1. If $\cos^{-1}\left(\frac{1}{x}\right)=\theta$, then $\tan\theta=$

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

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

2. $\sin(\cot^{-1}x)$

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

(c) $(1+x^2)^{-3/2}$ (d) $(1+x^2)^{-1/2}$

3. $\cos\left(\sin^{-1}\frac{5}{13}\right)=$

(a) $\frac{12}{13}$ (b) $-\frac{12}{13}$

(c) $\frac{5}{12}$ (d) None of these

4. The angle of elevation of the top of a tower from a point A due south of the tower is α and from a point B due east of the tower is β. If $AB=d$, then the height of the tower is

(a) $\frac{d}{\sqrt{\tan^2\alpha-\tan^2\beta}}$ (b) $\frac{d}{\sqrt{\tan^2\alpha+\tan^2\beta}}$

(c) $\frac{d}{\sqrt{\cot^2\alpha+\cot^2\beta}}$ (d) $\frac{d}{\sqrt{\cot^2\alpha-\cot^2\beta}}$

5. A person standing on the bank of a river observes that the angle subtended by a tree on the opposite bank is 60°. When he retires 40 *meters* from the bank, he finds the angle to be 30°. The breadth of the river is

(a) 20 *m* (b) 40 *m*

(c) 30 *m* (d) 60 *m*

6. If $f(x)=\frac{x}{x-1}$, then $\frac{f(a)}{f(a+1)}=$

(a) $f(-a)$ (b) $f\left(\frac{1}{a}\right)$

(c) $f(a^2)$ (d) $f\left(\frac{-a}{a-1}\right)$

7. If $f(x)=\cos(\log x)$, then $f(x^2)f(y^2)-\frac{1}{2}\left[f\left(\frac{x^2}{2}\right)+f\left(\frac{x^2}{y^2}\right)\right]$ has the value

(a) –2 (b) –1

(c) 1/2 (d) None of these

8. If $f(x)=\begin{cases} x, \text{ when } 0\le x\le 1 \\ 2-x, \text{ when } 1<x\le 2\end{cases}$, then $\lim_{x\to 1}f(x)=$

(a) 1 (b) 2

(c) 0 (d) Does not exist

9. $\lim_{x\to 1}\frac{\log x}{x-1}=$

(a) 1 (b) –1

(c) 0 (d) ∞

10. If $f(x)=\begin{cases}\frac{x^2-4x+3}{x^2-1}, \text{ for } x\ne 1 \\ 2, \text{ for } x=1\end{cases}$, then

(a) $\lim_{x\to 1+}f(x)=2$

(b) $\lim_{x\to 1-}f(x)=3$

(c) $f(x)$ is discontinuous at $x=1$

(d) None of these

11. Let $[x]$ denotes the greatest integer less than or equal to x. If $f(x)=[x\sin\pi x]$, then $f(x)$ is

(a) Continuous at $x=0$ (b) Continuous in $(-1,0)$

(c) Differentiable in (–1,1) (d) All the above

12. The function defined by $f(x)=\begin{cases}|x-3|; & x\ge 1 \\ \frac{1}{4}x^2-\frac{3}{2}x+\frac{13}{4}; & x<1\end{cases}$ is

(a) Continuous at $x=1$ (b) Continuous at $x=3$

(c) Differentiable at $x=1$ (d) All the above

13. The maximum distance from the origin of coordinates to the point z satisfying the equation $\left|z+\frac{1}{z}\right|=a$ is

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

(c) $\frac{1}{2}(\sqrt{a^2+4}+a)$ (d) None of these

14. Find the complex number z satisfying the equations $\left|\frac{z-12}{z-8i}\right|=\frac{5}{3}, \left|\frac{z-4}{z-8}\right|=1$

(a) 6 (b) $6\pm 8i$

(c) $6+8i, 6+17i$ (d) None of these

15. If z_1, z_2, z_3 are complex numbers such that $|z_1|=|z_2|=|z_3|=\left|\frac{1}{z_1}+\frac{1}{z_2}+\frac{1}{z_3}\right|=1$, then $|z_1+z_2+z_3|$ is

(a) Equal to 1 (b) Less than 1

(c) Greater than 3 (d) Equal to 3

16. If $z_1=10+6i, z_2=4+6i$ and z is a complex number such that $amp\left(\frac{z-z_1}{z-z_2}\right)=\frac{\pi}{4}$, then the value of $|z-7-9i|$ is equal to

(a) $\sqrt{2}$ (b) $2\sqrt{2}$

(c) $3\sqrt{2}$ (d) $2\sqrt{3}$

17. The term independent of y in the expansion of $(y^{-1/6} - y^{1/3})^9$ is

(a) 84 (b) 8.4

(c) 0.84 (d) – 84

18. The coefficient of the term independent of x in the expansion of $(1+x+2x^3)\left(\frac{3}{2}x^2 - \frac{1}{3x}\right)^9$ is

