Class: XII Session: 2020-21
Subject: Mathematics
Sample Question Paper (Theory)

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

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:

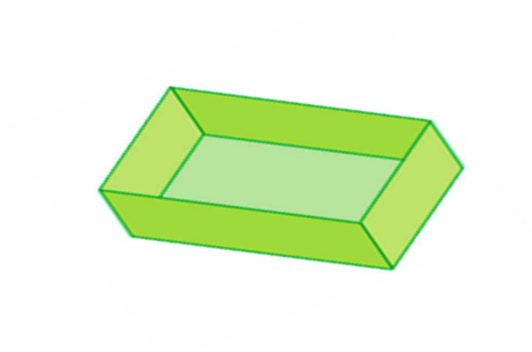
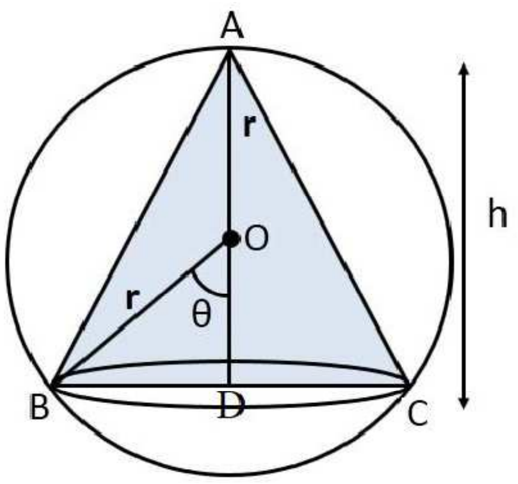
1. It consists of two sections**- I and II**.
2. Section **I** comprises of 16 very short answer type questions.
3. Section **II** contains **2** case studies. Each case study comprises of 5 case-based MCQs. An examinee is to attempt **any 4 out of 5 MCQs**.

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.

Sr.	PART-A	Marks
	Section- I All questions are compulsory. In case of internal choices attempt any one	
1	If R = { (x,y) : x + 2y = 8 } is a relation on N,write the range of R. OR If the function f : R → R given by f(x) = x^2 + 4 and g: R → R given by g(x) = $\frac{x}{x-1}$, x ≠ 1,find fog.	1
2	Let *A* = {1, 2, 3}, *B* = {4, 5, 6, 7} and let *f* = {(1, 4), (2, 5), (3, 6)} be a function from *A* to *B*. State whether f is one-one or not.	1
3	Let *A* = {*a*, *b*, *c*} and the relation *R* be defined on *A*, as follows: *R* = {(*a*, *a*), (*b*, *c*), (*a*, *b*)}.Then, write minimum number of ordered pairs to be added in *R* to make *R* reflexive and transitive.	1

	OR Write the principal values of sec–1(–2).	
4	If matrix A = [1 2 3] then find AA', where A' is the transpose of matrix A.	1
5	Given a square matrix A of order 3 × 3, such that $\|A\|$ = 12, find the value of $\|A$. adj $A\|$. OR If A is a non-singular matrix of order 3 and $\|A\|$ = – 4, find $\|$adj $A\|$.	1
6	If A is a square matrix such that $A^2 = A$, then find $(2 + A)^3 – 19A$	1
7	Evaluate: $\int \frac{\sin(x-\alpha)}{\sin(x+\alpha)} dx$ OR Evaluate: $\int e^{2x} \frac{1-sin2x}{1-cos2x} dx$	1
8	Find the area bounded by $y= x^2$,$he\ x-$ axis and the lines $x=-1$ and $x=1$.	1
9	If tangent to the curve $y^2 + 3x - 7 = 0$ at the point (□, k) is parallel to line x − y = 4, then value of k is ___?	1
10	Find a unit vector in the direction opposite to −3 j	1
11	Find a vector perpendicular to the vectors i + j and i + k .	1
12	If | a| = 10, |b| = 2, $\vec{a} \cdot \vec{b}$ = 12 then find | $\vec{a} \times \vec{b}$ |.	1
13	Find the direction cosines of the normal to YZ plane?	1
14	Find the number of lines making equal angles with coordinate axes in 3-dimension.	1
15	The probabilities of A and B solving a problem independently are 1/3 a*nd* ¼ respectively. If both of them try to solve the problem independently, what is the probability that the problem is solved?	1
16	An urn contains 6 balls of which two are red and four are black. Two balls are drawn at random. Find the Probability that they are of the different colours.	1
	Section II Both the Case study based questions are compulsory. Attempt any 4 sub parts from each question (17) and (18). Each question carries 1 mark .	
17	**CASE STUDY-BASED QUESTIONS** A farmer wants to construct a small tank with rectangular base and rectangular sides, open at the top is to be constructed so that its depth is 2 m and volume is 8 m^3. The cost of building tank is Rs. 70 per sq metre for the base and Rs. 45 per sq metre for sides.	4

