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FOR PUNJAB CLASS 12 PREPARATION

PSEB 12th Sample Paper 2027 Mathematics

EXAM	YEAR	TYPE	SUBJECT
Punjab Class 12	2027	Sample Paper	Maths

Sample Question Paper
Mathematics

Time Allowed: 3 Hours **Class XII** **Maximum Marks: 80**

Instructions:

1) All questions are compulsory.
2) Question paper consists of 18 questions divided into 4 sections A, B, C and D.
3) Section A comprises of 1 question of 20 multiple choice type questions of 1 mark each.
4) Section B comprises of 7 questions of 2 marks each.
5) Section C comprises of 7 questions of 4 marks each.
6) Section D comprises of 3 questions of 6 marks each.
7) An internal choice is provided in 3 questions of Section C and D each. You have to attempt only one of the alternatives in all such cases.
8) Use of calculator is not allowed.

Part-A **Marks**

Q.1 Choose the correct options in the following questions:

(i) A relation R on the set $A = \{1, 2, 3\}$ defined as $R = \{(1, 1), (2, 2), (1, 2), (2,1)\}$ is: 1

(a) Reflexive and symmetric but not transitive
(b) Symmetric and transitive but not reflexive
(c) Reflexive and transitive but not symmetric
(d) An equivalence relation

(ii) Let $f: [0, \pi] \to [-1,1]$ be defined by $f(x) = \sin x$. Then f is: 1

(a) One-one but not onto
(b) Many-one onto
(c) Bijective
(d) Neither one-one nor onto

(iii) Which one of the following inverse trigonometric functions has principal value range $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right] - \{0\}$? 1

(a) tan^{-1} (b) sin^{-1} (c) sec^{-1} (d) $cosec^{-1}$

(iv) If $A = \begin{bmatrix} 2 & -3 & 0 \\ -5 & 4 & -1 \end{bmatrix}$ and $B = \begin{bmatrix} 2 \\ 3 \end{bmatrix}$ then the order of $A'B$ is: 1

(a) 3×1 (b) 1×3 (c) 2×2 (d) 3×2

(v) If A is a square matrix of order 3×3 such that $|A| = 4$, then the value of $|2A|$ is: 1

(a) 8 (b) 16 (c) 32 (d) 64

(vi) Let $A = [a_{ij}]_{n \times n}$ be a square matrix. Which of the following statements correctly describes the conditions for A to be classified as a diagonal matrix? 1

(a) $a_{ij} = 0$ for all $i = j$
(b) $a_{ij} = 0$ for all $i \neq j$
(c) $a_{ij} = 1$ for all $i = j$, and $a_{ij} = 0$ for all $i \neq j$
(d) $a_{ij} = k\ (k \neq 0)$ for all $i = j$, and $a_{ij} = 0$ for all $i \neq j$

(vii) If the function defined by: $f(x) = \begin{cases} \frac{x^2-49}{x+7}, & x \neq -7 \\ \lambda - 2, & x = -7 \end{cases}$ is continuous at $x = -7$, then $|\lambda|$ equals: 1

(a) -12 (b)0 (c)12 (d) 9

(viii) Which of the following standard indefinite integral formulas is incorrect? 1

(a) $\int \frac{dx}{\sqrt{a^2-x^2}} = \sin^{-1}\left(\frac{x}{a}\right) + C$
(b) $\int \frac{dx}{x^2-a^2} = \frac{1}{2a}\ln\left|\frac{x-a}{x+a}\right| + C$
(c) $\int \frac{dx}{a^2+x^2} = \frac{1}{a}\tan^{-1}\left(\frac{x}{a}\right) + C$
(d) $\int \frac{dx}{\sqrt{x^2-a^2}} = \ln\left|x - \sqrt{x^2 - a^2}\right| + C$

(ix) If $\int \frac{f'(x)}{[f(x)]^2}\,dx = \frac{1}{g(x)} + C$, where $f(x)$ is a differentiable non-zero function, then $g(x)$ is equal to: 1

(a) $f(x)$ (b) $-f(x)$ (c) $[f(x)]^2$ (d) $-\frac{1}{f(x)}$

(x) The interval in which $y = 3 - 4x - x^2$ is decreasing is: 1

(a) $(-\infty, -2)$ (b) $(-\infty, 2)$ (c) $(-2, \infty)$ (d) $(2, \infty)$

(xi) The area enclosed by the curve $y = |x|$, the x-axis and the ordinates $x = -3$ and $x = 0$ is: 1

(a) $\frac{9}{2}$ (b) $\frac{3}{2}$ (c) 9 (d) 3

(xii) If $f(x)$ is an integrable function on $[0, \pi]$, which of the following conditions is sufficient to conclude that 1

$$\int_0^{\pi} f(x)\,dx = 0?$$

(a) $f(\pi - x) = f(x)$

(b) $f(\pi - x) = -f(x)$

(c) $f(\pi) = f(0)$

(d) $f(x)$ is continuous on $[0, \pi]$

(xiii) Which of the following conditions is necessary to obtain a particular solution from a general solution? 1

