No of Questions: 120 **Time: 2 ½ hours**

1. Let X be any non-empty set containing n elements. Then what is the number of relations on X?
a) $2n^2$ b) 2n
c) 2^{2n} d) n

2. Consider the following for any three non-empty sets A, B and C.
1. $A-(B\cup C)=(A-B)\cup(A-C)$
2. $A-B=A-(A\cap B)$
3. $A=(A\cap B)\cup(A-B)$
Which of the above is/are correct?
a) Only 1 b) 2 and 3
c) 1 and 2 d) 1 and 3

3. Consider the following statements:
1. Parallelism of lines is an equivalence relation.
2. x R y, if x is a father of y, is an equivalence relation.
Which of the statements given above is/are correct?
a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

4. For what value (s) of x is $\log_{10}\left\{999+\sqrt{x^2-3x+3}\right\}=3$ **?**
a) 0 b) 1 only
c) 2 only d) 1, 2

5. The number $\left(2+\sqrt{2}\right)^2$ **is**
a) a natural number
b) an irrational number
c) a rational number
d) a whole number

6. What is the decimal equivalent of $(101.101)^2$?
a) (5.225)10
b) (5.525)10
c) (5.625)10
d) (5.65)10

7. If $X=\left\{\left(4^n-3n-1\right)\mid n\in N\right\}$ **and** $Y=\left\{9(n-1)\mid n\in N\right\}$ **, then what is** $X\cup Y$ **equal to?**
a) X b) Y
c) N d) A null set

8. What is the binary number equivalent of the decimal number 32.25?
a) 100010.10 b) 100000.10
c) 100010.01 d) 100000.01

9. If $A=\{4n+2\mid n \text{ is a natural number}\}$ **and** $B=\{3n\mid n \text{ is a natural number}\}$ **, then what is** $(A\cap B)$ **equal to?**
a) $\{12n^2+6n\mid n \text{ is a natural number}\}$
b) $\{24n-12\mid n \text{ is a natural number}\}$
c) $\{60n+30\mid n \text{ is a natural number}\}$
d) $\{12n-6\mid n \text{ is a natural number}\}$

10. If A and B are two non-empty sets having n elements in common, then what is the number of common elements in the sets A × B and B × A?
a) n b) n^2
c) 2n d) Zero

11. What is the value of $\log_y x^5\ \log_x y^2 \log_z Z^3$?
a) 10 b) 20
c) 30 d) 60

12. If the equation $x^2+k^2=2(k+1)x$ has equal roots, then what is the value of k?
a) – 1/3 b) – ½
c) 0 d) 1

13. If α,β **are the roots of the equation** $\ell x^2-mx+m=0$ **,** $\ell\neq m,\ell\neq 0$**, then which one of the following statements is correct?**
a) $\sqrt{\frac{\alpha}{\beta}}+\sqrt{\frac{\beta}{\alpha}}-\sqrt{\frac{m}{\ell}}=0$
b) $\sqrt{\frac{\alpha}{\beta}}+\sqrt{\frac{\beta}{\alpha}}+\sqrt{\frac{m}{\ell}}=0$
c) $\sqrt{\frac{\alpha+\beta}{\alpha\beta}}-\sqrt{\frac{m}{\ell}}=0$
d) the arithmetic mean of a and B is the same as their geometric mean.

14. If x is an integer and satisfies $9<4x-1\leq 19$ **, then x is an element of which one of the following sets?**
a) {3, 4} b) {2, 3, 4}
c) {3, 4, 5} d) {2, 3, 4, 5}

15. If the roots of $ax^2+bx+c=0$ **are** $\sin\alpha$ **and** $\cos\alpha$ **for some** α **, then which one of the following is correct?**

a) $a^2+b^2=2ac$ b) $b^2-c^2=2ab$
c) $b^2-a^2=2ac$ d) $b^2+c^2=2ab$

16. Which of the following are the two roots of the equation $(x^2+2)^2+8x^2=6x(x^2+2)$?
a) $1\pm i$ b) $2\pm i$
c) $1\pm\sqrt{2}$ d) $2\pm i\sqrt{2}$

