Choose the correct or the most suitable answer from the given four alternatives:

1. If A , B and C are invertible matrices of some order, then which one of the following is not true?

(1) $adjA=|A|A^{-1}$ (2) $adj(AB) = (adjA)(adjB)$

(3) $\det A^{-1} =(\det A)^{-1}$ (4) $(ABC)^{-1} =C^{-1}B^{-1}A^{-1}$

2. If A = $\begin{bmatrix} 1 & \tan\frac{\theta}{2} \\ -\tan\frac{\theta}{2} & 1 \end{bmatrix}$ and AB = I_2 , then B =

(1) $(\cos^2\frac{\theta}{2})A$ (2) $(\cos^2\frac{\theta}{2})A^T$ (3) $(\cos^2\theta)I$ (4) $(\sin^2\frac{\theta}{2})A$

3. If $0 \le \theta \le \pi$ and the system of equations $x + (\sin\theta)y - (\cos\theta)z = 0, (\cos\theta)x - y + z = 0, (\sin\theta)x + y - z = 0$ has a non-trivial solution then θ is

(1) $\frac{2\pi}{3}$ (2) $\frac{3\pi}{4}$ (3) $\frac{5\pi}{6}$ (4) $\frac{\pi}{4}$

4. If A = $\begin{bmatrix} 7 & 3 \\ 4 & 2 \end{bmatrix}$, then $9I_2 - A$ =

(1) A^{-1} (2) $\frac{A^{-1}}{2}$ (3) $3A^{-1}$ (4) $2A^{-1}$

5. If A is a 3 x 3 non-singular matrix such that $AA^T = A^TA$ and $B = A^{-1}A^T$, then BB^T =

(1) A (2) B (3) I_3 (4) B^T

6. The conjugate of a complex number is $\frac{1}{i-2}$. Then, the complex number is

(1) $\frac{1}{i+2}$ (2) $\frac{-1}{i+2}$ (3) $-\frac{1}{i-2}$ (4) $\frac{1}{i-2}$

7. z_1, z_2 and z_3 are complex numbers such that $z_1 + z_2 + z_3 = 0$ and $|z_1| = |z_2| = |z_3| = 1$ then $z_1^2 + z_2^2 + z_3^2$ is

(1) 3 (2) 2 (3) 1 (4) 0

8. If α and β are the roots of $x^2 + x + 1 = 0$, then $\alpha^{2020} + \beta^{2020}$ is

(1) -2 (2) -1 (3) 1 (4) 2

9. If $|z - 2 + i| \le 2$, then the greatest value of $|z|$ is

(1) $\sqrt{3} - 2$ (2) $\sqrt{3} + 2$ (3) $\sqrt{5} - 2$ (4) $\sqrt{5} + 2$

10. The solution of the equation $|z| - z = 1 + 2i$ is

(1) $\frac{3}{2} - 2i$ (2) $-\frac{3}{2} + 2i$ (3) $2 - \frac{3}{2}i$ (4) $2 + \frac{3}{2}i$

11. A polynomial equation in x of degree n always has

(1) n distinct roots (2) n real roots (3) n imaginary roots (4) at most one root

12. The number of real numbers in $[0, 2\pi]$ satisfying $\sin^4 x - 2\sin^2 x + 1$ is

(1) 2 (2) 4 (3) 1 (4) ∞

13. The value of $\sin^{-1}(\cos), 0 \le x \le \pi$ is

(1) $\pi - x$ (2) $x - \frac{\pi}{2}$ (3) $\frac{\pi}{2} - x$ (4) $x - \pi$

14. If $\sin^{-1}x + \sin^{-1}y + \sin^{-1}z = \frac{3\pi}{2}$, the value of $x^{2017} + y^{2018} + z^{2019} - \frac{9}{x^{101} + y^{101} + z^{101}}$ is

(1) 0 (2) 1 (3) 2 (4) 3

15. $\sin^{-1}\left(\tan\frac{\pi}{4}\right) - \sin^{-1}\left(\sqrt{\frac{3}{x}}\right)$, Then x is a root of the equation

(1) $x^2 - x - 6 = 0$ (2) $x^2 - x - 12 = 0$ (3) $x^2 + x - 12 = 0$ (4) $x^2 + x - 6 = 0$

16. $\sin^{-1}(2\cos^{-1}x - 1) + \cos^{-1}(1 - 2\sin^2 x) =$

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{3}$ (3) $\frac{\pi}{4}$ (4) $\frac{\pi}{6}$

17. The eccentricity of the hyperbola whose latus rectum is 8 and conjugate axis is equal to half the distance between the foci is

(1) $\frac{4}{3}$ (2) $\frac{4}{\sqrt{3}}$ (3) $\frac{2}{\sqrt{3}}$ (4) $\frac{3}{2}$

18. The equation of the normal to the circle $x^2 + y^2 - 2x - 2y + 1 = 0$ which is parallel to the line $2x + 4y = 3$ is

(1) $x + 2y = 3$ (2) $x + 2y + 3 = 0$ (3) $2x + 4y + 3 = 0$ (4) $x - 2y + 3 = 0$

19. The ellipse $E_1: \frac{x^2}{9} + \frac{y^2}{4} = 1$ is inscribed in a rectangle R whose sides are parallel to the coordinate axes. Another ellipse E_2 passing through the point(0,4) circumscribes the rectangle R. The eccentricity of the ellipse is

(1) $\frac{\sqrt{2}}{2}$ (2) $\frac{\sqrt{3}}{2}$ (3) $\frac{1}{2}$ (4) $\frac{3}{4}$1.

