041/1/6 16-NOV-2021

PREBOARD EXAMINATION (2021-22)
TERM I-SET B

Subject: MATHEMATICS **Max. Marks: 40**
Grade: 12 **Time: 90 Minutes**
Name: **Section:** **Roll No:**

General Instructions:
1. The question paper contains three parts A, B and C
2. Section A consists of 20 questions of 1 mark each. Any 16 questions are to be attempted
3. Section B consists of 20 questions of 1 mark each. Any 16 questions are to be attempted
4. Section C consists of 10 questions (Q 41- Q 45 based on Case study) . Attempt any 8 questions.
5. There is no negative marking.

Section-A

In this section, attempt any 16 questions out of 1 – 20.
Each Question is of 1 mark weightage.

1. The maximum number of Equivalence relations on the set A = {1, 2, 3} are
a. 1 **b.** 2
c. 3 **d.** 5

2. If R be a relation defined as aRb iff $|a-b|>0$, then the relation is
a. Reflexive **b.** Symmetric
c. Transitive **d.** Symmetric and Transitive

3. $\cot\left\{\cos^{-1}\left(\frac{7}{25}\right)\right\} =$
a. $\frac{25}{24}$ **b.** $\frac{25}{7}$
c. $\frac{24}{25}$ **d.** None of these

4. $\tan^{-1}\frac{x}{\sqrt{a^2-x^2}}$ is equal to
a. $2\sin^{-1}\frac{x}{a}$ **b.** $\sin^{-1}\frac{2x}{a}$
c. $\sin^{-1}\frac{x}{a}$ **d.** $\cos^{-1}\frac{x}{a}$

5. Maximize Z = 3x + 4y, subject to the constraints x + y ≤ 1, x ≥ 0, y ≥ 0.
a. 4 **b.** 5
c. 6 **d.** 3

6. $\begin{bmatrix} 0 & a \\ b & 0 \end{bmatrix}^4 = I$,then

a. $a = 1 = 2b$

b. $a = b$

c. $a = b^2$

d. $ab = 1$

7. If k is a scalar and I is a unit matrix of order 3, then adj (kI) is equal to

a. $k^3 I$

b. $k^2 I$

c. $-k^3 I$

d. $-k^2 I$

8. The minors of -4 and 9 and the cofactors of -4 and 9 in matrix $\begin{bmatrix} -1 & -2 & 3 \\ -4 & -5 & -6 \\ -7 & 8 & 9 \end{bmatrix}$ are respectively

a. $42, 3, -42, 3$

b. $-42, -3, 42, -3$

c. $42, 3, -42, -3$

d. $42, 3, 42, 3$

9. If a square matrix A is such that $AA^T = I = A^T A$ then $|A|$ is equal to

a. 0

b. ± 1

c. ± 2

d. None of these

10. A is a square matrix of order 4 and I is a unit matrix, then it is true that

a. $det\,(2A) = 2det\,(A)$

b. $\det(2A) = 16\det\,(A)$

c. $\det(-A) = -\det(A)$

d. $\det(A + I) = det(A) + I$

11. The optimal value of the objective function is attained at the points:

a. Given the intersection of inequations with the axes only

b. Given by intersection of inequations with X-axis only

c. Given by corner points of the feasible region

d. None of these.

12. Let f(x)=| sin x | , then

a. f is everywhere differentiable

b. f is everywhere continuous but not differentiable at x = nπ, n ∈ Z

c. f is everywhere continuous but not differentiable at x = (2n + 1)π/2, n ∈ Z

d. None of these

13. If $f: R \to R$ is defined by

$$f(x) = \begin{cases} \dfrac{2\sin x - \sin 2x}{2x\cos x}, & \text{if } x \neq 0, \\ a, & \text{if } x = 0 \end{cases}$$

