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CUSAT CAT 2019 Question Paper

Cochin University of Science and Technology Common Admission Test (CUSAT CAT)

(BTECH-CAT2019)

1. The function $f(x) = \sin\left(\frac{\pi x}{n!}\right) - \cos\left(\frac{\pi x}{(n+1)!}\right)$ is

(A) not periodic
(B) periodic, with period $2n!$
(C) periodic, with period $2(n+1)!$
(D) constant

2. If $\Delta(n) = \begin{vmatrix} x^n & \sin x & \cos x \\ n! & \sin\frac{n\pi}{2} & \cos\frac{n\pi}{2} \\ \alpha & \alpha^2 & \alpha^3 \end{vmatrix}$, then the value of $\frac{d^n}{dx^n}[\Delta(x)]$ at $x = 0$ is

(A) –1
(B) 0
(C) 1
(D) 2

3. If $i = \sqrt{-1}$, then the value of i^{21} is

(A) 1
(B) - 1
(C) i
(D) $-i$

4. The value of $\begin{vmatrix} 1 & 0 & 0 & 0 & 0 \\ 2 & 2 & 0 & 0 & 0 \\ 4 & 4 & 3 & 0 & 0 \\ 5 & 5 & 5 & 4 & 0 \\ 6 & 6 & 6 & 6 & 5 \end{vmatrix} =$

(A) 5!
(B) 6!

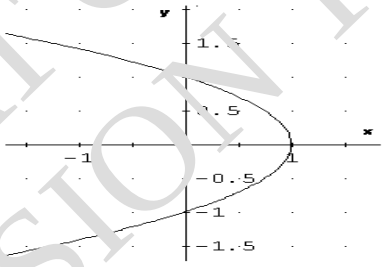
(C) $1.2^2.3.4^3.5.6^4$
(D) $1.2^2.3^3.4^4$

5. Which of the following statements are correct?

(i) If $\lim_{x \to a} \frac{f(x)-f(a)}{x-a}$ exists, then f is differentiable at a
(ii) If f is continuous at a, then f is differentiable at a
(iii) If limit of f at $x = a$ exists, then f is differentiable at a
(iv) If f is differentiable at a, then f is continuous at a

(A) i and ii
(B) ii and iii
(C) iii and iv
(D) i and iv

6. The function corresponding to the graph shown below is



(A) $y^2 = (1 - x)$
(B) $y^2 = (x - 1)$
(C) $y^2 + 1 = (x - 1)$
(D) $y^2 = (1 + x)$

7. $\lim_{x \to 0} \left(\frac{a^x - b^x}{x} \right) =$

(A) $\log\left(\frac{a}{b}\right)$

(B) $\log\left(\frac{b}{a}\right)$

(C) $\frac{b}{a}$

(D) $\log a^b$

8. Let $f(x)=x^2-1$ and $g(x)=4x+2$. The composition of two functions $(f\circ g)(x)$ is given by

(A) $8x^2+8x+3$
(B) $16x^2+16x+3$
(C) $4x^2-2$
(D) $4x^2+2$

9. The partial fraction decomposition of $f(x)=\frac{x^4+10x^2+3x+36}{(x-1)(x^2+1)^2}$ is of the form

(A) $\frac{A}{x-1}+\frac{Bx+C}{x^2+1}+\frac{Cx+D}{(x^2+1)^2}$
(B) $\frac{A}{x-1}+\frac{B}{x^2+1}+\frac{C}{(x^2+1)^2}$
(C) $\frac{A}{x-1}+\frac{B}{x^2+1}+\frac{Cx+D}{(x^2+1)^2}$
(D) $\frac{A}{x-1}+\frac{Bx+C}{x^2+1}+\frac{D}{(x^2+1)^2}$

10. The equation $|z-i|-|z+i|=k$, represents a hyperbola, if

(A) $0<k<2$
(B) $k<0$
(C) $k>2$
(D) $0<|k|<2$

11. $\log_7\log_7\sqrt{7\sqrt{7\sqrt{7}}}$ is equal to

(A) $3\log_7 7$
(B) $\log_7 2$
(C) $1-3\log_7 2$

(D) $1 - 3\log_2 7$

12. If $\sin^2\theta=\frac{1}{4}$ and $0<\theta<90°$, then the value of $\tan\theta$ is equal to

(A) $\frac{2}{\sqrt{3}}$

(B) $\frac{\sqrt{3}}{2}$

(C) 1

(D) $\frac{1}{\sqrt{3}}$

13. The sum of all three digit numbers which are odd is

(A) 247500
(B) 155700
(C) 175500
(D) 156500

14. The $(n+1)^{th}$ differentiation of an n^{th} order polynomial is

(A) zero
(B) a polynomial of order n
(C) a non-zero constant
(D) a polynomial of order 2

15. Last two digits of the natural number 19^{9^4} is

(A) 29
(B) 39
(C) 99
(D) 19

16. If $\int_a^b f(x)dx=a+2b$, then $\int_a^b (f(x)+5)dx=$¿¿

(A) $a+2b+5$
(B) $5b-5a$
(C) $7b-4a$
(D) $7b-6a$

17. The number of ways that a circle can be made out of 6 black and 4 white men standing on a ring, so that all the white men come together is

(A) 8564
(B) 8640
(C) 8644
(D) 8665

18. If $f(9)=9$ and $f'(9)=4$, then $\lim_{x\to 9}\frac{\sqrt{f(x)}-3}{\sqrt{x}-3}$ is equal to

(A) 2
(B) -2
(C) -4
(D) 4

19. The equation $z\bar{z}+2(z+\bar{z})-1=0$ represents

(A) a hyperbola
(B) a straight line
(C) an ellipse
(D) a circle

20. Let f be a polynomial. Then the second derivative of $f(e^x)$ is

(A) $f'(e^x)$

(B) $f''(e^x)e^{2x}+f'(e^x)e^x$

(C) $f''(e^x)e^x+f'(e^x)$

(D) $f''(e^x)e^{2x}+f'(e^x)$

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

(A) $\sqrt{3}$

(B) 4/3

(C) $4/\sqrt{3}$

(D) $2/\sqrt{3}$

22. $\int[\sin(\log x)+\cos(\log x)]dx$ is equal to

(A) $x\cos(\log x)+c$

(B) $\sin(\log x)+c$

(C) $\cos(\log x)+c$

(D) $x\sin(\log x)+c$

23. Thousand tickets are sold in a lottery in which there is one top prize of Rs.500, four prizes of Rs.100 each and five prizes of Rs. 10 each. A ticket costs Rs.1. The expected gain when you buy a ticket is