(a) Order of the differential equation

(b) Degree of the differential equation

(c) An initial condition

(d) Homogeneity

(xiv) If $\vec{a} \times \vec{b} = \vec{0}$, where $\vec{a} \neq \vec{0}$ and $\vec{b} \neq \vec{0}$, then: 1

(a) the vectors are perpendicular

(b) the vectors are parallel

(c) the vectors are equal

(d) the vectors are unit vectors

(xv) If the adjacent sides of a parallelogram are represented by $3\hat{\imath}$ and $4\hat{\jmath}$, then area of the parallelogram is: 1

(a) -12 sq. units (b) $12\hat{k}$ sq. units (c) 12 sq. units (d) 7 sq. units

(xvi) If vectors $\vec{a} = 3\hat{\imath} + 5\hat{\jmath} - m\hat{k}$ and $\vec{b} = \hat{\imath} - 3\hat{\jmath} + 2\hat{k}$ are perpendicular to each other, then $m + 1$ equals: 1

(a) -6 (b) -5 (c) 5 (d) 6

(xvii) The vector equation of the line which passes through the point $(3, -2, -4)$ and parallel to the line $\frac{x+4}{5} = \frac{y-1}{-2} = \frac{z+7}{7}$ is: 1

(a) $\vec{r} = 5\hat{\imath} - 2\hat{\jmath} + 7\hat{k} + \lambda(3\,\hat{\imath} - 2\hat{\jmath} - 4\hat{k})$

(b) $\vec{r} = 3\,\hat{\imath} - 2\hat{\jmath} - 4\hat{k} + \lambda(-4\hat{\imath} + \hat{\jmath} - 7\hat{k})$

(c) $\vec{r} = -3\,\hat{\imath} + 2\hat{\jmath} + 4\hat{k} + \lambda(5\hat{\imath} - 2\hat{\jmath} + 7\hat{k})$

(d) $\vec{r} = 3\,\hat{\imath} - 2\hat{\jmath} - 4\hat{k} + \lambda(5\hat{\imath} - 2\hat{\jmath} + 7\hat{k})$

(xviii) Feasible solutions of a Linear Programming Problem (LPP) are: 1

(a) Points within the boundary of the feasible region

(b) Points within and on the boundary of the feasible region

(c) Points on the boundary of the feasible region

(d) Points outside the boundary of the feasible region

(xix) If $P\left(\frac{A}{B}\right) = \frac{3}{5}, P(B) = \frac{1}{2}$, then $P(A \cap B)$ is equal to: 1

(a) $\frac{3}{10}$ (b) $\frac{3}{5}$ (c) $\frac{5}{6}$ (d) $\frac{1}{5}$

(xx) Which of the following is not true? 1

(a) If A and B are independent events, then $P(B/A) = P(B)$ provided $P(A) \neq 0$
(b) If A and B are independent events, then $P(A \cap B') = P(A)(1 - P(B))$
(c) If A and B' are independent events, then $P(A \cap B) = P(A)\, P(B')$
(d) If A' and B' are independent events, then $P(A' \cap B) = (1 - P(A))P(B)$

Part-B

Q.2 Show that all the diagonal elements of a skew-symmetric matrix are zero. 2

Q.3 Find $\frac{dy}{dx}$, if $x = a(\theta + \sin\theta)$, $y = a(1 - \cos\theta)$ 2

Q.4 Satnam is pouring water into a cylindrical flask at the rate of 400 cm^3/s, while the flask is leaking at the rate of 4 cm^3/s. Determine whether the water level in the flask is increasing or decreasing. Also, find the rate of change of the water level if the radius of the flask is 3cm. 2

Q.5 Evaluate $\int \frac{1}{sin^2 x(1-\cot x)^2}\, dx$ 2

Q.6 Find the area of the region bounded by the line $y = x$, the x-axis, and the ordinates $x = -1$ and $x = 1$. 2

Q.7 Solve the differential equation $\frac{dy}{dx} = (1 + x^2)(1 + y^2)$. 2

Q.8 An engineer wants to install a sensor perpendicular to two supporting rods represented by $\vec{a} = 2\hat{\imath} - \hat{\jmath} + \hat{k}$, $\vec{b} = \hat{\imath} + \hat{\jmath} + 2\hat{k}$. Find a vector along the direction in which the sensor should be installed. 2

Part-C

Q.9 (i) Find the value of $\sin^{-1}\left(\sin\frac{5\pi}{6}\right)$. 2

(ii) Express $\tan^{-1}\left(\sqrt{\frac{1-\cos x}{1+\cos x}}\right), 0 < x < \pi$ in the simplest form. 2

Q.10 A student obtains the determinant corresponding to the vertices of a triangle as −18. Without evaluating the determinant again, answer the following: 4

(i) What is the area of the triangle?
(ii) Why the area is not negative?
(iii) Are the three points collinear? Give reason.
(iv) State the determinant-based condition for three points to be collinear.