(a) $\frac{1}{3}$ (b) $\frac{19}{54}$

(c) $\frac{17}{54}$ (d) $\frac{1}{4}$

18. In a train five seats are vacant, then how many ways can three passengers sit

(a) 20 (b) 30

(c) 10 (d) 60

19. The product of any r consecutive natural numbers is always divisible by

(a) $r!$ (b) r^2

(c) r^n (d) None of these

21. Centre of circle $(x-x_1)(x-x_2) + (y-y_1)(y-y_2) = 0$ is

(a) $\left(\frac{x_1+y_1}{2}, \frac{x_2+y_2}{2}\right)$ (b) $\left(\frac{x_1-y_1}{2}, \frac{x_2-y_2}{2}\right)$

(c) $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$ (d) $\left(\frac{x_1-x_2}{2}, \frac{y_1-y_2}{2}\right)$

22. ABC is a triangle in which angle C is a right angle. If the coordinates of A and B be (–3, 4) and (3, –4) respectively, then the equation of the circumcircle of triangle ABC is

(a) $x^2 + y^2 - 6x + 8y = 0$

(b) $x^2 + y^2 = 25$

(c) $x^2 + y^2 - 3x + 4y + 5 = 0$

(d) None of these

23. Vertex of the parabola $y^2 + 2y + x = 0$ lies in the quadrant **[MP PET 1989]**

(a) First (b) Second

(c) Third (d) Fourth

24. The equation $x^2 - 2xy + y^2 + 3x + 2 = 0$ represents

(a) A parabola (b) An ellipse

(c) A hyperbola (d) A circle

25. For the ellipse $3x^2 + 4y^2 = 12$, the length of latus rectum is

(a) $\frac{3}{2}$ (b) 3

(c) $\frac{8}{3}$ (d) $\sqrt{\frac{3}{2}}$

26. For the ellipse $\frac{x^2}{64} + \frac{y^2}{28} = 1$, the eccentricity is

(a) $\frac{3}{4}$ (b) $\frac{4}{3}$

(c) $\frac{2}{\sqrt{7}}$ (d) $\frac{1}{3}$

27. The length of transverse axis of the parabola $3x^2 - 4y^2 = 32$ is

(a) $\frac{8\sqrt{2}}{\sqrt{3}}$ (b) $\frac{16\sqrt{2}}{\sqrt{3}}$

(c) $\frac{3}{32}$ (d) $\frac{64}{3}$

28. The directrix of the hyperbola is $\frac{x^2}{9} - \frac{y^2}{4} = 1$

(a) $x = 9/\sqrt{13}$ (b) $y = 9/\sqrt{13}$

(c) $x = 6/\sqrt{13}$ (d) $y = 6/\sqrt{13}$

29. If $x = \frac{3at}{1+t^3}, y = \frac{3at^2}{1+t^3}$, then $\frac{dy}{dx} =$

(a) $\frac{t(2+t^3)}{1-2t^3}$ (b) $\frac{t(2-t^3)}{1-2t^3}$

(c) $\frac{t(2+t^3)}{1+2t^3}$ (d) $\frac{t(2-t^3)}{1+2t^3}$

30. If $x = t + \frac{1}{t}, y = t - \frac{1}{t}$, then $\frac{d^2y}{dx^2}$ is equal to

(a) $-4t(t^2-1)^{-2}$ (b) $-4t^3(t^2-1)^{-3}$

(c) $(t^2+1)(t^2-1)^{-1}$ (d) $-4t^2(t^2-1)^{-2}$

31. If $x = t^2$, $y = t^3$, then $\frac{d^2y}{dx^2} =$

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

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

32. If $x = a\sin\theta$ and $y = b\cos\theta$, then $\frac{d^2y}{dx^2}$ is

(a) $\frac{a}{b^2}\sec^2\theta$ (b) $\frac{-b}{a}\sec^2\theta$

(c) $\frac{-b}{a^2}\sec^3\theta$ (d) $\frac{-b}{a^2}\sec^3\theta$

33. Let $y = t^{10} + 1$ and $x = t^8 + 1$, then $\frac{d^2y}{dx^2}$ is

(a) $\frac{5}{2}t$ (b) $20t^8$

(c) $\frac{5}{16t^6}$ (d) None of these

34. If $3\sin(xy)+4\cos(xy)=5$, then $\frac{dy}{dx}=$

(a) $-\frac{y}{x}$ (b) $\frac{3\sin(xy)+4\cos(xy)}{3\cos(xy)-4\sin(xy)}$

(c) $\frac{3\cos(xy)+4\sin(xy)}{4\cos(xy)-3\sin(xy)}$ (d) None of these

35. If $x^2e^y+2xye^x+13=0$, then dy/dx =

(a) $\frac{2xe^{y-x}+2y(x+1)}{x(xe^{y-x}+2)}$ (b) $\frac{2xe^{x-y}+2y(x+1)}{x(xe^{y-x}+2)}$