Then the value of a so that f is continuous at x = 0 is

a. 2

b. 1

c. -1

d. 0

14. If $y = \cos^2 \frac{3x}{2} - \sin^2 \frac{3x}{2}$, then $\frac{d^2y}{dx^2}$ is

a. $-3\sqrt{1 - y^2}$

b. 9y

c. -9y

d. $3\sqrt{1 - y^2}$

15. If $y = a\sin^3\theta$ and $x = a\cos^3\theta$, then at $\theta = \frac{\pi}{3}$, $\frac{dy}{dx}$ is equal to

a. $\frac{1}{\sqrt{3}}$

b. $-\sqrt{3}$

c. $\frac{-1}{\sqrt{3}}$

d. $\sqrt{3}$

16. If $y = \sqrt{x + \sqrt{x + \sqrt{x + \ldots \text{to } \infty}}}$, then $\frac{dy}{dx}$ is equal to

a. $\frac{x}{2y-1}$ **b.** $\frac{2}{2y-1}$

c. $-\frac{1}{2y-1}$ **d.** $\frac{1}{2y-1}$

17. If $y = \sin^{-1}\frac{x}{2} + \cos^{-1}\frac{x}{2}$, then the value of $\frac{dy}{dx}$ is

a. 1 **b.** -1

c. 0 **d.** 2

18. The function $f(x) = 2x^3 + 3x^2 - 12x + 1$ decreases in the interval

a. (2, 3) **b.** (1, 2)

c. (-2, 1) **d.** (-3, -2)

19. If $a^2x^4 + b^2y^4 = c^6$, then maximum value of xy is

a. $\frac{c^2}{\sqrt{ab}}$ **b.** $\frac{c^3}{ab}$

c. $\frac{c^3}{\sqrt{2ab}}$ **d.** $\frac{c^3}{2ab}$

20. The point on the curve $\sqrt{x} + \sqrt{y} = \sqrt{a}$ at which the normal is parallel to the x-axis, is

a. $(0, 0)$ **b.** $(0, a)$

c. $(a, 0)$ **d.** (a, a)

Section-B

In this section, attempt any 16 questions out of the questions 21 – 40.

Each Question is of 1 mark weightage

21. Which of the following functions from Z to itself are bijections?

a. $f(x) = x^3$ **b.** $f(x) = x + 2$

c. $f(x) = 2x + 1$ **d.** $f(x) = x^2 + x$

22. The relation $R = \{(1,1), (2,2), (3,3)\}$ on the set $\{1, 2, 3\}$ is

a. Symmetric only **b.** Reflexive only

c. An Equivalence Relation **d.** Transitive only

23. The value of $\tan\left\{\cos^{-1}\left(-\frac{2}{7}\right) - \frac{\pi}{2}\right\}$ is

a. $\frac{2}{3\sqrt{5}}$ **b.** $\frac{2}{3}$

c. $\frac{1}{\sqrt{5}}$ **d.** $\frac{4}{\sqrt{5}}$

24. The value of

$\sin^{-1}\left[\cos\left(\frac{33\pi}{5}\right)\right]$ is

a. $\frac{3\pi}{5}$ **b.** $\frac{-7\pi}{5}$

c. $\frac{\pi}{10}$ **d.** $-\frac{\pi}{10}$

25. Corner points of the feasible region determined by the system of linear constraints are (0, 3), (1, 1) and (3, 0). Let Z = px + qy, where p, q $>$ 0. Condition on p and q so that the minimum of Z occurs at (3,0) and (1, 1) is

a. p = 2q **b.** p = q/2
c. p = 3q **d.** p = q

26. If $A = \begin{bmatrix} \cos^2\alpha & \cos\alpha\sin\alpha \\ \cos\alpha\sin\alpha & \sin^2\alpha \end{bmatrix}$ and $A = \begin{bmatrix} \cos^2\beta & \cos\alpha\sin\beta \\ \cos\beta\sin\beta & \sin^2\beta \end{bmatrix}$ are two matrices such that the product AB is null matrix, then $\alpha - \beta$ is

a. 0 **b.** Multiple of π
c. An odd multiple of $\pi/2$ **d.** None of the above

27. If $f(x) = x^2 - 5x, A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$, then $f(\mathrm{A})$ is equal to

a. $\begin{bmatrix} -7 & 0 \\ 0 & -7 \end{bmatrix}$ **b.** $\begin{bmatrix} 0 & -7 \\ -7 & 0 \end{bmatrix}$
c. $\begin{bmatrix} 7 & 0 \\ 0 & 7 \end{bmatrix}$ **d.** $\begin{bmatrix} 0 & 7 \\ 7 & 0 \end{bmatrix}$

