

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:


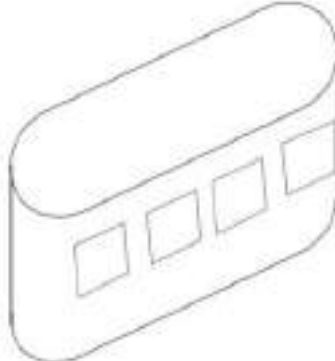
1. It consists of two sections- **I and II**.
2. Section **I** comprises of 16 very short answer type questions.
3. Section **II** contains **2** case studies. Each case study comprises of 5 case-based MCQs. An examinee is to attempt **any 4 out of 5 MCQs**.

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. No.	Part – A	Marks
	Section I All questions are compulsory. In case of internal choices attempt any one.	
1	Check whether the function $f: R \rightarrow R$ defined as $f(x) = x^3$ is one-one or not. OR	1

	How many reflexive relations are possible in a set A whose $n(A) = 3$.	1
2	A relation R in $S = \{1,2,3\}$ is defined as $R = \{(1, 1), (1, 2), (2, 2), (3, 3)\}$. Which element(s) of relation R be removed to make R an equivalence relation?	1
3	A relation R in the set of real numbers \mathbf{R} defined as $R = \{(a, b): \sqrt{a} = b\}$ is a function or not. Justify	1
	OR	
	An equivalence relation R in A divides it into equivalence classes A_1, A_2, A_3 . What is the value of $A_1 \cup A_2 \cup A_3$ and $A_1 \cap A_2 \cap A_3$	1
4	If A and B are matrices of order $3 \times n$ and $m \times 5$ respectively, then find the order of matrix $5A - 3B$, given that it is defined.	1
5	Find the value of A^2 , where A is a 2×2 matrix whose elements are given by	1
	$a_{ij} = \begin{cases} 1 & \text{if } i \neq j \\ 0 & \text{if } i = j \end{cases}$	
	OR	
	Given that A is a square matrix of order 3×3 and $ A = -4$. Find $ \text{adj } A $	1
6	Let $A = [a_{ij}]$ be a square matrix of order 3×3 and $ A = -7$. Find the value of $a_{11}A_{21} + a_{12}A_{22} + a_{13}A_{23}$ where A_{ij} is the cofactor of element a_{ij}	1
7	Find $\int e^x(1 - \cot x + \operatorname{cosec}^2 x) dx$	1
	OR	
	Evaluate $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} x^2 \sin x dx$	1
8	Find the area bounded by $y = x^2$, the x-axis and the lines $x = -1$ and $x = 1$.	1
9	How many arbitrary constants are there in the particular solution of the differential equation $\frac{dy}{dx} = -4xy^2$; $y(0) = 1$	1
	OR	
	For what value of n is the following a homogeneous differential equation:	1
	$\frac{dy}{dx} = \frac{x^3 - y^n}{x^2y + xy^2}$	
10	Find a unit vector in the direction opposite to $-\frac{3}{4}\hat{j}$	1
11	Find the area of the triangle whose two sides are represented by the vectors $2\hat{i}$ and $-3\hat{j}$.	1

