

QUESTION 1

1. Consider the following statements :

I. $\frac{d}{dx} \ln|x| = -\frac{1}{x}$ if $x < 0$

II. $\frac{d}{dx} \ln|x| = \frac{1}{x}$ if $x > 0$

Which of the statements given above is/are correct?

(a) I only

(b) II only ✓

(c) Both I and II

(d) Neither I nor II

QUESTION 2

2. If $y = \left| \sin\left(\frac{\pi}{4} - x\right) \right|$, then what is $\frac{dy}{dx}$ at

$x = \frac{\pi}{4}$ equal to?

(a) -1

(b) 0

(c) 1

(d) It does not exist ✓

QUESTION 3

3. Let f be a differentiable function such that $f(x+y) = f(x) + f(y)$ for all $x, y \in \mathbb{R}$. Which of the following statements is/are correct?

- I. If $f(x) = xg(x)$, then the derivative of $f(x)$ with respect to x is equal to $g(0)$.
- II. If $f(x) = x^2g(x)$, then the derivative of $f(x)$ with respect to x is equal to 0.

(Here g is a continuous function)

Select the answer using the code given below.

- (a) I only ✓
- (b) II only
- (c) Both I and II
- (d) Neither I nor II

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QUESTION 4

4. If

$$f(x) = x^{n-1} + x^{n-2} + x^{n-3} + \dots + 1$$

then what is $f'(2)$ equal to?

- (a) $n2^{n-1} - 2^n + 1$ ✓
- (b) $n2^n - 2^{n-1} + 1$
- (c) $n2^{n-1} - 2^n - 1$
- (d) $(n-1)2^{n-2} - 2^{n-1} + 1$

QUESTION 5

5. ABC is a triangle right angled at B . If $AC = 8$ units, then what is the area of the triangle of maximum area?

- (a) 32 square units
- (b) 24 square units
- (c) 16 square units
- (d) 12 square units

~~$y = x^2 + x$~~

QUESTION 6

6. For the curve $y = xe^{2x}$

- (a) minimum occurs at $x = -2$
- (b) minimum occurs at $x = -1$
- (c) minimum occurs at $x = -1/2$
- (d) maximum occurs at $x = -1/2$



QUESTION 7

7. Let $f(x) = \int x e^x dx$. Then $f(x)$ decreases in the interval

(a) $(-\infty, 0)$

(b) $(0, \infty)$

(c) $(-\infty, -1)$

(d) $(-1, \infty)$

$f(x) = \int x e^x dx$
 $f(x) = x e^x +$

[P.T.O.]

QUESTION 8

8. What is the solution of the differential equation $\frac{dy}{dx} = 1 + x \cot(y - x)$?

(a) $\sec(y - x) = c e^{\frac{x^2}{2}}$ ✓

(b) $\cos(y - x) = c e^{\frac{x^2}{2}}$

(c) $\operatorname{cosec}(y - x) = c e^{\frac{x^2}{2}}$

(d) $\sin(y - x) = c e^{\frac{x^2}{2}}$

QUESTION 9

9. Consider the following statements in respect of the function

$$f : R - \left\{ \frac{3}{5} \right\} \rightarrow R - \left\{ \frac{3}{5} \right\}$$

such that $f(x) = \frac{3x+2}{5x-3}$:

- I. $f(x)$ is a bijective function.
- II. $f^{-1}(x) = f(x)$

Which of the statements given above is/are correct? 1

- (a) I only
- (b) II only
- (c) Both I and II ✓
- (d) Neither I nor II

QUESTION 10

10. Let A and B be the sets having only 2 and 3 elements respectively. What is the total number of mappings from A to B ? 1

- (a) 4
- (b) 6
- (c) 8
- (d) 9 ✓

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QUESTION 11

1. What is $\int \frac{\sqrt{x}}{\sqrt{1-x^3}} dx$ equal to?

(a) $\frac{x^{3/2}}{3} + c$

(b) $\frac{2x^{3/2}}{3} + c$

(c) $\frac{1}{3} \sin^{-1}(x^{3/2}) + c$

(d) $\frac{2}{3} \sin^{-1}(x^{3/2}) + c$ ✓

12. What is $\int_{-2}^1 \frac{dx}{\sqrt{1-x^3}}$ equal to?

QUESTION 12

12. What is $\int \frac{1}{c(ax+bx+c)^2}$ equal to?

(a) $-\frac{1}{a+b+c}$

(b) $-\frac{1}{c(a+b+c)}$

(c) $\frac{1}{a+b+c}$

(d) $\frac{1}{c(a+b+c)}$ ✓

QUESTION 13

13. What is $\int e^{x \ln 10} e^x dx$ equal to?

(a) $\frac{(10e)^x}{1 + \ln 10} + c$ ✓

(b) $\frac{10e^x}{1 + \ln 10} + c$

(c) $\frac{e^{2x}}{2} + c$

(d) $\frac{e^{2x}}{4} + c$

$(10e)^x$

QUESTION 14

14. What is $\int_1^2 x^x (1 + \ln x) dx$ equal to?

(a) 4

(b) 3 ✓

(c) 2

(d) 1

| P.T.O.

QUESTION 15

5. If $f(x+y) = f(x) + f(y)$, then what is

$$\int_{-1}^1 f(x) dx$$

equal to?

(a) 0

(b) $\int_0^1 f(x) dx$

(c) $2 \int_0^1 f(x) dx$

(d) $2f(1)$

QUESTION 16

16. What is the area bounded by $y = e^{|x|}$ and the lines $|x| = 1$ and $y = 0$?

(a) $(e - 1)$ square units

(b) $(2e - 2)$ square units

(c) $2e$ square units

(d) $(2e - 1)$ square units

QUESTION 17

17. The slope of the tangent to the curve $y = f(x)$ at $(x, f(x))$ is $2x$. If the curve passes through the origin, then what is the area bounded by the curve, the x -axis and the line $x = 1$?