	 **Based on the above information, answer the following questions: (Attempt any four)** (i) Find a function that models the cost of the box. (ii) Find the length and breadth of the box for which the cost of the box is minimum. (iii) Find the cost of least expensive tank. (iv) If the volume is doubled, then find the increased cost of tank. (v) If the top is closed and the rate is same as for the base, then find the cost of least expensive tank.	
18	A man is making a toy. He wants to put one revolving right circular cone of maximum volume that can inscribed in a sphere of radius r. **(Attempt any four)** 	4

	Based on the above information answer the following questions : **(i)** What is the volume of cone (V) ? **(a)** $\frac{1}{3}\pi(-h^3+2h^2r)$ **(b)** $\frac{1}{2}\pi(-h^3+2h^2r)$ **(c)** $\frac{1}{4}\pi(-h^3+2h^2r)$ **(ii)** What is the volume of $\frac{dV}{dh}$? **(a)** $\frac{\pi}{2}(-3h^2+4hr)$ **(b)** $\frac{\pi}{4}(-3h^2+4hr)$ **(c)** $\frac{\pi}{3}(-3h^2+4hr)$ **(iii)** What is the value of $\frac{d^2V}{dh^2}$? **(a)** $-\frac{4\pi r^2}{3}$ **(b)** $-\frac{4\pi r^3}{3}$ **(c)** $-\frac{4\pi r}{3}$ **(iv)** What is the relation between h and r ? **(a)** $2h=4r$ **(b)** $3h=4r$ **(c)** $2h=3r$ **(v)** What is the value of OD ? **(a)** $r-h$ **(b)** $h-r$ **(c)** $r-\frac{h}{2}$	
	Part – B	
	Section III All questions are compulsory. In case of internal choices attempt any one.	
19	Evaluate $\tan^{-1}[2\sin(2\cos^{-1}\frac{\sqrt{3}}{2})]$.	2
20	If $\begin{bmatrix}1 & 2\\3 & 4\end{bmatrix}\cdot\begin{bmatrix}3 & 1\\2 & 5\end{bmatrix}=\begin{bmatrix}7 & 11\\k & 23\end{bmatrix}$, then find the value of k. OR Find the value of x from the following matrix equation: $[1 \quad x \quad 1].\begin{bmatrix}1 & 3 & 2\\2 & 5 & 1\\15 & 3 & 2\end{bmatrix}.\begin{bmatrix}1\\2\\x\end{bmatrix}=0.$	2
21	Show that the function $f(x)=\begin{cases}3x-2, & 0<x\le 1\\2x^2-x, & 1<x\le 2\\5x-4, & x>2\end{cases}$ is continuous at x=2	2
22	Find the equation of tangent to the curve y =$\sqrt{3x-2}$, which is parallel to the line 4x-2y+5=0.	2
23	If x$\sqrt{1+y}$ + y$\sqrt{1+x}$ = 0, find $\frac{dy}{dx}$	2
24	Find the area of the region bounded by the parabola $y^2=8x$ and the line $x=2$.	2
25	Evaluate: $\int x^2 e^{x^3}\,dx$	2

