SUPER 10

CBSE Class 12 MATHEMATICS

2021-22 Term I Sample Papers with **OMR Sheets**

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Highlights

- 10 Fully Solved Sample Papers with Marking Scheme
- CBSE Sample Paper 2021-22 with Solution
- Objective Qns. & Solns. CBSE Sample 2020-21
- Objective Qns. & Solns. 2020 Solved Paper
- Objective Qns. & Solns. CBSE Question Bank
- Latest Revised CBSE Syllabus for 2021-22 (issued on 28-07-2021)
- Covers all new variety Qns - Case base & MCQs etc.
- Separate OMR Answer Sheet for each Sample Paper

Based on the Pattern of Sample Paper issued by CBSE on 2nd Sep, 2021

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CONTENTS OF FREE SAMPLE BOOK

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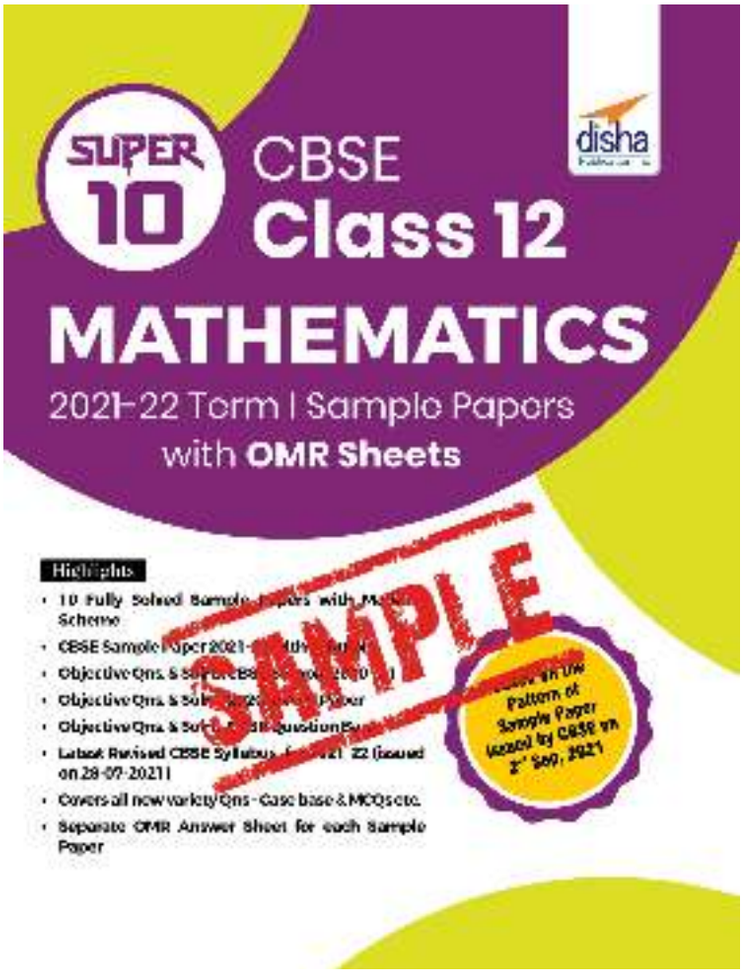

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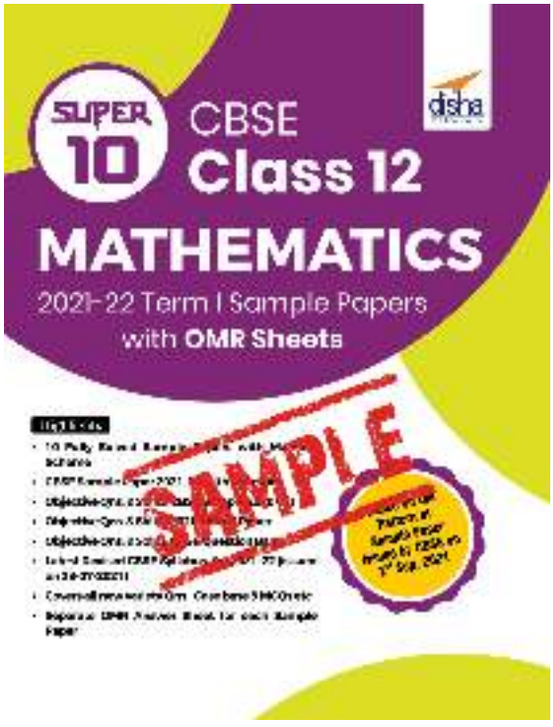
CONTENTS OF COMPLETE BOOK