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- (a) $1/3$ square unit
- (b) $2/3$ square unit
- (c) 1 square unit
- (d) $4/3$ square units

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QUESTION 18

18. What is the solution of

$$y dx - x dy - y^2 \cos x dx = 0?$$

(a) $y = \frac{x}{c + \sin x}$

(b) $y = \frac{x}{c - \sin x}$

(c) $y = \frac{x}{1 + c \sin x}$

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

QUESTION 19

19. What is the differential equation of the family of straight lines passing through the origin?

(a) $y \frac{dy}{dx} - x = 0$

(b) $y \frac{dy}{dx} + x = 0$

(c) $x \frac{dy}{dx} - y = 0$ ✓

(d) $x \frac{dy}{dx} + y = 0$

QUESTION 20

20. What is the degree of the differential equation representing the family of curves $y^2 = \sqrt{c}x$, where c is a positive parameter?

(a) 1

(b) 2

(c) 3

(d) 4

$2y \cdot \frac{dy}{dx}$

[P.T.O.]

QUESTION 21

A circle touches each of the lines $x - y = 0$ and $x + y = 0$ at unit distance from the origin. The centre of the circle may be at

- (a) $(\sqrt{2}, 0)$
- (b) $(\sqrt{3}, 0)$
- (c) $(1, 0)$
- (d) $(1, 1)$

QUESTION 22

2. A line $(\sin \theta)x + (\cos \theta)y = \sin 2\theta$ cuts the coordinate axes at points P and Q . Let M be the midpoint of the line segment PQ . What is the distance of M from the origin?

$$\sin \theta x + \cos \theta y = \sin 2\theta$$

$$Q = \left(\frac{\sin 2\theta}{\cos \theta}, 0 \right)$$

- (a) 2
- (b) 1
- (c) $\cos \theta + \sin \theta$
- (d) $\cos \theta - \sin \theta$

23. The centre and one of the foci (F) of an ellipse are at $(0, 0)$ and $(-c, 0)$

QUESTION 23

respectively. If $P(x, y)$ is any point on the ellipse and $2a$ is the length of major axis, then what is PF equal to?

(a) $a - (cx / a)$

(b) $a - (ax / c)$

(c) $a + (ax / c)$

(d) $a + (cx / a)$

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QUESTION 24

1. What is the equation of the line which is equidistant from the lines $2x - 4y - 7 = 0$ and $6x - 12y + 1 = 0$?

(a) $12x - 24y - 21 = 0$

(b) $12x - 24y - 19 = 0$

(c) $3x - 6y - 5 = 0$

(d) $4x - 8y - 3 = 0$

QUESTION 25

5. A ray of light passing through the point $P(1, 2)$ reflects on the x -axis at point N and the reflected ray passes through the point $Q(5, 3)$. What is the distance of the point N from the origin?

- (a) 3 units
- (b) $14/5$ units
- (c) $13/5$ units
- (d) 2 units

[P.T.O.]

QUESTION 26

26. A line cuts off intercept p on the x -axis and intercept q on the y -axis, where $p > q$. The sum of the intercepts is 2 and the product of the intercepts is -15 . What is the equation of the line?

$$\begin{aligned}
 p + q &= 2 & pq &= -15 \\
 p &= 2 - q \\
 (2 - q)q &= -15 \\
 2q - q^2 &= -15 \\
 -q^2 + 2q + 15 &= 0 \\
 q^2 - 2q - 15 &= 0
 \end{aligned}$$

(a) $3x - 5y - 15 = 0$

(b) $3x - 5y + 15 = 0$

(c) $5x - 3y - 15 = 0$

(d) $5x + 3y - 15 = 0$

QUESTION 27

27. Let P and Q be the points on the positive x -axis and positive y -axis respectively. A point $N(2, 1)$ divides the line segment PQ in the ratio $1 : 2$. What is the equation of the line?

(a) $2x + y - 5 = 0$

(b) $x + y - 3 = 0$

(c) $x + 2y - 4 = 0$

(d) $x - y - 1 = 0$

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QUESTION 28

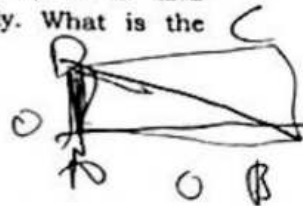
28. $ABCD$ is a square. The equations of AB , AD and BD are $y = 0$, $x = 0$ and $x + y - 4 = 0$ respectively. What is the equation of AC ?

(a) $x + y = 0$

(b) $x - y = 0$

(c) $x - y - 4 = 0$

(d) $x - y + 4 = 0$



QUESTION 29

29. ABC is a triangle, where the vertices A and B are fixed points both lying on the x -axis. Let $AB = 10$ cm. The vertex C moves such that $\frac{1}{\tan A} + \frac{1}{\tan B} = \frac{1}{k}$, where $k \neq 0$. What is the equation of the locus of the point C ?

(a) $y = 10k$

(b) $x = 10k$

(c) $ky = 10$

(d) $kx = 10$

QUESTION 30

30. What is the eccentricity (e) of the parabola $4x^2 + y = 0$?

(a) $e < 0$

(b) $0 < e < 1$

(c) $e = 1$

(d) $e > 1$

[P.T.O.]