17. If the equation $x^2-px+q=0$ and $x^2-ax+b=0$ have a common root and the roots of the second equation are equal then which one of the following is correct?
a) $aq=2(b+p)$ b) $aq=b+p$
c) $ap=2(b+p)$ d) $ap=b+p$

18. The solution of the simultaneous linear equation $2x+y=6$ and $3y=8+4x$ will also be satisfied by which one of the following linear equation ?
a) $x+y=5$
b) $2x+y=5$
c) $2x-3y=10$
d) $2x+3y=6$

19. If $x=1+\frac{y}{2}+\left(\frac{y}{2}\right)^2+\left(\frac{y}{2}\right)^3+....$ where $|y|<2$, what is 1y ?
a) $\frac{x-1}{x}$ b) $\frac{x-1}{2x}$
c) $\frac{2x-1}{x}$ d) $\frac{2x+1}{2x}$

20. If the nth term of an arithmetic progression is 3n + 7, then what is the sum of its first 50 terms?
a) 3925 b) 4100
c) 4175 d) 8200

21. Sum of first n natural number is given by $\frac{n(n+1)}{2}$. What is the geometric mean of the series $1,2,4,8,....,2^n$?
a) 2n b) $2^{\frac{n}{2}}$
c) $2^{\frac{1}{2}}$ d) 2^{n-1}

22. The 59th term of an AP is 449 and the 449th term is 59. Which term is equal to 0 (zero)?
a) 501stterm b) 502ndterm
c) 508thterm d) 509thterm

23. Which one of the following options is correct?
a) $\sin^2 30°, \sin^2 45°, \sin^2 60°$ are in GP
b) $\cos^2 30°, \cos^2 45°, \cos^2 60°$ are in GP
c) $\cot^2 30°, \cot^2 45°, \cot^2 60°$ are in GP
d) $\tan^2 30°, \tan^2 45°, \tan^2 60°$ are in GP

24. Consider the following statements:
1. The sum of cubes of first 20 natural numbers Is44400.
2. The sum of squares of first 20 natural numbers is2870.
Which of the above statements is/are correct?
a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

25. Let z be a non zero complex number. Then what is z^{-1} (multiplicative inverse of z) equal to
a) $\frac{\bar{z}}{|z|^2}$ b) $\frac{z}{|z|^2}$
c) $\frac{\bar{z}}{|z|}$ d) $\frac{|z|}{z}$

26. What is $\frac{\left(\sqrt{3}+i\right)}{\left(1+\sqrt{3i}\right)}$ equal to?
a) 1 + I b) 1-i
c) $\frac{\sqrt{3}(1-i)}{2}$ d) $\frac{\left(\sqrt{3}-i\right)}{2}$

27. If ω is a complex cube root of unity, then what is $\omega^{10}+\omega^{-10}$ equal to?
a) 2 b) -1
c) -2 d) 1

28. If $z=-\bar{z}$, then which one of the following is correct?
a) real part of z is zero.
b) The imaginary part of z is zero.
c) The real part of z is equal to imaginary
d) The sum of real and imaginary parts of z is z.

29. What is the last digit of $3^{3^{4n}+1}$, where n is a natural number?
a) 2 b) 7
c) 8 d) None of these

30. The value of the term independent of x in the expansion of $\left(x^2-\frac{1}{x}\right)^9$ is:
a) 9 b) 18
c) 48 d) 84

31. In how many ways can 3 books on Hindi and 3 books on English be arranged in a row on a shelf, so that not all the Hindi books are together?
a) 144 b) 360
c) 576 d) 720

32. In how many ways can a committee consisting of 3 men and 2 women be formed from 7 men and 5 women?
a) 45 b) 350
c) 700 d) 4200

33. What is the image of the point (2, 3) in the line y = – x?
a) (– 3, – 2)

b) (– 3, 2)
c) (– 2, – 3)
d) (3, 2)

34. If (a, b), (c, d) and (a – c, b – d) are collinear, then which one of the following is correct?
a) bc – ad = 0 b) ab – cd = 0
c) bc + ad = 0 d) ab + cd = 0

35. What is the maximum number of straight lines that can be drawn with any four points in a plane such that each line contains at least two of these points?
a) 2 b) 4
c) 6 d) 12