	OR Evaluate : Evaluate : $\int sin^5(2x+5)\ dx$	
26	If x= $acos\theta + bsin\theta$ and $y = asin\theta - bcos\theta$, show that $y^2 \frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = 0$	2
27	Find the equation of the plane passing the point (2, 1, 3) and through the intersection of the planes $\vec{r}.(2\hat{i}+\hat{j}+3\hat{k})=7$ *and* $\vec{r}.(2\hat{i}+5\hat{j}+3\hat{k})=9$	2
28	If P(A) = 0.6, P(B) = 0.5 and P(A|B) = 0.3, then find P(A U B).	2
	Section IV All questions are compulsory. In case of internal choices attempt any one.	
29	Evaluate : $\int \frac{x cos^{-1}x}{\sqrt{1-x^2}} dx$ OR Evaluate : $\int \frac{\sin x}{(1-\cos x)(2-\cos x)} dx$	3
30	Show that the relation R defined on N × N by (a,b) R (c,d) if and only if ad(b + c) =bc(a+d) is an equivalence relation	3
31	If vector $\|\vec{a}\| = a$ *then find the value of* $\|\vec{a}\times\hat{i}\|^2 + \|\vec{a}\times\hat{j}\|^2 + \|\vec{a}\times\hat{k}\|^2$.	3
32	Find the area of the ellipse $x^2+9y^2=36$ using integration OR Find the area of the region bounded by the curves $x^2+y^2=4$, y=$\sqrt{3}x$ *and x−axis in the first quadrant*	3
33	Prove $\frac{d}{dx}\ [\ \frac{x}{2}\sqrt{a^2-x^2} + \frac{a^2}{2}\sin^{-1}(\frac{x}{a})] = \sqrt{a^2-x^2}$ OR If x= $acos\theta + bsin\theta$ and $y = asin\theta - bcos\theta$, show that $y^2 \frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = 0$	3
34	Find the interval in which the function f(x) =$sin^4 x + cos^4 x$ on (0,π/2) is (a) strictly increasing , (b) strictly decreasing	3
35	Find the general solution of the following differential equation: $x\ dy-(y+2x^2)dx=0$	3
	Section V All questions are compulsory. In case of internal choices attempt any one.	
36	If A = $\begin{bmatrix} 2 & 3 & 1 \\ -3 & 2 & 1 \\ 5 & -4 & -2 \end{bmatrix}$, find A^{-1}. Using A^{-1}, solve the following system of equations: 2x − 3y + 5z = 16, 3x + 2y − 4z = −4 & x + y − 2z = −3. OR Show that: $\begin{vmatrix} -a^2 & ab & ac \\ ba & -b^2 & bc \\ ca & cb & -c^2 \end{vmatrix} = 4a^2b^2c^2$	5
37	Find the co-ordinates of the point where the line through the points A (3, 4, 1) and B (5, 1, 6) crosses the plane determined by the points P (2, 1,	5

	2), Q (3, 1, 0) and R (4, -2, 1). OR Find the length and foot of perpendicular drawn from the point (2,-1,5) to the line $\frac{x-11}{10}=\frac{y+2}{-4}=\frac{z+8}{-11}$.	
38	Solve the following linear programming problem (L.P.P) graphically. Maximize $Z=x+2y$ subject to constraints ; $x+2y\geq100$, $2x-y\leq0$, $2x+y\leq200$, $x,y\geq0$ OR A dealer wishes to purchase a number of fans and sewing machines. He has only Rs 5,760 to invest and has a space for at most 20 items. A fan costs him Rs 360 and a sewing machine Rs 240. His expectation is that he can sell a fan at a profit of Rs 22 and a sewing machine at a profit of Rest 18. Assuming that he can sell all the items that he can buy, how should he invest his money in order to maximize the profit? Formulate this as a liner programming problem and solve it graphically.	5

SAMPLE PAPER::MATHEMATICS

CLASS-XII-2020-21

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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 comprises of two 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 3 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.**
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PART-A

Section-I

1. If $cos^{-1}\alpha + cos^{-1}\beta + cos^{-1}\gamma = 3\pi,$ then find the value of: $(\alpha^3 + \beta^3 + \gamma^3) - \left(\frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma}\right)$

2. If R={(a, a^3): a is a prime number less than 5} be a relation. Find the range of R

3. Find the Principal value of $cot^{-1}\left(-\sqrt{3}\right) + tan^{-1}(1)$
   OR,
   Find the principal value of $cot^{-1}\left(tan\frac{3\pi}{4}\right)$

4. If A and B are two symmetric matrices of same order, then find whether the marix AB-BA is symmetric or skew-symmetric.
   OR,
   For the matrix $A = \begin{bmatrix} 1 & -2 \\ 3 & 5 \end{bmatrix}$ show that: (A')'=A

5. If $\begin{bmatrix} 2x+y & 4x \\ 5x-7 & 4x \end{bmatrix} = \begin{bmatrix} 7 & 7y-13 \\ y & x+6 \end{bmatrix}$ then find the value of x+y.