QUESTION 31

31. The variance of 10 observations is 25. If 2 is multiplied to each of the observations and subsequently 7 is subtracted from each multiplied observation, then what is the new variance?

(a) 125

(b) 100

(c) 50

(d) 25

QUESTION 32

32. If the random variable X has mean 5 and standard deviation 4, then what is the standard deviation of the random variable $Y = 3X + 4$?

(a) 16

(b) 12

(c) 10

(d) 6

$$Y = 15 + 4$$

QUESTION 33

33. For a binomial distribution with mean 4 and standard deviation $\sqrt{3}$, what is the value of $P(X = 0)$?

(a) $\left(\frac{1}{4}\right)^{16}$

(b) $\left(\frac{3}{4}\right)^{16}$

(c) $\left(\frac{1}{4}\right)^{12}$

(d) $\left(\frac{3}{4}\right)^{12}$

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QUESTION 34

34. If the correlation coefficient between the variables X and Y is zero, then the two lines of regression are

(a) $X + Y + 11 = 0$ and $2X + 3Y + 4 = 0$

(b) $X = \bar{X}$ and $Y = \bar{Y}$

(c) $X = 0.4Y + 10$ and $Y = 1.6X + 20$

(d) $\bar{X} + \bar{Y} + 11 = 0$ and $2\bar{X} + 3\bar{Y} + 4 = 0$

33
34
b

QUESTION 35

35. Four dice are rolled. What is the probability of getting a total of the numbers on the dice as 7? 2×6

(a) $5/1296$

(b) $7/324$

(c) $7/1296$

(d) $5/324$

$b \times b = 36$
 $36 \times b = 216$
 $216 \times b = 1296$

QUESTION 36

36. If $P(A \cap B) = 1/2$ and $P(\bar{A} \cap \bar{B}) = 1/2$, and $2P(A) = P(B) = k$, then what is the value of k ?

(a) $1/4$

(b) $1/2$

(c) $1/3$

(d) $2/3$

QUESTION 37

37. A committee has 6 men and 4 women. One member is selected randomly which is woman only. What is the probability that she belongs to a subgroup of 2 senior women?

(a) $1/3$

(b) $1/2$

(c) $2/3$

(d) $3/4$

[P.T.O.]

QUESTION 38

38. The standard deviation of X is 4 and the standard deviation of Y is 5. If the correlation coefficient r is 0.8, then what is the regression coefficient of Y on X ?

(a) -2

(b) -1

(c) 0

(d) 1

QUESTION 39

39. In a class, the probability of passing students in Mathematics is 0.7 and the probability of passing both Mathematics and Statistics is 0.5. What is the probability that a student passes Statistics given that the student passed Mathematics?

(a) $5/7$

(b) $4/7$

(c) $3/7$

(d) $2/7$

QUESTION 40

40. If the mean of 50 observations is 40 and the standard deviation is 8, then what is the coefficient of variation?

(a) 15%

(b) 20%

(c) 25%

(d) 30%

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QUESTION 41

41. If two fair dice are tossed, then what is the probability that the sum of the numbers on the faces of the dice is neither 5 nor 7? → 31

- (a) $11/18$ (1,4) (1,6) (2,5) (2,3)
(b) $2/3$ (3,2) (3,4) (4,1) (4,3)
(c) $13/18$ (5,2) (6,1) 10
(d) $5/6$

$$1 - \frac{10}{36} = \frac{36-10}{36} = \frac{26}{36} = \frac{13}{18}$$

QUESTION 42

42. Consider the following statements for three events A, B and C :

- I. $P(A \cap B \cap C) \leq P(A) + P(B) + P(C) - 2$
II. $P(A \cup B \cup C) \geq P(A) + P(B) + P(C)$

Which of the statements given above is/are correct?

- (a) I only
(b) II only
(c) Both I and II
(d) Neither I nor II

QUESTION 43

43. A Mathematics problem is given to two students X and Y to solve. The odds in favour of X solving the problem are 6 to 9 and the odds against Y in solving the problem are 6 to 5. What is the probability that the problem will be solved if both X and Y try to solve the problem?

(a) $27/55$

(b) $31/55$

(c) $37/55$

(d) $39/55$

[P.T.O.]

QUESTION 44

44. The events A and B are independent among three events A , B and D . If $P(A \cap B \cap D) = 0.04$, $P(D|A \cap B) = 0.25$ and $P(B) = 4P(A)$, then what is the value of $P(A \cup B)$?

(a) 0.88

(b) 0.84

(c) 0.28

(d) 0.16

For the next **three (03)** items that follow :

Let A , B , C and D be mutually exclusive and exhaustive events such that

$$\frac{P(A)}{6} = \frac{P(B)}{3} = \frac{P(C)}{4} = \frac{P(D)}{2}$$

QUESTION 45

45. What is $\frac{P(A) + 2P(B)}{3P(C) + P(D)}$ equal to?

(a) $5/4$

(b) $6/7$

(c) $2/5$

(d) $17/6$

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QUESTION 46

46. If G is the geometric mean of $P(A)$, $P(B)$, $P(C)$ and $P(D)$, then what is G equal to?

(a) $\frac{5}{2\sqrt{3}}$

(b) $\frac{2}{5\sqrt{3}}$

(c) $\frac{\sqrt{3}}{5}$

(d) $\frac{1}{5\sqrt{3}}$

Handwritten calculations for Question 46:

$$6 \times 3 \times 4 \times 2 = 144$$

$$\sqrt[4]{144} = \sqrt[4]{2^4 \times 3^2} = 2 \times \sqrt{3} = 2\sqrt{3}$$

QUESTION 47

47. If H is the harmonic mean of $P(A)$, $P(B)$, $P(C)$ and $P(D)$, then what is H equal to?

(a) $14/75$

(b) $15/76$

(c) $16/75$

(d) $16/15$

[P.T.O.]

