1. If \( * \) is the operation defined by \( a * b = a^b \) for \( a, b \in \mathbb{N} \), then \((2 * 3) * 2\) is equal to
   (A) 81  (B) 512  (C) 216  (D) 64  (E) 243
   ANSWER : D

2. The domain of the function \( f(x) = \begin{cases} (x^2 - 9) / (x - 3) & \text{if } x \neq 3 \\ 6 & \text{if } x = 3 \end{cases} \) is
   (A) (0, 3)  (B) (-\infty, 3)  (C) (-\infty, \infty)  (D) (3, \infty)  (E) (-3, 3)
   ANSWER : C

3. Let \( f(x) = x^3 \) and \( g(x) = 3^x \). The values of \( a \) such that \( g(f(a)) = f(g(a)) \) are
   (A) 0, 2  (B) 1, 3  (C) 0, \pm 3  (D) 1, \pm 2  (E) 0, \pm \sqrt{3}
   ANSWER : E

4. If \( f(x) = \frac{x + 1}{2x - 1} = 2x \), \( x \in \mathbb{N} \), then the value of \( f(2) \) is equal to
   (A) 1  (B) 4  (C) 3  (D) 2  (E) 5
   ANSWER : D

5. If \( A \setminus B = \{a, b\} \), \( B \setminus A = \{c, d\} \) and \( A \cap B = \{e, f\} \), then the set \( B \) is equal to
   (A) \{a, b, c, d\}  (B) \{e, f, c, d\}  (C) \{a, b, e, f\}  (D) \{c, d, a, e\}  (E) \{d, e, a, b\}
   ANSWER : B

6. The function \( f : A \to B \) is given by \( f(x) = x \), \( x \in A \), is one to one but not onto. Then
   (A) \( B \subset A \)  (B) \( A = B \)  (C) \( A' \subset B' \)  (D) \( A \subset B \)  (E) \( A \cap B = \emptyset \)
   ANSWER : D

7. The principal argument of the complex number \( z = \frac{1 + \sin \frac{\pi}{3} + i \cos \frac{\pi}{3}}{1 + \sin \frac{\pi}{3} - i \cos \frac{\pi}{3}} \) is
   (A) \( \frac{\pi}{3} \)  (B) \( \frac{\pi}{6} \)  (C) \( \frac{2\pi}{3} \)  (D) \( \frac{\pi}{2} \)  (E) \( \frac{\pi}{4} \)
   ANSWER : B

8. If \( \frac{(1 + i)(2 + 3i)(3 - 4i)}{(2 - 3i)(1 - i)(3 + 4i)} = a + ib \), then \( a^2 + b^2 = \)
   (A) 132  (B) 25  (C) 144  (D) 128  (E) 1
   ANSWER : E

9. Let \( z, w \) be two nonzero complex numbers. If \( \overline{z + iw} = 0 \) and \( \arg(zw) = \pi \), then \( \arg Z = \)
   (A) \( \pi \)  (B) \( \frac{\pi}{2} \)  (C) \( \frac{\pi}{4} \)  (D) \( \frac{\pi}{6} \)  (E) \( \frac{\pi}{8} \)
   ANSWER : C
10. If \( z = \frac{2-i}{i} \), then \( \text{Re}(z^2) + \text{Im}(z^2) \) is equal to
   (A) 1  (B) -1  (C) 2  (D) -2  (E) 3
   \text{ANSWER : A}

11. If \( |z+1| < |z-1| \), then \( z \) lies
   (A) On the x-axis  (B) On the y-axis  (C) In the region \( x < 0 \)
   (D) In the region \( y > 0 \)  (E) In the region \( x > y \)
   \text{ANSWER : C}

12. If \( \left| z - \frac{3}{z} \right| = 2 \), then the greatest value of \( |z| \) is
   (A) 1  (B) 2  (C) 3  (D) 4  (E) 5
   \text{ANSWER : C}

13. If the roots of the quadratic equation \( mx^2 - nx + k = 0 \) are \( \tan 330^\circ \) and \( \tan 120^\circ \) then the value of \( \frac{2m+n+k}{m} \) is equal to
   (A) 0  (B) 1  (C) 2  (D) 3  (E) 4
   \text{ANSWER : D}

14. If \( \alpha \) and \( \beta \) are the roots of \( 4x^2 + 2x + 1 = 0 \), then \( \beta = \)
   (A) \( \frac{1}{4\alpha} \)  (B) \( \frac{1}{2\alpha} \)  (C) \( \frac{1}{\alpha} \)  (D) \( \frac{1}{3\alpha} \)  (E) \( \frac{1}{\alpha} \)
   \text{ANSWER : A}

15. If \( \alpha \) and \( \alpha^2 \) are the roots of the equation \( x^2 + 6x + c = 0 \), then the positive value of \( c \) is
   (A) 2  (B) 3  (C) 4  (D) 9  (E) 8
   \text{ANSWER : E}

16. If one of the roots of the quadratic equation \( ax^2 - bx + a = 0 \) is 6, then value of \( \frac{b}{a} \) is equal to
   (A) \( \frac{1}{6} \)  (B) \( \frac{11}{6} \)  (C) \( \frac{37}{6} \)  (D) \( \frac{6}{11} \)  (E) \( \frac{6}{37} \)
   \text{ANSWER : C}

17. If the equation \( 2x^2 - (a+3)x + 8 = 0 \) has equal roots, then one of the values of \( a \) is
   (A) -9  (B) -5  (C) -11  (D) 11  (E) 9
   \text{ANSWER : C}