28. If A = $\begin{bmatrix} 0 & 3 & 3 \\ -3 & 0 & -4 \\ -3 & 4 & 0 \end{bmatrix}$ and $B = \begin{bmatrix} x \\ y \\ z \end{bmatrix}$, then $B'(AB)$is

a. Null Matrix **b.** Skew Symmetric Matrix
c. Symmetric Matrix **d.** Identity Matrix

29. The matrix $\begin{bmatrix} 5 & 10 & 3 \\ -2 & -4 & 6 \\ -1 & -2 & b \end{bmatrix}$ is a singular matrix, if b is equal to

a. -3 **b.** 3
c. 0 **d.** For any value of b

30. If $A = \begin{bmatrix} 1 & 2 \\ 3 & 5 \end{bmatrix}$, then the value of the determinant$|A^{2009} - 5A^{2008}|$is

a. -6 **b.** -5
c. -4 **d.** 4

31. $$If\ f(x) = \begin{cases} mx + 1, if\ x \leq \dfrac{\pi}{2} \\ \sin x + n, if\ x > \dfrac{\pi}{2} \end{cases}$$

is continuous at x = $\frac{\pi}{2}$, then

a. m = 1, n = 0 **b.** m = $\frac{n\pi}{2}$ + 1
c. n = $\frac{m\pi}{2}$ **d.** m = n = $\frac{\pi}{2}$

32. If $f(x) = 10\cos x + (13 + 2x)\sin x$, then $f''(x) + f(x) =$

a. $\cos x$ **b.** $4\cos x$
c. $\sin x$ **d.** $4\sin x$

33. If $x = a\sin\theta$ and $y = b\cos\theta$, then $\frac{d^2y}{dx^2}$ is equal to

a. $\frac{a}{b^2}\sec^2\theta$ **b.** $-\frac{b}{a}\sec^2\theta$

c. $\frac{b}{a^2}\sec^3\theta$

d. $-\frac{b}{a^2}\sec^3\theta$

34. If $y = e^{ax}\sin bx$, then $\frac{d^2y}{dx^2} - 2a\frac{dy}{dx} + a^2y$ is equal to

a. 0

b. 1

c. $-b^2y$

d. $-by$

35. If $\sec\left(\frac{x^2-y^2}{x^2+y^2}\right) = e^a$, then $\frac{dy}{dx}$ is equal to

a. $\frac{y^2}{x^2}$

b. $\frac{y}{x}$

c. $\frac{x}{y}$

d. $\frac{x^2-y^2}{x^2+y^2}$

36. Derivative of $\sec^{-1}\left(\frac{1}{1-2x^2}\right)$ w.r.t. $\sin^{-1}(3x-4x^3)$ is

a. $\frac{1}{4}$

b. $\frac{3}{2}$

c. 1

d. $\frac{2}{3}$

37. The point P of the curve $y^2 = 2x^3$ such that the tangent at P is perpendicular to the line $4x - 3y + 2 = 0$ is given by

a. $(2, 4)$

b. $(1, \sqrt{2})$

c. $(1/2, -1/2)$

d. $(1/8, -1/16)$

38. The function $f(x) = a\cos x + b\tan x + x$ has extreme values at $x = 0$ and $x = \frac{\pi}{6}$, then

a. $a = -\frac{2}{3}, b = -1$

b. $a = \frac{2}{3}, b = -1$

c. $a = -\frac{2}{3}, b = 1$

d. $a = \frac{2}{3}, b = 1$

39. The angle of intersection of the curves $y = x^2$ and $x = y^2$ is

a. $\tan^{-1}\left(\frac{4}{3}\right)$

b. $\tan^{-1}(1)$

c. $90°$

d. $\tan^{-1}\left(\frac{3}{4}\right)$

40. The maximum value of function $f(x) = \sin x\,(1 + \cos x), x \in R$ is

a. $\frac{3^{3/2}}{4}$

b. $\frac{3^{5/3}}{4}$

c. $\frac{3}{2}$

d. $\frac{3^{7/5}}{4}$

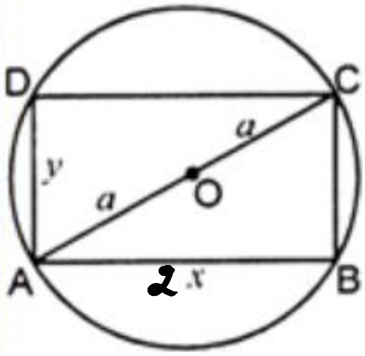
Section-C

In this section, attempt any 8 questions out of the 10 questions.