QUESTION 48

For the next **three (03)** items that follow :

Five numbers are randomly picked from the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and arranged them in ascending order [$x_1 < x_2 < x_3 < x_4 < x_5$; x_1 being the smallest number and x_5 being the largest number selected].

48. What is $P(x_1 = 4)$ equal to?

(a) $5/84$

(b) $1/14$

(c) $1/7$

(d) $19/84$

QUESTION 49

49. What is $P(x_3 = 6)$ equal to?

(a) $5/21$

(b) $10/21$

(c) $11/21$

(d) $17/21$

QUESTION 50

50. What is $P(x_1 = 2, x_2 = 3, x_3 = 8)$ equal to?

(a) $1/12$

(b) $1/60$

(c) $1/252$

(d) 0

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QUESTION 51

51. Let A and B be symmetric matrices of the same order. Which of the following statements is/are correct?

- I. $(AB - BA)$ is also a symmetric matrix.
- II. $(BA - AB)$ is a skew-symmetric matrix.

Select the answer using the code given below.

- (a) I only
- (b) II only
- (c) Both I and II
- (d) Neither I nor II

QUESTION 52

52. If $A = \begin{bmatrix} -1 & 2 \\ 3 & -4 \end{bmatrix}$, then what is $|A^{-1}|$ equal to?

(a) -2

(b) -1

(c) $-1/2$

(d) 2

QUESTION 53

53. Let S be the set of all real numbers and R be a relation on S defined by $xRy \Rightarrow |x| \leq y$. Then R is

- (a) reflexive only
- (b) transitive only
- (c) both reflexive and transitive
- (d) neither reflexive nor transitive

[P.T.O.]

QUESTION 54

54. 4-digit numbers are formed with 1, 2, 3 and 4. What is the number of the 4-digit numbers in which at least one digit is repeated? 5

(a) 256

(b) 244

(c) 232

(d) 220

$$4P_1 \times 4P_2 \times 4P_3 \times 4P_4$$

$$= \frac{4!}{3!} \times \frac{4!}{2!} \times \frac{4!}{1!} \times \frac{4!}{0!}$$

$$= 4 \times 12 \times 24 \times 24$$

QUESTION 55

55. Given

$S = \{(x, y, z) \in \mathbb{R}^3 : xyz = 210, x < y < z,$
where x, y, z are positive integers}

What is the total number of elements
in S ?

(a) 10

(b) 12

(c) 13

(d) More than 13

QUESTION 56

56. If $x = 4 + i$, where $i = \sqrt{-1}$, then what is
 $x^3 + 2x^2 - 63x + 171$ equal to?

(a) -1

(b) 0

(c) 1

(d) 2

Handwritten work:
 $x = 4 + i$
 $x^3 + 2x^2 - 63x + 171$

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QUESTION 57

57. Let α and β be the roots of the equation

$$x^2 - p(x+1) - q = 0$$

What is

$$\frac{\alpha^2 + 2\alpha + 1}{\alpha^2 + 2\alpha + q} + \frac{\beta^2 + 2\beta + 1}{\beta^2 + 2\beta + q}$$

equal to?

(a) -1

(b) 0

(c) 1

(d) 2

QUESTION 58

58. If the sum of the roots of the equation

$$\frac{1}{2x+p} + \frac{1}{2x+q} = \frac{1}{r}$$

is zero, then what is r equal to?

(a) $p - q$

(b) $p + q$

(c) $(p - q) / 2$

(d) $(p + q) / 2$

[P.T.O.]

QUESTION 59

59. Let α and β be the roots of the equation $ax^2 + bx + c = 0$ and $p_n = \alpha^n + \beta^n$, where $n > 1$. What is

$$ap_{n+1} + bp_n + cp_{n-1}$$

equal to?

(a) 0

(b) 1

(c) $a + b + c$

(d) $a - b + c$

QUESTION 60

60. If p, q and r are in AP, then what is

$$p^3 + 3pr(p+r) + r^3$$

equal to?

(a) q^3

(b) $2q^3$

(c) $3q^3$

(d) $8q^3$

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QUESTION 61

51. What is $6\sin(\pi/18) - 8\sin^3(\pi/18)$ equal to?

(a) $1/4$

(b) $1/2$

(c) 1

(d) 2

$$\begin{array}{r} 2 \\ 3 \cdot 75 \\ 0.75 \\ \hline 0.75 \\ \hline 0.75 \\ \hline 0.75 \end{array}$$

QUESTION 62

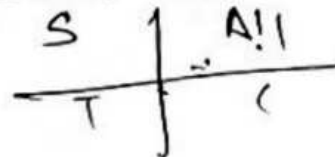
52. How many values of θ satisfy the equation $\tan^2 \theta + \cot^2 \theta = 2$, where $0^\circ < \theta < 360^\circ$?

(a) 1

(b) 2

(c) 4

(d) 8



2

QUESTION 63

63. What is $\sin(\tan^{-1} 0.75)$ equal to?

(a) 1

(b) $4/5$

(c) $3/5$

(d) $1/2$

~~sin~~ ~~and~~
 $\tan^{-1} 0.75 = \theta$
 $\tan \theta = 0.75$

$$H^2 = \frac{1}{P^2 + B^2}$$

$$= 0.75^2 \times$$

QUESTION 64

64. What is $\tan^2\left(\frac{1}{2}\cos^{-1}\frac{1}{3}\right)$ equal to?

(a) $1/2$

(b) 1

(c) 2

(d) 4

$\rightarrow 2$
 $\cos^{-1} \frac{1}{3} = 2$
 $\cos 2 = \frac{1}{3} = \frac{B}{H}$
 $H^2 = P^2 + B^2$
 $P^2 = H^2 - B^2$
 $P^2 = 8 \quad \therefore = \sqrt{8}$

QUESTION 65

65. What is

$$\tan(1125^\circ)\cot(405^\circ) + \tan(765^\circ)\cot(675^\circ)$$

equal to?