18. If \( 6^{th} \) term of G.P. is 2, then the product of first 11 terms of the G.P. is equal to
   (A) 512  (B) 1024  (C) 2048
   (D) 256  (E) 32
   \text{ANSWER : C}

19. If the produce of five consecutive terms of a G.P. is \( \frac{243}{32} \), then the middle term is
20. If \(a_1, a_2, a_3, a_4\) are in A.P., then \[\frac{1}{\sqrt{a_1} + \sqrt{a_2}} + \frac{1}{\sqrt{a_2} + \sqrt{a_3}} + \frac{1}{\sqrt{a_3} + \sqrt{a_4}} = \]

(A) \(\frac{\sqrt{a_4} - \sqrt{a_1}}{a_3 - a_2}\)
(B) \(\frac{a_4 - a_1}{a_3 - a_2}\)
(C) \(\frac{a_3 - a_2}{\sqrt{a_4} - \sqrt{a_1}}\)
(D) \(\frac{a_1 - a_4}{a_3 - a_2}\)
(E) \(\frac{a_5 - a_0}{a_1 - a_4}\)

**ANSWER : A**

21. If \(a_1, a_2, a_3, \ldots a_{20}\) are in A.P. and \(a_1 + a_{20} = 45\), then \(a_1, a_2, a_3, \ldots a_{20}\) is equal to

(A) 90  
(B) 900  
(C) 350  
(D) 450  
(E) 730

**ANSWER : D**

22. Sum of the series \[1(1) + 2(1 + 3) + 3(1 + 3 + 5) + 4(1 + 3 + 5 + 7) + \ldots + 10(1 + 3 + 5 + 7 + \ldots + 19)\] is equal to

(A) 385  
(B) 1025  
(C) 1125  
(D) 2025  
(E) 3025

**ANSWER : E**

23. In an A.P., the 6th term is 52 and 11th term is 112. Then the common difference is equal to

(A) 4  
(B) 20  
(C) 12  
(D) 8  
(E) 6

**ANSWER : C**

24. If the coefficients of \(x^3\) and \(x^4\) in the expansion of \((3 + kx)^9\) are equal, then the value of \(k\) is

(A) 3  
(B) \(\frac{1}{3}\)  
(C) 2  
(D) \(\frac{1}{2}\)  
(E) 1

**ANSWER : C**

25. The total number of 7 digit positive integral numbers with district digits that can be formed using the digits 4, 3, 7, 2, 1, 0, 5 is

(A) 4320  
(B) 4340  
(C) 4310  
(D) 4230  
(E) 4220

**ANSWER : A**

26. If \(^nP_4 = 5 \cdot ^nP_4\), then the value of \(n\) is equal to

(A) 5  
(B) 6  
(C) 7  
(D) 8  
(E) 9

**ANSWER : D**

27. The remainder when \(2^{2016}\) is divided by 63, is

(A) 1  
(B) 8  
(C) 17  
(D) 32  
(E) 61

**ANSWER : A**

28. If \(^nC_2 + ^nC_3 = ^6C_3\) and \(^nC_x = ^nC_3, x \neq 3\), then the value of \(x\) is equal to

(A) 5  
(B) 4  
(c) 2  
(D) 6  
(E) 1

**ANSWER : C**
29. If \( \sum_{k=0}^{18} \frac{k}{18} C_k = a \sum_{k=0}^{18} \frac{1}{18} C_k \), then the value of \( a \) is equal to
   (A) 3 (B) 9 (C) 6 (D) 18 (E) 36
   ANSWER : B

30. If the square of the matrix \( \begin{pmatrix} a & b \\ a-b & 1 \end{pmatrix} \) is the unit matrix, then \( b \) is equal to
   (A) \( \frac{a}{1+a^2} \) (B) \( \frac{1-a^2}{a} \) (C) \( \frac{1+a^2}{a} \) (D) \( \frac{a}{1-a^2} \) (E) \( 1+a^2 \)
   ANSWER : B

31. If \( \begin{bmatrix} 1 & 3 & 2 \\ 0 & 5 & 1 \\ 0 & 2 & 0 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ x \end{bmatrix} = 0 \), then the values of \( x \) are
   (A) 1, 5 (B) -1, -5 (C) 1, 6 (D) -1, -6 (E) 3, 3
   ANSWER : D

32. If \( A = \begin{bmatrix} 8 & 27 & 125 \\ 2 & 3 & 5 \\ 1 & 1 & 1 \end{bmatrix} \), then the value of \( A^2 \) is equal to
   (A) 0 (B) 36 (C) 64 (D) 2400 (E) 3600
   ANSWER : E

33. If \( A= \begin{bmatrix} x & 1 & -x \\ 0 & 1 & -1 \\ x & 0 & 7 \end{bmatrix} \) and \( \det(A) = \begin{bmatrix} 3 & 0 & 1 \\ 2 & -1 & 2 \\ 0 & 0 & 3 \end{bmatrix} \), then the value of \( x \) is
   (A) -3 (B) 3 (C) 2 (D) -8 (E) -2
   ANSWER : A

34. The coefficient of \( x^2 \) in the expansion of the determinant
   \[
   \begin{vmatrix}
   x^2 & x^3 + 1 & x^5 + 2 \\
x^2 + 3 & x^2 + x & x^3 + x^4 \\
x + 4 & x^3 + x^5 & 2 \\
   \end{vmatrix}
   \]
   is
   (A) -10 (B) -8 (C) -2 (D) -6 (E) 8
   ANSWER : A