(A) Rs.2
(B) – 0.25 of a rupee
(C) – 0.5 of a rupee
(D) Rs.1

24. If $f:R\to R$ and $g:R\to R$ are one to one, real valued functions, then the value of the integral $\int_{-\pi}^{\pi}[f(x)+f(-x)][g(x)-g(-x)]\,dx$ is

(A) $-\pi$

(B) π

(C) 1
(D) 0

25. If E(X^2)=276 and Variance of X = 20, then the value of E(X) is

(A) 0
(B) 16
(C) 20
(D) 256

26. $\lim_{x \to \pi/4} \frac{1 - \tan x}{1 - \sqrt{2}\sin x} =$

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

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

(C) $\frac{1}{2\sqrt{2}}$

(D) 2

27. Let $f(x) = \sin\frac{1}{x}, \quad x \neq 0.$ Then $f(x)$ can be continuous at $x = 0$

(A) if $f(0) = 1$

(B) if $f(0) = 0$

(C) if $f(0) = -1$

(D) for no definite value of $f(0)$

28. If one of the diameters of the circle, given by the equation $x^2 + y^2 - 4x + 6y - 12 = 0$, is a chord of a circle S, whose centre is at (–3, 2), then the radius of S is

(A) 10

(B) $5\sqrt{2}$

(C) $5\sqrt{3}$

(D) 5

29. Let $f(-x) = f(x)$. Then $f'(x)$ must be

(A) an even function
(B) an odd function
(C) a periodic function
(D) neither even nor odd

30. Let u be a vector coplanar with the vectors $a = 2i + 3j - k$ and $b = j + k$. If u is perpendicular to a and $u \cdot b = 24$, then $|u|^2$ is equal to

(A) 84
(B) 336
(C) 315
(D) 256

31. The expression of dy/dx of the function $y = a^{x^{a^{x-a}}}$ is

(A) $\frac{y^2}{x(1 - y \log x)}$

(B) $\frac{y^2 \log y}{x(1 - y \log x)}$

(C) $\frac{y^2 \log y}{x(1 - y \log x \log y)}$

(D) $\frac{y^2 \log y}{x(1 + y \log x \log y)}$

32. The fixed point P on the curve $y = x^2 - 4x + 5$ such that the tangent at P is perpendicular to the line $x + 2y - 7 = 0$ is given by

(A) (1, 2)
(B) (2, 1)
(C) (3, 2)
(D) (2, 3)

33. If the tangent at $(1, 7)$ to the curve $x^2 = y - 6$ touches the circle $x^2 + y^2 + 16x + 12y + c = 0$, then the value of c is

(A) 85
(B) 195
(C) 185
(D) 95

34. Let y = y(x) be the solution of the differential equation $\sin x \frac{dy}{dx} + y\cos x = 4x, x \in (0,\pi)$. If $y\left(\frac{\pi}{2}\right) = 0$, then $y\left(\frac{\pi}{6}\right)$ is equal to

(A) $-\frac{4}{9}\pi^2$

(B) $\frac{4}{9\sqrt{3}}\pi^2$

(C) $\frac{8}{9\sqrt{3}}\pi^2$

(D) $-\frac{8}{9}\pi^2$

35. The value of b for which the function $f(x) = \sin x - bx + c$ is decreasing in the interval $(-\infty, \infty)$ is given by

(A) $b < 1$

(B) $b > 1$

(C) $b \geq 1$

(D) $b \leq 1$

36. The least value of $f(x) = \frac{x^3}{3} - abx$ occurs at $x =$

(A) G.M. of a, b
(B) A.M. of a, b
(C) H.M. of a, b
(D) square of a and b

37. Let $a = j - k$ and $c = i - j - k$. Then the vector b satisfying $a \times b + c = 0$ and $a \cdot b = 3$ is

(A) $-i + j - 2k$

(B) $2i - j + 2k$

(C) $i - j - 2k$

(D) $i + j - 2k$

38. If $f(a+x)=f(x)$, then $\int_0^{na} f(x)dx$, where $n \in N$, is equal to

(A) $(n-1)\int_0^a f(x)dx$

(B) $n\int_0^a f(x)dx$

(C) $\int_0^{(n-1)a} f(x)dx$

(D) $\int_0^{\frac{na}{2}} f(x)dx$

39. The area of the region bounded by the curves $y=x^2$ and $x=y^2$ is

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

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

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

(D) 3

40. The differential equation of the family of circles with centre on the x axis is

(A) $y\frac{d^2y}{dx^2}+\left(\frac{dy}{dx}\right)^2+1=0$

(B) $\frac{d^2y}{dx^2}+\left(\frac{dy}{dx}\right)^2+1=0$

(C) $y\frac{d^2y}{dx^2}-\left(\frac{dy}{dx}\right)^2+1=0$

(D) $y\frac{d^2y}{dx^2}+\frac{dy}{dx}+1=0$

41. The value of the integral $\int_0^1 e^{x^2}\,dx$ lies in the interval

(A) (0, 1)
(B) (– 1, 0)
(C) (1, *e*)
(D) (– 1, *e*)

42. The equation of a plane passing through the line of intersection of the planes x+2y+3z = 2 and x – y + z = 3 and at a distance $\frac{2}{\sqrt{3}}$ from the point (3, 1, – 1) is

(A) 5x – 11y + z = 17

(B) $\sqrt{2}x + y = 3\sqrt{2} - 1$

(C) $x + y + z = \sqrt{3}$

(D) $x - \sqrt{2}y = 1 - \sqrt{2}$

43. The integrating factor of the differential equation $\frac{dy}{dx} + y\tan x = \sec x$ is

(A) $\sec x$

(B) $\tan x$

(C) $\sin x$

(D) $\cos x$

44. Consider the system of equations x – 2y + 3z = –1; –x + y – 2z = k; x – 3y + 4z = 1.
STATEMENT-1: The system of equations has no solution for k ≠ 3 and

STATEMENT-2: The determinant $\begin{vmatrix} 1 & -3 & -1 \\ -1 & -2 & k \\ 1 & 4 & 1 \end{vmatrix} \neq 0$, for k ≠ 3.