(a) 2

(b) 1

(c) 0

(d) -2

QUESTION 66

66. If A is a square matrix of order 3 and $|A|=2$, then what is $\text{adj}(\text{adj}A)$ equal to?

(a) $8A$

(b) $4A$

(c) $2A$

(d) $2I$, where I is the identity matrix of order 3

QUESTION 67

67. If A is a square matrix of order 3 such that

$$A(\text{adj}A) = \begin{bmatrix} 64 & 0 & 0 \\ 0 & 64 & 0 \\ 0 & 0 & 64 \end{bmatrix} = 64I$$

then what is $|A|$ equal to?

(a) 4

(b) 8

(c) 16

(d) 64

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QUESTION 68

68. Let

$$A = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} = \frac{1}{2} \begin{bmatrix} 1 & -i \\ i & 1 \end{bmatrix} + \frac{1}{2} \begin{bmatrix} 1 & i \\ -i & 1 \end{bmatrix}$$

What is the least value of θ for which $A + A^T = I$, where I is the identity matrix of order 2?

(a) $\pi/2$

(b) $\pi/3$

(c) $\pi/4$

(d) $\pi/6$

$AB = AC$

QUESTION 69

69. Let A , B and C be the square matrices of order 2 such that $AB = AC$. Which of the statements given below is/are correct?

- I. B and C are not necessarily equal if A is a singular matrix.
- II. B and C are equal if A is a non-singular matrix.

Select the answer using the code given below.

- (a) I only
- (b) II only
- (c) Both I and II
- (d) Neither I nor II

QUESTION 70

70. If A is a square matrix of order 3 and $|A| = 4$, then what is $|\text{adj}A|$ equal to?

(a) 64

(b) 16

(c) 8

(d) 4

| P.T.O.

QUESTION 71

For the next **two (02)** items that follow :

From the top of a building, the angles of depression of the top and bottom of a tower of height h are α and β respectively. Let H be the height of the building and D be the horizontal distance between the building and the tower.

71. What is $H^2 + D^2$ equal to?

(a) $\frac{h^2 \cos^2 \alpha}{\sin^2 (\beta - \alpha)}$

(b) $\frac{h^2 \cos^2 \beta}{\sin^2 (\beta - \alpha)}$

(c) $\frac{h^2 \cos^2 \alpha}{\sin^2 (\beta + \alpha)}$

(d) $\frac{h^2 \cos^2 \beta}{\sin^2 (\beta + \alpha)}$

QUESTION 72

72. If $\alpha = 15^\circ$ and $\beta = 45^\circ$, then which one of the following is correct?

(a) $H = \sqrt{2}D$

(b) $D = \sqrt{2}H$

(c) $2H = \sqrt{3}D$

(d) $H = D$

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QUESTION 73

For the next **two (02)** items that follow :

The angles A , B and C of a triangle ABC are in the ratio $1 : 2 : 7$.

73. What is the ratio of the side of greatest length to the side of least length?

(a) $7 : 1$

(b) $\sqrt{7} : 1$

(c) $(3 + \sqrt{5}) : 2$

(d) $(3 + \sqrt{5}) : 3$

$$x + 2x + 7x = 180$$

$$10x = 180$$

$$x = 18$$

$$A = 18^\circ \quad B = 36^\circ$$

$$C = 126^\circ$$

QUESTION 74

74. What is $\sin A \cdot \cos B$ equal to?

(a) $1/4$

(b) $1/2$

(c) 1

(d) 2

$$2 \sin 18^\circ \cos 36^\circ$$

$$2$$

~~A~~

QUESTION 75

For the next **two** (02) items that follow :

In a triangle ABC, $\frac{a+b}{13} = \frac{b+c}{11} = \frac{c+a}{12}$.

75. What is $\sin A : \sin B : \sin C$ equal to?

(a) 5 : 6 : 7

(b) 7 : 6 : 5

(c) 13 : 11 : 12

(d) 12 : 11 : 13

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

QUESTION 76

76. What is $\cos A : \cos B : \cos C$ equal to?

(a) 7 : 19 : 25

(b) 11 : 12 : 13

(c) 7 : 11 : 13

(d) 12 : 11 : 13

$$\cos A = \frac{a^2 + b^2 - c^2}{2ab}$$

[P.T.O.]

QUESTION 77

For the next **two (02)** items that follow :

Given that $\tan\left(\frac{A}{2} + \frac{B}{2}\right) = p$ and $\tan\left(\frac{A}{2} - \frac{B}{2}\right) = q$,
where $pq \neq \pm 1$.

77. What is $\tan A$ equal to?

(a) $\frac{p-q}{1+pq}$

(b) $\frac{p+q}{1-pq}$

(c) $\frac{p+q}{1+pq}$

(d) $\frac{p-q}{1-pq}$

Ans
12w

QUESTION 78

78. What is $\tan B$ equal to?

(a) $\frac{p-q}{1+pq}$

(b) $\frac{p+q}{1-pq}$

(c) $\frac{p+q}{1+pq}$

(d) $\frac{p-q}{1-pq}$

For the next **two (02)** items that follow :

Let $4(A+B) = \pi$.