Sample Paper 6

Time : 90 Minutes **Max Marks : 40**

General Instructions

1. *This question paper contains three sections – A, B and C. Each part is compulsory.*
2. *Section-A has **20** MCQs, attempt any **16** out of 20.*
3. *Section-B has **20** MCQs, attempt any **16** out of 20.*
4. *Section-C has **10** MCQs, attempt any **8** out of 10.*
5. *All questions carry equal marks.*
6. *There is no negative marking.*

SECTION-A

*In this section, attempt **any 16** questions out of questions 1-20. Each question is of 1 mark weightage.*

1. If $f(x)=\frac{1}{x+1}-\log(1+x), x>0$, then f is

(a) An increasing function (b) A decreasing function
(c) Both increasing and decreasing function (d) None of these

2. If $f(x)=x^2\sin\frac{1}{x}$, where $x \neq 0$, then the value of the function f at $x = 0$, so that the function is continuous at $x=0$, is

(a) 0 (b) -1 (c) 1 (d) None of these

3. $\begin{vmatrix}\log_3 512 & \log_4 3\\ \log_3 8 & \log_4 9\end{vmatrix}\times\begin{vmatrix}\log_2 3 & \log_8 3\\ \log_3 4 & \log_3 4\end{vmatrix}=$

(a) 7 (b) 10 (c) 13 (d) 17

4. If A is a square matrix such that $A^2 = A$, then $(I - A)^3 + A$ is equal to

(a) I (b) 0 (c) $I - A$ (d) $I + A$

5. The least value of k for which the function $x^2 + kx + 1$ is an increasing function in the interval $1 < x < 2$ is

(a) -4 (b) -3 (c) -1 (d) -2

6. If $f(x)=\begin{cases} mx+1, & \text{if } x\le\frac{\pi}{2}\\ \sin x+n, & \text{if } x>\frac{\pi}{2}\end{cases}$ 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) $m=n=\frac{\pi}{2}$

7. Let $f: R \to R$ be a function defined by $f(x) = x^3 + 4$, then f is

(a) injective (b) surjective

(c) bijective (d) None of these

8. If $\begin{bmatrix} 2+x & 3 & 4 \\ 1 & -1 & 2 \\ x & 1 & -5 \end{bmatrix}$ is a singular matrix, then x is

(a) $\frac{13}{25}$ (b) $-\frac{25}{13}$

(c) $\frac{5}{13}$ (d) $\frac{25}{13}$

9. Total number of possible matrices of order 3×3 with each entry 2 or 0 is

(a) 9 (b) 27 (c) 81 (d) 512

10. For the every value of x the function $f(x) = \frac{1}{5^x}$ is

(a) Decreasing (b) Increasing

(c) Neither increasing nor decreasing (d) Increasing for $x > 0$ and decreasing for $x < 0$

11. The number of all one-one functions from set $A = \{1, 2, 3\}$ to itself is

(a) 2 (b) 6 (c) 3 (d) 1

12. If $y = \log\left(\frac{1-x^2}{1+x^2}\right)$, then $\frac{dy}{dx}$, is equal to

(a) $\frac{4x^3}{1-x^4}$ (b) $\frac{-4x}{1-x^4}$

(c) $\frac{1}{4-x^4}$ (d) $\frac{-4x^3}{1-x^4}$

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

(a) $x = 3, y = 1$ (b) $x = 2, y = 3$

(c) $x = 2, y = 4$ (d) $x = 3, y = 3$

14. The sum of the products of the elements of any row of a determinant A with the co-factor of same row is always equal to

(a) 1 (b) 0 (c) $|A|$ (d) $\frac{1}{2}|A|$

15. If A and B are two matrices of the order $3 \times m$ and $3 \times n$, respectively and $m = n$, then order of mamtrix $(5A - 2B)$ is