STATEMENT

Then

(A) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1
(B) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1
(C) Statement-1 is True and Statement-2 is False
(D) Statement-1 is False and Statement-2 is True

45. Seven people seat themselves indiscriminately around table. The probability that two distinguished persons will be next to each other is

(A) 1/3

(B) 1/2

(C) 1/4

(D) 1/8

46. For a normal curve, the greatest ordinate is

(A) $2\pi\sigma$

(B) $\sigma\sqrt{2\pi}$

(C) $\frac{1}{\sqrt{2\pi\sigma}}$

(D) $\frac{1}{\sigma\sqrt{2\pi}}$

47. If lines $\frac{x-1}{-3}=\frac{y-2}{2k}=\frac{z-3}{2}$ and $\frac{x-1}{3k}=\frac{y-}{1}=\frac{z-6}{-5}$ are mutually perpendicular, then k is equal to

(A) $-10/7$

(B) $-7/10$

(C) -10

(D) -7

48. If A is an 3×3 non-singular matrix such that $AA^t = A^tA$ and $B = A^{-1}A^t$, then BB^t equals

(A) I + B
(B) I
(C) B^{-1}
(D) $(B^{-1})^t$

49. If the median of 21 observations is 40 and if the observations greater than the median are increased by 5, then the median of the new data will be

(A) 45

(B) 40

(C) $40+\frac{50}{21}$

(D) $45 - \frac{50}{21}$

50. The area (in sq. units) of the quadrilateral formed by the tangents at the end points of the latus rectum to the ellipse $\frac{x^2}{9}+\frac{y^2}{5}=1$, is

(A) 18

(B) 27

(C) 27/2

(D) 27/4

51. Let A and B be two events such that $P(\overline{A \cup B}) = 1/6$, $P(A \cap B) = 1/4$ and $P(\overline{A}) = 1/4$, where $\overline{A}$ stands for the complement of the event A. Then the events A and B are

(A) mutually exclusive and independent
(B) equally likely but not independent
(C) independent but not equally likely
(D) independent and equally likely

52. Solution of the equation $\sin x - \cos x = \sqrt{2}$ is

(A) $2n\pi + \frac{3\pi}{4}, n \in \mathbb{Z}$

(B) $2n\pi, n \in \mathbb{Z}$

(C) $2\pi, n \in \mathbb{Z}$

(D) $(2n+1)\pi, n \in \mathbb{Z}$

53. Which of the following functions is not one to one?

(A) $f : \mathbb{R} \to \mathbb{R}, \ f(x) = 2x + 5$

(B) $f : [0, \pi] \to [-1, 1], \ f(x) = \cos x$

(C) $f : [-\pi/2, \pi/2] \to [1, 7], \ f(x) = 3\sin x + 4$

(D) $f : \mathbb{R} \to [-1, 1],\ f(x) = \sin x$

54. If $u = e^{\left(\frac{x^2}{y^2}\right)} + e^{\left(\frac{y^2}{x^2}\right)}$, then $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} =$

(A) u

(B) $\frac{\partial^2 u}{\partial x \partial y}$

(C) $\frac{1}{x} + \frac{1}{y}$

(D) 0

55. The value of the sum $\sum_{n=1}^{13} \left(i^n + i^{n+1}\right)$ where $i = \sqrt{-1}$ is equal to

(A) i

(B) $i - 1$

(C) $-i$

(D) 0

56. Let A and B be two 2×2 matrices. Consider the statements

(i) $AB = 0 \Rightarrow A = 0$ or $B = 0$

(ii) $AB = I \Rightarrow A = B^{-1}$

(iii) $(A+B)^2 = A^2 + 2AB + B^2$. Then

(A) (i) is false, (ii) and (iii) are true
(B) (i) and (iii) are false, (ii) is true
(C) (i) and (ii) are false, (iii) is true
(D) (ii) and (iii) are false, (i) is true

57. The remainder when $x = 1! + 2! + 3! + \ldots + 100!$ is divided by 240, is

(A) 187
(B) 33
(C) 73
(D) 153

58. A black and a red dice are rolled. The conditional probability of obtaining a sum greater than 9, given that the black die resulted in a 5 is

(A) 1/6
(B) 1/9
(C) 3/4
(D) 1/3

59. The area bounded by the curve $|x|+|y|=1$ is

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

60. If $a_n = \sqrt{7+\sqrt{7+\sqrt{7+\ldots}}}$ having n radical signs, then by methods of mathematical induction which of the following is true?

(A) $a_n < 4$, for every $n \geq 1$

(B) $a_n < 3$, for every $n \geq 1$

(C) $a_n < 7$, for every $n \geq 1$

(D) $a_n > 3$, for every $n \geq 1$

61. The period of $\sin^2\theta$ is

(A) π

(B) π

(C) π^3

(D) $\pi/2$

62. Consider the function $f(x) = (x-1)^{\frac{1}{2-x}}$. The value of $f(2)$ so that f is continuous at $x=2$ is

(A) 1

(B) e

(C) $1/e$

(D) $1/e^2$

63. If $f(x) = x^n$, then the value of $f(1) - \frac{f'(1)}{1!} + \frac{f''(1)}{2!} - \frac{f'''(1)}{3!} + \ldots + (-1)^n \frac{f^{(n)}(1)}{n!}$ is

(A) 2^n

(B) 2^{n-1}

(C) 0

(D) 1

64. The sine of the angle between the pair of lines represented by the equation $x^2 - 7xy + 12y^2 = 0$ is

(A) $1/\sqrt{170}$

(B) $1/12$

(C) $1/13$

(D) $-1/13$

65. If the tangent at the point P on the circle $x^2 + y^2 + 6x + 6y = 2$ meets the straight line $5x - 2y + 6 = 0$ at a point Q on the y-axis, then the length of PQ is

(A) 4

(B) 5

(C) $2\sqrt{5}$

(D) $3\sqrt{5}$

66. Let the matrix $F(x) = \begin{bmatrix} \cos x & -\sin x & 0 \\ \sin x & \cos x & 0 \\ 0 & 0 & 1 \end{bmatrix}$. Then $F(x)F(y) =$

(A) $F(xy)$

(B) $F(x+y)$

(C) $F(x)+F(y)$

(D) $F(x-y)$

67. If a line is equally inclined with the coordinate axes, then the angle of inclination is

(A) $\cos^{-1}(1/2)$

(B) $\cos^{-1}(1/\sqrt{2})$

(C) $\cos^{-1}(1/\sqrt{3})$

(D) $\cos^{-1}(\sqrt{3}/2)$

68. If $N = m!$ (where m is a fixed positive integer > 2), then

$$\frac{1}{\log_2 N} + \frac{1}{\log_3 N} + \frac{1}{\log_4 N} + \ldots + \frac{1}{\log_m N} =$$

(A) - 2

(B) - 1

(C) 0

(D) 1

69. The monthly sales for the first 11 months of the year of a certain salesman were Rs.12,000. But due to his illness during the last month the average sales for the whole year came down to Rs. 11,875. The value of the sale during the last month was

(A) Rs 4,500

(B) Rs 6,000

(C) Rs 10,000

(D) Rs 8,000

70. If $\sin^{-1} x + \sin^{-1} y + \sin^{-1} z = 3\pi/2$, then the value of $x^{100} + y^{100} + z^{100} - \frac{9}{x^{101} + y^{101} + z^{101}}$ is