35. Let \( A = \begin{bmatrix} 1 & -1-i\sqrt{3} \\ -1-i\sqrt{3} & 2 \end{bmatrix} \). Then \( A^{100} = \)
   (A) \( 2^{100} \) (B) \( 2^{99}A \) (C) \( 2^{98}A \) (D) \( A \) (E) \( A^2 \)
36. The least integer satisfying \( \frac{396}{10} - \frac{19-x}{10} < \frac{376}{10} - \frac{19-9x}{10} \) is
   (A) 1   (B) 2   (C) 3   (D) 4   (E) 5
   **ANSWER : C**

37. If \(|x-1| + |x-3| \leq 8\), then the values of \(x\) lie in the interval
   (A) \((-\infty, -2)\)   (B) \((-2, 6)\)   (C) \((-3, 7)\)
   (D) \((-2, \infty)\)   (E) \((6, \infty)\)
   **ANSWER : B**

38. Let \(p\) : 57 is an odd prime number,
   \(q\) : 4 is a divisor of 12.
   \(r\) : 15 is the LCM of 3 and 5
   Be three simple logical statements. Which one of the following is true?
   (A) \(p \lor (\neg q \land r)\)   (B) \(\neg p \lor (q \land r)\)   (C) \((p \land q) \lor \neg x\)
   (D) \((p \lor q) \land \neg r\)   (E) \((p \lor q) \land r\)
   **ANSWER : B**

39. Let \(p, q, r\) be three simple statements. Then \(\neg (p \lor q) \lor \neg (p \lor r)\)
   (A) \((\neg p) \land (\neg q \lor \neg r)\)   (B) \((\neg p) \land (q \lor r)\)
   (C) \(p \land (q \lor r)\)   (D) \((p \lor q) \land r\)
   (E) \((p \lor q) \land r\)
   **ANSWER : A**

40. If \(p : 3\) is a prime number and \(q :\) one plus one is three, then the compound statement “It is not that 3 is a prime number or it is not that one plus one is three” is
   (A) \(\neg p \lor q\)   (B) \(\neg p \lor \neg (p \lor q)\)
   (C) \(p \land q\)   (D) \(\neg p \lor \neg q\)
   (E) \(p \lor \neg q\)
   **ANSWER : D**

41. The value of \(\sin^2 \frac{\pi}{8} + \sin^2 \frac{3\pi}{8} + \sin^2 \frac{5\pi}{8} + \sin^2 \frac{7\pi}{8}\) is equal to
   (A) \(\frac{1}{8}\)   (B) \(\frac{1}{4}\)   (C) \(\frac{1}{2}\)
   (D) 1   (E) 2
   **ANSWER : E**

42. The value of \(\frac{\sqrt{3}}{\sin 15°} - \frac{1}{\cos 15°}\) is equal to
   (A) \(4\sqrt{2}\)   (B) \(2\sqrt{2}\)
   (C) \(\sqrt{2}\)   (D) \(\frac{1}{\sqrt{2}}\)
   (E) \(\frac{\sqrt{3}}{2}\)
   **ANSWER : A**

43. If \(\sin x + \cos x = \sqrt{2}\), then \(\sin x \cos x =\)
   (A) 1   (B) \(\frac{1}{2}\)
   (C) 2   (D) \(\sqrt{2}\)
   (E) \(\frac{1}{\sqrt{2}}\)
   **ANSWER : B**
44. If \( \tan \theta = \frac{1}{2} \) and \( \tan \phi = \frac{1}{3} \), then \( \tan (2\theta + \phi) = \)

\[ \begin{align*}
& (A) \quad \frac{3}{4} \\
& (B) \quad \frac{4}{3} \\
& (C) \quad \frac{1}{3} \\
& (D) \quad 3 \\
& (E) \quad \frac{1}{2}
\end{align*} \]

**ANSWER : C**

45. The value of \( x \) satisfying the equation \( \tan^{-1} x + \tan^{-1} \left( \frac{2}{3} \right) = \tan^{-1} \left( \frac{7}{4} \right) \) is equal to

\[ \begin{align*}
& (A) \quad \frac{1}{2} \\
& (B) \quad -\frac{1}{2} \\
& (C) \quad \frac{3}{2} \\
& (D) \quad -\frac{1}{3} \\
& (E) \quad \frac{1}{3}
\end{align*} \]

**ANSWER : A**

46. If \( \tan A - \tan B = x \) and \( \cot B - \cot A = y \), then \( \cot (A-B) \) is

\[ \begin{align*}
& (A) \quad \frac{1}{x-y} \\
& (B) \quad \frac{1}{x+y} \\
& (C) \quad \frac{1}{x+y} \\
& (D) \quad \frac{1}{x+y} \\
& (E) \quad \frac{1}{x+y}
\end{align*} \]

**ANSWER : E**

47. If \( \tan^{-1} x + \tan^{-1} y = \frac{2\pi}{3} \), then \( \cot^{-1} x + \cot^{-1} y \) is equal to

\[ \begin{align*}
& (A) \quad \frac{\pi}{2} \\
& (B) \quad \frac{1}{2} \\
& (C) \quad \frac{\pi}{3} \\
& (D) \quad \frac{\sqrt{3}}{2} \\
& (E) \quad \pi
\end{align*} \]

**ANSWER : C**

48. If the orthocenter, centroid, incentre and circumcentre coincide in a triangle \( ABC \), and if the length of side \( AB \) is \( \sqrt{75} \) units, then the length of the altitude of the triangle through the vertex \( A \) is

\[ \begin{align*}
& (A) \quad \sqrt{3} \text{ units} \\
& (B) \quad 3 \text{ units} \\
& (C) \quad \frac{\sqrt{15}}{2} \text{ units} \\
& (D) \quad \frac{15}{2} \text{ units} \\
& (E) \quad \frac{\sqrt{5}}{2} \text{ units}
\end{align*} \]