(a) $m \times 3$ (b) 3×3

(c) $m \times n$ (d) $3 \times n$

16. On the interval (1, 3), the function $f(x) = 3x + \frac{2}{x}$ is

(a) Strictly decreasing (b) Strictly increasing

(c) Decreasing in (2, 3) only (d) Neither increasing nor decreasing

17. The solution set of constraints $x + 2y \geq 11$, $3x + 4y \leq 30$, $2x + 5y \leq 30$ and $x \geq 0$, $y \geq 0$, includes the point

(a) (2, 3) (b) (3, 2) (c) (3, 4) (d) (4, 3)

18. If $A = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$, then A^2 is equal to

(a) $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 0 \\ 1 & 0 \end{bmatrix}$

(c) $\begin{bmatrix} 0 & 1 \\ 0 & 1 \end{bmatrix}$ (d) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

19. If $y = \sqrt{\sin x + y}$, then $\frac{dy}{dx}$ is equal to

(a) $\frac{\cos x}{2y - 1}$ (b) $\frac{\cos x}{1 - 2y}$

(c) $\frac{\sin x}{1 - 2y}$ (d) $\frac{\sin x}{2y - 1}$

20. If matrix $A = [a_{ij}]_{2 \times 2}$, where $a_{ij} = 1$, if $i \neq j$ and 0 if $i = j$, then A^2 is equal to

(a) I (b) A (c) 0 (d) None of these

SECTION - B

*In this section, attempt **any 16** questions out of the questions 21-40. Each question is of 1 mark weightage.*

21. The function $f(x) = \tan x - x$:

(a) always increases (b) always decreases

(c) never decreases (d) some times increases and some times decreases

22. The number of equivalence relations in the set {1, 2, 3} containing (1, 2) and (2, 1) is

(a) 2 (b) 3 (c) 1 (d) 4

23. The minors of – 4 and 9 and the co-factors of – 4 and 9 in determinant $\begin{vmatrix} -1 & -2 & 3 \\ -4 & -5 & -6 \\ -7 & 8 & 9 \end{vmatrix}$ are respectively.

(a) 42, 3; – 42, 3 (b) – 42, –3; 42, – 3 (c) 42, 3; – 42, – 3 (d) 42, 3; 42, 3

24. If $f'(x)$ is zero in the interval (a, b), then in this interval it is

(a) Increasing function (b) Decreasing function

(c) Only for $a > 0$ and $b > 0$ is increasing function (d) None of these

25. The derivative of $\cos^{-1}(2x^2 - 1)$ w.r.t. $\cos^{-1}x$ is

(a) 2 (b) $\frac{-1}{2\sqrt{1 - x^2}}$

(c) $\frac{2}{x}$ (d) $1 - x^2$

26. If $x = t^2$ and $y = t^3$, then $\frac{d^2y}{dx^2}$ is equal to

(a) $\frac{3}{2}$ (b) $\frac{3}{4t}$ (c) $\frac{3}{2t}$ (d) $\frac{3}{2t}$

27. The function $f(x) = \cot^{-1} x + x$ increases in the interval

(a) $(1, \infty)$ (b) $(-1, \infty)$ (c) $(-\infty, \infty)$ (d) $(0, \infty)$

28. If $f : R \to S$, defined by $f(x) = \sin x - \sqrt{3}\cos x + 1$, is onto, then the interval of S is

(a) $[-1, 3]$ (b) $[-1, 1]$ (c) $[0, 1]$ (d) $[0, 3]$

29. If $A = \begin{vmatrix} 5 & 6 & 3 \\ -4 & 3 & 2 \\ -4 & -7 & 3 \end{vmatrix}$, then co-factors of the elements of 2nd row are,

(a) 39, –3, 11 (b) –39, 3, 11

(c) –39, 27, 11 (d) –39, –3, 11

30. Let R be the relation in the set {1, 2, 3, 4} given by R = {(1, 2), (2, 2), (1, 1), (4, 4), (1, 3), (3, 3), (3, 2)}. Choose the correct answer.

(a) R is reflexive and symmetric but not transitive. (b) R is reflexive and transitive but not symmetric.

(c) R is symmetric and transitive but not reflexive. (d) R is an equivalence relation.