$A+B = \frac{\pi}{4}$

QUESTION 79

79. What is $(1 + \tan A)(1 + \tan B)$ equal to?

(a) 1

(b) 2

(c) 4

(d) 6

$$A + B = \frac{\pi}{4}$$

$$\tan(A + B) = 1$$

QUESTION 80

80. What is $(\cot A - 1)(\cot B - 1)$ equal to?

(a) $1/2$

(b) 1

(c) $3/2$

(d) 2

$$\cot A = \frac{1}{\tan A}$$

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QUESTION 81

81. The vertices of a triangle are $A(2, 0, 0)$, $B(0, 6, 0)$ and $C(0, 0, 4)$. If AD , BE and CF are the medians of the triangle, then what is $AD^2 + BE^2 + CF^2$ equal to?

(a) 81

(b) 84

(c) 87

(d) 90

QUESTION 82

82. A line makes angles α , β and γ with the positive directions of x -axis, y -axis and z -axis respectively such that $\alpha + \beta = 90^\circ$. Which of the following statements is/are correct?

I. The maximum value of $\cos\alpha + \cos\beta$ is $\sqrt{2}$.

II. The minimum value of $\cos\alpha + \cos\beta + \cos\gamma$ is 1.

Select the answer using the code given below.

(a) I only

(b) II only

(c) Both I and II

(d) Neither I nor II

[P.T.O.]

QUESTION 83

83. What is the area of the triangle whose vertices are $(0, 7, 10)$, $(-1, 6, 6)$ and $(-4, 9, 6)$?

(a) 9 square units

(b) 12 square units

(c) 15 square units

(d) 18 square units

QUESTION 84

84. If O is the origin and P is the point $(2, -4, 6)$, then what is the equation of the plane through P and perpendicular to OP ?

(a) $x + 2y + 3z - 28 = 0$

(b) $x - 2y + 3z - 28 = 0$

(c) $x - 2y + 3z + 28 = 0$

(d) $2x - 4y + 6z - 55 = 0$

QUESTION 85

85. The image of the point $P(1, 3, 4)$ with respect to the plane $Ax + By + Cz + D = 0$ is $(-3, 5, 2)$. If $A + B + C = 2$, then what is D equal to?

(a) -3

(b) 3

(c) 6

(d) D cannot be determined due to insufficient data

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QUESTION 86

86. Let $\vec{a}$, $\vec{b}$, $\vec{c}$ and $\vec{d}$ be the vectors.
Consider the following :

I. $(\vec{a} \times \vec{b}) \cdot (\vec{c} \times \vec{d}) = \vec{a} \cdot \vec{c} \vec{b} \cdot \vec{d} - \vec{a} \cdot \vec{d} \vec{b} \cdot \vec{c}$

II. $(\vec{a} \times \vec{b}) \times (\vec{c} \times \vec{d})$

III. $(\vec{a} \cdot \vec{b}) \cdot (\vec{c} \cdot \vec{d})$

IV. $(\vec{a} \cdot \vec{b}) \times (\vec{c} \cdot \vec{d})$

V. $(\vec{a} \times \vec{b}) \cdot \vec{c} \times \vec{d}$

where '.' represents dot product and 'x' represents cross product of vectors.
How many of the above are **not** well-defined?

(a) One

(b) Two

(c) Three

(d) Four

QUESTION 87

87. The scalar projection of $\vec{a} = \lambda\hat{i} + \hat{j} - 2\hat{k}$ on $\vec{b} = 2\hat{i} - \hat{j} - \lambda\hat{k}$ is $7/3$. What is the value of λ ?

(a) 1

(b) 2

(c) 3

(d) 4

$$\vec{a} = \frac{|\vec{a} \cdot \vec{b}|}{|\vec{b}|^2} =$$

$$\frac{1}{2} = \frac{1}{-1}$$

[P.T.O.]

QUESTION 88

88. How much angle does

$$\vec{r} = (\cos \theta)\hat{i} + (\sin \theta)\hat{j} + \hat{k}$$

make with the positive direction of z-axis?

(a) $\pi/2$

(b) $\pi/3$

(c) $\pi/4$

(d) $\pi/6$

QUESTION 89

89. Let $\vec{a}$ and $\vec{b}$ be unit vectors inclined at 30° . What is the area of the parallelogram whose sides are represented by the vectors $\vec{a} + 3\vec{b}$ and $3\vec{a} + \vec{b}$?

- (a) $8\sqrt{3}$ square units
- (b) 8 square units
- (c) $4\sqrt{3}$ square units
- (d) 4 square units

QUESTION 90

90. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be unit vectors such that $\vec{a} \cdot \vec{b} = \vec{a} \cdot \vec{c} = 0$. If the angle between $\vec{b}$ and $\vec{c}$ is $\pi/6$, then what is $\vec{a}$ equal to?

(a) $(\vec{b} \times \vec{c})$

(b) $\sqrt{2}(\vec{b} \times \vec{c})$

(c) $2(\vec{b} \times \vec{c})$

(d) $\sqrt{3}(\vec{b} \times \vec{c})$

Handwritten solution:
 $|\vec{b} + \vec{c}|^2 = |\vec{b}|^2 + |\vec{c}|^2 + 2|\vec{b}||\vec{c}|\cos(\pi/6)$
 $|\vec{b} + \vec{c}|^2 = 1 + 1 + 2 \cdot 1 \cdot 1 \cdot \frac{\sqrt{3}}{2} = 2 + \sqrt{3}$
 $|\vec{b} + \vec{c}| = \sqrt{2 + \sqrt{3}}$

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QUESTION 91

91. What is the domain of the function $f(x) = \log_x e$?

(a) $(0, \infty)$

(b) $(0, \infty) - \{1\}$

(c) $(0, \infty) - \{e\}$

(d) $(0, \infty) - \{10\}$

QUESTION 92

92. If $f(x)$ is the integral of

$$\frac{1 + \cos^2 x - 2\cos x}{x \sin^2 x \tan x}$$

then what is $\lim_{x \rightarrow 0} f'(x)$ equal to?

