

1. The direction cosines of two lines that are at right angles are  $l_1, m_1, n_1$  and  $l_2, m_2, n_2$ , then the direction cosines of a line which is perpendicular to both these lines are
- (A)  $l_1 + kl_2, m_1 - km_2, n_1 + kn_2$
- (B)  $m_1n_2 - m_2n_1, n_1l_2 - n_2l_1, l_1m_2 - l_2m_1$
- (C)  $l_1 - l_2, m_1 - m_2, n_1 - n_2$
- (D)  $l_1 + l_2, m_1 + m_2, n_1 + n_2$
2. If  $|\vec{a}| = 4$ ;  $|\vec{b}| = 2$  and the angle between  $\vec{a}$  and  $\vec{b}$  is  $\frac{\pi}{6}$ , then  $|\vec{a} \times \vec{b}|$  is
- (A) 3
- (B) 4
- (C) 16
- (D) 9
3. If the vectors  $\vec{a} = 3\vec{i} + 6\vec{j} + 2\vec{k}$  and  $\vec{b}$  are collinear and  $|\vec{b}| = 28$ , then  $\vec{b} =$
- (A)  $\pm 3 (2\vec{i} + 6\vec{j} + \vec{k})$
- (B)  $\pm 4 (3\vec{i} + 6\vec{j} + 2\vec{k})$
- (C)  $\pm 28 (3\vec{i} + 6\vec{j} + 2\vec{k})$
- (D)  $\pm 2 (3\vec{i} + 6\vec{j} + 2\vec{k})$

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4. For three vectors,  $|\vec{a}| = |\vec{b}| = |\vec{c}|$ , angle between each pair of these vectors is  $\frac{\pi}{3}$  and

$$|\vec{a} + \vec{b} + \vec{c}| = \sqrt{6}, \text{ then } |\vec{a}| \text{ is}$$

- (A) 1  
(B)  $\sqrt{3}$   
(C) -1  
(D) 2
5. The value of the limit  $\lim_{x \rightarrow 0} \frac{\log(1+ax) - \log(1-bx)}{x}$  is

- (A)  $a - b$   
(B)  $a + b$   
(C)  $ab$   
(D)  $\frac{a}{b}$

6. If the function  $x = x(y)$  is defined as  $x = e^{y+e^y+e^{y+\dots\infty}}$  then  $\frac{dy}{dx}$  is given by

- (A)  $1 + x$   
(B)  $\frac{1}{x}$   
(C)  $\frac{1}{x} - 1$   
(D)  $\frac{x}{1+x}$

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7. The value of the integral  $\int e^{2x} \left( \frac{1 + \sin 2x}{1 + \cos 2x} \right) dx$  is

(A)  $\frac{1}{2} e^{2x} \tan 2x + c$

(B)  $\frac{1}{2} e^{2x} \tan x + c$

(C)  $\frac{1}{2} e^{2x} \sin 2x + c$

(D)  $\frac{1}{2} e^{2x} \cos 2x + c$

8. If  $\int_m^{m+1} f(x) dx = m^2$ , where  $m \in \mathbb{Z}$ , then  $\int_{-1}^3 f(x) dx$  is

(A) 54

(B) 16

(C) 6

(D) 36

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9. If  $f(\theta) = \left| \begin{array}{cc} \sec \theta & \cos \theta \\ \cos^2 \theta & \cos^2 \theta \end{array} \right|$ , then the value of the definite integral  $\int_0^{\pi/2} f(\theta) d\theta$  is

(A)  $\frac{1}{5}$

(B)  $\frac{1}{4}$

(C)  $\frac{1}{3}$

(D)  $\frac{1}{2}$

10. The solution of  $\frac{dy}{dx} = \frac{1}{y^2 + \sin y}$ ,  $y \neq 0$ , with an arbitrary constant  $c$  is

(A)  $x = y^3 - \cos^2 y + c$

(B)  $x = y - \cos y + c$

(C)  $x = \frac{y^3}{3} - \cos y + c$

(D)  $x = y^2 - \frac{\cos y}{3} + c$

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11. The differential equation governing the solution  $ax^2 - by^2 = 16$  is  $y \left( \frac{d^2y}{dx^2} \right) + \left( \frac{dy}{dx} \right)^2 =$