Each Question is of 1 mark weightage.

Questions 41- 45 are based on case study

A gardener wants to construct a rectangular bed of garden in a circular patch of land. He takes the maximum Perimeter of the rectangular region as possible. (Refer the images given below for calculations).



41 The Perimeter (P) of the rectangle is

a. $4x + 4\sqrt{a^2 - x^2}$ **b.** $x + \sqrt{a^2 - x^2}$

c. $4x + \sqrt{a^2 - x^2}$ **d.** $x + 4\sqrt{a^2 - x^2}$

42 To find the critical points put

a. $\frac{dp}{dx} > 0$ **b.** $\frac{dp}{dx} < 0$

c. $\frac{dp}{dx} = 0$ **d.** None of these

43 Value of y is

a. $\frac{a}{2}$ **b.** $\frac{a}{\sqrt{2}}$

c. 2a **d.** $\sqrt{2}a$

44 P is maximum when the rectangle is

a. Square **b.** Parallelogram

c. Rectangle **d.** Trapezium

45 If a rectangle of maximum Perimeter which can be inscribed in a circle of radius 10 cm is square then the side of the region is

a. $10\sqrt{8}$ cm **b.** $2\sqrt{10}\ cm$

c. $20\sqrt{2}\ cm$ **d.** $10\sqrt{2}$ cm

46 A mapping $f: N \to N$, where N is the set of natural numbers is defined as

$$f(n) = \begin{cases} n^2, \text{for } n \text{ odd} \\ 2n + 1, \text{for } n \text{ even} \end{cases}$$

For $n \in N$. Then, f is

a. Surjective but not injective **b.** Injective but not surjective

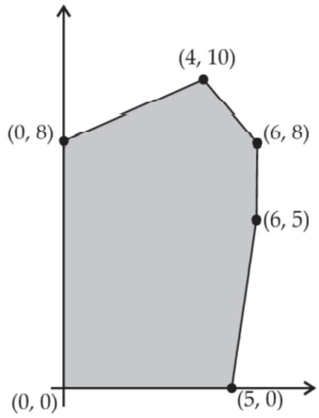
c. Bijective **d.** Neither injective nor surjective

47 Cos $[\tan^{-1}\{\sin(\cot^{-1} x)\}]$ is equal to

a. $\sqrt{\frac{x^2+2}{x^2+3}}$ **b.** $\sqrt{\frac{x^2+2}{x^2+1}}$

c. $\sqrt{\frac{x^2+1}{x^2+2}}$ **d.** None of these

48 The feasible solution for an LPP is shown in Figure. Let Z = 3x – 4y be the objective function. Minimum of Z occurs at



a. (0, 8) **b.** (0, 0)

c. (5, 0) **d.** (4, 10)

49 If $\begin{bmatrix} 1 & 1 & 1 \\ 1 & -2 & -2 \\ 1 & 3 & 1 \end{bmatrix}\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 3 \\ 4 \end{bmatrix}$, then $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$ is equal to

a. $\begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$ **b.** $\begin{bmatrix} 1 \\ 2 \\ -3 \end{bmatrix}$

c. $\begin{bmatrix} 5 \\ -2 \\ 1 \end{bmatrix}$ **d.** $\begin{bmatrix} 1 \\ -2 \\ 3 \end{bmatrix}$

50 If $y = \tan^{-1}\frac{\sqrt{1+x^2}-\sqrt{1-x^2}}{\sqrt{1+x^2}+\sqrt{1-x^2}}$, then $\frac{dy}{dx}$ is equal to

a. $\frac{x^2}{\sqrt{1-x^4}}$ **b.** $\frac{x^2}{\sqrt{1+x^4}}$

c. $\frac{x}{\sqrt{1+x^4}}$ **d.** $\frac{x}{\sqrt{1-x^4}}$

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