**ANSWER : C**

49. If \( A (2, 4) \) and \( B (6, 10) \) are two fixed points and if a point \( P \) moves so that \( \angle APB \) is always a right angle, then the locus of \( P \) is

\[ \begin{align*}
& (A) \quad x^2 + y^2 + 8x + 14y + 52 = 0 \\
& (B) \quad x^2 + y^2 - 8x + 14y - 52 = 0 \\
& (C) \quad x^2 + y^2 + 8x - 14y + 52 = 0 \\
& (D) \quad x^2 + y^2 - 8x - 14y - 52 = 0 \\
& (E) \quad x^2 + y^2 - 8x + 14y + 52 = 0
\end{align*} \]

**ANSWER : E**

50. The points \((-1, 0)\) and \((-2, 1)\) are the two extremities of a diagonal of a parallelogram. If \((-6, 5)\) is the third vertex, then the fourth vertex of the parallelogram is

\[ \begin{align*}
& (A) \quad (2, -6) \\
& (B) \quad (2, -5) \\
& (C) \quad (3, -4) \\
& (D) \quad (-3, 4) \\
& (E) \quad (3, -5)
\end{align*} \]

**ANSWER : C**
51. The slope of the straight line \( \frac{x}{10} - \frac{y}{4} = 3 \) is
   \( \frac{5}{2} \) (A) \( \frac{-5}{2} \) (B) \( \frac{2}{5} \) (C) \( \frac{-2}{5} \) (D) \( \frac{4}{3} \) (E) \( \frac{2}{5} \)
   ANSWER : C

52. If y-intercept of the line \( 4x - ay = 8 \) is thrice its x-intercept, then the value of \( a \) is equal to
   \( \frac{3}{4} \) (A) \( \frac{4}{3} \) (B) \( \frac{-3}{4} \) (C) \( \frac{-4}{3} \) (D) \( \frac{-2}{3} \) (E) \( \frac{2}{3} \)
   ANSWER : D

53. The equation of one of the straight lines passing through the point \( (0, 1) \) and is at a distance of \( \frac{3}{5} \) units from the origin is
   \( 4x + 3y = 3 \) (A) \( -x + y = 1 \) (B) \( x + y = 1 \) (C) \( x + y = 1 \)
   \( 5x + 4y = 4 \) (D) \( -5x + 4y = 4 \) (E) \( \frac{3}{5} \)
   ANSWER : A

54. The nearest point on the line \( x + y - 3 = 0 \) from the point \( (3, -2) \) is
   \( (3, 5) \) (A) \( (4, 1) \) (B) \( (3, -5) \) (C) \( (5, -1) \) (D) \( (5, -1) \)
   ANSWER : D

55. The image of the origin with respect to the line \( 4x + 3y = 25 \), is
   \( (4, 3) \) (A) \( (3, 4) \) (B) \( (6, 8) \) (C) \( (4, 6) \) (D) \( (8, 6) \)
   ANSWER : E

56. If the area of the circle \( 4x^2 + 4y^2 + 8x - 16y + \lambda = 0 \) is 9 \( \pi \) sq. units, then the value of \( \lambda \) is
   \( 4 \) (A) \( -4 \) (B) \( 16 \) (C) \( -16 \) (D) \( -8 \) (E) \( 8 \)
   ANSWER : D

57. The radius of the circle passing through the points \( (2, 3) \), \( (2, 7) \) and \( (5, 3) \) is
   \( 5 \) (A) \( 4 \) (B) \( \frac{5}{2} \) (C) \( \frac{2}{5} \) (D) \( 2 \) (E) \( \sqrt{5} \)
   ANSWER : C

58. If a diameter of the circle \( x^2 + y^2 - 2x - 6y + 6 = 0 \) is a chord of another circle \( C \) having centre \( (2, 1) \), then the radius of the circle \( C \) is
   \( 2 \) (A) \( \sqrt{3} \) (B) \( 3 \) (C) \( \sqrt{5} \) (D) \( 5 \) (E) \( \sqrt{2} \)
   ANSWER : C

59. In the family of concentric circles \( 2(x^2 + y^2) = k \), the radius of the circle passing through \( (1, 1) \) is
   \( \sqrt{2} \) (A) \( 4 \) (B) \( 2\sqrt{2} \) (C) \( 1 \) (D) \( 3\sqrt{2} \) (E) \( 3\sqrt{2} \)
   ANSWER : A
60. Let P be a point on an ellipse at a distance of 8 units from a focus. If the eccentricity is \( \frac{4}{5} \), then the distance of the point P from the directrix is

(A) \( \frac{5}{8} \)  
(B) \( \frac{8}{5} \)  
(C) 5  
(D) 8  
(E) 10  

ANSWER : E

61. If (-3, 0) is the vertex and y-axis is the directrix of a parabola, then its focus is at the point

(A) (0, -6)  
(B) (-6, 0)  
(C) (6, 0)  
(D) (0, 0)  
(E) (3, 0)  

ANSWER : B

62. The foci o the ellipse \( 4x^2 + 9y^2 = 1 \) are

(A) \( \pm \frac{\sqrt{3}}{2}, 0 \)  
(B) \( \pm \frac{\sqrt{5}}{2}, 0 \)  
(C) \( \pm \frac{\sqrt{5}}{3}, 0 \)  
(D) \( \pm \frac{\sqrt{5}}{6}, 0 \)  
(E) \( \pm \frac{\sqrt{5}}{4}, 0 \)  

ANSWER : D

63. The directrix of a parabola is \( x+8 = 0 \) and its focus is at (4,3). Then the length of the latus-rectum of the parabola is