(A)  $y \frac{dy}{dx}$

(B)  $\left( \frac{1}{x} \right) \frac{dy}{dx}$

(C)  $\left( \frac{y}{x} \right) \frac{dy}{dx}$

(D)  $\left( \frac{x}{y} \right) \frac{dy}{dx}$

12. If  $\frac{dy}{dx} = u^2$ , where  $u = 4x + y + 1$  then,

(A)  $2 \tan^{-1} \left( \frac{u}{2} \right) = x + c$

(B)  $\tan^{-1} \left( \frac{u}{2} \right) = 2(x + c)$

(C)  $y = 2 \tan^{-1} x + c$

(D)  $\frac{u^2}{2} = \tan^{-1} xy + c$

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13. The order and degree of the differential equation  $\sqrt[3]{\frac{dy}{dx}} \sqrt{\frac{d^3y}{dx^3}} = 4$  is

(A) 2, 3

(B) 3, 6

(C) 3, 2

(D) 3, 1

14. If  $y = (1234)e^{11x} + (5678)e^{-11x}$  then  $\frac{d^2y}{dx^2}$  is equal to

(A) 1234y

(B) 5678y

(C) 121y

(D) 1331y

15. The differential equation that represents the family of lines  $ax + by + c = 0$  is

(A)  $\frac{dy}{dx} = 0$

(B)  $x + y \frac{dy}{dx} + \frac{d^2y}{dx^2} = 0$

(C)  $\frac{d^2y}{dx^2} = 0$

(D)  $y = x \frac{dy}{dx} + c$

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16. If  $P(A) = x$ ,  $P(B) = 2x$ ,  $P(A \cap B) = \frac{1}{2}$ ,  $P(\bar{A} \cap \bar{B}) = \frac{2}{3}$ , then the value of  $x$  is
- (A)  $\frac{5}{18}$
  - (B)  $\frac{5}{36}$
  - (C)  $\frac{6}{36}$
  - (D)  $\frac{11}{36}$
17. A die is rolled 3 times, the probability of getting a number larger than the previous number each time is
- (A)  $\frac{5}{54}$
  - (B)  $\frac{1}{18}$
  - (C)  $\frac{13}{216}$
  - (D)  $\frac{23}{216}$
18. If Ramu and Raju can solve 80% and 60% respectively of the problems in a book, what is the probability that at least one of them will solve “the problem selected at random” from the book.
- (A) 0.92
  - (B) 0.86
  - (C) 0.68
  - (D) 0.94

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19. The dual of the statement  $p \vee (q \vee r) \equiv (p \vee q) \vee r$  is

(A)  $p \wedge (q \vee r) \equiv (p \wedge q) \vee r$

(B)  $p \wedge (q \wedge r) \equiv (p \wedge q) \wedge r$

(C)  $p \vee (q \wedge r) \equiv (p \wedge q) \vee r$

(D) None of these

20. A function is defined as  $f(x) = \frac{kx}{x+1}$ ,  $x \neq -1$ , then for what value of  $k$  is  $f(f(x)) = x$

(A)  $-1$

(B)  $1$

(C)  $\sqrt{3}$

(D)  $-\sqrt{2}$

21. The maximum value of  $1 + 8 \sin^2\theta^2 \cos^2\theta^2$  is

(A)  $0$

(B)  $-8$

(C)  $3$

(D)  $10$

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22. The coefficient of  $x^4$  in the expansion of  $\frac{2x + 1 + 3x^2}{e^x}$  is
- (A)  $-\frac{36}{15}$
- (B)  $\frac{29}{24}$
- (C)  $\frac{3}{2}$
- (D)  $-\frac{8}{5}$
23. A set S has 5 distinct elements. Then the number of distinct one-one functions that can be defined from S to S is
- (A) 32
- (B)  $2^{25}$
- (C) 120
- (D)  $5^5$
24. The digit in the units place of  $1! + 2! + 3! + 4! + \dots + n!$ , where  $n > 4$  is
- (A) 1
- (B) 2
- (C) 3
- (D) 4

