Mathematics and Statistics (Arts and Science)

HSC Board Exam February–March 2027 – Practice Paper

Practice Question Paper

Time: 3 hours **Max. Marks: 80**

(1) The question paper is divided into FOUR sections.
(2) Section A: Q.1 contains EIGHT multiple choice type questions, each carrying TWO marks. Q.2 contains FOUR very short answer type questions, each carrying ONE mark.
(3) Section B: Q.3 to Q.14 contain TWELVE short answer type questions, each carrying TWO marks. Attempt any EIGHT.
(4) Section C: Q.15 to Q.26 contain TWELVE short answer type questions, each carrying THREE marks. Attempt any EIGHT.
(5) Section D: Q.27 to Q.34 contain EIGHT long answer type questions, each carrying FOUR marks. Attempt any FIVE.
(6) Use of log table is allowed. Use of calculator is not allowed.
(7) Figures to the right indicate full marks.
(8) Use of graph paper is not necessary. Only a rough sketch of the graph is expected.
(9) For each MCQ, write the correct answer along with its alphabet, e.g. (a) ..... / (b) ..... etc. Only the first attempt of each MCQ will be evaluated.
(10) Start the answer to each section on a new page.

SECTION A – Q.1 Select and write the correct answer for the following multiple choice type of questions. **[16]**

(i) The negation of the statement pattern $(p \wedge \sim q) \rightarrow r$ is .....

(a) $(p \wedge \sim q) \wedge \sim r$ (b) $(\sim p \vee q) \wedge \sim r$
(c) $(p \wedge \sim q) \vee r$ (d) $\sim p \vee q \vee r$

(ii) If $A = \begin{bmatrix} 4 & 3 \\ 2 & 5 \end{bmatrix}$ and $A \cdot (\text{adj } A) = kI$, where I is the identity matrix of order 2, then k = ...

(a) 14 (b) 26
(c) −14 (d) 196

(iii) The principal value of $\sin^{-1}(-\sqrt{3}/2) + \cot^{-1}(-1/\sqrt{3})$ is .....

(a) $-2\pi/3$ (b) $\pi/3$
(c) $-\pi/3$ (d) π

(iv) The acute angle between the lines represented by $3x^2 - 7xy + 2y^2 = 0$ is .....

(a) 30° (b) 45°
(c) 60° (d) 90°

(v) If $|\bar{a}| = 3$, $|\bar{b}| = 4$ and $\bar{a} \cdot \bar{b} = 6$, then $|\bar{a} \times \bar{b}|$ = ...

(a) 6 (b) $6\sqrt{3}$
(c) 12 (d) $2\sqrt{3}$

(vi) If $y = \log[e^x/(1 + e^x)]$, then dy/dx = ...

(a) $e^x/(1 + e^x)$ (b) $1/(1 + e^x)$
(c) 1 (d) $-1/(1 + e^x)$

(vii) $\int_{-2}^{2} (x^3 \cos x + 4)\, dx$ = ...

(a) 0 (b) 8

(c) 16 (d) 4

(viii) For a binomial distribution X ~ B(n, p), the mean is 9 and the variance is 6.3. Then n = ...

(a) 15 (b) 20

(c) 25 (d) 30

Q.2 Answer the following questions. **[4]**

(i) Write the truth value of the statement: "If 5 is an even number, then 9 is a prime number."

(ii) Find the distance of the point (1, 2, −3) from the plane $2x + y - 2z + 4 = 0$.

(iii) Evaluate: $\int (\sin x + \cos x)^2\, dx$

(iv) The p.d.f. of a continuous random variable X is $f(x) = kx^2$ for $0 \le x \le 3$, and $f(x) = 0$ otherwise. Find k.

SECTION B Attempt any EIGHT of the following questions (Q.3 to Q.14, 2 marks each). **[16]**

Q.3 Without using a truth table, show that $\sim[p \vee (\sim p \wedge q)] \equiv \sim p \wedge \sim q$.

Q.4 Find the inverse of $A = \begin{bmatrix} 3 & -2 \\ 4 & -1 \end{bmatrix}$ by the adjoint method.

Q.5 Find the general solution of $2\sin^2\theta + 5\cos\theta - 4 = 0$.

Q.6 Find the joint equation of the pair of lines through the origin which are perpendicular to the lines $5x - 2y = 0$ and $x + 3y = 0$.

Q.7 Find a unit vector perpendicular to both $\bar{a} = \hat{i} + 2\hat{j} - \hat{k}$ and $\bar{b} = 2\hat{i} - \hat{j} + 3\hat{k}$.

Q.8 Find the angle between the planes $2x - y + z = 6$ and $x + y + 2z = 7$.

Q.9 If $y = \tan^{-1}[4x / (1 - 4x^2)]$, where $|x| < 1/2$, find dy/dx.

Q.10 Complete the following activity to find the approximate value of $\sqrt{81.36}$.

Activity: Let $f(x) = \sqrt{x}$, $a = 81$, $h =$ ☐

$f'(x) =$ ☐

$f(a) = \sqrt{81} = 9$ and $f'(a) =$ ☐

$f(a + h) \approx f(a) + h \cdot f'(a)$

$\therefore \sqrt{81.36} \approx 9 + 0.36 \times$ ☐ $=$ ☐

Q.11 Evaluate: $\int x \cos 4x\, dx$

Q.12 Evaluate: $\int_0^{\pi/4} \sec^2 x / (3 + \tan x)\, dx$

Q.13 Obtain the differential equation by eliminating the arbitrary constants A and B from $y = Ae^{3x} + Be^{-2x}$.