(a) 0

(b) $1/2$

(c) $1/3$

(d) $1/4$



QUESTION 93

93. Consider the following statements in respect of the function $f(x) = [3x]$, where $[\cdot]$ is the greatest integer function :

- I. $f(x)$ is continuous at $x = 1/3$.
- II. $f(x)$ is differentiable at $x = 1/4$.

Which of the statements given above is/are correct?

- (a) I only
- (b) II only
- (c) Both I and II
- (d) Neither I nor II

QUESTION 94

94. What is $\lim_{x \rightarrow 0} \frac{\sin^2 x}{x|x|}$ equal to?

25.2 → -1
(a) -1

(b) 0

(c) 1

(d) Limit does not exist

[P.T.O.]



QUESTION 95

95. Let $f(x) = p|x| + q$, where p and q are real constants. If $f'(x)$ exists at $x = 0$, then what is the value of p ?

(a) -1

(b) 0

(c) 1

(d) q

QUESTION 96

96. Consider the following statements in respect of the given function :

$$f(x) = \begin{cases} \frac{x^3}{|x|}, & x \neq 0 \\ 0, & x = 0 \end{cases}$$

I. $f(x)$ is continuous everywhere.

II. $f(x)$ is differentiable everywhere.

Which of the statements given above is/are correct?

(a) I only

(b) II only

(c) Both I and II

(d) Neither I nor II



QUESTION 97

97. What is $\lim_{x \rightarrow \infty} (\sqrt{x} + \sqrt{x} - \sqrt{x})$ equal to?

(a) $-1/2$

(b) 0

(c) $1/2$

(d) 1

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QUESTION 98

98. If m and n are the roots of the equation $x^2 - px + q = 0$, then what is

$$\lim_{x \rightarrow m} \frac{e^{x^2 - px + q} - 1}{(x - m)(x - n)}$$

Handwritten note: $\frac{e^{x^2 - px + q}}{(x - m)(x - n)}$

equal to?

(a) -1

(b) 0

(c) 1

(d) e



QUESTION 99

99. Let $f(x) = x^n + k$, where n is a natural number and k is a positive real constant such that $f(x) + f\left(\frac{1}{x}\right) = f(x)f\left(\frac{1}{x}\right)$ and $f(2) = 9$. What is $f(-1)$ equal to?

(a) -2

(b) -1

(c) 0

(d) 1

QUESTION 100

100. If $f(x) = \cos\left\{\frac{\pi}{3}[x] + x\right\}$ for $1 < x < 2$, where $[\cdot]$ is the greatest integer function, then what is $f\left(\frac{\pi}{2}\right)$ equal to?

(a) -1

(b) $-\sqrt{3}/2$

(c) $-1/2$

(d) $1/2$

[P.T.O.



QUESTION 101

101. What is the LCM of $(11110)_2$, $(10100)_2$ and $(11011)_2$?

(a) $(1000001100)_2$

(b) $(1000011100)_2$

(c) $(1000111100)_2$

(d) $(1000011101)_2$

QUESTION 102

102. What is the coefficient of x^{-n} in the expansion of the following?

$$(1+x)^{2n} \left(1 + \frac{1}{x}\right)^{2n}$$

(a) 1

(b) $2n(2n-1)(2n-2) \dots (n+1)n$

(c) $4n(4n-1)(4n-2) \dots (2n+1)(2n)$

(d) Such term does not exist



QUESTION 103

103. Consider the following statements in respect of the expansion of $(x^2 + x^{-2} + 2)^4$:

- I. The number of terms in the expansion is 5.
- II. One of the coefficients in the expansion has a maximum value equal to 70.

Which of the statements given above is/are correct?

- (a) I only
- (b) II only
- (c) Both I and II
- (d) Neither I nor II

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QUESTION 104

104. Consider the following relations from A to B, where $A = \{1, 3, 5\}$ and $B = \{2, 4, 6, 8\}$:

- I. $\{(1, 2), (3, 2), (3, 6), (5, 8)\}$
- II. $\{(3, 4), (5, 8), (1, 6), (3, 2)\}$
- III. $\{(1, 2), (3, 6)\}$
- IV. $\{(1, 6), (3, 2), (5, 2)\}$

Which of the above is/are function(s) from A to B?

- (a) I, III and IV
- (b) IV only
- (c) II and IV
- (d) III only



QUESTION 105

105. If $x^2 - 2x\cos\theta + 1 = 0$, then what is the magnitude of x ?

(a) -1

(b) 0

(c) 1

(d) $\sqrt{2}$

$$\begin{aligned} x(x - 2\cos\theta) + 1 &= 0 \\ x - 2\cos\theta + 1 &= 0 \\ x &= 2\cos\theta - 1 \end{aligned}$$

QUESTION 106

106. Consider the following statements in respect of sets A and B :

I. If $x \in A$ and $A \in B$, then $x \in B$.

II. If $A \subset B$ and $x \in B$, then $x \in A$.

Which of the statements given above is/are correct?

(a) I only

(b) II only

(c) Both I and II

(d) Neither I nor II

[P.T.O.]