(A) – 1

(B) 0

(C) 1

(D) 3

71. The sum of the series $\frac{1}{1!}+\frac{1+2}{2!}+\frac{1+2+3}{3!}+\ldots$ is

(A) e

(B) $\frac{e}{2}$

(C) $\frac{3e}{2}$

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

72. Using the fact that $\sum_{1}^{\infty}\frac{1}{n^2}=\frac{\pi^2}{6}$, the value of $\sum_{1}^{\infty}\frac{1}{(2n-1)^2}$ is

(A) $\frac{\pi^2}{12}$

(B) $\frac{\pi^2}{12}-1$

(C) $\frac{\pi^2}{8}$

(D) $\frac{\pi^2}{8}-1$

73. If x_1, x_2, x_3 and y_1, y_2, y_3 are both in G.P. with the same common ratio, then the points $(x_1, y_1), (x_2, y_2)$ and (x_3, y_3)

(A) lie on a straight line
(B) lie on an ellipse
(C) lie on a circle
(D) are vertices of a triangle

74. A peacock perched on the top of a 12 m high tree spots a snake moving towards its hole at the base of the tree from a distance equal to thrice the height of the tree. The peacock

flies towards the snake in a straight line and they both move at the same speed. At what distance from the base of the tree will the peacock catch the snake?

(A) 16 m

(B) 18 m

(C) 14 m

(D) 12 m

75. Let $M = \{(a_1, a_2, a_3) \mid a_i \in \{1, 2, 3, 4\}, a_1 + a_2 + a_3 = 6\}$. Then number of elements in M is

(A) 8
(B) 9
(C) 10
(D) 12

76. A solution curve of the differential equation $xy' = 2y$ passing through (1, 2) also passes through

(A) (2, 1)
(B) (0, 0)
(C) (4, 24)
(D) (2, 4)

77. If the line $x + 3y + 2 = 0$ and its perpendicular line are conjugate with respect to $3x^2 - 5y^2 = 15$, then the equation to conjugate line is

(A) $3x - y = 15$

(B) $3x - y + 10 = 0$

(C) $3x - y = 4$

(D) $3x - y + 12 = 0$

78. An event A is independent of itself if and only if $P(A)$ is

(A) 0 or 1

(B) 1/2

(C) 0

(D) 0, 1/2

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

(A) 1, 2/3

(B) 3, 1

(C) 3, 3

(D) 1, 2

80. The differential equation whose linearly independent solutions are $\cos 2x, \sin 2x, e^{-x}$ is

(A) $(D^3 + D^2 + 4D + 4)y = 0$

(B) $(D^3 - D^2 + 4D - 4)y = 0$

(C) $(D^3 + D^2 - 4D - 4)y = 0$

(D) $(D^3 - D^2 - 4D + 4)y = 0$

81. An example of a function which is continuous but not differentiable is

(A) $f(x) = |x|$

(B) $f(x) = x$

(C) $f(x) = \log x$

(D) $f(x) = -x$

82. If three distinct numbers are chosen randomly from the first 100 natural numbers, then the probability that all three of them are divisible by both 2 and 3 is

(A) $\frac{4}{55}$

(B) $\frac{4}{55}$

(C) $\frac{4}{55}$

(D) $\frac{4}{1155}$

83. The family of curves that is orthogonal to $xy = c^2$ is

(A) $y = c_1 x$

(B) $y = c_1 / x$

(C) $x^2 + y^2 = c_1$

(D) $x^2 - y^2 = c_1$

84. If $a_1, a_2, \ldots, a_n$ are in a group, then the inverse of $a_1 . a_2 \ldots a_n$ is

(A) $a_n + a_2 + \ldots + a_n$

(B) identity element

(C) $a_1^{-1} \ldots a_n^{-1}$

(D) $a_n^{-1} . a_{n-1}^{-1} \ldots a_1^{-1}$

85. Let $\mathbb{Z}$ be the set of all integers and let * be a binary operation in $\mathbb{Z}$ defined by $a * b = a + b + 10$ for all $a, b \in \mathbb{Z}$ The identity element of this group is

(A) 0

(B) 10

(C) - 10

(D) 1

86. The angle between the lines $6x = -3y = -4z$ and $2x = -y = z$ is

(A) $\frac{\pi}{3}$

(B) 0

(C) $\frac{\pi}{4}$

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

87. The equation of the tangent at $(3, -6)$ to the parabola $y^2 = 12x$ is

(A) $x - y - 3 = 0$

(B) $x + y - 3 = 0$

(C) $x - y + 3 = 0$

(D) $x + y + 3 = 0$

88. Let $f:[0,\pi/2] \to \mathbb{R}$ be continuous and satisfy $\int_0^{\sin x} f(t)dt = \sqrt{3}\, x/2$ for $0 \le x \le \pi/2$. Then $f(1/2)$ equals

(A) $1/2$

(B) $1/\sqrt{2}$

(C) $1/\sqrt{3}$

(D) 1

89. The value of $\lim_{n\to\infty}\left(1-\frac{1}{n}\right)^{2n}$ is

(A) e^2

(B) e^{-2}

(C) 1

(D) 0

90. The shortest distance of the point (2, 10, 1) from the plane $r.(3i - j + 4k) = 2\sqrt{26}$ is

(A) $2\sqrt{26}$

(B) $\sqrt{26}$

(C) 2

(D) $\frac{1}{\sqrt{26}}$

91. The equation of the plane passing through the point (2, 1, -1) and the line of intersection of the planes $r.(i + 3j - k) = 0$ and $r.(j + 2k) = 0$ is

(A) $x + 4y - z = 0$

(B) $x + 9y + 11z = 0$

(C) $2x + y - z + 5 = 0$

(D) $2x - y + z = 0$

92. If $(1+x)^n = C_0 + C_1x + C_2x^2 + \ldots + C_nx^n$, then the value of $C_0 + 2C_1 + 3C_2 + \ldots + (n+1)C_n$ is

(A) $(n+2)2^{n-1}$

(B) $(n+2)2^n$

(C) $(n+1)2^{n-1}$

(D) $(n+1)(n+2)2^n$

93. The value of x for which the matrix $\begin{bmatrix} 8 & x & 0 \\ 4 & 0 & 2 \\ 2 & 6 & 0 \end{bmatrix}$ is singular, is

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

94. The determinant of the matrix $\begin{bmatrix} 1 & x & 1+x+x^2 \\ 1 & y & 1+y+y^2 \\ 1 & 1+z & 1+z+z^2 \end{bmatrix}$ is equal to