6. Find the additive inverse of the matrix:

$\begin{bmatrix} 2 & -5 & 0 \\ 4 & 3 & -1 \end{bmatrix}$

7. At what point the tangent to the curve $y = e^{2x}$ at the point (0,1) meets X-axis.

8. Evaluate: $\int e^x\{af(x) + f'(x)\}dx$

9. Find the solution of : $(2y - 1)dx - (2x + 3)dy = 0$

10. Find the vector equation of a plane which is at a distance of 7 units from the origin and normal to the vector $3\imath + \widehat{5\jmath} - 6\hat{k}$

11. If the direction cosines of a line are (1/c,1/c,1/c), then find the value of c

12. What are the direction cosines of a line which makes equal angles with the coordinate axes?

13. A box contains 3 orange balls, 3 green balls and 2 blue balls. Three balls are drawn at random from the box without replacement. Find the probability of drawing 2 green balls and one blue ball.

14. If P(A)=3/10, P(B)=2/5 and P(AUB)=3/5, then find the value of: P(B/A)+P(A/B)

15. If two line $\vec{r} = \vec{a_1} + \lambda\,\vec{b_1}$ and $\vec{r} = \vec{a_2} + \mu\,\vec{b_2}$ are coplanar then find the value of : $(\vec{a_2} - \vec{a_1}).(\vec{b_1} \text{ X } \vec{b_2})$

16. If $|\vec{a}| = 4$ and $-3 \leq \lambda \leq 2$, then find the range of $\left|\lambda\,\vec{a}\right|$

SECTION-II

17. If f(x) is a continuous function defined on [a,b], then $\int_a^b f(x)dx = \int_a^b f(a+b-x)$dx
On basis of the above information answer the following questions:

i) $\int_a^b \frac{f(x)}{f(x)+f(a+b-x)}dx$=

(a) $\frac{a+b}{2}$ (b) $\frac{a-b}{2}$ (c) $\frac{b-a}{2}$ (d) $b - a$

ii) If $f(x) = \log(tanx)$, the $f\left(\frac{\pi}{2} - x\right) =$

(a) $f(x)$ (b) $-f(x)$ (c) $f(x)/2$ (d)2 $f(x)$

iii) $\int_{\pi/6}^{\pi/3} \log(tanx)\,dx =$

(a) $\frac{\pi}{12}$ (b) $\frac{\pi}{6}$ (c) $\frac{\pi}{3}$ (d) 0

iv) If $g(x) = \frac{x^{1/n}}{x^{1/n}+(a+b-x)^{1/n}}$, then $g(a+b-x) =$

(a) $g(x)$ (b)$1 - g(x)$ (c) $\frac{1}{2}g(x)$ (d) 2 $g(x)$

v) $\int_a^b \frac{x^{1/n}}{x^{1/n}+(a+b-x)^{1/n}}dx =$

(a) 0 (b) $\frac{a+b}{2}$ (c) $\frac{a-b}{2}$ (d) $\frac{b-a}{2}$

18. A fair die is rolled. Consider the events A={1,3,5},B={2,3} and C={2,3,4,5}
On the basis of above information, answer the following questions:
(i) P(A/B)=
(a) 1/6 (b) 1/3 (c) ½ (d) ¼
(ii) P(B/A)=
(a) 1/6 (b) 1/3 (c) ½ (d) ¼
(iii) P(A/C)=
(a) 1/6 (b) 1/3 (c) ½ (d) ¼
(iv) P(A∩ $B/C) =$
(a) 1/6 (b) 1/3 (c) ½ (d) ¼
(v) P(AU$B/C) =$
(a) 1/3 (b) ¼ (c) ¾ (d) 1

PART::B

SECTION-III

19. Find the values of $\widehat{\lambda}$ and μ for which $\left(2\hat{\imath}+6\hat{\jmath}+27\hat{k}\right)\times(\hat{\imath}+\widehat{\lambda\jmath}+\mu\hat{k})$=0

20. If $f(x)=\begin{cases}\frac{cos^2x-sin^2x-1}{\sqrt{x^2+1}-1}, & x\neq 0\\ a, & x=0\end{cases}$ is continuous at x=0, find the value of "a".

21. If $\vec{a}$ and $\vec{b}$ are unit vectors, then find the angle between $\vec{a}$ and $\vec{b}$, given that $(\sqrt{3}\vec{a}-\vec{b})$ is a unit vector.