36. What is the slope of the line perpendicular to the line x/4 + y/3 = 1 ?
a) 3/4 b) – ¾
c) – 4/3 d) 4/3

37. What is the equation of a line parallel to x-axis at a distance of 5 units below x-axis?
a) x = 5 b) x = – 5
c) y = 5 d) y = – 5

38. The equation of a straight line which makes an angle 45°with the x-axis with y-intercept 101 units is:
a) 10x + 101y = 1
b) 101x + y = 1
c) x + y – 101 = 0
d) x – y + 101 = 0

39. What is the radius of the circle passing through the points (0, 0), (a, 0) and (0, b)?
a) $\sqrt{a^2-b^2}$
b) $\sqrt{a^2+b^2}$
c) $\frac{1}{2}\sqrt{a^2+b^2}$
d) $2\sqrt{a^2+b^2}$

40. Consider the following statements in respect of circles $x^2+y^2-2x-2y=0$ and $x^2+y^2=1$
1. The radius of the first circle is twice that of the second
2. Both the circles pass through the origin.
Which of the statements given above is/are correct?
a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

41. Consider the ellipse $x_2/a_2 + y_2/b_2 = (b > a)$. Then, which one of the following is correct?
a) Real foci do not exist
b) Foci are (± ae, 0)
c) Foci are (± be, 0)
d) Foci are (0, ± be)

42. What are the points of intersection of the curve $4x^2-9y^2=1$ with its conjugate axis?
a) (1/ 2, 0) and (– 1/2, 0)
b) (0, 2) and (0, – 2)
c) (0, 3) and (0, – 3)
d) No such point exists

43. If sin (π cos x) = cos (π sin x), then what is one of the values of sin 2x?
a) -1/4 b) -1/2
c) -3/4 d) – 1

44. What is the minimum value of cos θ + cos2 θ?
a) –2 b) – 9/8
c) 0 d) – 9/16

45. What is the measure of the angle 114° 35' 30'' in radian?
a) 1 rad b) 2 rad
c) 3 rad d) 4 rad

46. For which acute angle θ, cosec2 θ = 3 √3 cot θ – 5?
a) 5π/12 b) π/3
c) π/6 d) π/4

47. What is the value of tan 15° + cot 15°?
a) √3 b) 2√3
c) 4 d) 2

48. What is the value of $\frac{\cos 15^\circ+\cos 45^\circ}{\cos^3 15^\circ+\cos^3 45^\circ}$?
a) 1/4 b) 1/2
c) 1/3 d) None of these

49. If x = sinθ + cosθ and y = sinθ.cosθ, then what is the value of $x^4-4x^2y-2x^2+4y^2+4y+1$?
a) 0 b) 1
c) 2 d) None of these

50. What is the angle subtended by 1 m pole at a distance 1 km on the ground in sexagesimal measure?
a) 9/50π degree b) 9/5π degree
c) 3.4 minute d) 3.5 minute

51. What is the value of sin 15°?
a) $\frac{\sqrt{3}-1}{2\sqrt{2}}$ b) $\frac{\sqrt{3}+1}{2\sqrt{2}}$
c) $\frac{\sqrt{3}-1}{\sqrt{3}+1}$ d) $\frac{\sqrt{3}+1}{\sqrt{3}-1}$

52. The expression $\frac{\cot x+\cos ec\ x-1}{\cot x-\cos ec\ x+1}$ is equal to:
a) $\frac{\sin x}{1-\cos x}$ b) $\frac{1-\cos x}{\sin x}$
c) $\frac{1+\cos x}{\sin x}$ d) $\frac{\sin x}{1+\cos x}$

53. What is the value of: $\cos\left[\tan^{-1}\left\{\tan\left(\frac{15\pi}{4}\right)\right\}\right]$?

a) $-\frac{1}{\sqrt{2}}$ b) 0

c) $\frac{1}{\sqrt{2}}$ d) $\frac{1}{2\sqrt{2}}$

54. The formula $\sin^{-1}\{2x(1-x^2)\} = 2\sin^{-1}x$ = is true for all values of x lying in the interval

a) [–1, 1]
b) [0, 1]
c) [–1, 0]
d) [–1/√2, 1/√2]