QUESTION 107

107. A research group conducted a survey of 500 consumers and reported that 370 consumers preferred product X and 240 consumers preferred product Y . What is the least number that must have preferred both the products?

(a) 90

(b) 100

(c) 110

(d) Cannot be determined due to insufficient data

QUESTION 108

108. The Cartesian product $A \times A$ has 25 elements among which are found $(3, 1)$, $(6, 2)$, $(5, 3)$. Which of the following statements is/are correct?

I. It is possible to determine other elements of $A \times A$.

II. $(5, 5) \in A \times A$ and $(1, 3) \notin A \times A$

Select the answer using the code given below.

(a) I only

(b) II only

(c) Both I and II

(d) Neither I nor II

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QUESTION 109

109. Consider the following statements in respect of a relation R from a set A to a set B :

- I. The set B is called codomain of the relation R .
- II. The range of the relation is always equal to codomain of the relation R .
- III. The domain of the relation R must be equal to the set A .

Which of the statements given above is/are correct?

- (a) I only
- (b) III only
- (c) I and II
- (d) I and III

QUESTION 110

110. Consider the following system of linear inequalities :

$$x - y \leq 3 \text{ and } x + y \geq 5$$

The solution of the inequalities lies in

- (a) first quadrant only
- (b) second quadrant only
- (c) both first quadrant and second quadrant only
- (d) all the four quadrants

[P.T.O.]



QUESTION 111

11. If $\frac{1}{b-a} + \frac{1}{b-c} = \frac{2}{b}$, then a , b and c are in

(a) AP

(b) GP

(c) HP

(d) Neither in AP nor in GP nor in HP

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QUESTION 112

112. Let P , Q , R and S be the sum of n terms, $2n$ terms, $3n$ terms and $4n$ terms respectively of an AP such that $Q = 3P$. Which one of the following is correct?

(a) $5R = 3S$

(b) $6R = 5S$

(c) $8R = 7S$

(d) $9R = 8S$

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QUESTION 113

113. In a GP, the 3rd, 5th and 7th terms are x , $x^2 + 2$ and $x^3 + 10$ respectively, where $x > 1$. What is the 8th term?

(a) 18

(b) $18\sqrt{3}$

(c) 54

(d) $54\sqrt{3}$

$$a_3 = x \quad a_5 = x^2 + 2 \quad a_7 = x^3 + 10$$

$$a_n = ar^{n-1}$$

$$\frac{ar^{n-1}}{ar^{3-1}} = \frac{x^2 + 2}{x}$$

$$ar^{n-2} = \frac{x^2 + 2}{x}$$

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$$6(a \times 9) = 2a \times 81$$

QUESTION 114

14. If $(1+i)^n - 16 = 0$, where $i = \sqrt{-1}$ and n is a positive integer, then what is the least value of n ?

(a) 2

(b) 4

(c) 8

(d) 16



QUESTION 115

15. What is $i \times i^4 \times i^9 \times i^{16} \times \dots \times i^{576}$, where $i = \sqrt{-1}$, equal to?

(a) $-i$

(b) -1

(c) 1

(d) i

QUESTION 116

16. If $z = x + iy$ be such that $\left| \frac{z + \lambda i}{z - \lambda i} \right| = 1$,

where $i = \sqrt{-1}$ and λ is a positive real number, then which of the following statements is/are correct?

I. z lies on the line $y = x$.

II. The amplitude of z is $\frac{\pi}{4}$.

Select the answer using the code given below.

(a) I only

(b) II only

(c) Both I and II

(d) Neither I nor II

[P.T.O.]



QUESTION 117

117. What is

$$\begin{vmatrix} \frac{1}{a} & bc & a^3 \\ \frac{1}{a} + \frac{1}{b} & c(a+b) & a^3 + b^3 \\ \frac{1}{a} + \frac{1}{b} + \frac{1}{c} & ab+bc+ca & a^3 + b^3 + c^3 \end{vmatrix}$$

equal to?

(a) 0

(b) 3

(c) $(a+b+c)(ab+bc+ca)$

(d) $a^3 + b^3 + c^3 - 3abc$

QUESTION 118

118. If

$$ae + bg = cf + dh = p, af + bh = ce + dg = q$$

then what is

$$\begin{vmatrix} a & b \\ c & d \end{vmatrix} \times \begin{vmatrix} e & f \\ g & h \end{vmatrix}$$

equal to? $(ad-bc)(eh-gf)$

(a) $p^2 q^2$ $ad(eh-gf) - bc(ch-ge)$

(b) pq $adeh - adgf - bceh$

(c) $p^2 + q^2$

(d) $p^2 - q^2$

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QUESTION 119

119. If

$$x + ay + a^2z = 1, x + by + b^2z = 1, x + cy + c^2z = 1$$

where $a \neq b \neq c$, then what is $x + y + z$ equal to?

$$x + ay + a^2z = 1$$

(a) $x = 1 - ay - a^2z$

(b) 1

$$\begin{array}{r|l} +1 & 2 \ 0 \\ \hline & \text{(c)} \ 3 \end{array}$$

$$\begin{array}{r|l} 1 & 2 \\ \hline & \text{(d)} \ a + b + c \end{array}$$



QUESTION 120

120. Let

$$A = \begin{pmatrix} 1 & -\tan \theta \\ \tan \theta & 1 \end{pmatrix} \text{ and } B = \begin{pmatrix} 1 & \tan \theta \\ -\tan \theta & 1 \end{pmatrix}$$

If $C = AB^{-1}$, then what is $\det(C)$ equal to?

(a) $\sec^2 \theta$

(b) $\sec^4 \theta$

(c) $\cos^2 \theta$

(d) 1

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[P.T.O.]