_2.

Q. 30. Solve the linear programming problem graphically. Maximize: $z = 3x + 5y$ Subject to:

$$x + 4y \leq 24, \quad 3x + y \leq 21, \quad x + y \leq 9, \quad x \geq 0, \quad y \geq 0$$

Also, find the maximum value of z.

Q. 31. If $x = f(t)$ and $y = g(t)$ are differentiable functions of t so that y is a function of x and if $\frac{dx}{dt} \neq 0$, then prove that

$$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}}.$$

Hence, find the derivative of 7^x with respect to x^7.

Q. 32. Evaluate:

$$\int \sin^{-1} x \left(\frac{x + \sqrt{1 - x^2}}{\sqrt{1 - x^2}} \right) dx$$

Q. 33. Prove that:

$$\int_a^b f(x)\, dx = \int_a^b f(a + b - x)\, dx$$

Hence, evaluate:

$$\int_0^3 \frac{\sqrt{x}}{\sqrt{x + \sqrt{3 - x}}}\, dx$$

Q. 34. If a body cools from 80°C to 50°C at room temperature of 25°C in 30 minutes, find the temperature of the body after 1 hour.