55. DIRECTION: Read the following information are fully and give the answer.
ABC is a triangle rightangled at B.The hypotenuse (AC) is four times the perpendicular (BD) drawn to it from the opposite vertex and AD < DC. **What is ∠ABD?**

a) 15° b) 30°
c) 45° d) None of these

56. What is $\sin\left[\sin^{-1}\left(\frac{3}{5}\right)+\sin^{-1}\left(\frac{4}{5}\right)\right]$ equal to?

a) 0 b) 1/2
c) 1 d) 2

57. From the top of a lighthouse 120 m above the sea, the angle of depression of a boat is 15°. What is the distance of the boat from the lighthouse?

a) 400 m b) 421 m
c) 448 m d) 460 m

58. Let R be the set of real numbers and let $f:R\to R$ be a function such that $f(x)=\frac{x^2}{1+x^2}$. What is the range of f?

a) R b) R – {1}
c) [0, 1] d) [0, 1)

59. What is the value of $\lim_{x\to\infty}\left(\frac{x-2}{x+2}\right)^{x+2}$?

a) 0 b) e^4
c) e^{-2} d) e^{-4}

60. What is the inverse of the function $y = 5^{\log x}$?

a) $x = 5^{1/\log y}$ b) $x = y^{1/\log 5}$
c) $x = 5^{\log y}$ d) $x = y^{\log 5}$

61. If $f(x)=\begin{cases}3x-4, 0\le x\le 2\\ 2x+\lambda, 2<x\le 3\end{cases}$ is continuous at $x=2$, then what is the value of λ?

a) 1 b) –1
c) 2 d) –2

62. Consider the following statements:
I. f (x) = |x – 3| is continuous at x = 0.
II. f (x) = |x – 3| is differentiable at 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

63. Which one of the following functions is differentiable for all real values of x?

a) $\frac{x}{|x|}$ b) $x|x|$

c) $\frac{1}{|x|}$ d) $\frac{1}{x}$

64. Let N be the set of natural numbers and f : N →N, be a function given by f(x) = x + 1, x ∈ N. Which one of the following is correct?

a) f is one-one and onto
b) f is one-one but not onto
c) f is only onto
d) f is neither one-one nor onto

65. A can hit a target 4 times in 5 shots;
B can hit a target 3 times in 4 shots;
C can hit a target 2 times in 3 shots;
All the three fire a shot each. What is the probability that two shots are at least hit?

a) 1/6 b) 3/5
c) 5/6 d) 1/3

66. A coin is tossed. If a head is observed, a number is randomly selected from the set {1, 2, 3} and if a tail is observed, a number is randomly selected from the set {2, 3, 4, 5}. If the selected number be denoted by X, what is the probability that X = 3?

a) 2/7 b) 1/5
c) 1/6 d) 7/24

67. Two numbers X and Y are simultaneously drawn from the set {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}. What is the conditional probability of exactly one of the two numbers X and Y being even, given (X + Y) = 15?

a) 1 b) 3/4
c) 1/2 d) 1/4

68. A box contains 6 distinct dolls. From this box, 3 dolls are randomly selected one by one with replacement. What is the probability of selecting 3 distinct dolls?

a) 5/54 b) 12/25
c) 1/20 d) 5/9

69. If A and B are two events such that $P(A\cup B)=\frac{3}{4}$, $P(A\cap B)=\frac{1}{4}$, $P(\bar{A})=\frac{2}{3}$ where $\bar{A}$ is the complement of A, then what is Pb) equal to?

a) 1/3 b) 2/3
c) 1/9 d) 2/9

70. If X follows a binomial distribution with parameters n = 100 and p = 1/3, then P(X = r) is maximum when

a) r = 16 b) r = 32
c) r = 33 d) r = 34

71. Which one of following is correct? The three planes
2x + 3y – z –2 = 0, 3x + 3y + z – 4 = 0, x – y + 2z – 5 = 0 intersect

a) at a point b) at two points
c) at three points d) in a line

72. Which one of the following planes contains the z-axis?

a) x – z = 0 b) z + y = 0
c) 3x + 2y = 0 d) 3x + 2z = 0

73. What is the value of n so that the angle between the lines having direction ratios (1, 1, 1) and (1, –1, n) is 60°?

a) √3 b) √6
c) 3 d) None of these

74. What is the acute angle between the planes x + y + 2z = 3 and – 2x + y – z = 11?

a) π/ 5 b) π/ 4
c) π/ 6 d) π/3

75. If a line OP of length r (where 'O' is the origin) makes an angle α with x-axis and lies in the xz-plane, then what are the coordinates of P?