(A) 5  
(B) 9  
(C) 10  
(D) 12  
(E) 24  

ANSWER : E

64. If the eccentricity of the ellipse \( ax^2 + 4y^2 = 4a \), \( a < 4 \) is \( \frac{1}{\sqrt{2}} \), then its semi minor axis is equal to

(A) 2  
(B) \( \sqrt{2} \)  
(C) 1  
(D) \( \sqrt{3} \)  
(E) 3  

ANSWER : B

65. The hyperbola \( \frac{x^2}{a^2} - \frac{y^2}{b^2} = 1 \) passes through the point \( (\sqrt{6},3) \) and the length of the latus rectum is \( \frac{18}{5} \). Then the length of the transverse axis is equal to

(A) 5  
(B) 4  
(C) 3  
(D) 2  
(E) 1  

ANSWER : D

66. The angle between \( \vec{a} \) and \( \vec{b} \) is \( \frac{5\pi}{6} \) and the projection of \( \vec{a} \) on \( \vec{b} \) is \( \frac{9}{\sqrt{3}} \) then \( |\vec{a}| \) is equal to

(A) 12  
(B) 8  
(C) 10  
(D) 4  
(E) 6  

ANSWER : E

67. The direction cosines of the straight line given by the planes \( x = 0 \) and \( z = 0 \) are

(A) 1,0,0  
(B) 0,0,1  
(C) 1,1,0  
(D) 0,1,0  
(E) 0,1,1  

ANSWER : D

68. \( \vec{a} = 2\hat{i} - \hat{j} - m\hat{k} \) and \( \vec{b} = \frac{4}{7}\hat{i} - \frac{2}{7}\hat{j} + 2\hat{k} \) are collinear, then the value of m is equal to

(A) -7  
(B) -1  
(C) 2  
(D) 7  
(E) -2  

ANSWER : A
69. Let \( \vec{a} = 2\hat{i} + 5\hat{j} - 7\hat{k}, \vec{b} = \hat{i} + 3\hat{j} + 5\hat{k} \). Then \((3\vec{a} - 5\vec{b}), (4\vec{a} \times 5\vec{b}) = \)

(A) – 7  (B) 0  (C) – 13  (D) 1  (E) – 8

**ANSWER : B**

70. If \( \vec{a} + 2\vec{b} - \vec{c} = \vec{0} \) and \( \vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a} = \lambda \vec{a} \times \vec{b} \), then the value of \( \lambda \) is equal to

(A) 5  (B) 4  (C) 2  (D) – 2  (E) – 4

**ANSWER : D**

71. If \( \vec{a} \vec{b} = \vec{0} \) and \( \vec{a} + \vec{b} \) and makes an angle of 60° with \( \vec{b} \) then \( |\vec{a}| \) is equal to

(A) 0  (B) \( \frac{1}{\sqrt{3}} |\vec{b}| \)  (C) \( \frac{1}{|\vec{b}|} \)  (D) \( |\vec{b}| \)  (E) \( \sqrt{3} |\vec{b}| \)

**ANSWER : E**

72. If \( \vec{a} + \vec{b} \) and \( \vec{a} - \vec{b} \) are perpendicular and \( \vec{b} = 3\hat{i} - 4\hat{j} + 2\hat{k} \), then \( |\vec{a}| \) is equal to

(A) \( \sqrt{41} \)  (B) \( \sqrt{39} \)  (C) \( \sqrt{19} \)  (D) \( \sqrt{29} \)  (E) \( \sqrt{31} \)

**ANSWER : D**

73. The straight line \( \vec{r} = (\hat{i} + \hat{j} + \hat{k}) + \alpha(2\hat{i} - \hat{j} + 4\hat{k}) \) meets the xy plane at the point

(A) (2, –1, 0)  (B) (3,4,0)  (C) \( \left(\frac{1}{2}, \frac{3}{4}, 0\right) \)  (D) \( \left(\frac{1}{2}, \frac{7}{4}, 0\right) \)  (E) \( \left(\frac{1}{2}, \frac{5}{4}, 0\right) \)

**ANSWER : E**

74. The equation of the plane passing through \((-1, 5, -7)\) and parallel to the plane \(2x - 5y + 7z + 11 = 0\), is

(A) \( \vec{r} \cdot (2\hat{i} - 5\hat{j} - 7\hat{k}) + 76 = 0 \)  (B) \( \vec{r} \cdot (2\hat{i} - 5\hat{j} + 7\hat{k}) + 76 = 0 \)

(C) \( \vec{r} \cdot (2\hat{i} - 5\hat{j} + 7\hat{k}) + 75 = 0 \)  (D) \( \vec{r} \cdot (2\hat{i} - 5\hat{j} + 7\hat{k}) + 65 = 0 \)

(E) \( \vec{r} \cdot (2\hat{i} - 5\hat{j} - 7\hat{k}) + 55 = 0 \)

**ANSWER : B**

75. The angle subtended at the point (1,2,3) by the points P(2,4,5) and Q (3,3,1), is

(A) 90°  (B) 60°  (C) 30°  (D) 0°  (E) 45°

**ANSWER : A**

76. If the two lines \( x - 1 = \frac{1 - y}{a} = \frac{z}{4} \) and \( x - 3 = \frac{2y - 3}{4} = \frac{z - 2}{2} \) are perpendicular, then the value of a is equal to

(A) – 4  (B) 5  (C) – 5  (D) 4  (E) – 2

**ANSWER : C**
77. If the line \( \frac{x+1}{2} = \frac{y+1}{3} = \frac{z+1}{4} \) meets the plane \( x + 2y + 3z = 14 \) at P, then the distance between P and the origin is