31. The co-ordinates of the point on the curve $y = x^2 - 3x + 2$ where the tangent is perpendicular to the straight line $y = x$ are

(a) (0, 2) (b) (1, 0)

(c) (– 1, 6) (d) (2, – 2)

32. The maximum value of xy subject to x + y = 8 is:

(a) 8 (b) 16 (c) 20 (d) 24

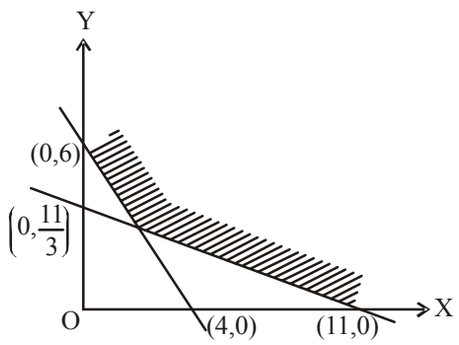
33. $\cos^{-1}\frac{1}{2} + 2\sin^{-1}\frac{1}{2}$ is equal to

(a) $\pi/4$ (b) $\pi/6$ (c) $\pi/3$ (d) $2\pi/3$

34. The matrix $\begin{bmatrix} 0 & -5 & 8 \\ 5 & 0 & 12 \\ -8 & -12 & 0 \end{bmatrix}$ is a

(a) diagonal matrix (b) symmetric matrix (c) skew-symmetric matrix (d) scalar matrix

35. For the following feasible region, the linear constraints are



(a) $x \geq 0,\ y \geq 0,\ 3x + 2y \geq 12,\ x + 3y \geq 11$ (b) $x \geq 0,\ y \geq 0,\ 3x + 2y \leq 12,\ x + 3y \geq 11$

(c) $x \geq 0,\ y \geq 0,\ 3x + 2y \leq 12,\ x + 3y \leq 11$ (d) None of these

36. If normal to the curve $y = f(x)$ is parallel to x-axis, then correct statement is

(a) $\frac{dy}{dx} = 0$ (b) $\frac{dy}{dx} = 1$

(c) $\frac{dx}{dy} = 0$ (d) None of these

37. The matrix $P = \begin{bmatrix} 0 & 0 & 4 \\ 0 & 4 & 0 \\ 4 & 0 & 0 \end{bmatrix}$ is

(a) square matrix (b) diagonal matrix

(c) unit matrix (d) None of these

38. If $\begin{vmatrix} a & b & 0 \\ 0 & a & b \\ b & 0 & a \end{vmatrix} = 0, (a \neq 0)$ then

(a) a is one of cube root of unity (b) b is one of cube root of unity

(c) (a/b) is one of cube root of unity (d) (b/a) is one of cube root of -1

39. Let $f(x) = \begin{cases} \frac{x^3 + x^2 - 16x + 20}{(x-2)^2}, & \text{if } x \neq 2 \\ k & \text{if } x = 2 \end{cases}$.

If f(x) be continuous for all x, then k =

(a) 7 (b) –7 (c) ±7 (d) None of these

40. Angle between the tangents to the curve $y = x^2 - 5x + 6$ at the points (2, 0) and (3, 0) in

(a) $\pi/3$ (b) $\pi/2$ (c) $\pi/6$ (d) $\pi/4$

SECTION - C

*In this section, attempt **any 8** questions. Each question is of 1 mark weightage. Questions 46-50 are based on a case-study.*

41. If $A = \begin{bmatrix} \alpha & 0 \\ 1 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 0 \\ 5 & 1 \end{bmatrix}$, then value of α for which $A^2 = B$, is

(a) 1 (b) –1 (c) 4 (d) no real values

42. If $A = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$, then $A^2 + 2A$ equals

(a) 4A (b) 3A (c) 2A (d) A

43. The order of the single matrix obtained from $\begin{bmatrix} 1 & -1 \\ 0 & 2 \\ 2 & 3 \end{bmatrix} \left\{ \begin{bmatrix} -1 & 0 & 2 \\ 2 & 0 & 1 \end{bmatrix} - \begin{bmatrix} 0 & 1 & 23 \\ 1 & 0 & 21 \end{bmatrix} \right\}$ is