a) (r cos α, 0, r sin α)
b) (0, 0, r sin α)
c) (r cos α, 0, 0)
d) (0, 0, r cos α)

76. What is the arithmetic mean of the series ${}^nC_0, {}^nC_1, \ldots {}^nC_n$, **?**

a) $\frac{2^n}{n}$ b) $\frac{2^n}{(n+1)}$
c) $\frac{2^{(n+1)}}{n}$ d) $\frac{2^{(n+1)}}{(n+1)}$

77. If X is changed to a + hU and Y to b + kV, then which one of the following is the correct relation between the regression coefficients bXY and bUV?

a) h b_{XY}= k b_{UV} b) k b_{XY}= h b_{UV}
c) b_{XY}= b_{UV} d) $k^2 b_{XY}$= h2b_{UV}

78. The average age of 20 students in a class is 15 yr. If the teacher's age is included, the average increases by one. What is the teacher's age?

a) 30 yr b) 21 yr
c) 42 yr d) 36 yr

79. Correlation between two variable is said to be perfect if

a) one variable increases, the other also increases
b) one variable increases, the other decreases
c) one variable increases, the other also increases proportionally
d) one variable increases, the other decreases proportionally

80.

Class Interval	1-5	6-10	11-15	16-20
Frequency	3	7	6	5

Consider the following statements in respect of the above frequency distribution.

I. The median is contained in the modal class
II. The distribution is bell-shaped.

Which of the above statements is/are correct?

a) Only I b) Only II
c) Both I and II d) Neither I nor II

81. Directions:
Note: Study the following Table and Answer the Questions that follow.

Year	Male			Female			
	Urban	Rural	Total	Urban	Rural	Total	Total
1995	280	350			310		1350
1996	370		670	180		450	
1997		130	440		190		
1998	400	280		290			
Total				1060	850		

What is the total population in 1998?

a) 1000 b) 1020
c) 1040 d) 1050

82. The mean of 10 observations is 5. If 2 is added to each observation and then multiplied by 3, then what will be the new mean?

a) 5 b) 7
c) 15 d) 21

83. Marks obtained by 7 students in a subject are 30, 55, 75, 90, 50, 60, 39. The number of students securing marks less than the mean marks is

a) 7 b) 6
c) 5 d) 4

84. What is the derivative of $\tan^{-1}\left(\frac{\sqrt{x}-x}{1+x^{3/2}}\right)$ **at** $x=1$**?**

a) –1/4 b) 1/2
c) 3/2 d) 1

85. If $f(x)=\cos x, g(x)=\log x$ **and** $y=(gof)(x)$ **, then what is the value of** $\frac{dy}{dx}$ **at** $x=0$**?**

a) 0 b) 1
c) –1 d) 2

86. If $f(x) = 2^x$, then what is the f''(x) equal to ?
a) $2^x (\ln)^2$ b) $x(x-1)2^{x-2}$
c) $2^{X+1}(\ln 2)$ d) $2^x (\log_{10}2)^2$

87. The derivative of $\sec^2 x$ with respect to $\tan^2 x$ is
a) 1 b) 2
c) 2 sec x tan x d) 2 $\sec^2$ x tan x

88. The motion of a particle is described as $s = 2 - 3t + 4t^3$. What is the acceleration of the particle at the point where its velocity is zero?
a) 0 b) 4 unit
c) 8 unit d) 12 unit

89. A stone thrown vertically upward satisfies the equation $s = 64t - 16t^2$, where s is in meter and t is in second. What is the time required to reach the maximum height?
a) 1s b) 2s
c) 3s d) 4s

90. What is the value of P for which the function $f(x) = p\sin x + \frac{\sin 3x}{3}$ has an extremum at $x = \frac{\pi}{3}$?
a) 0 b) 1
c) –1 d) 2