(c) $-\frac{2xe^{y-x}+2y(x+1)}{x(xe^{y-x}+2)}$ (d) None of these

36. If *A*, *B* ,*C* are three forces in equilibrium acting at a point and if 60^o, 150^o and 150^o respectively denote the angles between *A* and *B*, *B* and *C* and *C* and *A,* then the forces are in proportion of

(a) $\sqrt{3}:1:1$ (b) $1:1:\sqrt{3}$

(c) $1:\sqrt{3}:1$ (d) $1:2.5:2.5$

37. If the angle α between two forces of equal magnitude is reduced to $\alpha-\frac{\pi}{3}$, then the magnitude of their resultant becomes $\sqrt{3}$ times of the earlier one. The angle α is

(a) $\pi/2$ (b) $2\pi/3$

(c) $\pi/4$ (d) $4\pi/5$

38. The resultant of two forces *P* and *Q* is *R*. If one of the forces is reversed in direction, the resultant becomes R', then

(a) $R'^2=P^2+Q^2+2PQ\cos\alpha$

(b) $R'^2=P^2-Q^2-2PQ\cos\alpha$

(c) $R'^2+R^2=2(P^2+Q^2)$

(d) $R'^2+R^2=2(P^2-Q^2)$

39. Forces proportional to *AB*, *BC* and 2*CA* act along the sides of triangle *ABC* in order, their resultants represented in magnitude and direction is

(a) $\overrightarrow{CA}$ (b) $\overrightarrow{AC}$

(c) $\overrightarrow{BC}$ (d) $\overrightarrow{CB}$

40. *ABCD* is a parallelogram. A particle *P* is attracted towards *A* and *C* by forces proportional to *PA* and *PC* respectively and repelled from *B* and *D* by forces proportional to *PB* and *PD*. The resultant of these forces is

(a) $2\overrightarrow{PA}$ (b) $2\overrightarrow{PB}$

(c) $2\overrightarrow{PC}$ (d) None of these

41. A particle is acted upon by three forces *P*, *Q* and *R*. It cannot be in equilibrium, if $P:Q:R=$

(a) $1:3:5$ (b) $3:5:7$

(c) $5:7:9$ (d) $7:9:11$

42. Forces of 7 *N*, 5*N* and 3*N* acting on a particle are in equilibrium, the angle between the pair of forces 5 and 3 is

(a) 30^o (b) 60^o

(c) 90^o (d) 120^o

43. If $A=\begin{bmatrix}\cos\alpha & -\sin\alpha\\ \sin\alpha & \cos\alpha\end{bmatrix}$ and $B=\begin{bmatrix}\cos\beta & -\sin\beta\\ \sin\beta & \cos\beta\end{bmatrix}$, then the correct relation is

(a) $A^2=B^2$ (b) $A+B=B-A$

(c) $AB=BA$ (d) None of these

44. If $A=\begin{bmatrix}1&0&1\\0&1&1\\1&0&0\end{bmatrix}$, then *A* is

(a) Symmetric (b) Skew-symmetric

(c) Non-singular (d) Singular

45. If $A=\begin{bmatrix}1&0&0\\0&1&0\\a&b&-1\end{bmatrix}$, then $A^2=$

(a) Unit matrix (b) Null matrix

(c) A (d) – A

46. The roots of the equation $\begin{vmatrix}1+x&1&1\\1&1+x&1\\1&1&1+x\end{vmatrix}=0$ are

(a) 0, – 3 (b) 0, 0, – 3

(c) 0, 0, 0, – 3 (d) None of these

47. One of the roots of the given equation

$\begin{vmatrix}x+a&b&c\\b&x+c&a\\c&a&x+b\end{vmatrix}=0$ is

(a) $-(a+b)$ (b) $-(b+c)$

(c) $-a$ (d) $-(a+b+c)$

48. If three geometric means be inserted between 2 and 32, then the third geometric mean will be

(a) 8 (b) 4

(c) 16 (d) 12

49. If five G.M.'s are inserted between 486 and 2/3 then fourth G.M. will be

(a) 4 (b) 6

(c) 12 (d) – 6

50. The G.M. of roots of the equation $x^2 - 18x + 9 = 0$ is
(a) 3 (b) 4
(c) 2 (d) 1

51. Let
$R = \{(3,3),(6,6),(9,9),(12,12),(6,12),(3,9),(3,12),(3,6)\}$
be a relation on the set $A = \{3,6,9,12\}$. The relation is
(a) An equivalence relation
(b) Reflexive and symmetric only
(c) Reflexive and transitive only
(d) Reflexive only