20. Consider an ellipse whose centre is of the origin and its major axis is along x-axis. If its eccentricity is $\frac{3}{5}$ and the distance between its foci is 6, then the area of the quadrilateral inscribed in the ellipse with diagonals as major and minor axis of the ellipse is

(1) 8 (2) 32 (3) 80 (4) 40

21. The locus of a point whose distance from $(-2,0)$ is $\frac{2}{3}$ times its distance from the line $x = \frac{-9}{2}$ is

(1) a parabola (2) a hyperbola (3) an ellipse (4) a circle

22. If a vector $\vec{\alpha}$ lies in the plane of $\vec{\beta}$ and $\vec{\gamma}$, then

(1) $[\vec{\alpha}, \vec{\beta}, \vec{\gamma}] = 1$ (2) $[\vec{\alpha}, \vec{\beta}, \vec{\gamma}] = -1$ (3) $[\vec{\alpha}, \vec{\beta}, \vec{\gamma}] = 0$ (4) $[[\vec{\alpha}, \vec{\beta}, \vec{\gamma}] = 2$

23. If $\vec{a}$ and $\vec{b}$ are unit vectors such that $[\vec{a}, \vec{b}, \vec{a} \times \vec{b}] = \frac{\pi}{4}$, then the angle between $\vec{a}$ and $\vec{b}$ is

(1) $\frac{\pi}{6}$ (2) $\frac{\pi}{4}$ (3) $\frac{\pi}{3}$ (4) $\frac{\pi}{2}$

24. Consider the vectors $\vec{a}, \vec{b}, \vec{c}, \vec{d}$ such that $(\vec{a} \times \vec{b}) \times (\vec{c} \times \vec{d}) = \vec{o}$. LetP_1 and P_2 be the planes determined by the pairs of vectors , $\vec{a}, \vec{b}$ and $\vec{c}, \vec{d}$respectively. Then the angle between P_1 and P_2 is

(1) 0° (2) 45° (3) 60° (4) 90°

25. The angle between the line $\vec{r} = (\hat{\imath} + 2\hat{\jmath} - 3\hat{k}) + t(2\hat{\imath} + \hat{\jmath} - 2\hat{k})$ and the plane $\vec{r} \cdot (\hat{\imath} + \hat{\jmath}) + 4 = 0$ is

(1) 0° (2) 30° (3) 45° (4) 90°

26. The vector equation $\vec{r} = (\hat{\imath} - 2\hat{\jmath} - \hat{k}) + t(6\hat{\imath} - \hat{k})$ represents a straight line passing through the points

(1) $(0,6,-1)$ and $(1,-2,-1)$ (2) $(0,6,-1)$ and $(-1,-4,-2)$
(3) $(1,-2,-1)$ and $(1,4,-2)$ (4) $(1,-2,-1)$ and $(0,-6,1)$

27. A balloon rises straight up at 10 m/s. An observer is 40 m away from the spot where the balloon left the ground. The rate of change of the balloon's angle of elevation in radian per second when the balloon is 30 metres above the ground.

(1) $\frac{3}{25}$ radians/sec (2) $\frac{4}{25}$ radians/sec (3) $\frac{1}{5}$ radians/sec (4) $\frac{1}{3}$ radians/sec

28. The slope of the line normal to the curve f(x) = 2cos4x at x = $\frac{\pi}{2}$ is

(1) $-4\sqrt{3}$ (2) -4 (3) $\frac{\sqrt{3}}{12}$ (4) $4\sqrt{3}$

29. The maximum value of the product of two positive numbers, when their sum of the squares 200, is

(1) 100 (2) $25\sqrt{7}$ (3) 28 (4) $24\sqrt{14}$

30. The curve $y = ax^4 + bx^2$ with $ab > 0$

(1) has no horizontal tangent (2) is concave up
(3) is concave down (4) has no points of inflection

31. If we measure the side of a cube to be 4 cm with an error of 0.1 cm, then the error in our Calculation of the volume is