(a) 2×3 (b) 2×2 (c) 3×2 (d) 3×3

44. If the matrix equation $\begin{bmatrix} x^2 \\ y^2 \end{bmatrix} - 3\begin{bmatrix} x \\ 2y \end{bmatrix} = \begin{bmatrix} -2 \\ -9 \end{bmatrix}$, then the values of x and y are

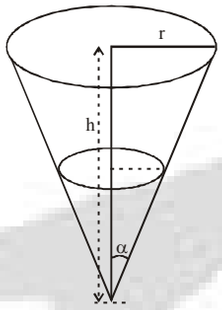
(a) (1, 3) (b) (2, 3) (c) both (a) & (b) (d) None of these

45. If $A = \begin{bmatrix} 1 & 0 \\ -1 & 7 \end{bmatrix}$ and $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, then the value of k so that $A^2 = 8A + kI$ is

(a) $k = 7$ (b) $k = -7$ (c) $k = 0$ (d) None of these

Case Study

A group of class XII students had to analyse the water in a water tank has the shape of an inverted right circular cone with its axis vertical and vertex lowermost. Its semi-vertical angle is $\tan^{-1}(0.5)$. Water is poured into it at a constant rate of 5 cubic metre per hour. The figure of the water tank is given below.



In the class, teacher asked the following questions to the students who analysed the scenario. [Use $\pi = \frac{22}{7}$]

46. The relation between r and h.

(a) $r = 2h$ (b) $h = 2r$ (c) $r^2 = h$ (d) $h^2 = r$

47. The rate at which the level of water is rising at instant when the depth of water in the tank is 4 m.

(a) $\frac{35}{88}$ m/h (b) $\frac{25}{88}$ m/h (c) $\frac{53}{88}$ m/h (d) $\frac{35}{53}$ m/h

48. The relation between volume (V), surface area (S) and radius (r) is

(a) $V^2 = \frac{1}{9}Sr^2(S - 2\pi r^2)$ (b) $V^2 = \frac{2}{9}Sr^2(S - 2\pi r^2)$

(c) $V^2 = \frac{1}{9}Sr(S - 2\pi r)$ (d) $V^2 = \frac{1}{9}Sr^2(S - \pi r^2)$

49. The surface area for which volume of water tank is maximum

(a) $S = 2\pi r^2$ (b) $S = 4\pi r^2$ (c) $S = \pi r^2$ (d) $S = 8\pi r^2$

50. What is the maximum volume of the water tank?

(a) $V = \frac{\pi}{3}r^2\sqrt{8\pi r^2 - 1}$ (b) $V = \frac{2\pi}{3}r^2\sqrt{8\pi r^2 - 1}$

(c) $V = \frac{\sqrt{2\pi}}{3}r^2\sqrt{8\pi r^2 - 1}$ (d) $V = \frac{2}{9}r^2\sqrt{8\pi r^2 - 1}$

OMR ANSWER SHEET

Sample Paper No – ☐

- ✶ Use Blue / Black Ball pen only.
- ✶ Please do not make any atray marks on the answer sheet.
- ✶ Rough work must not be done on the answer sheet.
- ✶ Darken one circle deeply for each question in the OMR Answer sheet, as faintly darkend / half darkened circle might by rejected.

Start time : _____ End time _____ Time taken _____

1. Name (in Block Letters)

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

2. Date of Exam

☐☐ ☐☐ ☐☐

3. Candidate's Signature ☐

SECTION-A

1.	(a)	(b)	(c)	(d)	9.	(a)	(b)	(c)	(d)	17.	(a)	(b)	(c)	(d)
2.	(a)	(b)	(c)	(d)	10.	(a)	(b)	(c)	(d)	18.	(a)	(b)	(c)	(d)
3.	(a)	(b)	(c)	(d)	11.	(a)	(b)	(c)	(d)	19.	(a)	(b)	(c)	(d)
4.	(a)	(b)	(c)	(d)	12.	(a)	(b)	(c)	(d)	20.	(a)	(b)	(c)	(d)
5.	(a)	(b)	(c)	(d)	13.	(a)	(b)	(c)	(d)					
6.	(a)	(b)	(c)	(d)	14.	(a)	(b)	(c)	(d)					
7.	(a)	(b)	(c)	(d)	15.	(a)	(b)	(c)	(d)					
8.	(a)	(b)	(c)	(d)	16.	(a)	(b)	(c)	(d)					