OR,

The x-coordinate of a point on the line joining the points P(2,2,1) and Q(5,1,-2) is 4. Find the z-coordinate.

22. Find the domain of the function $f(x)=cos^{-1}x+sin^{-1}2x$

23. Evaluate: $\int_{-\pi}^{\pi}(1-x^2)sinx.cos^2x\,dx$

24. The probability distribution of a random variable X is given below:

$$P(X=x)=\begin{cases}kx^2, x=1,2,3\\ k(x+1), x=4,5,6\\ 0, x=otherwise\end{cases}$$

Where "k" is a constant. Find k.

OR,

A and B throw a pair of dice alternatively. A wins the game, if he gets a total of 6 and B wins, if she gets a total of 7. If A starts the game, then find the probability of winning the game by A in the third throw of pair of dice.

25. Find a matrix A such that 2A-3B+5C=0, where,
B= $\begin{bmatrix} -2 & 2 & 0 \\ 3 & 1 & 4 \end{bmatrix}$ and C = $\begin{bmatrix} 2 & 0 & -2 \\ 7 & 1 & 6 \end{bmatrix}$

26. If $y = x^{1/x}$, find: dy/dx

OR,

If $x = a(\theta + sin\theta), y = a(1 - cos\theta)$, find dy/dx

27. Evaluate: $\int \frac{x^2-1}{x^2+4} dx$

28. Show that $f(x) = x^9 + 4x^7 + 11$ is an increasing function for all $x \in R$

SECTION-IV

29. If $f: R - \{2\} \to R - \{3\}$ is defined by $f(x) = \frac{3x+1}{x-2}$, where R is the set of real numbers, show that f is bijective.

30. Evaluate: $\int \frac{2x^2+1}{x^2(x^2+4)} dx$

OR, $\int \frac{2x-5e^{2x}}{(2x-3)^3} dx$

31. Solve the differential equation:

$$(xdy - ydx)ysin\frac{y}{x} - (ydx + xdy)xcos\frac{y}{x} = 0$$

OR,

Solve : $(x^2 - yx^2)dy + (y^2 + x^2y^2)dx = 0$, given that: x=1, when y=1

32. If $x = a\{cos\theta + logtan\frac{\theta}{2}\}$ and $y = asin\theta$, find $\frac{d^2y}{dx^2}$

33. A point on the hypotenuse of a right angled triangle is at a distance of 'a' units and 'b' units from the sides. Show that the minimum length of hypotenuse is $\left(a^{2/3} + b^{2/3}\right)^{3/2}$

34. If the straight line $xcos\alpha + ysin\alpha = P$ touches the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, prove that

$$P^2 = a^2cos^2\alpha + b^2cos^2\alpha$$

35. 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)

SECTION-V

36. Solve the given LPP graphically:
Minimise (z)=$5x + 8y$
Subject to constraints: $2x + y \geq 140, 3x + 5y \geq 350, x, y \geq 0$
OR,
Solve the given LPP graphically:
Maximise (z)=$22x + 18y$
Subject to constraints: $x + y \leq 20, 360x + 240y \leq 5760, x, y \geq 0$

37. A variable plane which remains at a constant distance 3p from origin cut the coordinate axes at A,B,C. Show that the locus of the centroid of triangle ABC is $x^{-2} + y^{-2} + z^{-2} = p^{-2}$
OR,
Show that the area of the parallelogram whose diagonals are given by $\vec{a}$ and $\vec{b}$ is $\frac{|\vec{a}| \times \vec{b}}{2}$. Also find the area of the parallelogram whose diagonals are: $2\hat{\imath} - \hat{\jmath} + \hat{k}$ and $\hat{\imath} + 3\hat{\jmath} - \hat{k}$

38. If $A = \begin{bmatrix} cos\alpha & -sin\alpha & 0 \\ sin\alpha & cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$, find $adjA$ and verify that: $A(adjA) = (adjA)A = |A|I$
OR,
If $A = \begin{bmatrix} 1 & 3 & 4 \\ 2 & 1 & 2 \\ 5 & 1 & 1 \end{bmatrix}$, find A^{-1}. Hence, solve the system of equations:

$$x + 3y + 4z = 8\,;\; 2x + y + 2z = 5 \;\; and \;\; 5x + y + z = 7$$

(Prepared by: HJB)

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