52. $x^2 = xy$ is a relation which is
(a) Symmetric (b) Reflexive
(c) Transitive (d) None of these

53. Let R = {(1, 3), (4, 2), (2, 4), (2, 3), (3, 1)} be a relation on the set A = {1, 2, 3, 4}. The relation R is
(a) Reflexive (b) Transitive
(c) Not symmetric (d) A function

54. The number of reflexive relations of a set with four elements is equal to
(a) 2^{16} (b) 2^{12}
(c) 2^8 (d) 2^4

55. Let S be the set of all real numbers. Then the relation $R = \{(a, b) : 1 + ab > 0\}$ on S is
(a) Reflexive and symmetric but not transitive
(b) Reflexive and transitive but not symmetric
(c) Symmetric, transitive but not reflexive
(d) Reflexive, transitive and symmetric
(e) None of the above is true

56. If A is the set of even natural numbers less than 8 and B is the set of prime numbers less than 7, then the number of relations from A to B is
(a) 2^9 (b) 9^2
(c) 3^2 (d) 2^{9-1}

57. Of the members of three athletic teams in a school 21 are in the cricket team, 26 are in the hockey team and 29 are in the football team. Among them, 14 play hockey and cricket, 15 play hockey and football, and 12 play football and cricket. Eight play all the three games. The total number of members in the three athletic teams is
(a) 43 (b) 76
(c) 49 (d) None of these

58. In a class of 100 students, 55 students have passed in Mathematics and 67 students have passed in Physics. Then the number of students who have passed in Physics only is
(a) 22 (b) 33
(c) 10 (d) 45

59. If l, m, n are real and $l \neq m$, then the roots of the equation $(l-m)x^2 - 5(l+m)x - 2(l-m) = 0$ are
(a) Complex (b) Real and distinct
(c) Real and equal (d) None of these

60. If the roots of the equation $x^2 - 8x + (a^2 - 6a) = 0$ are real, then
(a) $-2 < a < 8$ (b) $2 < a < 8$
(c) $-2 \le a \le 8$ (d) $2 \le a \le 8$

61. The roots of the equation $x^2 + 2\sqrt{3}x + 3 = 0$ are
(a) Real and unequal (b) Rational and equal
(c) Irrational and equal (d) Irrational and unequal

62. The roots of the quadratic equation $(a+b-2c)x^2 - (2a-b-c)x + (a-2b+c) = 0$ are
(a) $a+b+c$ and $a-b+c$ (b) $\frac{1}{2}$ and $a-2b+c$
(c) $a-2b+c$ and $\frac{1}{a+b-x}$ (d) None of these

63. If α, β are the roots of $ax^2 + bx + c = 0$, then the equation whose roots are $2+\alpha, 2+\beta$ is
(a) $ax^2 + x(4a-b) + 4a - 2b + c = 0$
(b) $ax^2 + x(4a-b) + 4a + 2b + c = 0$
(c) $ax^2 + x(b-4a) + 4a + 2b + c = 0$
(d) $ax^2 + x(b-4a) + 4a - 2b + c = 0$

64. If the ratio of the roots of $x^2 + bx + c = 0$ and $x^2 + qx + r = 0$ be the same, then
(a) $r^2c = b^2q$ (b) $r^2b = c^2q$
(c) $rb^2 = cq^2$ (d) $rc^2 = bq^2$

65. If one root of $x^2 - x - k = 0$ is square of the other, then k =
(a) $2 \pm \sqrt{3}$ (b) $3 \pm \sqrt{2}$
(c) $2 \pm \sqrt{5}$ (d) $5 \pm \sqrt{2}$

66. If S is a set of $P(x)$ is polynomial of degree ≤ 2 such that $P(0) = 0$, $P(1) = 1$, $P'(x) > 0\ \forall x \in (0,1)$, then
(a) $S = 0$
(b) $S = ax + (1-a)x^2\ \forall a \in (0,\infty)$
(c) $S = ax + (1-a)x^2\ \forall a \in R$
(d) $S = ax + (1-a)x^2\ \forall a \in (0,2)$

67. If α and β, α and γ, α and δ are the roots of the equations $ax^2+2bx+c=0$, $2bx^2+cx+a=0$ and $cx^2+ax+2b=0$ respectively, where a, b and c are positive real numbers, then $\alpha+\alpha^2=$
(a) – 1 (b) 0
(c) *abc* (d) $a+2b+c$
(e) *abc*

68. If *ST* and *SN* are the lengths of the subtangent and the subnormal at the point $\theta=\frac{\pi}{2}$ on the curve $x=a(\theta+\sin\theta), y=a(1-\cos\theta), a\neq 1$, then
(a) $ST=SN$ (b) $ST=2SN$
(c) $ST^2=aSN^3$ (d) $ST^3=aSN$