(A) \( \sqrt{14} \)  (B) \( \sqrt{15} \)  (C) \( \sqrt{13} \)  (D) \( \sqrt{12} \)  (E) \( \sqrt{17} \)

**ANSWER : A**

78. The point of the intersection of the straight lines

\( \vec{r} = (3\hat{i} - 4\hat{j} + 5\hat{k}) + \lambda(-\hat{i} - 2\hat{j} + 2\hat{k}) \) and

\( \frac{3-x}{-1} = \frac{y+4}{2} = \frac{z-5}{7} \) is

(A) \((-3, -4, -5)\)  (B) \((-3, 4, 5)\)  (C) \((-3, 4, -5)\)

(D) \((-3, -4, 5)\)  (E) \((3, -4, 5)\)

**ANSWER : E**

79. The vector of the straight line \( \frac{x-2}{-1} = \frac{y}{-3} = \frac{1-z}{2} \) is

(A) \( \vec{r} = 2\hat{i} + \hat{k} + t(\hat{i} + 3\hat{j} + 2\hat{k}) \)  (B) \( \vec{r} = 2\hat{i} - \hat{k} + t(\hat{i} - 3\hat{j} - 2\hat{k}) \)

(C) \( \vec{r} = 2\hat{i} + \hat{k} + (\hat{i} - 3\hat{j} + 2\hat{k}) \)  (D) \( \vec{r} = 2\hat{i} - \hat{j} + t(\hat{i} - 3\hat{j} - 2\hat{k}) \)

(E) \( \vec{r} = 2\hat{i} + \hat{k} + (\hat{i} - 3\hat{j} - 2\hat{k}) \)

**ANSWER : E**

80. The straight line \( \vec{r} = (\hat{i} - \hat{j} + 52\hat{k}) + t(2\hat{i} + 5\hat{j} + 3\hat{k}) \) is parallel to the plane \( \vec{r}.(2\hat{i} + \hat{j} - 3\hat{k}) = 5 \). Then the distance the straight line and the plane is

(A) \( \frac{9}{\sqrt{14}} \)  (B) \( \frac{8}{\sqrt{14}} \)  (C) \( \frac{7}{\sqrt{14}} \)  (D) \( \frac{6}{\sqrt{14}} \)  (E) \( \frac{5}{\sqrt{14}} \)

**ANSWER : B**

81. Two fair dice are rolled. Then the probability of getting a composite number as the sum of the face values is equal to

(A) \( \frac{7}{12} \)  (B) \( \frac{5}{2} \)  (C) \( \frac{1}{12} \)  (D) \( \frac{3}{4} \)  (E) \( \frac{2}{3} \)

**ANSWER : A**

82. If the mean of the numbers a, b, 8, 5, 10 is 6 and their variance is 6.8, then ab is equal to

(A) 6  (B) 7  (C) 12  (D) 14  (E) 25

**ANSWER : C**

83. In a class, in an examination in Mathematics, 10 students scored 100 marks each, 2 students scored zero and the average of the remaining students is 72 marks. If the class average is 76, then the number of students in the class is

(A) 44  (B) 40  (C) 38  (D) 34  (E) 32

**ANSWER : D**

84. A bag contains 3 red, 4 white and 5 blue balls. If two balls are drawn at random, then the probability that they are different colours is

(A) \( \frac{47}{66} \)  (B) \( \frac{23}{33} \)  (C) \( \frac{47}{132} \)  (D) \( \frac{47}{33} \)  (D) \( \frac{70}{33} \)

**ANSWER : A**
85. There are 5 positive numbers and 6 negative numbers. Three numbers are chosen at random and multiplied. The probability that the product being a negative number is
(A) 11/34   (B) 17/33   (C) 16/35   (D) 15/44   (E) 16/33

**ANSWER : E**

86. The value of \( \lim_{x \to 0} \cot 4x \) \( \csc 3x \) is equal to
(A) 4/3  (B) \( \frac{1}{4} \)  (C) 2/3  (D) 3/2  (E) 0

**ANSWER : B**

87. Let \( f(x) = \begin{cases} 
\cos x & \text{if } x \geq 0 \\
-\cos x & \text{if } x < 0 
\end{cases} \)
which one of the following statements is not true?
(A) \( f(x) \) is continuous at \( x = 1 \)  (B) \( f(x) \) is continuous at \( x = -1 \)
(C) \( f(x) \) is continuous at \( x = 2 \)  (D) \( f(x) \) is continuous at \( x = -2 \)
(E) \( f(x) \) is continuous at \( x = 0 \)

**ANSWER : E**

88. The value of \( \lim_{n \to \infty} \frac{n^3 - nP_3}{n^3} \) is equal to
(A) - 5/6  (B) 5/6  (C) 1/6  (D) -1/6  (E) 2/3

**ANSWER : A**

89. If \( f(x) = 3x + 5 \) and \( g(x) = x^2 - 1 \), then \( (f \circ g) (x^2 - 1) \) is equal to
(A) \( 3x^4 - 3x + 5 \)  (B) \( 3x^4 - 6x^2 + 5 \)  (C) \( 6x^4 + 3x^2 + 5 \)
(D) \( 6x^4 - 6x + 5 \)  (E) \( 3x^2 + 6x + 4 \)

**ANSWER : B**

90. The period of the function \( f(x) = (4x - 1) \) is
(A) \( \pi \)  (B) \( \pi /2 \)  (C) \( 2\pi \)  (D) \( \pi /4 \)  (E) \( 3\pi /4 \)