SECTION-B

21.	(a)	(b)	(c)	(d)	29.	(a)	(b)	(c)	(d)	37.	(a)	(b)	(c)	(d)
22.	(a)	(b)	(c)	(d)	30.	(a)	(b)	(c)	(d)	38.	(a)	(b)	(c)	(d)
23.	(a)	(b)	(c)	(d)	31.	(a)	(b)	(c)	(d)	39.	(a)	(b)	(c)	(d)
24.	(a)	(b)	(c)	(d)	32.	(a)	(b)	(c)	(d)	40.	(a)	(b)	(c)	(d)
25.	(a)	(b)	(c)	(d)	33.	(a)	(b)	(c)	(d)					
26.	(a)	(b)	(c)	(d)	34.	(a)	(b)	(c)	(d)					
27.	(a)	(b)	(c)	(d)	35.	(a)	(b)	(c)	(d)					
28.	(a)	(b)	(c)	(d)	36.	(a)	(b)	(c)	(d)					

SECTION-C

41.	(a)	(b)	(c)	(d)	45.	(a)	(b)	(c)	(d)	49.	(a)	(b)	(c)	(d)
42.	(a)	(b)	(c)	(d)	46.	(a)	(b)	(c)	(d)	50.	(a)	(b)	(c)	(d)
43.	(a)	(b)	(c)	(d)	47.	(a)	(b)	(c)	(d)					
44.	(a)	(b)	(c)	(d)	48.	(a)	(b)	(c)	(d)					

No. of Qns. Attempted		Correct		Incorrect		Marks	

Page for Rough Work

Sample Paper 6

ANSWER KEYS																			
1	(b)	**6**	(c)	**11**	(b)	**16**	(b)	**21**	(a)	**26**	(b)	**31**	(b)	**36**	(c)	**41**	(d)	**46**	(b)
2	(a)	**7**	(c)	**12**	(b)	**17**	(c)	**22**	(a)	**27**	(c)	**32**	(b)	**37**	(a)	**42**	(b)	**47**	(a)
3	(b)	**8**	(b)	**13**	(b)	**18**	(d)	**23**	(b)	**28**	(a)	**33**	(d)	**38**	(d)	**43**	(d)	**48**	(a)
4	(a)	**9**	(d)	**14**	(c)	**19**	(a)	**24**	(d)	**29**	(c)	**34**	(c)	**39**	(a)	**44**	(c)	**49**	(b)
5	(d)	**10**	(a)	**15**	(d)	**20**	(a)	**25**	(a)	**30**	(b)	**35**	(a)	**40**	(b)	**45**	(b)	**50**	(c)

SOLUTIONS

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

3. **(b)** $\begin{vmatrix}\log_3 512 & \log_4 3\\ \log_3 8 & \log_4 9\end{vmatrix}\times\begin{vmatrix}\log_2 3 & \log_8 3\\ \log_3 4 & \log_3 4\end{vmatrix}$

$$=\left(\frac{\log 512}{\log 3}\times\frac{\log 9}{\log 4}-\frac{\log 3}{\log 4}\times\frac{\log 8}{\log 3}\right)\times\left(\frac{\log 3}{\log 2}\times\frac{\log 4}{\log 3}-\frac{\log 3}{\log 8}\times\frac{\log 4}{\log 3}\right)$$

$$=\left(\frac{\log 2^9}{\log 3}\times\frac{\log 3^2}{\log 2^2}-\frac{\log 2^3}{\log 2^2}\right)\times\left(\frac{\log 2^2}{\log 2}-\frac{\log 2^2}{\log 2^3}\right)$$

$$=\left(\frac{9\times 2}{2}-\frac{3}{2}\right)\left(2-\frac{2}{3}\right)=\frac{15}{2}\times\frac{4}{3}=10.$$

4. **(a)**

5. **(d)** To be increasing, $\frac{d}{dx}\left(x^2+kx+1\right)>0\Rightarrow 2x+k>0.$

For $x\in(1,2)$, the least value of k is –2.

6. **(c)**

7. **(c)** Let $f(x_1)=f(x_2)$ for $x_1, x_2 \in R$.

