

**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:**

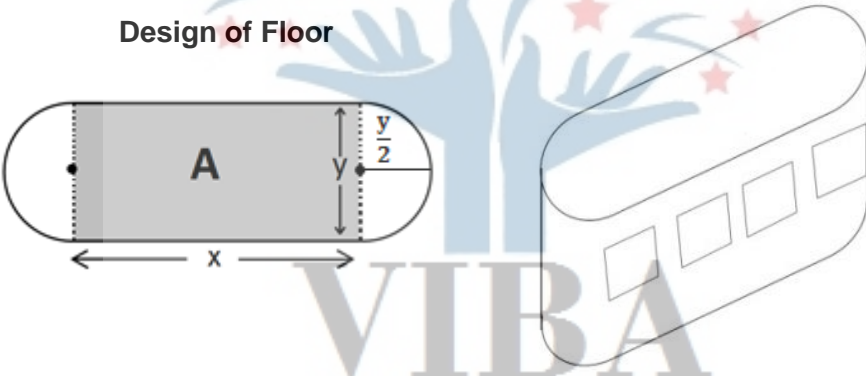
1. It consists of two sections- **I and II**.
2. Section **I** comprises of 16 very short answer type questions.
3. Section **II** contains **2** case studies. Each case study comprises of 5 case-based MCQs. An examinee is to attempt **any 4 out of 5 MCQs**.

**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.

<b>Sr. No.</b>	<b>Part – A</b>	<b>Marks</b>
	<b>Section I</b> <b>All questions are compulsory. In case of internal choices attempt any one.</b>	
1	Check whether the function $f: R \rightarrow R$ defined as $f(x) = x^3$ is one-one or not.  <b>OR</b>	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
	<b>OR</b>	
	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 $2 \times 2$ matrix whose elements are given by	1
	$a_{ij} = \begin{cases} 1 & \text{if } i \neq j \\ 0 & \text{if } i = j \end{cases}$	
	<b>OR</b>	
	Given that A is a square matrix of order $3 \times 3$ and $ A  = -4$ . Find $ \text{adj } A $	1
6	Let $A = [a_{ij}]$ be a square matrix of order $3 \times 3$ 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
	<b>OR</b>	
	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
	<b>OR</b>	
	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
<b>Section II</b>		
<b>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</b>		
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;"><b>Design of Floor</b></p>  <p style="text-align: center;"><b>Building</b></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) <math>x + \pi y = 100</math>  b) <math>2x + \pi y = 200</math>  c) <math>\pi x + y = 50</math>  d) <math>x + y = 100</math></p>	

	<p>(ii) The area of the rectangular region A expressed as a function of x is</p> <p>a) <math>\frac{2}{\pi} (100x - x^2)</math></p> <p>b) <math>\frac{1}{\pi} (100x - x^2)</math></p> <p>c) <math>\frac{x}{\pi} (100 - x)</math></p> <p>d) <math>\pi y^2 + \frac{2}{\pi} (100x - x^2)</math></p>	1
	<p>(iii) The maximum value of area A is</p> <p>a) <math>\frac{\pi}{3200} m^2</math></p> <p>b) <math>\frac{3200}{\pi} m^2</math></p> <p>c) <math>\frac{5000}{\pi} m^2</math></p> <p>d) <math>\frac{1000}{\pi} m^2</math></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) <math>\frac{3000}{\pi} m^2</math></p> <p>b) <math>\frac{5000}{\pi} m^2</math></p> <p>c) <math>\frac{7000}{\pi} m^2</math></p> <p>d) No change Both areas are equal</p>	1

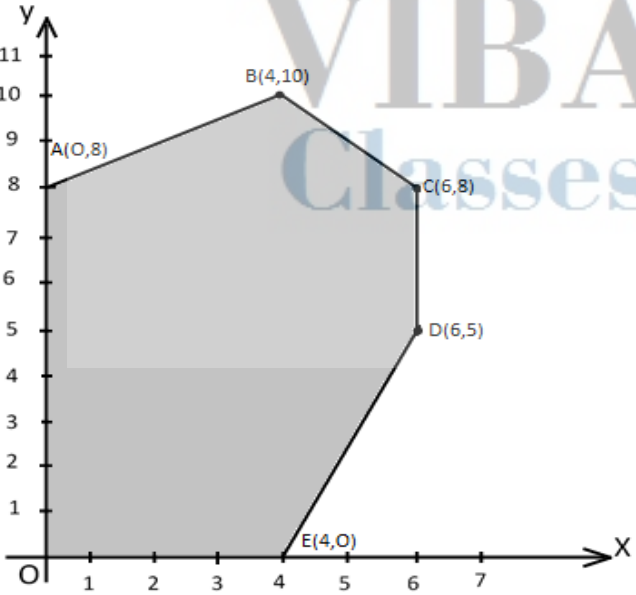
18	<p>In an office three employees Vinay, Sonia and Iqbal process incoming copies of a certain form. Vinay process 50% of the forms. Sonia processes 20% and Iqbal the remaining 30% of the forms. Vinay has an error rate of 0.06, Sonia has an error rate of 0.04 and Iqbal has an error rate of 0.03</p> <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 <b>NOT</b> 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 <sub>1</sub> , E <sub>2</sub> and E <sub>3</sub> 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
	<b>Part – B</b>	
	<b>Section III</b>	
	<b>VIBA Classes</b>	
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 . <p style="text-align: center;"><b>OR</b></p> 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
	<b>Section IV</b> <b>All questions are compulsory. In case of internal choices attempt any one.</b>	
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  <math>\vec{r} = 3\hat{i} + 2\hat{j} - 4\hat{k} + \lambda(\hat{i} + 2\hat{j} + 2\hat{k})</math>  and <math>\vec{r} = 5\hat{i} - 2\hat{j} + \mu(3\hat{i} + 2\hat{j} + 6\hat{k})</math>  If the lines intersect find their point of intersection</p> <p style="text-align: center;"><b>OR</b></p> <p>Find the foot of the perpendicular drawn from the point (-1, 3, -6) to the plane <math>2x + y - 2z + 5 = 0</math>. Also find the equation and length of the perpendicular.</p>	5
38	<p>Solve the following linear programming problem (L.P.P) graphically.  Maximize <math>Z = x + 2y</math>  subject to constraints ;  <math>x + 2y \geq 100</math>  <math>2x - y \leq 0</math>  <math>2x + y \leq 200</math>  <math>x, y \geq 0</math></p> <p style="text-align: center;"><b>OR</b></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 <math>Z = 3x - 4y</math> be the objective function. Find the maximum and minimum value of <math>Z</math> and also the corresponding points at which the maximum and minimum value occurs.</p>	

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