91. The radius of a circle is uniformly increasing at the rate of 3 cm/s. What is the rate of increase in area, when the radius is 10 cm?
a) 6π cm^2/s b) 10π cm^2/s
c) 30π cm^2/s d) 60π cm^2/s

92. What is the area under the curve $y = |x| + |x - 1|$ between x = 0 and x = 1?
a) 1/2 b) 1
c) 3/2 d) 2

93. What is $\int \frac{dx}{\sin^2 x \cos^2 x}$ equal to?
a) tan x + cot x + c
b) tan x – cot x + c
c) (tan x + cot x)2 + c
d) (tan x – cot x)2 + c

94. What is the area enclosed by the curve $2X2 + y2 = 1$?
a) 2π b) π
c) $\frac{\pi}{2}$ d) $\frac{\pi}{\sqrt{2}}$

95. What is $\int_0^{\pi/2} \frac{\sin^3 x}{\sin^3 x + \cos^3 x} dx$?
a) π b) π/2
c) π/4 d) 0

96. What is the area bounded by the curve $\sqrt{x} + \sqrt{y} = \sqrt{a}\,(x, y \geq 0)$ and the coordinate axes?
a) $\frac{5a^2}{6}$ b) $\frac{a^2}{3}$
c) $\frac{a^2}{2}$ d) $\frac{a^2}{6}$

97. What does the solution of the differential equation xdy – ydx = 0 represent?
a) Rectangular hyperbola
b) Straight line passing through (0, 0)
c) Parabola with vertex at (0, 0)
d) Circle with centre at (0, 0)

98. What is the differential equation of the curve $y = ax^2 + bx$?
a) $x^2 \frac{d^2y}{dx^2} - 2x\frac{dy}{dx} + 2y = 0$
b) $x^2 \frac{d^2y}{dx^2} - y\left(\frac{dy}{dx}\right)^2 + 2 = 0$
c) $\left(1 - x^2\right)\frac{d^2y}{dx^2} - \left(y\frac{dy}{dx}\right)^2 = 0$
d) None of the above

99. What is the solution of the differential equation $3ex \tan y\, dx + (1 + e^x) \sec^2 y\, dy = 0$?
a) $(1 + e^x) \tan y = c$
b) $(1 + e^x)^3 \tan y = c$
c) $(1 + e^x)^2 \tan y = c$
d) $(1 + e^x) \sec^2 y = c$

100. What does the differential equation $y\frac{dy}{dx} + x = a$ (where a is a constant) represent?
a) A set of circles having centre on the Y-axis
b) A set of circles having centre on the X-axis
c) A set of ellipses
d) A pair of straight lines

101. What is the degree of the differential equation $\left(\frac{d^3y}{dx^3}\right)^{2/3} + 4 - 3\left(\frac{d^2y}{dx^2}\right) = 0$?
a) 3 b) 2
c) 2/3 d) Not defined

102. The differential equation of the curve y = sin x is
a) $\frac{d^2y}{dx^2} + y\frac{dy}{dx} + x = 0$
b) $\frac{d^2y}{dx^2} + y = 0$
c) $\frac{d^2y}{dx^2} - y = 0$
d) $\frac{d^2y}{dx^2} + x = 0$

103. What is the largest value of a third order determinant whose elements are 0 or 1?

a) 0 b) 1
c) 2 d) 3

104. What should be the value of k so that the system of linear equations x – y + 2z = 0, kx – y + z = 0, 3x + y – 3z = 0 does not possess a unique solution?
a) 0 b) 3
c) 4 d) 5

105. If $|A_{n\times n}| = 3$ and $|\text{adj } A| = 243$, what is the value of n?
a) 4 b) 5
c) 6 d) 7

106. What is the value of k, if

$$\begin{vmatrix} k & b+c & b^2+c^2 \\ k & c+a & c^2+a^2 \\ k & a+b & a^2+b^2 \end{vmatrix} = (a-b)(b-c)(c-a)\text{?}$$

a) 1 b) –1
c) 2 d) 0

107. If the lines 3y + 4x =1, y = x + 5 and 5y + bx = 3 are concurrent, then what is the value of b?
a) 1 b) 3
c) 6 d) 0

108. What is the value of the determinant

$$\begin{vmatrix} x+1 & x+2 & x+4 \\ x+3 & x+5 & x+8 \\ x+7 & x+10 & x+14 \end{vmatrix}\text{?}$$

a) x + 2 b) x2 + 2
c) 2 d) – 2

109. What is $\begin{vmatrix} -a^2 & ab & ac \\ ab & -b^2 & bc \\ ac & bc & -c^2 \end{vmatrix}$ **equal to?**
a) 4abc b) $4a^2bc$
c) $4a^2b^2c^2$ d) $-4a^2b^2c^2$