$\Rightarrow \quad x_1^3+4=x_2^3+4 \Rightarrow x_1^3-x_2^3=0$

$\Rightarrow \quad (x_1+x_2)(x_1^2+x_2^2+x_1x_2)=0$

$\Rightarrow \quad (x_1-x_2)\left(\left(x_1+\frac{x_2}{2}\right)^2+\frac{3}{4}x^2\right)=0$

$x_1-x_2=0\Rightarrow x_1=x_2$ $\therefore$ f is one-one.

Let $k\in R$.

$f(x)=k\Rightarrow x^3+4=k\Rightarrow x=(k-4)^{1/3}\in R$

$\therefore$ f is onto

8. **(b)**

9. **(d)** Since, total number of possible matrices of order 3×3 with each entry 2 or $0=(1+1)^9=2^9=512$

10. **(a)** $f(x)=5^{-x}\Rightarrow f'(x)=-5^{-x}\log_e 5=-\frac{\log_e 5}{5^x}$

$\Rightarrow f'(x)<0$ for all x

i.e., f(x) is decreasing for all x.

11. **(b)** One-one function from {1, 2, 3} to itself is simply a permutation on three symbols 1, 2, 3. Therefore, total number of one-one maps from {1, 2, 3} to itself is same as total number of permutations on symbols 1, 2, 3, which is 3! = 6.

12. **(b)**

13. **(b)** Here, $4x = x + 6$

$\Rightarrow \quad x = 2$ [By comparison of matrices]

and $4x = 7y - 13 \Rightarrow 8 = 7y - 13 \Rightarrow y = 3$

14. **(c)** We know that the row to row multiplication of a determinant is always equal to the value of the determinant *i.e.*, |A|.

15. **(d)** As, $m = n$, so A and B are of same orders $3 \times n$

Hence, the order of matrix $(5A - 2B)$ is same as $3 \times n$

16. **(b)** $f(x)=3x+\frac{2}{x}\Rightarrow f'(x)=3-\frac{2}{x^2}$

Clearly $f'(x) > 0$ on the interval (1, 3)

$\therefore f(x)$ is strictly increasing.

17. **(c)** Obviously, solution set of constraints included the point (3, 4).

18. **(d)** $A^2=\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}.\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$

19. **(a)**

20. **(a)** Since, $A=[a_{ij}]_{2\times 2}$, where $a_{ij}=1$, if $i\neq j$ and 0 if $i=j$

So, $A=\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}$. Hence $A^2=\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}\begin{bmatrix}0 & 1\\ 1 & 0\end{bmatrix}=\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}=I$

21. **(a)** Given function : $f(x) = \tan x - x$ ...(i)

Differentiating the eq. (i), we get

$f'(x) = \sec^2 x - 1$ at $x = 0$

$f'(0) = \sec^2 0 - 1 = (1)^2 - 1 = 1 - 1$

$f(0) = 0$ i.e. $f(x)$ is always increase.

22. **(a)** The smallest equivalence relation R_1 containing (1, 2) and (2, 1) is {(1, 1), (2, 2), (3,3), (1, 2), (2,1)}. Now, we are left with only 4 pairs namely (2, 3), (3, 2), (1, 3) and (3, 1). If we add any one, say (2, 3) to R_1, then for symmetry we must add (3, 2) also and now for transitivity we are forced to add (1 , 3) and (3, 1). Thus, the only equivalence relation bigger than R_1 is the universal relation. This shows that the total number of equivalence relations containing (1, 2) and (2, 1) is two.

23. **(b)**

24. **(d)** If the function is monotonic, then its value must change according to its monotonocity.

25. **(a)**

26. **(b)**

27. **(c)** $f'(x) = -\dfrac{1}{1+x^2} + 1$

$f'(x) = \dfrac{x^2}{1+x^2} \Rightarrow f'(x) \geq 0$

$\Rightarrow$ Always increasing

28. **(a)** $f(x)$ is onto $\therefore S =$ range of $f(x)$

Now $f(x) = \sin x - \sqrt{3}\cos x + 1 = 2\sin\left(x - \dfrac{\pi}{3}\right) + 1$

$\because -1 \leq \sin\left(x - \dfrac{\pi}{3}\right) \leq 1 \Rightarrow -1 \leq 2\sin\left(x - \dfrac{\pi}{3}\right) + 1 \leq 3$

$\therefore f(x) \in [-1,\ 3] = S$

29. **(c)**

30. **(b)**

31. **(b)** $y = x^2 - 3x + 2 \Rightarrow \dfrac{dy}{dx} = 2x - 3 = -1 \Rightarrow x = 1$

At $x = 1, y = 0$

$\therefore$ point is (1, 0).