69. The equation of the tangent to the curve $x=2\cos^3\theta$ and $y=3\sin^3\theta$ at the point $\theta=\pi/4$ is
(a) $2x+3y=3\sqrt{2}$ (b) $2x-3y=3\sqrt{2}$
(c) $3x+2y=3\sqrt{2}$ (d) $3x-2y=3\sqrt{2}$

70. The curve given by $x+y=e^{xy}$ has a tangent parallel to the *y*-axis at the point
(a) (0, 1) (b) (1, 0)
(c) (1, 1) (d) (–1, –1)

71. $\sin 15^\circ+\cos 105^\circ=$
(a) 0 (b) $2\sin 15^\circ$
(c) $\cos 15^\circ+\sin 15^\circ$ (d) $\sin 15^\circ-\cos 15^\circ$

72. The value $\cos 105^\circ+\sin 105^\circ$ is
(a) $\frac{1}{2}$ (b) 1
(c) $\sqrt{2}$ (d) $\frac{1}{\sqrt{2}}$

73. The value of $\cos y\cos\left(\frac{\pi}{2}-x\right)-\cos\left(\frac{\pi}{2}-y\right)\cos x+\sin y\cos\left(\frac{\pi}{2}-x\right)+\cos x\sin\left(\frac{\pi}{2}-y\right)$ is zero, if
(a) $x=0$ (b) $y=0$
(c) $x=y$ (d) $x=n\pi-\frac{\pi}{4}+y, (n\in I)$

74. $\sin\left(\frac{\pi}{10}\right)\sin\left(\frac{3\pi}{10}\right)=$
(a) 1/2 (b) – 1/2
(c) 1/4 (d) 1

75. If $x\sin 45^\circ\cos^2 60^\circ=\frac{\tan^2 60^\circ \operatorname{cosec} 30^\circ}{\sec 45^\circ\cot^2 30^\circ}$, then $x=$
(a) 2 (b) 4
(c) 8 (d) 16

76. $1+\cos 2x+\cos 4x+\cos 6x=$
(a) $2\cos x\cos 2x\cos 3x$ (b) $4\sin x\cos 2x\cos 3x$
(c) $4\cos x\cos 2x\cos 3x$ (d) None of these

77. If $\frac{\sin A-\sin C}{\cos C-\cos A}=\cot B$, then *A,B,C* are in
(a) A.P. (b) G.P.
(c) H.P. (d) None of these

78. $\cos\frac{2\pi}{15}\cos\frac{4\pi}{15}\cos\frac{8\pi}{15}\cos\frac{16\pi}{15}=$
(a) 1/2 (b) 1/4
(c) 1/8 (d) 1/16

79. The value of $\cos^2\frac{\pi}{12}+\cos^2\frac{\pi}{4}+\cos^2\frac{5\pi}{12}$ is
(a) $\frac{3}{2}$ (b) $\frac{2}{3}$
(c) $\frac{3+\sqrt{3}}{2}$ (d) $\frac{2}{3+\sqrt{3}}$

80. The value of $\sin\frac{\pi}{16}\sin\frac{3\pi}{16}\sin\frac{5\pi}{16}\sin\frac{7\pi}{16}$ is
(a) $\frac{1}{16}$ (b) $\frac{\sqrt{2}}{16}$
(c) $\frac{1}{8}$ (d) $\frac{\sqrt{2}}{8}$

81. Point of intersection of the diagonals of square is at origin and coordinate axis are drawn along the diagonals. If the side is of length *a*, then one which is not the vertex of square is
(a) $(a\sqrt{2},0)$ (b) $\left(0,\frac{a}{\sqrt{2}}\right)$
(c) $\left(\frac{a}{\sqrt{2}},0\right)$ (d) $\left(-\frac{a}{\sqrt{2}},0\right)$

82. *ABC* is an isosceles triangle. If the coordinates of the base are *B* (1,3) and *C* (– 2, 7), the coordinates of vertex *A* can be
(a) (1, 6) (b) $\left(-\frac{1}{2},5\right)$
(c) $\left(\frac{5}{6},6\right)$ (d) None of these

83. If $A(at^2, 2at)$, $B(a/t^2, -2a/t)$ and $C(a,0)$, then $2a$ is equal to
(a) A.M. of *CA* and *CB* (b) G.M. of *CA* and *CB*
(c) H.M. of *CA* and *CB* (d) None of these

84. If coordinates of the points *A* and *B* are (2, 4) and (4, 2) respectively and point *M* is such that *A–M–B* also *AB* = 3 *AM*, then the coordinates of *M* are

(a) $\left(\frac{8}{3},\frac{10}{3}\right)$ (b) $\left(\frac{10}{3},\frac{14}{4}\right)$

(c) $\left(\frac{10}{3},\frac{6}{3}\right)$ (d) $\left(\frac{13}{4},\frac{10}{4}\right)$