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25. For  $n \in \mathbb{N}$ ,  $6^n - 5n - 1$  is always divisible by

- (A) 50
- (B) 25
- (C) 75
- (D) 125

26. The quadratic equation whose roots are  $p$  and  $q$  where

$$p = \lim_{x \rightarrow 0} \frac{3 \sin x - 4 \sin^3 x}{x} \quad \text{and} \quad q = \lim_{x \rightarrow 0} \frac{2 \tan x}{1 - \tan^2 x} \text{ is}$$

- (A)  $x^2 + 5x + 6 = 0$
- (B)  $x^2 + 3x + 2 = 0$
- (C)  $x^2 - 5x + 6 = 0$
- (D)  $x^2 - 3x + 2 = 0$

27. If  $(1 + i)^{100} = 2^{49} (x + iy)$ , then  $x^2 + y^2$  is equal to

- (A) 0
- (B) 32
- (C) 16
- (D) 4

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28. For the complex number  $i, i^{4n} + i^{4n+1} + i^{4n+2} + i^{4n+3} + i^{4n+4} + i^{4n+5} + i^{4n+6}$  is
- (A) 16  
 (B) 4  
 (C) 1  
 (D) 0
29. In the expansion of  $\frac{(2-x)(2+x)}{(1-x)(1+x)}, |x| < 1$ , the term that is independent of  $x$  is
- (A) 3  
 (B) 4  
 (C) 5  
 (D) 2
30. For three real numbers  $a, b, c$  with  $a \neq 6$ ; if  $\begin{vmatrix} a & 2b & 2c \\ 3 & b & c \\ 4 & a & b \end{vmatrix} = 0$ , then  $abc =$
- (A)  $a + b + c$   
 (B)  $ab + b - c$   
 (C) 0  
 (D)  $b^3$

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31. The number of solutions of the system of equations

$$2x + y - z = 7; x - 3y + 2z = 1; x + 4y - 3z = 5$$

- (A) 0
- (B) 2
- (C) 3
- (D) 1

32. For non-zero numbers  $p, q, r, a, b, c$ , if  $\begin{vmatrix} pa & qb & rc \\ qc & ra & pb \\ rb & pc & qa \end{vmatrix} = pqr \begin{vmatrix} a & b & c \\ c & a & b \\ b & c & a \end{vmatrix}$  then

- (A)  $pqr = 1$
- (B)  $p + q + r = 1$
- (C)  $p + q + r = 0$
- (D)  $pqr = 0$

33. Let  $\begin{vmatrix} x & 2 & x \\ x^2 & x & 6 \\ x & x & 6 \end{vmatrix} = Ax^4 + Bx^3 + Cx^2 + Dx + E$ , then the value of  $9A - 4B + 3C + 5D + 6E$  is

- (A) 36
- (B) 38
- (C) 35
- (D) 37

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34. If  $A = \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$ , then the matrix  $A^{2014}$  is same as

- (A)  $A$
- (B)  $-A$
- (C)  $I$
- (D)  $-I$

35. If  $A = \begin{vmatrix} -1 & 2 & 0 \\ 3 & 1 & 5 \\ -1 & 2 & -1 \end{vmatrix}$ , then  $|\text{adj}(\text{adj}A)|$  is

- (A) 1492
- (B) 1592
- (C) 1694
- (D) 2401

36. The value of  $\sec^2(\tan^{-1}2) + \text{cosec}^2(\cot^{-1}3)$  is

- (A) 5
- (B) 20
- (C) 10
- (D) 15

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37. Given that  $\sin \alpha + \sin \beta = p$  and  $\cos \alpha - \cos \beta = q$ , then the value of  $\cos(\alpha - \beta)$  is