(A) $(z-y)(z-x)(y-x)$

(B) $(x-y)(x-z)(y-z)$

(C) $(x-y)^2(y-z)^2(z-x)^2$

(D) $(x^2-y^2)(y^2-z^2)(z^2-x^2)$

95. The probability of obtaining 'no head' in an infinite sequence of independent tosses of a coin is

(A) 0

(B) 1

(C) 1/2

(D) 1/3

96. If X is a Poisson random variable such that $E(X^2) = 30$, then the variance of X is

(A) 6
(B) 5
(C) 30
(D) 25

97. A problem in Mathematics is given to three students A, B, C and their respective probability of solving the problem is $\frac{1}{2}$, $\frac{1}{3}$ and $\frac{1}{4}$. Probability that the problem is solved is

(A) $\frac{3}{4}$

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

(C) $\frac{2}{3}$

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

98. The value of the constant c for which the function defined by

$$f(x) = \begin{cases} cx(1-x), & \text{if } 0 < x < 1 \\ 0, & \text{otherwise} \end{cases}$$

is a probability density function, is

(A) 1
(B) 0
(C) 3
(D) 6

99. If $(1.05)^{50} = 11.658$, then $\sum_{n=1}^{49} (1.05)^n$ equals

(A) 208.34
(B) 212.12
(C) 212.16
(D) 213.16

100. The value of $(\sqrt{3}+i)^{14}+(\sqrt{3}-i)^{14}$ is

(A) 2^{14}

(B) $(2i)^{14}$

(C) 2^7

(D) $(2i)^7$

101. If $-1 \le x \le 2$ and $1 \le y \le 3$, then least possible value of $2y - 3x$ is

(A) 0
(B) – 4
(C) – 5
(D) – 3

102. The solution set of $|x-1| \ge |x-3|$ is

(A) $(-\infty, 2)$
(B) (0, 2)
(C) $[2, \infty]$
(D) [0, 2]

103. If a, b, c are the position vectors of the vertices of an equilateral triangle whose orthocenter is at the origin, then

(A) $a+b+c=0$

(B) $a^2+b^2+c^2=0$

(C) $a+b=c$

(D) $a=b+c$

104. The number of ways in which 6 men and 5 women can sit at a round table if no two women are to sit together is given by

(A) 6! × 5!
(B) 30

(C) $4! \times 5!$
(D) $7! \times 5!$

105. If z_1 and z_2 are any two complex numbers, then $Re(z_1z_2)$ is

(A) $Re(z_1)Re(z_2) + Im(z_1)Im(z_2)$

(B) $Re(z_1)Re(z_2) - Im(z_1)Im(z_2)$

(C) $Re(z_1)Im(z_2) + Re(z_2)Im(z_1)$

(D) $Re(z_1)Im(z_1) - Re(z_2)Im(z_2)$

106. If $x^{2/3} + y^{2/3} = a^{2/3}$, then dy/dx is

(A) $\sqrt{\frac{x}{y}}$

(B) $-\sqrt[3]{\frac{y}{x}}$

(C) $-\sqrt{\frac{y}{x}}$

(D) $\frac{y^2}{x}$

107. If a, b and c are in arithmetic progression, then the value of the determinant

$$\begin{vmatrix} x+2 & x+3 & x+2c \\ x+3 & x+4 & x+2b \\ x+4 & x+5 & x+2a \end{vmatrix}$$ is

(A) 0
(B) 1
(C) x
(D) $2x$

108. The solution of $\tan^{-1}(2x)+\tan^{-1}(3x)=\frac{\pi}{4}$ is

(A) – 1
(B) 1/6
(C) 0
(D) – ½

109. Which of the following statements is false?

(A) An equation of form $a * x = b$ has a unique solution for x in a group

(B) An equation of form $a * x = e$ has a unique solution for x in a group

(C) Given $n \in N$, there exist a group with n elements

(D) If H and K are abelian groups, then $H \times K$ need not be abelian

110. Define $a \otimes b = lcm(a,b) + \gcd(a,b)$ and $a \oplus b = a^b + b^a$. The value of $(1 \oplus 2) \otimes (3 \oplus 4)$ is

(A) 145
(B) 286
(C) 436
(D) 572

111. In a Poisson distribution, P(X = 2) = P(X = 3). Given that $e^{-3} = 0.050$. Then P(X = 5) is

(A) 0.202
(B) 0.352
(C) 0.125
(D) 0.101

112. There are four prime numbers written in ascending order. The product of the first three is 385 and that of the last three is 1001. The last number is

(A) 11
(B) 13
(C) 17
(D) 19

113. If the area of a triangle is 4 sq. units with vertices at (–2, 0), (0, 4) and (0, k), then the value of k is

(A) 2
(B) 0
(C) 8
(D) 4

114. The value of sin(15°) is

(A) $\frac{\sqrt{3}+1}{2\sqrt{2}}$

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

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

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

115. If $x-3$ and $x+3$ are the factors of $4x^3 + ax^2 + bx$, then the values of a and b are respectively

(A) 3, 18
(B) 6,12
(C) 0, – 36
(D) 12, – 5

116. The point at which the tangent to the curve $y=\sqrt{4x-3}-1$ has its slope 2/3 is

(A) (2,3)
(B) (3,2)
(C) (1,3)
(D) (3,1)

117. The area enclosed by the graph of $2|x|+3|y|=6$ above the x-axis is

(A) 12
(B) 10
(C) 6
(D) 24

118. If $\alpha,\beta\in C$ are the distinct roots of the equation $x^2 - x + 1 = 0$, then $\alpha^{101}+\beta^{107}$ is equal to

(A) 2

(B) –1

(C) 0

(D) 1

119. The solution of the differential equation $\frac{dy}{dx} = y \log y \cot x$ is

(A) $y = c \cos x$

(B) $y = c \sin x$

(C) $y = c \log \sin x$

(D) $y = e^{c \sin x}$

120. A polynomial of odd degree with real coefficients must have

(A) at least one real root
(B) no real root
(C) only real roots
(D) at least one root which is not real

121. The length of the latus rectum of the rectangular hyperbola $xy = 32$ is

(A) $8\sqrt{2}$

(B) 32
(C) 8
(D) 16

122. The foci of the ellipse $16x^2 + 25y^2 = 400$ are

(A) $(0, \pm 3)$

(B) $(\pm 3, 0)$

(C) $(0, \pm 5)$

(D) $(\pm 5, 0)$

123. If $f(x) = \int_{-\frac{1}{1+t^3}}^{x^2} dt$, then $f'(2)$ is

(A) $\frac{4}{65}$

(B) $-\frac{1}{9}$

(C) $\ln\frac{65}{2}$

(D) $\ln\frac{9}{2}$

124. If $a = i - 2j + k$, $b = 2i + j - k$ and $c = i + 2j - k$, then $a \times (b \times c)$ is

(A) $-9i - 6j - 3k$

(B) $9i + 6j + 3k$

(C) $-9i + 6j - 3k$

(D) $9i - 6j - 3k$

125. If $A = \begin{bmatrix} x & 1 \\ -1 & -x \end{bmatrix}$, then the value x satisfying $A^2 = 0$, is

(A) 0

(B) ± 1

(C) -1

(D) 1

126. The average translational kinetic energy of O_2 molecules at a particular temperature is 0.048 eV. The translational kinetic energy of N_2 molecules at the same temperature is