85. The point of trisection of the line joining the points (0, 3) and (6, –3) are

(a) $(2,0)$ and $(4,-1)$ (b) $(2,-1)$ and $(4,1)$

(c) $(3,1)$ and $(4,-1)$ (d) $(2,1)$ and $(4,-1)$

86. The sides AB, BC, CD and DA of a quadrilateral are $x+2y=3, x=1, x-3y=4, 5x+y+12=0$ respectively. The angle between diagonals AC and BD is

(a) 45^o (b) 60^o

(c) 90^o (d) 30^o

87. Given vertices $A(1,1), B(4,-2)$ and $C(5,5)$ of a triangle, then the equation of the perpendicular dropped from C to the interior bisector of the angle A is

(a) $y-5=0$ (b) $x-5=0$

(c) $y+5=0$ (d) $x+5=0$

88. If the straight line through the point $P(3,4)$ makes an angle $\frac{\pi}{6}$ with the x-axis and meets the line $12x+5y+10=0$ at Q, then the length PQ is

(a) $\frac{132}{12\sqrt{3}+5}$ (b) $\frac{132}{12\sqrt{3}-5}$

(c) $\frac{132}{5\sqrt{3}+12}$ (d) $\frac{132}{5\sqrt{3}-12}$

89. If $\int \frac{2x+3}{(x-1)(x^2+1)}dx = \log_e\left\{(x-1)^{\frac{5}{2}}(x^2+1)^a\right\} - \frac{1}{2}\tan^{-1}x + A$, where A is any arbitrary constant, then the value of 'a' is

(a) 5/4 (b) – 5/3

(c) – 5/6 (d) – 5/4

90. If $\int \frac{(2x^2+1)\,dx}{(x^2-4)\,(x^2-1)} = \log\left[\left(\frac{x+1}{x-1}\right)^a \left(\frac{x-2}{x+2}\right)^b\right] + C$, then the values of a and b are respectively

(a) 1/2, 3/4 (b) –1, 3/2

(c) 1, 3/2 (d) –1/2, 3/4

91. The area bounded by the curves $y=\ln x$, $y=\ln|x|$, $y=|\ln x|$ and $y=|\ln|x||$ is

(a) 4 *sq. unit* (b) 6 *sq. unit*

(c) 10 *sq. unit* (d) None of these

92. $\int_0^{\pi} \frac{\sin\left(n+\frac{1}{2}\right)x}{\sin x}dx$, $(n \in N)$ equals

(a) $n\pi$ (b) $(2n+1)\frac{\pi}{2}$

(c) π (d) 0

93. If $\int_0^1 e^{x^2}(x-\alpha)dx = 0$, then

(a) $1<\alpha<2$ (b) $\alpha<0$

(c) $0<\alpha<1$ (d) None of these

94. The degree of the differential equation $3\frac{d^2y}{dx^2} = \left\{1+\left(\frac{dy}{dx}\right)^2\right\}^{3/2}$ is

(a) 1 (b) 2

(c) 3 (d) 6

95. The differential equation representing the family of curves $y^2 = 2c(x+\sqrt{c})$, where c is a positive parameter, is of

(a) Order 1 (b) Order 2

(c) Degree 3 (d) Degree 4

96. The order of the differential equation whose general solution is given by $y = C_1e^{2x+C_2} + C_3e^x + C_4\sin(x+C_5)$ is

(a) 5 (b) 4

(c) 3 (d) 2

97. The order and degree of the differential equation $\left(1+3\frac{dy}{dx}\right)^{\frac{2}{3}} = 4\frac{d^3y}{dx^3}$ are

(a) $1, \frac{2}{3}$ (b) 3, 1

(c) 3, 3 (d) 1, 2

98. The degree of the differential equation $\frac{d^2y}{dx^2} + 3\left[\frac{dy}{dx}\right]^2 = x^2\log\left[\frac{d^2y}{dx^2}\right]$ is

(a) 1 (b) 2

(c) 3 (d) None of these

99. The differential equation of the family of curves $y = Ae^{3x} + Be^{5x}$, where A and B are arbitrary constants, is

(a) $\frac{d^2y}{dx^2} + 8\frac{dy}{dx} + 15y = 0$ (b) $\frac{d^2y}{dx^2} - 8\frac{dy}{dx} + 15y = 0$

(c) $\frac{d^2y}{dx^2} - \frac{dy}{dx} + y = 0$ (d) None of these

100. The probabilities that a student passes in Mathematics, Physics and Chemistry are *m, p* and *c* respectively. On these subjects, the student has a 75% chance of passing in at least one, a 50% chance of passing in at least two and a 40% chance of passing in exactly two. Which of the following relations are true