(A)  $\frac{p^2 - q^2}{p^2 + q^2}$

(B)  $\frac{2pq}{p^2 + q^2}$

(C)  $\frac{2pq}{p^2 - q^2}$

(D)  $\frac{p^2 + q^2}{p^2 - q^2}$

38. The value of  $\sqrt{3} \operatorname{cosec} 20^\circ - \sec 20^\circ$  is

(A)  $\frac{1}{2}$

(B)  $\frac{1}{4}$

(C) 2

(D) 4

39. If  $x = \sin^2\theta + \cos^4\theta$ , then for all values of  $\theta$ , the interval  $x$  belongs to is

(A)  $0 \leq x \leq 1$

(B)  $1 \leq x \leq 2$

(C)  $\frac{3}{4} \leq x \leq 1$

(D)  $\frac{1}{4} \leq x \leq \frac{1}{2}$

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40. The equality  $\cot^{-1}\alpha = \tan^{-1} \frac{1}{\alpha}$  holds good only when
- (A)  $\alpha = 0$
  - (B)  $|\alpha| \leq 1$
  - (C)  $\alpha < 0$
  - (D)  $\alpha > 0$
41. The approximate value of  $\tan^{-1} (1.001)$  is
- (A)  $\frac{\pi}{4} + 0.1$
  - (B)  $\frac{\pi}{4} + 0.005$
  - (C)  $\frac{\pi}{4} + 0.002$
  - (D)  $\frac{\pi}{4} + 0.0005$
42. The roots of  $x^2 - 2\sqrt{3}x + 2 = 0$  represent the lengths of two sides of a triangle and if the angle between these sides is  $60^\circ$ , then the perimeter of the triangle is
- (A)  $3 + 2\sqrt{6}$
  - (B)  $2\sqrt{3} + 2\sqrt{6}$
  - (C)  $2\sqrt{3} + \sqrt{6}$
  - (D)  $3\sqrt{2} + 6$

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43. The area bounded by the ellipse  $\frac{x^2}{175} + \frac{y^2}{343} = 1$  is
- (A)  $150\sqrt{7}\pi$
  - (B)  $115\pi$
  - (C)  $200\pi$
  - (D)  $245\pi$
44. If  $x - 2y - a = 0$  is a chord of the parabola  $y^2 = 4ax$ , then its length is given by
- (A)  $10a$
  - (B)  $20a$
  - (C)  $30a$
  - (D)  $40a$
45. A pair of straight lines is given by  $x^2(\sin^2\alpha - 1) + y^2\cos^2\alpha - yx \cos^2\alpha = 0$ , the angle between them is given by
- (A)  $\pi$
  - (B)  $\frac{\pi}{4}$
  - (C)  $\frac{\pi}{2}$
  - (D)  $\frac{2\pi}{3}$

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46. If the projection of a line segment on  $x$ ,  $y$  and  $z$  axes are 4, 2,  $\sqrt{21}$  respectively, then length of the line segment is
- (A)  $6 + \sqrt{21}$
- (B)  $\sqrt{41}$
- (C)  $4 + 2\sqrt{21}$
- (D)  $\sqrt{43}$
47. The equations of common tangents to the circle  $x^2 + y^2 = 8$  and parabola  $y^2 = 16x$  are
- (A)  $x = \pm (y + 2)$
- (B)  $x = \pm (y + 4)$
- (C)  $y = \pm (x + 2)$
- (D)  $y = \pm (x + 4)$
48. If  $p$ ,  $q$ ,  $r$  are in Arithmetic Progression, then  $px + qy + r = 0$  represents a
- (A) point
- (B) single line
- (C) family of concurrent lines
- (D) family of circles