(A) 0.0015 eV
(B) 0.048 eV
(C) 0.003 eV
(D) 0.768 eV

127. Arrange the following electromagnetic radiation per quantum in the order of increasing energy: (i) Red light (ii) γ-ray (iii) X-ray (iv) Radiowave

(A) i, ii, iv, iii
(B) iii, i, ii, iv
(C) ii, i, iv, iii
(D) iv, i, iii, ii

128. $^{22}_{10}Ne$ nucleus decays into two α-particles and an unknown nucleus. The unknown nucleus is

(A) *nitrogen*
(B) *carbon*
(C) *boron*
(D) *oxygen*

129. Which of the following cannot be accelerated in a cyclotron?

(A) *Protons*
(B) *Deuterons*
(C) *Alpha particles*
(D) *Neutrons*

130. For a paramagnetic material, the dependence of the magnetic susceptibility χ on the absolute temperature T is given by

(A) $\chi = CT$
(B) $\chi = C/T$
(C) $\chi = CT^2$
(D) $\chi = C/T^{-2}$

131. The unit of power of a lens is

(A) *metre*
(B) *watt*
(C) *watt/m*
(D) dioptre

132. The momentum of an X-ray photon is 5×10^{-23} kgms^{-1}. The energy of this photon is

(A) $9 \times 10^{-15} J$
(B) $3 \times 10^{-15} J$
(C) $3 \times 10^{-23} J$
(D) $12 \times 10^{-15} J$

133. To convert a galvanometer into an ammeter, one should connect

(A) *a low resistance in series with it*
(B) *a high resistance in series with it*
(C) *a low resistance in with it*
(D) a high resistance in parallel with it

134. The wavelength of blue light (λ=420 nm) in water (refractive index 1.33) is about

(A) 320 *nm*
(B) 390 nm
(C) 315 *nm*
(D) 560 nm

135. The root mean square speed of the molecules of an enclosed gas is v. What will be the root mean square speed if the pressure is doubled, the temperature remaining the same?

(A) $v/2$
(B) v
(C) $2v$
(D) 4v

136. Which one of the following forms a virtual and erect image for all positions of the object?

(A) Convex lens
(B) Concave lens
(C) Plano-convex lens
(D) Concave mirror

137. If the distance between two masses is doubled, the gravitational attraction between them is

(A) reduced to half
(B) reduced to a quarter
(C) doubled
(D) unaltered

138. A piece of copper and another of germanium are cooled from room temperature to 80 K. The resistance of

(A) *each of them increases*
(B) *each of them decreases*
(C) *copper increases ∧ germanium decreases*
(D) copper decreases and germanium increases

139. When $^{7}_{3}Li$ nuclei are bombarded by protons, the resultant nuclei is $^{8}_{4}Be$. The emitted particles will be

(A) gamma photons
(B) neutrons
(C) alpha particle
(D) beta particle

140. Let $\hat{i} \wedge \hat{j}$ be the unit vectors along x and y directions. Then the magnitude of $\hat{i}+\hat{j}$ is

(A) 1
(B) 2
(C) 0
(D) $\sqrt{2}$

141. A projectile has a maximum range of 100 m. Neglecting air resistance, what is the maximum height attained by it?

(A) 50 m
(B) 100 m
(C) 5 m
(D) 25 m

142. The frequency of the charged particle circulating at right angles to a uniform magnetic field does not depend upon the

(A) speed of the particle
(B) mass of the particle
(C) charge of the particle
(D) magnetic field

143. The following four gases are at the same temperature. In which gas do the molecules have the maximum root mean square speed?

(A) Carbon dioxide
(B) Oxygen
(C) Nitrogen
(D) Hydrogen

144. In the following, column I lists some physical quantities and the column II gives approximate energy values associated with those. Choose appropriate values of energies as per the choices given below

Column I		Column II	
(i)	Energy of thermal neutrons	a	3 eV
(ii)	Binding energy per nucleon	b	10 keV
(iii)	Energy of X-rays	c	8 MeV
(iv)	Photoelectric threshold of a metal	d	0.025 eV
		e	1 eV
		f	0.8 eV

(A) $i \rightarrow d,\ ii \rightarrow c,\ iii \rightarrow b,\ iv \rightarrow a$

(B) $i \rightarrow f,\ ii \rightarrow c,\ iii \rightarrow e,\ iv \rightarrow d$

(C) $i \rightarrow c,\ ii \rightarrow e,\ iii \rightarrow f,\ iv \rightarrow b$

(D) $i \rightarrow d,\ ii \rightarrow c,\ iii \rightarrow f,\ iv \rightarrow e$

145. The unit of momentum is

(A) Nm
(B) Ns
(C) Nm^{-1}
(D) Ns^{-1}

146. The ratio of electrostatic force and gravitational force between a proton and an electron is

(A) 2.4×10^{39}
(B) 2.4×10^{-39}
(C) 2.4×10^{-37}
(D) 2.4×10^{37}

147. The charge carriers in an electrolyte are

(A) Negative ions
(B) Positive ions
(C) Negative and positive ions
(D) None of the above

148. A spherical black body with a radius of 12 cm radiates 450 watt power at 500 K. If the radius were halved and the temperature doubled, the power radiated in watt would be

(A) 225
(B) 450
(C) 1800
(D) 1000

149. The ratio of resolving powers of an optical microscope for two wavelengths $\lambda_1 = 4000$ Å and $\lambda_2 = 6000$ Å is

(A) 8 : 27
(B) 3 : 2
(C) 9 : 4
(D) 16 : 81

150. The centripetal acceleration required for a particle to move on a circle of radius r with speed v is

(A) v^2/r
(B) v/r
(C) v/r^2
(D) $vr^2/2$

151. The ratio of wavelengths of the last line of Balmer series and the last line of Lyman series is

(A) 2
(B) 4
(C) 1
(D) 0.5

152. Two cars moving in opposite directions approach each other with speed of 22 m/s and 16.5 m/s respectively. The driver of the first car blows a horn having a frequency 400 Hz. The frequency heard by the driver of the second car is [velocity of sound 340 m/s]

(A) 350 Hz
(B) 361 Hz
(C) 411 Hz
(D) 448 Hz

153. The magnetic susceptibility is negative for

(A) diamagnetic material only
(B) paramagnetic material only
(C) ferromagnetic material only
(D) paramagnetic and ferromagnetic materials