(a) $p+m+c=\frac{19}{20}$ (b) $p+m+c=\frac{27}{20}$

(c) $pmc=\frac{1}{10}$ (d) $pmc=\frac{1}{4}$

101. One bag contains 5 white and 4 black balls. Another bag contains 7 white and 9 black balls. A ball is transferred from the first bag to the second and then a ball is drawn from second. The probability that the ball is white, is

(a) $\frac{8}{17}$ (b) $\frac{40}{153}$

(c) $\frac{5}{9}$ (d) $\frac{4}{9}$

102. Two numbers are selected at random from the numbers 1, 2, ... *n*. The probability that the difference between the first and second is not less than *m* (where $0<m<n$), is

(a) $\frac{(n-m)(n-m+1)}{(n-1)}$ (b) $\frac{(n-m)(n-m+1)}{2n}$

(c) $\frac{(n-m)(n-m-1)}{2n(n-1)}$ (d) $\frac{(n-m)(n-m+1)}{2n(n-1)}$

103. Three groups *A, B, C* are competing for positions on the Board of Directors of a company. The probabilities of their winning are 0.5, 0.3, 0.2 respectively. If the group *A* wins, the probability of introducing a new product is 0.7 and the corresponding probabilities for group *B* and *C* are 0.6 and 0.5 respectively. The probability that the new product will be introduced, is

(a) 0.18 (b) 0.35

(c) 0.10 (d) 0.63

104. Consider two events *A* and *B* such that $P(A)=\frac{1}{4}, P\left(\frac{B}{A}\right)=\frac{1}{2}, P\left(\frac{A}{B}\right)=\frac{1}{4}.$ For each of the following statements, which is true

I. $P(A^c/B^c)=\frac{3}{4}$

II. The events *A* and *B* are mutually exclusive

III. $P(A/B)+P(A/B^c)=1$

(a) I only (b) I and II

(c) I and III (d) II and III

105. A purse contains 4 copper coins and 3 silver coins, the second purse contains 6 copper coins and 2 silver coins. If a coin is drawn out of any purse, then the probability that it is a copper coin is

(a) 4/7 (b) 3/4

(c) 37/56 (d) None of these

106. The points *D, E, F* divide *BC, CA* and *AB* of the triangle *ABC* in the ratio 1 : 4, 3 : 2 and 3 : 7 respectively and the point *K* divides *AB* in the ratio $1:3$, then $(\overrightarrow{AD}+\overrightarrow{BE}+\overrightarrow{CF}):\overrightarrow{CK}$ is equal to

(a) 1 : 1 (b) 2 : 5

(c) 5 : 2 (d) None of these

107. If two vertices of a triangle are $\mathbf{i}-\mathbf{j}$ and $\mathbf{j}+\mathbf{k}$, then the third vertex can be

(a) $\mathbf{i}+\mathbf{k}$ (b) $\mathbf{i}-2\mathbf{j}-\mathbf{k}$

(c) $\mathbf{i}-\mathbf{k}$ (d) $2\mathbf{i}-\mathbf{j}$

(e) All the above

108. If $\mathbf{a}$ of magnitude 50 is collinear with the vector $\mathbf{b}=6\,\mathbf{i}-8\,\mathbf{j}-\frac{15\,\mathbf{k}}{2}$, and makes an acute angle with the positive direction of *z*-axis, then the vector $\mathbf{a}$ is equal to

(a) $24\,\mathbf{i}-32\,\mathbf{j}+30\,\mathbf{k}$ (b) $-24\,\mathbf{i}+32\,\mathbf{j}+30\,\mathbf{k}$

(c) $16\,\mathbf{i}-16\,\mathbf{j}-15\,\mathbf{k}$ (d) $-12\,\mathbf{i}+16\,\mathbf{j}-30\,\mathbf{k}$

109. If three non-zero vectors are $\mathbf{a}=a_1\mathbf{i}+a_2\mathbf{j}+a_3\mathbf{k}$, $\mathbf{b}=b_1\mathbf{i}+b_2\mathbf{j}+b_3\mathbf{k}$ and $\mathbf{c}=c_1\mathbf{i}+c_2\mathbf{j}+c_3\mathbf{k}$. If $\mathbf{c}$ is the unit vector perpendicular to the vectors $\mathbf{a}$ and $\mathbf{b}$ and the angle between $\mathbf{a}$ and $\mathbf{b}$ is $\frac{\pi}{6}$, then $\begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}^2$ is equal to

(a) 0 (b) $\frac{3(\Sigma a_1^2)(\Sigma b_1^2)(\Sigma c_1^2)}{4}$

(c) 1 (d) $\frac{(\Sigma a_1^2)(\Sigma b_1^2)}{4}$

110. Let the unit vectors $\mathbf{a}$ and $\mathbf{b}$ be perpendicular and the unit vector $\mathbf{c}$ be inclined at an angle θ to both $\mathbf{a}$ and $\mathbf{b}$. If $\mathbf{c}=\alpha\,\mathbf{a}+\beta\,\mathbf{b}+\gamma\,(\mathbf{a}\times\mathbf{b})$, then