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49. The tangents drawn at any point on these two curves  $3x^2y - y^3 - 2 = 0$  and  $x^3 - 3xy^2 + 2 = 0$  cut at
- (A)  $90^\circ$
  - (B)  $60^\circ$
  - (C)  $45^\circ$
  - (D)  $30^\circ$
50. The smaller of the two areas enclosed between the ellipse  $\frac{x^2}{4} + \frac{y^2}{16} = 1$  and the line  $\frac{x}{2} + \frac{y}{4} = 1$  is
- (A)  $2\pi - 4$
  - (B)  $2\left(\pi - \frac{1}{2}\right)$
  - (C)  $2\pi^2$
  - (D)  $\frac{\pi^2}{8}$
51. For some natural number  $n$ , if  $\sum n = 55$ , then  $\sum n^2$  is
- (A) 3125
  - (B) 605
  - (C) 1025
  - (D) 385

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52. If the sum of two of the roots of  $x^3 + ax^2 + bx + c = 0$  is zero, then the value of  $ab$  is
- (A)  $2c$
  - (B)  $3c$
  - (C)  $-c$
  - (D)  $c$
53. The value of the sum  ${}^{18}C_2 + {}^{18}C_4 + {}^{18}C_6 + \dots + {}^{18}C_{18}$  is
- (A)  $2^{17} - 1$
  - (B)  $2^{18} - 1$
  - (C)  $2^{19} - 1$
  - (D)  $2^{18}$
54. The sum of the series  $1 + \frac{x}{2} + \frac{x(x-1)}{2.4} + \frac{x(x-1)(x-2)}{2.4.6} + \dots$  to  $\infty$  is
- (A)  $\left(\frac{3}{4}\right)^x$
  - (B)  $\left(\frac{4}{3}\right)^x$
  - (C)  $\left(\frac{3}{2}\right)^x$
  - (D)  $\left(-\frac{3}{2}\right)^x$

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55. The value of  $5^{\frac{1}{2}} \cdot 5^{\frac{1}{4}} \cdot 5^{\frac{1}{8}} \dots$  to  $\infty$  is

- (A) 25
- (B) 5
- (C) 125
- (D)  $\frac{1}{5}$

56. The product of all  $n^{\text{th}}$  roots of unity ( $n > 1$ ) is

- (A) 1
- (B)  $(n)^{n-1}$
- (C) 0
- (D)  $(-1)^{n-1}$

57. If  $\alpha, \beta, \gamma$  are the direction cosines of a line then for some real number  $c$ , the value of  $c[\cos 2\alpha + \cos 2\beta + \cos 2\gamma]$  is

- (A)  $-c$
- (B) 0
- (C)  $2c$
- (D)  $c$

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58. If  $\vec{a} = 3\hat{i} - 5\hat{j}$ ;  $\vec{b} = 6\hat{i} + 3\hat{j}$  and  $\vec{c} = \vec{a} \times \vec{b}$ , then  $|\vec{a}| : |\vec{c}| : |\vec{b}| =$

(A)  $34 : 39 : 45$

(B)  $39 : 35 : 34$

(C)  $\sqrt{34} : 39 : \sqrt{45}$

(D)  $\sqrt{34} : \sqrt{39} : \sqrt{45}$

59. If  $\vec{a}, \vec{b}$  are non-collinear vectors and  $x, y$  are scalars such that

$$(2\vec{a} - \vec{b})x + (2\vec{b} - \vec{a})y + (\vec{a} + 2\vec{b}) = \vec{0}, \text{ then}$$

(A)  $x = -\frac{4}{3}, y = -\frac{5}{3}$

(B)  $x = -\frac{4}{3}, y = \frac{5}{3}$

(C)  $x = 0, y = 4$

(D)  $x = \frac{5}{3}, y = \frac{4}{3}$

60. If ABCD is a square, then  $\vec{AB} + 2\vec{BC} + 3\vec{CD} + 4\vec{DA}$  is

(A)  $5\vec{CA}$

(B)  $2\vec{CA}$

(C)  $3\vec{CA}$

(D)  $8\vec{CA}$

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