154. If the magnitude of sum of two vectors is equal to the magnitude of difference of the two vectors, the angle between these vectors is

(A) 0°
(B) 90°
(C) 45°
(D) 180°

155. Given the value of Rydberg constant is $1 \times 10^7\ m^{-1}$, the wave number of the last line of the Balmer series in hydrogen spectrum will be

(A) $0.025 \times 10^4\ m^{-1}$
(B) $0.5 \times 10^7\ m^{-1}$
(C) $0.25 \times 10^7\ m^{-1}$
(D) $2.5 \times 10^7\ m^{-1}$

156. The vectors $2\hat{i}-3\hat{j}+4\hat{k}$, $a\hat{i}+b\hat{j}+c\hat{k}$ are normal to each other only if

(A) a = 2, b = 3, c = –4
(B) a = 4, b = 4, c = –5
(C) a = 4, b = 4, c = 5
(D) a = –2, b = 3, c = 4

157. The order and degree of the differential equation $y''' - y'' + y^3 = 0$ are

(A) (3, 2)
(B) (2, 3)
(C) (2, 2)
(D) (3, 3)

158. A bag contains 6 green balls, 8 white balls and 10 black balls. If a ball is drawn from the bag, what is the probability of it being either white or black?

(A) 1/18
(B) 1/8
(C) 3/4
(D) 1/12

159. The value of $\hbar$ (h bar) is _____ erg-sec.

(A) 6.6253×10^{-27}
(B) 1.0545×10^{-27}
(C) 6.6253×10^{-31}
(D) 1.0544×10^{-34}

160. According to Bohr's postulates, which of the following quantity takes discrete values?

(A) Kinetic energy
(B) Angular momentum
(C) Potential energy
(D) Momentum

161. A chain reaction is possible when the mass of the fuel is greater than the

(A) critical mass
(B) neutron mass
(C) proton mass
(D) electron mass

162. In Raman effect, the spectral line with lower frequency than the incident frequency is

(A) Anti-Stokes' line
(B) Fraunhofer line
(C) Rayleigh line
(D) Stokes' line

163. In n-type semiconductor, Silicon is doped with

(A) Aluminium
(B) Arsenic
(C) Indium
(D) Germanium

164. The Bragg's equation $2d\sin\theta = n\lambda$ has no solution for

(A) $\lambda<d$
(B) $\lambda<2d$
(C) $\lambda>2d$
(D) $\lambda=2d$

165. A long solenoid has 1000 turns. When a current of 4A flows through it, the magnetic flux linked with each turn of the solenoid is 4×10^{-3} Wb. The self-inductance of the solenoid is

(A) 4H
(B) 2H
(C) 3H
(D) 1H

166. The acceleration due to gravity at a height 1 km above the earth is the same as at a depth 'd' below the surface of earth. Then

(A) d = 05 km
(B) 1 km
(C) 0.75 km
(D) 2 km

167. The least distance of distinct vision for a normal eye is

(A) 100 m
(B) 5 m
(C) 0.25 m
(D) infinity

168. Sound travels fastest in

(A) vacuum
(B) liquids
(C) gases
(D) solids

169. The law that states "The induced e.m.f. is proportional to the rate of change of its number of lines of magnetic force linking the circuit" is

(A) Lenz's law
(B) Faraday law
(C) Ohms law
(D) Joule-Thomson law

170. Two charges are placed a certain distance apart in air. When a dielectric sheet is placed between them the electrostatic force between them will

(A) become zero
(B) increase
(C) remain unchanged
(D) decrease

171. The resistance of a conductor carrying a current 3 A which has a potential difference of 15 V between its two ends is

(A) 15 Ohm
(B) 5 Ohm
(C) 0.5 Ohm
(D) 1/5 Ohm

172. The value of $A \cdot B + \bar{A} \cdot A$ is

(A) B

(B) always 0

(C) always 1

(D) $\bar{B}$

173. Which of the following flip-flops does not have race problem?

(A) D-flip-flop
(B) T-flip-flop
(C) Master-slave flip-flop
(D) JK flip-flop

174. A microprocessor with a 12 bit address bus will be able to access _____ kilobytes of memory.

(A) 8
(B) 4
(C) 1
(D) 2

175. The displacement of a particle is given by

$$x = A^2 \sin^2 kt$$

where t denotes time. The unit of k is

(A) Hertz
(B) Meter
(C) Radian
(D) Second

176. Planck's constant has the dimension of

(A) Force
(B) Energy
(C) Linear momentum
(D) Angular momentum

177. The statement that the velocity of light in vacuum = velocity of light in the medium is

(A) Dimensionally correct
(B) Dimensionally incorrect
(C) Numerically incorrect
(D) Both (A) and (C)

178. Two vectors have magnitude 3 and 5. If the angle between them is 60°, then the dot product of two vectors will be

(A) 6.5
(B) 7.5
(C) 7.9
(D) 8

179. If the distance covered by a particle happens to be zero, then the displacement of the particle

(A) must be zero
(B) may or may not be zero
(C) cannot be zero
(D) depends upon the particle

180. Two bullets are fired horizontally with different velocities from the same height. Which one will reach the ground first?

(A) The slower one
(B) Faster one
(C) It cannot be predicted
(D) Both will reach simultaneously

181. The angular velocity of a particle rotating in a circular orbit 100 times per minute is

(A) 60 deg/s
(B) 1.66 rad/s
(C) 1.66 deg/s
(D) 1.66 rad/minute

182. Frictional forces act in a direction

(A) perpendicular to the surface in contact
(B) parallel to surface in contact
(C) parallel to normal reaction
(D) inclined at 45° to normal reaction

183. Which one of the following is true for an elastic collision between two bodies?

(A) Kinetic energy of the system is conserved
(B) Total momentum of the system is conserved
(C) Both kinetic energy and momentum of the system are conserved
(D) Neither kinetic energy nor momentum of the system is conserved

184. When a mass is rotating in an orbit about a fixed axis, its angular momentum is directed

(A) along the radius of the orbit
(B) tangential to the orbit
(C) along the axis of rotation
(D) perpendicular to the plane of the orbit.