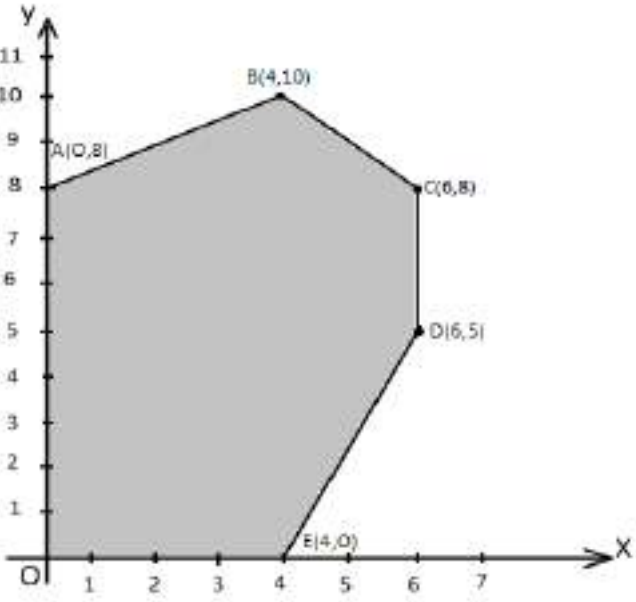
12	Find the angle between the unit vectors \hat{a} and \hat{b} , given that $ \hat{a} + \hat{b} = 1$	1
13	Find the direction cosines of the normal to YZ plane?	1
14	Find the coordinates of the point where the line $\frac{x+3}{3} = \frac{y-1}{-1} = \frac{z-5}{-5}$ cuts the XY plane.	1
15	The probabilities of A and B solving a problem independently are $\frac{1}{3}$ and $\frac{1}{4}$ respectively. If both of them try to solve the problem independently, what is the probability that the problem is solved?	1
16	The probability that it will rain on any particular day is 50%. Find the probability that it rains only on first 4 days of the week.	1
Section II		
Both the Case study based questions are compulsory. Attempt any 4 sub parts from each question (17-21) and (22-26). Each question carries 1 mark		
17	<p>An architect designs a building for a multi-national company. The floor consists of a rectangular region with semicircular ends having a perimeter of 200m as shown below:</p> <p style="text-align: center;">Design of Floor</p>  <p style="text-align: center;">Building</p>  <p>Based on the above information answer the following:</p>	
	<p>(i) If x and y represents the length and breadth of the rectangular region, then the relation between the variables is</p> <p>a) $x + \pi y = 100$ b) $2x + \pi y = 200$ c) $\pi x + y = 50$ d) $x + y = 100$</p>	

	<p>(ii) The area of the rectangular region A expressed as a function of x is</p> <p>a) $\frac{2}{\pi} (100x - x^2)$</p> <p>b) $\frac{1}{\pi} (100x - x^2)$</p> <p>c) $\frac{x}{\pi} (100 - x)$</p> <p>d) $\pi y^2 + \frac{2}{\pi} (100x - x^2)$</p>	1
	<p>(iii) The maximum value of area A is</p> <p>a) $\frac{\pi}{3200} m^2$</p> <p>b) $\frac{3200}{\pi} m^2$</p> <p>c) $\frac{5000}{\pi} m^2$</p> <p>d) $\frac{1000}{\pi} m^2$</p>	1
	<p>(iv) The CEO of the multi-national company is interested in maximizing the area of the whole floor including the semi-circular ends. For this to happen the value of x should be</p> <p>a) 0 m</p> <p>b) 30 m</p> <p>c) 50 m</p> <p>d) 80 m</p>	1
	<p>(v) The extra area generated if the area of the whole floor is maximized is :</p> <p>a) $\frac{3000}{\pi} m^2$</p> <p>b) $\frac{5000}{\pi} m^2$</p> <p>c) $\frac{7000}{\pi} m^2$</p> <p>d) No change Both areas are equal</p>	1

18	<p>In an office three employees Vinay, Sonia and Iqbal process incoming copies of a certain form. Vinay process 50% of the forms. Sonia processes 20% and Iqbal the remaining 30% of the forms. Vinay has an error rate of 0.06, Sonia has an error rate of 0.04 and Iqbal has an error rate of 0.03</p>  <p>Based on the above information answer the following:</p>	
	<p>(i) The conditional probability that an error is committed in processing given that Sonia processed the form is :</p> <p>a) 0.0210 b) 0.04 c) 0.47 d) 0.06</p>	1
	<p>(ii)The probability that Sonia processed the form and committed an error is :</p> <p>a) 0.005 b) 0.006 c) 0.008 d) 0.68</p>	1
	<p>(iii)The total probability of committing an error in processing the form is</p> <p>a) 0 b) 0.047 c) 0.234</p>	1

	d) 1	
	(iv)The manager of the company wants to do a quality check. During inspection he selects a form at random from the days output of processed forms. If the form selected at random has an error, the probability that the form is NOT processed by Vinay is : a) 1 b) 30/47 c) 20/47 d) 17/47	1
	(v)Let A be the event of committing an error in processing the form and let E ₁ , E ₂ and E ₃ be the events that Vinay, Sonia and Iqbal processed the form. The value of $\sum_{i=1}^3 P (E_i A)$ is a) 0 b) 0.03 c) 0.06 d) 1	1
	Part – B	
	Section III	
19	Express $\tan^{-1}\left(\frac{\cos x}{1-\sin x}\right)$, $\frac{-3\pi}{2} < x < \frac{\pi}{2}$ in the simplest form.	2
20	If A is a square matrix of order 3 such that $A^2 = 2A$, then find the value of A . OR If $A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$, show that $A^2 - 5A + 7I = 0$. Hence find A^{-1} .	2 2
21	Find the value(s) of k so that the following function is continuous at $x = 0$	2