**ANSWER : D**

91. If \( 2^x + 2^y = 2^{x+y} \), then the value of \( \frac{dy}{dx} \) at \( (1,1) \) is equal to
(A) - 2  (B) -1  (C) 0  (D) 1  (E) 2

**ANSWER : B**

92. If \( f(x) = \frac{\sin^{-1} x}{\sqrt{1-x^2}} \), then the value of \( (1 - x^2) f'(x) - xf(x) \) is
(A) 0  (B) 1  (C) 2  (D) 3  (E) 4

**ANSWER : B**
93. If \( f(x) = \left(\frac{x}{2}\right)^{10} \), then \( f'(1) + \frac{f''(1)}{1!} + \frac{f'''(1)}{2!} + \frac{f''''(1)}{3!} + \ldots + \frac{f^{(10)}(1)}{10!} \) is equal to
   (A) 1  (B) 10  (C) 11  (D) 512  (E) 1024
   \[ \text{ANSWER : A} \]

94. If \( f'(4) = 5, g'(4) = 12, f(4)g(4) = 2 \) and \( g(4) = 6, \) then \( \left(\frac{f}{g}\right)'(4) = \)
   (A) \frac{5}{36}  (B) \frac{11}{18}  (C) \frac{23}{36}  (D) \frac{13}{18}  (E) \frac{19}{3}
   \[ \text{ANSWER : D} \]

95. If the derivative of \((ax - 5)e^{3x}\) at \( x = 0 \) is -13, then the value of \( a \) is equal to
   (A) 8  (B) -5  (C) 5  (D) -2  (E) 2
   \[ \text{ANSWER : E} \]

96. Let \( y = \tan^{-1}(\sec x + \tan x) \). Then \( \frac{dy}{dx} = \)
   (A) \frac{1}{4}  (B) \frac{1}{2}  (C) \frac{1}{\sec x + \tan x}  (D) \frac{1}{\sec^2 x}  (E) \frac{1}{\tan x}
   \[ \text{ANSWER : B} \]

97. If \( s = \sec^{-1}\left(\frac{1}{2x^2 - 1}\right) \) and \( t = \sqrt{1 - x^2}, \) then \( \frac{ds}{dt} \) at \( x = \frac{1}{2}i^2 \)
   (A) 1  (B) 2  (C) -2  (D) 4  (E) -4
   \[ \text{ANSWER : D} \]

98. The minimum value of \( 2x^3 - 9x^2 + 12x + 4 \) is
   (A) 4  (B) 5  (C) 6  (D) 7  (E) 8
   \[ \text{ANSWER : E} \]

99. The slope of the curve \( y = e^x \cos x, \ x \in (-\pi, \pi) \) is maximum at
   (A) \( x = \frac{\pi}{2} \)  (B) \( x = -\frac{\pi}{2} \)  (C) \( x = \frac{\pi}{4} \)  (D) \( x = 0 \)  (E) \( x = \frac{\pi}{3} \)
   \[ \text{ANSWER : D} \]

100. If \( y = f(x) \) is continuous on \([0,6]\), different on \((0,6)\), \( f(0) = -2 \) and \( f(6) = 16 \), then at some point between \( x = 0 \) and \( x = 6 \), \( f'(x) \) must be equal to
    (A) -18  (B) -3  (C) 3  (D) 14  (E) 18
    \[ \text{ANSWER : C} \]

101. The equation of the tangent to the curve \( y = x^3 - 6x + 5 \) at \((2,1)\) is
    (A) \( 6x - y - 11 = 0 \)  (B) \( 6x - y - 13 = 0 \)  (C) \( 6x + y + 11 = 0 \)
    (D) \( 6x - y + 11 = 0 \)  (E) \( x - 6y - 11 = 0 \)
    \[ \text{ANSWER : A} \]
102. Let \( f(x) = 2x^3 - 5x^2 - 4x + 3 \), \( \frac{1}{2} \leq x \leq 3 \). The point at which the tangent to the curve is parallel to the x axis, is

(A) (1, – 4)    (B) (2, – 9 )    (C) (2, – 4)    (D) (2, – 1)    (E) ( 2 – 5)

\[\text{ANSWER: B}\]

103. Two sides of a triangle are 8 m and 5 m in length. The angle between them is increasing at the rate 0.08 rad/sec. When the angle between the sides of fixed length is \( \frac{\pi}{3} \), the rate at which the area of the triangle is increasing is

(A) 0.4 m²/sec    (B) 0.8n²/sec    (C) 0.6m²/sec

(D) 0.04m²/sec    (E) 0.08 m²/sec

\[\text{ANSWER: B}\]

104. If \( y = 8x^3 - 60x^2 + 144x + 27 \) is strictly decreasing function in the interval

(A) ( – 5, 6)    (B)( –∞ , 2)    (C) 5,6)    (D)( 3, ∞ )    (E) 2,3)

\[\text{ANSWER: E}\]

105. \( \int (\sec x)^n (\tan x + \tan x) \) dx is equal to

(A) \( \sec^{m+1} x + C \)    (B) \( \tan^{m+2} x + C \)    (C) \( \frac{\sec^{m+2} x}{m+2} + C \)

(D) \( \frac{\tan^{m+2} x}{m+2} + C \)    (E) \( \frac{\sec^{m+1} x}{m+1} + C \)

\[\text{ANSWER: C}\]

106. \( \int \frac{1}{7} \sin \left( \frac{x}{7} + 10 \right) \) dx is equal to

(A) \( \frac{1}{7} \cos \left( \frac{x}{7} + 10 \right) + C \)    (B) \( -\frac{1}{7} \cos \left( \frac{x}{7} + 10 \right) + C \)    (C) \( -\cos \left( \frac{x}{7} + 10 \right) + C \)

