CBSE
Pre Board Examination – 2020-21
Mathematics
Class – XII

Max. Marks: 80
Time Allowed: 3 hrs

General Instructions:

1. *This question paper contains two parts A and B. Each part is compulsory. Part A carries 24 marks and Part B carries 56 marks.*
2. *Part-A has Objective Type Questions and Part -B has Descriptive Type Questions.*
3. *Both Part A and Part B have choices.*

Part – A:

1. *It consists of two sections- I and II.*
2. *Section I comprises of 16 very short answer type questions.*
3. *Section II contains 2 case studies. Each case study comprises of 5 case-based MCQs. An examinee is to attempt any 4 out of 5 MCQs.*

Part – B:

1. *It consists of three sections- III, IV and V.*
2. *Section III comprises of 10 questions of 2 marks each.*
3. *Section IV comprises of 7 questions of 3 marks each.*
4. *Section V comprises of 3 questions of 5 marks each.*
5. *Internal choice is provided in 3 questions of Section –III, 2 questions of Section-IV and 3 questions of Section-V. You have to attempt only one of the alternatives in all such questions.*

PART A
Section - I

Section I has 16 questions of 1 mark each. Internal choice is provided in 5 questions.

1. Consider the set A has 5 elements, then the total number of injective functions from Set A onto itself is ________. [1]

OR

Let $f: R \to R$ is defined by $f(x) = |x|$. Is function f onto ? Give reason.

2. If R is a relation defined on set $A = \{1, 2, 3\}$ as $R = \{ (1, 1), (1, 2), (2,3)\}$. Is Relation R is transitive, if not which ordered pairs should be added to make it transitive ? [1]

3. The relation $R = \{(a, b): |a - b| \ \textit{is a multiple of}\ 3 \}$ in set $A = \{1, 2, 3, \dots .10\}$ is an equivalence relation. Write the equivalence class related to 2. [1]

OR

Let $A = \{1, 2, 3, 4\}$ and $B = \{5, 6, 7\}$. Let $f: A \to B$ is defined as $f = \{ (1, 6), (2, 5), (3, 6), (4, 7)\}$. Is function bijective. Give reason.

4. If AB = 16I, then write A^{-1} in terms of B. [1]

5. If for matrix A, |A| = 5, find |4A|, where matrix A is of order 2×2. [1]

OR

Find the invers of matrix $\begin{bmatrix} 7 & 1 \\ 4 & -3 \end{bmatrix}$

6. Given square matrix A of order 3, such that $|A'| = 15$, find $|A.adj\ A|$. [1]

7. If $\int e^{-2\log x}\, dx = f(x) + C$, then find $f(x)$. [1]

OR

Evaluate: $\int_{-1}^{1} |(1-x)|dx$.

8. Find the area of the region bounded by the curve $y = \frac{1}{x}$, x axis and between $x = 1, x = 4$. [1]

9. Write the order and degree of the differential equation $x - \cos\left(\frac{dy}{dx}\right) = 0$ [1]

OR

Show that the differential equation $2y\, e^{x/y} dx + \left(y - 2xe^{\frac{x}{y}}\right) dy = 0$ is homogeneous.

10. Find a unit vector in the direction of $\vec{a} + \vec{b}$ where $\vec{a} = 2\hat{\imath} + \hat{\jmath} - 5\hat{k}$ and $\vec{b} = \hat{\imath} - 4\hat{\jmath} + \hat{k}$ [1]

11. If $\vec{b}$ is a unit vector and $(\vec{x} - \vec{b}).(\vec{x} + \vec{b}) = 80$, then find $|\vec{x}|$. [1]

12. Find the projection of $\vec{a}$ on $(\vec{a} + \vec{b})$ where $\vec{a} = \hat{\imath} + 2\hat{\jmath} - 4\hat{k}$ and $\vec{b} = 2\hat{\imath} + 3\hat{\jmath} + \hat{k}$ [1]

13. Write the direction cosines of a line equally inclined to the three coordinated axes. [1]

14. Write the vector equation of the line $\frac{x-5}{3} = \frac{y+4}{7} = \frac{6-z}{2}$ [1]

15. A black and a red die are rolled together. Find the conditional probability of obtaining the sum 8, given that the red die resulted in a number less than 4. [1]

16. Find the value of k, for which the following distribution is a probability distribution. [1]

X	30	10	50
P(X)	$\frac{1}{2}$	$\frac{1}{5}$	k

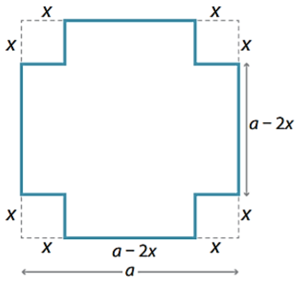
Section-II

Case study based questions are compulsory. Attempt any four sub parts of each question.