(a) $\alpha=\beta=\cos\theta,\ \gamma^2=\cos\ 2\theta$

(b) $\alpha=\beta=\cos\theta,\ \gamma^2=-\cos\ 2\theta$

(c) $\alpha=\cos\theta,\ \beta=\sin\theta,\ \gamma^2=\cos\ 2\theta$

(d) None of these

111. The vector $\mathbf{a}+\mathbf{b}$ bisects the angle between the vectors $\mathbf{a}$ and $\mathbf{b},$ if

(a) $|\mathbf{a}|=|\mathbf{b}|$

(b) $|\mathbf{a}|=|\mathbf{b}|$ or angle between **a** and **b** is zero

(c) $|\mathbf{a}|=m|\mathbf{b}|$

(d) None of these

112. The points O, A, B, C, D are such that $\overrightarrow{OA}=\mathbf{a}$, $\overrightarrow{OB}=\mathbf{b}$, $\overrightarrow{OC}=2\mathbf{a}+3\mathbf{b}$ and $\overrightarrow{OD}=\mathbf{a}-2\mathbf{b}$. If $|\mathbf{a}|=3|\mathbf{b}|$, then the angle between $\overrightarrow{BD}$ and $\overrightarrow{AC}$ is

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{4}$

(c) $\frac{\pi}{6}$ (d) None of these

113. If $\vec{A}=\mathbf{i}+2\mathbf{j}+3\mathbf{k}$, $\vec{B}=-\mathbf{i}+2\mathbf{j}+\mathbf{k}$ and $\vec{C}=3\mathbf{i}+\mathbf{j}$, then the value of t such that $\vec{A}+t\vec{B}$ is at right angle to vector $\vec{C}$, is

(a) 2 (b) 4

(c) 5 (d) 6

114. Let $\mathbf{b}=4\mathbf{i}+3\mathbf{j}$ and **c** be two vectors perpendicular to each other in the *xy*-plane. All vectors in the same plane having projections 1 and 2 along **b** and **c** respectively, are given by

(a) $2\mathbf{i}-\mathbf{j}, \frac{2}{5}\mathbf{i}+\frac{11}{5}\mathbf{j}$ (b) $2\mathbf{i}+\mathbf{j}, -\frac{2}{5}\mathbf{i}+\frac{11}{5}\mathbf{j}$

(c) $2\mathbf{i}+\mathbf{j}, -\frac{2}{5}\mathbf{i}-\frac{11}{5}\mathbf{j}$ (d) $2\mathbf{i}-\mathbf{j}, -\frac{2}{5}\mathbf{i}+\frac{11}{5}\mathbf{j}$

115. The radius of the circle in which the sphere $x^2+y^2+z^2+2x-2y-4z-19=0$ is cut by the plane $x+2y+2z+7=0$ is

(a) 1 (b) 2

(c) 3 (d) 4

116. The equation of motion of a rocket are: $x=2t, y=-4t, \quad z=4t$ where the time 't' is given in seconds, and the co-ordinates of a moving point in kilometers. What is the path of the rocket? At what distance will be the rocket be from the starting point 0(0, 0, 0) in 10 seconds

(a) Straight line, 60 *km* (b) Straight line, 30 *km*

(c) Parabola, 60 *km* (d) Ellipse, 60 *km*

117. The plane $lx+my=0$ is rotated an angle α about its line of intersection with the plane $z=0$, then the equation to the plane in its new position is

(a) $lx+my\pm z\sqrt{(l^2+m^2)}\tan\alpha=0$

(b) $lx-my\pm z\sqrt{(l^2+m^2)}\tan\alpha=0$

(c) $lx+my\pm z\sqrt{(l^2+m^2)}\cos\alpha=0$

(d) $lx-my\pm z\sqrt{(l^2+m^2)}\cos\alpha=0$

118. The distance between two points P and Q is d and the length of their projections of PQ on the co-ordinate planes are d_1, d_2, d_3. Then $d_1^2+d_2^2+d_3^2=kd^2$ where 'k' is

(a) 1 (b) 5

(c) 3 (d) 2

119. If P_1 and P_2 are the lengths of the perpendiculars from the points (2,3,4) and (1,1,4) respectively from the plane $3x-6y+2z+11=0$, then P_1 and P_2 are the roots of the equation

(a) $P^2-23P+7=0$ (b) $7P^2-23P+16=0$

(c) $P^2-17P+16=0$ (d) $P^2-16P+7=0$

120. The edge of a cube is of length 'a' then the shortest distance between the diagonal of a cube and an edge skew to it is

(a) $a\sqrt{2}$ (b) a

(c) $\sqrt{2}/a$ (d) $a/\sqrt{2}$

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