	$f(x) = \begin{cases} \frac{1-\cos kx}{x \sin x} & \text{if } x \neq 0 \\ \frac{1}{2} & \text{if } x = 0 \end{cases}$	
22	Find the equation of the normal to the curve $y = x + \frac{1}{x}$, $x > 0$ perpendicular to the line $3x - 4y = 7$.	2
23	Find $\int \frac{1}{\cos^2 x (1 - \tan x)^2} dx$ OR Evaluate $\int_0^1 x(1-x)^n dx$	2 2
24	Find the area of the region bounded by the parabola $y^2 = 8x$ and the line $x = 2$.	2
25	Solve the following differential equation: $\frac{dy}{dx} = x^3 \operatorname{cosec} y$, given that $y(0) = 0$.	2
26	Find the area of the parallelogram whose one side and a diagonal are represented by coinitial vectors $\hat{i} - \hat{j} + \hat{k}$ and $4\hat{i} + 5\hat{k}$ respectively	2
27	Find the vector equation of the plane that passes through the point $(1,0,0)$ and contains the line $\vec{r} = \lambda \hat{j}$.	2
28	A refrigerator box contains 2 milk chocolates and 4 dark chocolates. Two chocolates are drawn at random. Find the probability distribution of the number of milk chocolates. What is the most likely outcome? OR Given that E and F are events such that $P(E) = 0.8$, $P(F) = 0.7$, $P(E \cap F) = 0.6$. Find $P(\bar{E} \bar{F})$	2 2
	Section IV All questions are compulsory. In case of internal choices attempt any one.	
29	Check whether the relation R in the set Z of integers defined as $R = \{(a, b) : a + b \text{ is "divisible by 2"}\}$ is reflexive, symmetric or transitive. Write the equivalence class containing 0 i.e. $[0]$.	3
30	If $y = e^{x \sin^2 x} + (\sin x)^x$, find $\frac{dy}{dx}$.	3
31	Prove that the greatest integer function defined by $f(x) = [x]$, $0 < x < 2$ is not differentiable at $x = 1$	3

	$2x + 3y + 4z = 17$ $y + 2z = 7$	
37	<p>Find the shortest distance between the lines</p> $\vec{r} = 3\hat{i} + 2\hat{j} - 4\hat{k} + \lambda(\hat{i} + 2\hat{j} + 2\hat{k})$ <p>and $\vec{r} = 5\hat{i} - 2\hat{j} + \mu(3\hat{i} + 2\hat{j} + 6\hat{k})$</p> <p>If the lines intersect find their point of intersection</p> <p style="text-align: center;">OR</p> <p>Find the foot of the perpendicular drawn from the point (-1, 3, -6) to the plane $2x + y - 2z + 5 = 0$. Also find the equation and length of the perpendicular.</p>	5
38	<p>Solve the following linear programming problem (L.P.P) graphically.</p> <p>Maximize $Z = x + 2y$</p> <p>subject to constraints ;</p> $x + 2y \geq 100$ $2x - y \leq 0$ $2x + y \leq 200$ $x, y \geq 0$ <p style="text-align: center;">OR</p> <p>The corner points of the feasible region determined by the system of linear constraints are as shown below:</p> 	5
	<p>Answer each of the following:</p> <p>(i) Let $Z = 3x - 4y$ be the objective function. Find the maximum and minimum value of Z and also the corresponding points at which the maximum and minimum value occurs.</p>	

	<p>(ii) Let $Z = px + qy$, where $p, q > 0$ be the objective function. Find the condition on p and q so that the maximum value of Z occurs at $B(4,10)$ and $C(6,8)$. Also mention the number of optimal solutions in this case.</p>	
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