Each subpart carries 1 mark.

17. **Case Study based-1**

A square sheet of cardboard with each side 'a' cm is to be used to make an open top box by cutting a small square of cardboard from each of the corners and bending up the sides.



(a) The volume V cm^3 of the box is given by ______________ [1]

(i) $V(x) = 4ax^3 - 4x^2 + a^2x$

(ii) $V(x) = 4x^3 - 4ax^2 + a^2x$

(iii) $V(x) = 4a^3 - 4x^2 + a^2$

(iv) $V(x) = 4ax^3 + 4x^2 + a^2x$

(b) Perimeter of the given net of the box is _________________ [1]

(i) $P(x) = 8x - 2a$

(ii) $P(x) = 4a$

(iii) $P(x) = 8a - 2x$

(iv) $P(x) = 2x$

(c) The rate of change of Volume with respect to '*x*' is ____________ [1]

(i) $12ax^2 - 8x + a^2$

(ii) $12x^2 - 8ax + a^2$

(iii) $-8x$

(iv) $12ax^2 + 8x + a^2$

(d) The local maximum volume of the box at $x =$ ______ [1]

(i) $\frac{a}{3}$ (ii) $\frac{a}{6}$ (iii) $\frac{3}{a}$ (iv) $\frac{6}{a}$

(e) The maximum volume of the box at $a = 3$ is _______________ [1]

(i) 4 (ii) 6 (iii) 27 (iv) 2

18. **Case Study based-2**

A car dealer offers purchasers a three-year warranty on a new car. He sells two models, the Zippy and the Nifty. For the first 50 cars sold of each model the number of claims under the warranty is shown in the table below.

	Claim	No claim
Zippy	35	15
Nifty	40	10

One of the purchasers is chosen at random. Let A be the event that no claim is made by the purchaser under the warranty and B the event that the car purchased is a Nifty.

(a) P (A ∩ B) is _______ [1]

(i) 0.1 (ii) 0.2 (iii) 0.01 (iv) 0.02

(b) P (A′) is ________ [1]

(i) $\frac{1}{4}$ (ii) $\frac{1}{2}$ (iii) $\frac{3}{4}$ (iv) $\frac{2}{5}$

(c) Given that the purchaser chosen does not make a claim under the warranty, find the probability that the car purchased is a Zippy. [1]

(i) 0.2 (ii) 0.4 (iii) 0.6 (iv) 0.8

(d) Given that the purchaser chosen does not make a claim under the warranty, find the probability that the car purchased is a Nifty. [1]

(i) 0.8 (ii) 0.6 (iii) 0.4 (iv) 0.2

(e) Write the correct statement. [1]

(i) The given information in a table is a probability distribution.

(ii) Making a claim is independent of the make of the car purchased.

(iii) Making a claim is not independent of the make of the car purchased.

(iv) All the above are wrong statements.

Part –B
Section III

All questions are compulsory. In case of internal choices attempt any one.

19. Write $\tan^{-1}\left[\frac{\sqrt{1+x^2}\ -1}{x}\right]$, $x \neq 0$ in the simplest form. [2]

20. If A $=\begin{bmatrix} 2 & 3 \\ 5 & -2 \end{bmatrix}$ be such that $A^{-1} = kA$, then find the value of k. [2]

OR

Given a square matrix A of order 3×3, such that |A|= 12, find the value of |A. adj A|.

21. Find the value of $'k'$ so that the function f defined by [2]

$$f(x) = \begin{cases} kx+1, & if\ x \leq \pi \\ \cos x, & if\ x > \pi \end{cases}$$

is continuous at $x = \pi$.