110. A square matrix $[a_{ij}]$ such that $a_{ij}= 0$ for $i \neq j$ and $a_{ij}= k$ where k is a constant for i = j is called:
a) diagonal matrix, but not scalar matrix
b) scalar matrix
c) unit matrix
d) None of the above

111. What is the vector whose magnitude is 3, and is perpendicular to $\hat{i}+\hat{j}$ and $\hat{j}+\hat{k}$?
a) $3\left(\vec{i}+\vec{j}+\vec{k}\right)$
b) $\sqrt{3}\left(\vec{i}-\vec{j}+\vec{k}\right)$
c) $\sqrt{3}\left(\vec{i}+\vec{j}+\vec{k}\right)$
d) $3\left(\vec{i}-\vec{j}+\vec{k}\right)$

112. Let $\bar{a}=2\bar{j}-3\bar{k}, \bar{b}=\hat{j}+3\hat{k}$ and $\bar{c}=-3\bar{i}+3\hat{j}+\hat{k}$. Let $\hat{n}$ be a unit vector such that $\bar{a}.\hat{n}=\bar{b}.\hat{n}=0$. What is the value of $\bar{c}.\hat{n}$?
a) 1 b) √19
c) 3 d) –3

113. What is the number of vectors of length 5 unit perpendicular to the vectors $\bar{a}=(1,1,0)$ and $\bar{b}=(0,1,1)$?
a) 1 b) 2
c) 3 d) 4

114. If $\bar{a}=\hat{i}-2\hat{j}+5\hat{k}$, $\bar{b}=2\hat{i}+\hat{j}-3\hat{k}$, then what is $(\bar{b}-\bar{a})\cdot(3\bar{a}+\bar{b})$ equal to?
a) 106 b) –106
c) 53 d) –53

115. A vector $\bar{b}$ is collinear with the vector $\bar{a}=(2,1,-1)$ and satisfies the condition $\bar{a}\cdot\bar{b}=3$. What is $\bar{b}$ equal to?
a) (1, 1/2, –1/2) b) (2/3, 1/3, –1/3)
c) (1/2, 1/4, –1/4) d) (1, 1, 0)

116. What is the projection of the vector $\hat{i}-2\hat{j}-\hat{k}$ on the vector $4\hat{i}-4\hat{j}+7\hat{k}$?
a) √5/2 b) 19/9
c) √5/4 d) 11/3

117. If $\bar{a}\cdot\bar{b}=0$ and $\bar{a}\times\bar{b}=\bar{0}$ then which one of the following is correct?
a) $\bar{a}$ is parallel to $\bar{b}$
b) $\bar{a}$ is perpendicular to $\bar{b}$
c) $\bar{a}=\bar{0}$ or $\bar{b}=\bar{0}$
d) None of the above

118. A relation R is defined on the set Z of integers as follows:
$mRn \Leftrightarrow m+n$ is odd.
Which of the following statements is/are true for R?
1. R is reflexive
2. R is symmetric
3. R is transitive

Select the correct answer using the code given below:
a) 2 only b) 2 and 3
c) 1 and 2 d) 1 and 3

119. What is the value of $0.\overline{2}+0.\overline{23}$?
a) $0.\overline{43}$ b) $0.\overline{45}$
c) $0.\overline{223}$ d) $0.2\overline{23}$

120. If $f(x)=\sqrt{x+\sqrt{x+\sqrt{x+\sqrt{....\infty}}}}$, then what is $f(x)$ equal to?

a) $\frac{1}{1-2f(x)}$ b) $\frac{1}{2f(x)-1}$

c) $\frac{1}{1+2f(x)}$ d) $\frac{1}{2+f(x)}$

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