(1) 0.4 cu.cm (2) 0.45 cu.cm (3) 2 cu.cm (4) 4.8 cu.cm

32. The change in the surface area $S = 6x^2$ of a cube when the edge length varies from x_0 to $x_0 + dx$ is

(1) $12x_0 + dx$ (2) $12x_0\, dx$ (3) $6x_0\, dx$ (4) $6x_0 + dx$

33. The approximate change in the volume V of a cube of side x metres caused by increasing the side by 1% is

(1) $0.3xdxm^3$ (2) $0.03xm^3$ (3) $0.03x^2m^3$ (4) $0.03x^3m^3$

34. For any value of $n \in \mathbb{Z}, \int_0^{\pi} e^{cos^2 x} cos^3[(2x+1)x]\, dx$ is

(1) $\frac{\pi}{2}$ (2) π (3) 0 (4) 2

35. If $\frac{\Gamma(n+2)}{\Gamma(n)} = 90$, then n is

(1) 10 (2) 5 (3) 8 (4) 9

36. If $f(x) = \int_1^x \frac{e^{\sin u}}{u}\, du, x > 1$ and $\int_1^3 \frac{e^{\sin x^2}}{x}\, dx = \frac{1}{2}[f(a) - f(1)]$, then one of the possible value of a is

(1) 3 (2) 6 (3) 9 (4) 5

37. If $f(x) = \int_0^x t\cos t\, dt$, then $\frac{df}{dx}$ is

(1) $\cos x - x\sin x$ (2) $\sin x + x\cos x$ (3) $x\cos x$ (4) $x\sin x$

38. Consider a game where the player tosses a six-sided fair die. If the face that comes up is 6, the player wins $Rs 36$, otherwise he loses $Rs\ k^2$, where k is the face that comes up $k = \{1, 2, 3, 4, 5\}$. The expected amount to win at this game in Rs is

(1) $\frac{19}{6}$ (2) $-\frac{19}{6}$ (3) $\frac{3}{2}$ (4) $-\frac{3}{2}$

39. A random variable X has binomial distribution with $n = 25$ and $p = 0.8$ then standard deviation of X is

(1) 6 (2) 4 (3) 3 (4) 2

40. If X is a binomial random variable with expected value 6 and variance 2.4, Then $P\{X = 5\}$ is

(1) $\binom{10}{5}\left(\frac{3}{5}\right)^6\left(\frac{2}{5}\right)^4$ (2) $\binom{10}{5}\left(\frac{3}{5}\right)^{10}$ (3) $\binom{10}{5}\left(\frac{3}{5}\right)^4\left(\frac{2}{5}\right)^6$ (4) $\binom{10}{5}\left(\frac{3}{5}\right)^5\left(\frac{2}{5}\right)^5$

41. If $f(x) = \begin{cases} 2x & 0 < x < 1 \\ 0 & otherwise \end{cases}$ otherwise is a probability density function of a random variable, then the value of a is

(1) 1 (2) 2 (3) 3 (4) 4

42. Which one of the following is a binary operation on $\mathbb{N}$?

(1) Subtraction (2) Multiplication (3) Division (4) All the above .

43. In the set $\mathbb{Q}$ define $\odot\ b = a + b + ab$. For what value of y, $3 \odot (y \odot 5) = 7$?

(1) $y = \frac{2}{3}$ (2) $y = -\frac{2}{3}$ (3) $y = -\frac{3}{2}$ (4) $y = 4$

44. Which one is the contrapositive of the statement $(p \vee q) \to r$?

(1) $\neg r \to (\neg p \wedge \neg q)$ (2) $\neg r \to (p \vee q)$
(3) $r \to (p \wedge q)$ (4) $p \to (q \vee r)$

45. Determine the truth value of each of the following statements:

(a) $4 + 2 = 5$ *and* $6 + 3 = 9$ (b) $3 + 2 = 5$ *and* $6 + 1 = 7$
(c) $4 + 5 = 9$ *and* $1 + 2 = 4$ (d) $3 + 2 = 5$ *and* $4 + 7 = 11$

(1) F T F T (2) T F T F (3) T T F F (4) F F T T

46. $\frac{d}{dx}\left(\frac{2}{\pi} sinx°\right)$ is

(1) $\frac{\pi}{180} cosx°$ (2) $\frac{1}{90} cosx°$ (3) $\frac{\pi}{90} cosx°$ (4) $\frac{2}{\pi} cosx°$

47. If pv = 81, then $\frac{dp}{dv}$ at v=9 is

(1)1 (2)-1 (3)2 (4)-2

48. If y = mx+c and f(0) = f'(0)= 1, then f(2) is

(1)1 (2)2 (3)3 (4)-3

49. The differential coefficient of $\log_{10} x$ with respect to $\log_x 10$ is

(1)1 (2)$-(\log_{10} x)^2$ (3) $(\log_x 10)^2$ (4)$\frac{x^2}{100}$

50. If f(x) = $\begin{cases} 2a - x & for -a < x < a \\ 3x - 2a & for\ x \geq a \end{cases}$, then which one of the following is true?

(1) f(x) is not differentiable at x= a

(2) f(x) is discontinuous at x = a

(3)f(x) is continuous for all x in R

(4) f(x) is differentiable for all x≥a

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