Q.11 4

If $(x-3)^2 + (y-4)^2 = 25$, prove that $\frac{\left[1+\left(\frac{dy}{dx}\right)^2\right]^3}{\left(\frac{d^2y}{dx^2}\right)^2} + \frac{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}}{\frac{d^2y}{dx^2}} = 20.$

OR

If $f(x) = (\tan x)^x$, $g(x) = x^{\tan x}$, then find that amongst $f(x)$ and $g(x)$, which function changes less rapidly with respect to the independent variable x, when $x = \frac{\pi}{4}$. Also find the difference between $f'\left(\frac{\pi}{4}\right)$ and $g'\left(\frac{\pi}{4}\right)$. $\left(Take\ \pi = 3.14\ and\ log_e\left(\frac{\pi}{4}\right) = -0.2\right)$. 4

Q.12 Let $I = \int_0^\pi x\, g(x)\, dx$, where $g(\pi - x) = g(x)$. Show that $I = \frac{\pi}{2}\int_0^\pi g(x)\, dx$. Hence evaluate $\int_0^\pi \frac{x \sin x}{1 + cos^2 x}\, dx$. 4

OR

Show that for any continuous function $f(x)$, $\int_0^a f(x)\, dx = \int_0^a f(a - x)\, dx$. Hence evaluate $\int_0^{\pi/4} \ln(1 + \tan x)\, dx$. 4

Q.13 Solve the differential equation $x \log x \frac{dy}{dx} + y = \frac{2}{x}\log x$ 4

Q.14 Solve the following linear programming problem graphically: 4
Maximise and minimise $Z = 3x + 2y$ subject to the constraints

$$4x + y \geq 8, \quad x + y \leq 8, \quad x - y \geq 0, \quad x \geq 0, \quad y \geq 0$$

Q.15 Bag I contains 4 red balls and 7 white balls. Bag II contains 5 red balls and 6 white balls. One of the bags is chosen at random and a ball is drawn from it. Find the probability of drawing: 4

(i) a red ball?

(ii) a white ball?

Which ball is more likely to be drawn?

OR

In a population, 1% of people have a specific disease. A diagnostic test for this disease gives a positive result in 99% of people who actually have the disease, and in 2% of healthy people (false positive). A person is selected at random. Find the probability that: 4

(i) the test result is positive.

(ii) the test result is negative.

Which test outcome (positive or negative) is more likely to occur for a randomly selected person?

Part-D

Q.16 If twice Ravneet's present age is subtracted from the sum of twice Manisha's present age and Navdeep's present age, the result is 4. Five years ago, subtracting the sum of Manisha's age and Navdeep's age from twice Ravneet's age gave 8. Five years hence, subtracting twice Manisha's age from the sum of Ravneet's and Navdeep's ages will give 1. Using matrices, find the present ages of Manisha, Ravneet and Navdeep. 6

OR

If $A' = \begin{bmatrix} 0 & \tan\frac{x}{2} \\ -\tan\frac{x}{2} & 0 \end{bmatrix}$ and I is the identity matrix of order 2, show that 6

$$I + A = (I - A)\begin{bmatrix} \cos x & -\sin x \\ \sin x & \cos x \end{bmatrix}$$

Q.17 Write the appropriate property to be used in evaluating the integral given by 6

$$\int_0^{\pi} \frac{x\, dx}{25\, cos^2 x + 49\, sin^2 x}$$

and hence evaluate.

OR

Prove that the volume of the largest right circular cylinder that can be inscribed in a sphere of radius R is $\frac{1}{\sqrt{3}}$ of the volume of the sphere. A student claimed that "the cylinder of maximum volume have same radius as that of half the radius of the sphere". Examine this claim using your result and justify? 6

Q.18 (a) The scalar product of the vector $\hat{\imath} + 2\hat{\jmath} - \hat{k}$ with a unit vector along the sum of $-\hat{\imath} + 5\hat{\jmath} - 6\hat{k}$ and $p\hat{\imath} - 2\hat{\jmath} + 3\hat{k}$ is equal to one. Find the value of p. 4

(b) Find the area of the parallelogram whose adjacent sides are determined by the vectors $\vec{a} = 3\hat{\imath} + 5\hat{\jmath} - \hat{k}$ and $\vec{b} = \hat{\imath} - 3\hat{\jmath} + 2\hat{k}$. 2

OR

(a) Find the shortest distance between the lines 4

$$\vec{r} = -2\hat{\imath} + \hat{\jmath} + 3\hat{k} + \mu(3\hat{\imath} - 2\hat{\jmath} - \hat{k}) \text{ and } \vec{r} = -3\,\hat{\imath} - \hat{\jmath} + 2\hat{k} + \lambda(\hat{\imath} - 2\hat{\jmath} + \hat{k})$$

(b) Find the angle between the pair of lines $\frac{x-3}{2} = \frac{y-1}{-1} = \frac{z+2}{-2}$ and $\frac{2-x}{3} = \frac{y+1}{-5} = \frac{z+56}{-4}$ 2