22. Find the equation of the tangent to the curve $y = \sqrt{3x-2}$ which is parallel to the line $4x - 2y + 5 = 0$. [2]

23. Evaluate $\int_0^1 \frac{2x+3}{5x^2+1}\ dx$ [2]

OR

Evaluate $\int_0^{\frac{\pi}{2}} \frac{\cos x}{(1+\sin x)\,(2+\sin x)}\ dx$

24. Using integration, find the area of the region bounded by the parabola $y = x^2$ and the line $y = |x|$. [2]

25. Find the particular solution of the differential equation $(1+e^{2x})dy + (1+y^2)e^x dx = 0$ given that when $x = 0, y = 1$. [2]

26. Find a vector of magnitude 6, perpendicular to each of the vectors $(\vec{a} + \vec{b})$ and $(\vec{a} - \vec{b})$ where $\vec{a} = \hat{\imath} + \hat{\jmath} + \hat{k}\ and\ \vec{b} = \hat{\imath} + 2\hat{\jmath} + 3\hat{k}$ [2]

27. Find the equation of the plane passing through the line of intersection of the planes $\hat{r}.\left(\hat{\imath}+\hat{\jmath}+\hat{k}\right)=1$ and $\hat{r}.\left(2\hat{\imath}+3\hat{\jmath}-\hat{k}\right)+4=0$ and parallel to the x –axis. [2]

28. Two dice are thrown. Find the probability that the numbers appeared have a sum 8 if it is known that the second die always exhibits 4. [2]

OR

Suppose that 5% of men and 0.25% of women have grey hair. A grey haired person is selected at random. What is the probability of this person being male? Assume that there are equal number of males and females.

Section IV

All questions are compulsory. In case of internal choices attempt any one.

29. Consider the binary operations $*: R \times R \rightarrow R$ defined as $a * b = |a-b|$ and $a \# b = a, \quad \forall\, a, b \in R$. Show that * is commutative but not associative, # is associative but not commutative. [3]

30. If $y = x^{logx} + (\cos x)^{x^2}$ find $\frac{dy}{dx}$. [3]

OR

If $xy = e^{(x-y)}$, then show that $\frac{dy}{dx} = \frac{y(x-1)}{x(y+1)}$.

31. Show that the function $f(x) = |x-3|,\ x \in R$ is continuous but not differentiable at $x = 3$. [3]

32. Find the intervals in which the function f is given by $f(x) = (x-1)(x-2)^2$is strictly increasing or strictly decreasing. [3]

33. Find $\int \frac{e^x\, dx}{(2+e^x)(4+e^{2x})}$ [3]

34. Using integration find the area of the region in the first quadrant enclosed by the $x-axis$, the line $y = x$ and the circle $x^2+y^2=32$. [3]

OR

Using the method of integration find the area of the triangle ABC, coordinates of whose vertices are A(2, 0), B(4, 5) and C(6, 3).

35. Find the particular solution of the differential equation $dy = \cos x\,(\,2 - y\, cosec\ x\,)dx$, given that $y = 2$ when $x = \frac{\pi}{2}$. [3]

Section V

All questions are compulsory. In case of internal choices attempt any one.

36. Given $A = \begin{vmatrix} 1 & -1 & 0 \\ 2 & 3 & 4 \\ 0 & 1 & 2 \end{vmatrix}$ and $B = \begin{vmatrix} 2 & 2 & -4 \\ -4 & 2 & -4 \\ 2 & -1 & 5 \end{vmatrix}$ verify that $BA = 6I$, use the result to solve the system of linear equations [5]

$$x - y = 3\ , \quad 2x + 3y + 4z = 17, \quad y + 2z = 7$$

OR

If $A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$ find A^{-1} and hence prove that $A^2 - 4A - 5I = 0$.

37. Find the equation of the perpendicular drawn from the point $(1, -2, 3)$ to the plane $2x - 3y + 4z + 9 = 0$. Also find the coordinates of the foot of the perpendicular. [5]

OR

Find the equation of the line passing through the point $P(4, 6, 2)$ and the point of intersection of the line $\frac{x-1}{3} = \frac{y}{2} = \frac{z+1}{7}$ and the plane $x + y - z = 8$.

38. Solve the following LPP graphically [5]

Minimise $Z = 5x + 10\,y$ subject to the constraints

$x + 2y \le 120$
$x + y \ge 60$
$x - 2y \ge 0$
$x, y \ge 0$

OR

The corner points of the feasible region determined by the following system of linear inequalities:

$2x + y \le 10$
$x + 3y \le 15$
$x, y \ge 0$

are $(0, 0), (5, 0), (3, 4)$ and $(0, 5)$. Let $Z = px + qy$, where $p, q \ge 0$, what is the condition on p, q that maximum Z occurs at both $(3, 4)$ and $(0, 5)$. Show this information by plotting the graph and identify the feasible region.

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