(D) \( -7 \cos \left( \frac{x}{7} + 10 \right) + C \)    (E) \( \cos (x + 70) + C \)

\[\text{ANSWER: C}\]

107. \( \int \left( \frac{x-a}{x} - \frac{x}{x+a} \right) \) dx is equal to

(A) \( \log \left( \frac{x+a}{x} \right) + C \)    (B) \( a \log \left( \frac{x+a}{x} \right) + C \)    (C) \( a \log \left( \frac{x}{x+a} \right) + C \)

(D) \( \log \left( \frac{x}{x+a} \right) + C \)    (E) \( a \log \left( \frac{x-a}{x+a} \right) + C \)

\[\text{ANSWER: B}\]
108. \[ \int x^4 e^x \cos(e^x) \, dx \] is equal to

(A) \( \frac{1}{3} \sin(e^x) + C \) (B) \( \frac{1}{4} \sin(e^x) + C \) (C) \( \frac{1}{5} \sin(e^x) + C \)
(D) \( \sin(e^x) + C \) (E) \( \sin(e^x) + C \)

**Answer: C**

109. \[ \int \frac{2x + \sin 2x}{1 + \cos 2x} \, dx \] is equal to

(A) \( x + \log |\tan x| + C \) (B) \( x \log |\tan x| + C \) (C) \( x \tan x + C \)
(D) \( \log |\cos x| + C \) (E) \( \log |\sin x| + C \)

**Answer: C**

110. \[ \int \frac{1}{\sin x \cos x} \, dx \] is equal to

(A) \( \log |\tan x| + C \) (B) \( \log |\sin 2x| + C \) (C) \( \log |\sec x| + C \)
(D) \( \log |\cos x| + C \) (E) \( |\sin x| + C \)

**Answer: A**

111. \[ \int \frac{1}{8 \sin^2 x + 1} \, dx \] is equal to

(A) \( \sin^{-1}(\tan x) + C \) (B) \( \frac{1}{3} \sin^{-1}(\tan x) + C \) (C) \( \frac{1}{3} \tan^{-1}(3 \tan x) + C \)
(D) \( \tan^{-1}(3 \tan x) + C \) (E) \( \sin^{-1}(3 \tan x) + C \)

**Answer: C**

112. \[ \int_0^{\pi/2} \log \left( \frac{\cos x}{\sin x} \right) \, dx \] is equal to

(A) \( \pi /2 \) (B) \( \pi /4 \) (C) \( \pi \) (D) \( 2 \pi \) (E) 0

**Answer: E**

113. The value of \( \int_{\frac{1}{4}}^{1} 4x^2 |x| \, dx \) is equal to

(A) 17 (B) 16 (C) 15 (D) 14 (E) 13

**Answer: A**

114. The area of the region bounded by \( y^2 = 16 - x^2 \), \( y = 0 \), \( x = 0 \) in the first quadrant is (in square units)

(A) \( 8 \pi \) (B) \( 6 \pi \) (C) \( 2 \pi \) (D) \( 4 \pi \) (E) \( \pi /2 \)

**Answer: D**
115. The value of \[\int_{2}^{4} (x-2)(x-3)(x-4) \, dx\] is equal to
(A) 1/2  \hspace{1cm} (B) 2  \hspace{1cm} (C) 3  \hspace{1cm} (D) 1/3  \hspace{1cm} (E) 0
\textbf{ANSWER : E}

116. The area bounded by the lines \(y - 2x = 2, y = 4\) and the y-axis is equal to (in square units)
(A) 1  \hspace{1cm} (B) 4  \hspace{1cm} (C) 0  \hspace{1cm} (D) 3  \hspace{1cm} (E) 2
\textbf{ANSWER : A}

117. The general solution of the differential equation \((x + y + 3) \frac{dy}{dx} = 1\) is
(A) \(x + y + 3 = Ce^y\)  \hspace{1cm} (B) \(x + y + 4 = Ce^y\)  \hspace{1cm} (C) \(x + y + 3 = Ce^{-y}\)
(D) \(x + y + 4 = Ce^y\)  \hspace{1cm} (E) \(x + y + 4e^y = C\)
\textbf{ANSWER : B}

118. The differential equation representing the family of curves \(y^2 = a(ax+b)\) where \(a\) and \(b\) are arbitrary constants, is of
(A) order 1, degree 1  \hspace{1cm} (B) order 1, degree 3  \hspace{1cm} (C) order 2, degree 3
(D) order 1, degree 4  \hspace{1cm} (E) order 2, degree 1
\textbf{ANSWER : E}

119. The solution of the differential equation \(\frac{x \, dy}{dx} - y = 10x^2\) is
(A) \(\sin^{-1}\left(\frac{y}{x}\right) - 5x^2 = C\)  \hspace{1cm} (B) \(\sin^{-1}\left(\frac{y}{x}\right) = 10x^2 + C\)  \hspace{1cm} (C) \(\frac{y}{x} = 5x^2 + C\)
(D) \(\sin^{-1}\left(\frac{y}{x}\right) = 10x^2 + Cx\)  \hspace{1cm} (E) \(\sin^{-1}\left(\frac{y}{x}\right) + 5x^2 = C\)
\textbf{ANSWER : A}

120. The general solution of the differential equation \(x \, dy - y \, dx = y^2 \, dx\) is
(A) \(y = \frac{x}{C - x}\)  \hspace{1cm} (B) \(x = \frac{2y}{C + x}\)  \hspace{1cm} (C) \(y = (C + x)(2x)\)
(D) \(y = \frac{2x}{C + x}\)  \hspace{1cm} (E) \(x = \frac{y}{C - x}\)
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