Q.14 The probability distribution of a discrete random variable X is:

x	1	2	3
P(X = x)	0.2	0.5	0.3

Find E(X) and Var(X).

SECTION C Attempt any EIGHT of the following questions (Q.15 to Q.26, 3 marks each). **[24]**

Q.15 Using a truth table, prove that $\sim p \to (q \to r) \equiv (q \wedge \sim r) \to p$.

Q.16 Complete the following activity to solve the equations $2x + 3y = 13$ and $3x - 2y = 0$ by the method of inversion.

Activity: The equations can be written as $AX = B$, where $A = \begin{bmatrix} 2 & 3 \\ 3 & -2 \end{bmatrix}$, $X = \begin{bmatrix} x \\ y \end{bmatrix}$ and $B = \begin{bmatrix} 13 \\ 0 \end{bmatrix}$

$|A| = \square \neq 0$, so A^{-1} exists.

adj $A = \begin{bmatrix} \square & -3 \\ -3 & \square \end{bmatrix}$

$A^{-1} = (1/|A|)$ adj $A = (-1/13)$ adj A

(adj $A)B = \begin{bmatrix} \square \\ \square \end{bmatrix}$

$X = A^{-1}B = (-1/13)$(adj $A)B$

$\therefore x = \square$, $y = \square$

Q.17 Show that $\sin^{-1}(5/13) + \tan^{-1}(7/17) = \pi/4$.

Q.18 Show that the equation $2x^2 + 3xy - 2y^2 + x + 7y - 3 = 0$ represents a pair of straight lines. Also find the angle between them.

Q.19 Find λ if the points A(3, 2, 1), B(4, λ, 5), C(4, 2, −2) and D(6, 5, −1) are coplanar.

Q.20 Find the shortest distance between the lines
$\bar{r} = (\hat{i} + 2\hat{j} + \hat{k}) + \lambda(\hat{i} - \hat{j} + \hat{k})$ and $\bar{r} = (2\hat{i} - \hat{j} - \hat{k}) + \mu(2\hat{i} + \hat{j} + 2\hat{k})$.

Q.21 A small workshop makes desk lamps and wall lamps. A desk lamp needs 2 hours of assembly and 1 hour of finishing; a wall lamp needs 1 hour of assembly and 1 hour of finishing. In a week, at most 40 hours of assembly and 30 hours of finishing are available. The profit is ₹40 on a desk lamp and ₹30 on a wall lamp. Formulate the problem as an L.P.P. to maximise the profit.

Q.22 If $y = e^{2x} \sin x$, show that $d^2y/dx^2 - 4\,dy/dx + 5y = 0$.

Q.23 Find the intervals in which $f(x) = 2x^3 - 21x^2 + 60x + 5$ is (a) increasing (b) decreasing.

Q.24 Complete the following activity to evaluate $\int e^x (x^2 + 5x + 5)/(x + 5)^2\,dx$.

Activity: $(x^2 + 5x + 5)/(x + 5)^2 = x(x + 5)/(x + 5)^2 + 5/(x + 5)^2 = x/(x + 5) + \square$

Let $f(x) = \square$, then $f'(x) = 5/(x + 5)^2$

$I = \int e^x[f(x) + f'(x)]\,dx = \square + c$

$\therefore I = \square + c$

Q.25 Find the area of the region bounded by the parabola $y = x^2$ and the line $y = 2x + 3$.

Q.26 Solve the differential equation $dy/dx + 3y/x = x$.

SECTION D Attempt any FIVE of the following questions (Q.27 to Q.34, 4 marks each). **[20]**

Q.27 Solve the following equations by the method of reduction:
$x + y + z = 4$, $2x - y + z = 8$, $x + 3y - 2z = -7$

Q.28 Solve the following L.P.P. graphically:
Maximise $z = 3x + 4y$ subject to $2x + y \leq 16$, $x + 2y \leq 14$, $x \geq 0$, $y \geq 0$.

Q.29 Find the vector and Cartesian equations of the plane passing through the points A(1, 2, 0), B(2, 0, 1) and C(0, 1, 3).

Q.30 An open box is to be made from a rectangular sheet of tin 30 cm × 14 cm by cutting equal squares from the four corners and folding up the sides. Find the side of the square to be cut off so that the volume of the box is maximum. Also find the maximum volume.

Q.31 Complete the following activity to evaluate $I = \int_2^6 \sqrt{(x+1)} / (\sqrt{(x+1)} + \sqrt{(9-x)})\, dx$.

Activity: Using $\int_a^b f(x)\, dx = \int_a^b f(a+b-x)\, dx$, with $a + b =$ ☐,

$I = \int_2^6 \sqrt{(\square)} / (\sqrt{(9-x)} + \sqrt{(x+1)})\, dx$ ...(2)

Adding I and (2): $2I = \int_2^6 \square\, dx = [x]_2^6 =$ ☐

$\therefore I =$ ☐

Q.32 Evaluate: $\int x^2 / [(x^2+1)(x^2+9)]\, dx$

Q.33 The number of bacteria in a culture increases at a rate proportional to the number present. There are 800 bacteria at the start and 1200 after 3 hours. How many bacteria will there be after 9 hours?

Q.34 A test has 6 multiple choice questions, each with 4 alternatives of which exactly one is correct. A student guesses the answer to every question. Find the probability that the student gets (a) exactly 2 answers correct (b) at least one answer correct.

All the best for your exam!