32. **(b)** (xy) will be maximum at $\dfrac{x}{1} = \dfrac{y}{1} = \dfrac{8}{1+1}$

$\Rightarrow x = 4, y = 4$

$\therefore$ Maximum value of $xy = 4 \times 4 = 16$

33. **(d)** $\cos^{-1}\dfrac{1}{2} + 2\sin^{-1}\dfrac{1}{2} = \dfrac{\pi}{3} + \dfrac{2\pi}{6} = \dfrac{2\pi}{3}$

34. **(c)** **35.** **(a)** **36.** **(c)**

37. **(a)** Since, number of rows = number of columns = 3

Hence, the matrix $P = \begin{bmatrix} 0 & 0 & 4 \\ 0 & 4 & 0 \\ 4 & 0 & 0 \end{bmatrix}$ is a square matrix.

38. **(d)** $a^3 + b^3 = 0 \Rightarrow b^3 = -a^3$

$\dfrac{b^3}{a^3} = -1 \Rightarrow \dfrac{b}{a} = (-1)^{1/3} \quad (\because a \neq 0)$

39. **(a)**

40. **(b)**

41. **(d)** Given that $A = \begin{bmatrix} \alpha & 0 \\ 1 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 0 \\ 5 & 1 \end{bmatrix}$

and $A^2 = B$

$\Rightarrow \begin{bmatrix} \alpha & 0 \\ 1 & 1 \end{bmatrix}\begin{bmatrix} \alpha & 0 \\ 1 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 5 & 1 \end{bmatrix} \Rightarrow \begin{bmatrix} \alpha^2 & 0 \\ \alpha + 1 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 5 & 1 \end{bmatrix}$

$\Rightarrow \alpha^2 = 1, \alpha + 1 = 5 \quad \Rightarrow \alpha = \pm 1, \alpha = 4$

$\because$ There is no common value

$\therefore$ There is no real value of α for which $A^2 = B$

42. **(b)** $A^2 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = A$

$\therefore A^2 + 2A = A + 2A = 3A$

43. **(d)** When a 3×2 matrix is post multiplied by a 2×3 matrix, the product is a 3×3 matrix.

44. **(c)** $\begin{bmatrix} x^2 \\ y^2 \end{bmatrix} - 3\begin{bmatrix} x \\ 2y \end{bmatrix} = \begin{bmatrix} x^2 - 3x \\ y^2 - 6y \end{bmatrix} = \begin{bmatrix} -2 \\ -9 \end{bmatrix}$

Now equating the elements $x^2 - 3x = -2$ on solving this $x = 1, 2$

And $y^2 - 6y = -9$ on solving this $y = 3$

45. **(b)** We have, $A^2 = \begin{bmatrix} 1 & 0 \\ -1 & 7 \end{bmatrix}\begin{bmatrix} 1 & 0 \\ -1 & 7 \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ -8 & 49 \end{bmatrix}$

and $8A + kI = 8\begin{bmatrix} 1 & 0 \\ -1 & 7 \end{bmatrix} + k\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

$= \begin{bmatrix} 8 & 0 \\ -8 & 56 \end{bmatrix} + \begin{bmatrix} k & 0 \\ 0 & k \end{bmatrix} = \begin{bmatrix} 8+k & 0 \\ -8 & 56+k \end{bmatrix}$

Thus, $A^2 = 8A + kI \Rightarrow \begin{bmatrix} 1 & 0 \\ -8 & 49 \end{bmatrix} = \begin{bmatrix} 8+k & 0 \\ -8 & 56+k \end{bmatrix}$

$\Rightarrow 1 = 8 + k$ and $56 + k = 49 \quad \Rightarrow k = -7$

46. **(b)** **47.** **(a)** **48.** **(a)** **49.** **(b)** **50.** **(c)**