185. In practice, Poisson's ratio σ lies between

(A) $-\infty$ to $+\infty$
(B) 0 and $+\infty$
(C) 0 and 0.5
(D) – 0.5 and 0

186. Two wires of the same material and length but cross sectional area in the ratio 1 : 2 are used to suspend the same loads. The extension in them will be in the ratio

(A) 1 : 2
(B) 2 : 1
(C) 4 : 1
(D) 1 : 4

187. A liquid will not wet the surface of a solid, if the angle of contact is

(A) 0^o
(B) 45^o
(C) 60^o
(D) $> 90^o$

188. When two capillary tubes of different diameters are dipped in liquid vertically, the rise of the liquid in the capillary tubes is

(A) same in both the tubes
(B) more in the tube of larger diameter
(C) more in the tube of smaller diameter
(D) less in the tube of smaller diameter

189. Pyrometer is a device for measuring

(A) pressure
(B) temperature
(C) density
(D) viscosity

190. The internal energy of a gas during isothermal expansion

(A) increases
(B) remains constant
(C) decreases
(D) becomes zero

191. Which one of the following expressions does not represent simple harmonic motion (SMH)?

(A) A sin ωt
(B) A sin 2ωt
(C) A sin ωt + A cos ωt
(D) A $\sin^2$ ωt

192. If x is the displacement of the particle from the mean position, the total energy of a particle executing simple harmonic motion is

(A) proportional to x
(B) proportional to x^2
(C) independent of x
(D) proportional to $\sqrt{x}$

193. If the refractive index of water is 1.33, the speed of light in water will be

(A) 3 x 10^8 m/s
(B) 0.44 x 10^8 m/s
(C) 1.33 x 10^8 m/s
(D) 2.25 x 10^8 m/s

194. The correct arrangement of colors in the descending order of their wavelength

(A) yellow, violet, green, orange
(B) orange, yellow, green, violet
(C) violet, green, yellow, orange
(D) orange, green, violet, yellow

195. Field inside a solenoid is

(A) directly proportional to its length
(B) directly proportional to the current
(C) inversely proportional to the number of turns
(D) inversely proportional to the current

196. L, C and R represent the quantities inductance, capacitance and resistance respectively. The combination which has the dimensions of frequency is

(A) (1/RC)
(B) (C/L)
(C) (R/LC)
(D) (RL/C)

197. Poynting vector of a plane electromagnetic wave propagating in the direction $\hat{k}$ is

(A) perpendicular to $\hat{k}$

(B) parallel to $\hat{k}$

(C) antiparallel to $\hat{k}$

(D) at an angle $\pi/4$ to $\hat{k}$

198. Two identical fuses are rated at 10 A

(A) in parallel, the combination acts as a fuse of rating 10 A
(B) in parallel, the combination acts as a fuse of rating 20 A
(C) in series, the combination acts as a fuse of rating 20 A
(D) in series, the combination acts as a fuse of rating 5 A

199. A half-wave rectifier is being used to rectify an alternating voltage of frequency 50 Hz. The number of pulses of rectified current obtained in one second is

(A) 50
(B) 25
(C) 100
(D) 1

200. Two coils of inductances L_1 and L_2 are linked such that their mutual inductance is M. Then

(A) $M = L_1 - L_2$
(B) $M = L_1 + L_2$
(C) $M = (L_1 + L_2)/2$
(D) the maximum value of M is $\sqrt{L_1 L_2}$

201. For how many orbitals, the quantum numbers n = 3, l = 2, m_l = +2 are possible?

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

202. Which of the following ions has maximum magnetic moment?

(A) Mn^{2+}
(B) Fe^{2+}
(C) Ti^{2+}
(D) Cr^{2+}

203. Arrange the following molecular species in increasing order of stability.

(A) $N_2^+ > N_2 > N_2^- > N_2^{2-}$

(B) $N_2^{2-} > N_2^- > N_2 > N_2^+$

(C) $N_2 > N_2^+ = N_2^- > N_2^{2-}$

(D) $N_2 > N_2^+ > N_2^- > N_2^{2-}$

204. The compound formed by elements A and B crystallizes in the cubic structure where A atoms are at the corners of a cube and B atoms are at the face centers. The formula of the compound is

(A) AB_3
(B) AB
(C) A_3B
(D) A_2B_2

205. Schottky defect in crystals is observed when

(A) unequal number of cations and anions are missing from the lattice
(B) equal number of cations and anions are missing from the lattice
(C) an ion leaves its normal site and occupies an interstitial site
(D) density of the crystal is increased

206. Which one of the following octahedral complexes does not show geometric isomerism? (A and B are monodentate ligands)

(A) $[MA_2B_4]$
(B) $[MA_3B_3]$
(C) $[MA_4B_2]$
(D) $[MA_5B]$

207. Which of the following is the strongest ligand?

(A) Cl^-
(B) F^-
(C) NO_2^-
(D) CN^-

208. The product obtained after positron emission from $_{31}Ga^{68}$ is

(A) $_{31}Ge^{68}$
(B) $_{30}Zn^{68}$
(C) $_{30}Zn^{69}$
(D) $_{31}Ga^{69}$

209. Which of the following is not a mineral of aluminum?

(A) Bauxite
(B) Cryolite
(C) China clay
(D) Malachite

210. When bismuth chloride is dissolved in water a white precipitate appears. The white precipitate is

(A) $Bi(OH)_3$
(B) BiOH
(C) BiO(OH)
(D) BiOCl

211. Which of the following compound is formed when I_2 is dissolved in ammonium hydroxide (density = 0.88 g/cm^3)?

(A) NH_4I
(B) $NI_3 \cdot 6NH_3$
(C) $NI_3 \cdot 4NH_3$
(D) $NI_3 \cdot NH_4OH$

212. Which of the following is NOT a metal ion indicator?

(A) Bromocresol blue
(B) Murexide
(C) Calmagite
(D) Solochrome black T

213. In brown ring test for nitrate ions, brown ring is formed having composition

(A) $[Fe(H_2O)_6]^{2+}$
(B) $[Fe(H_2O)_5NO]^{2+}$
(C) $[Fe(H_2O)_5NO]^{3+}$
(D) $[Fe(H_2O)_5NO_2]^{2+}$

214. Which is mismatched regarding the shape?

(A) XeF_4 - Square planar
(B) $XeOF_4$ - Square pyramidal
(C) XeF_6 - Distorted octahedral
(D) XeO_3 - Bent T shape

215. Which of the following is not a product of the breakdown of organic matter in water by aerobic bacteria?

(A) CO_2

(B) H_2O

(C) NO_3^-

(D) H_2S

216. Addition of phosphate containing fertilizers in water bodies causes

(i) enhanced growth of algae
(ii) increase in amount of dissolved oxygen
(iii) deposition of calcium phosphate
(iv) decrease in fish population

(A) (i) and (ii)
(B) (i) and (iv)
(C) (ii) and (iii)
(D) (i) and (iii)

217. The compound which is not isomeric with methoxypropane

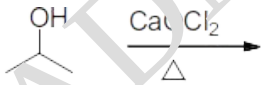
(A) diethyl ether
(B) butan-1-ol
(C) butanone
(D) 2-methylpropan-2-ol

218. Which of the following will evolve CO_2 on reaction with $NaHCO_3$?

I Salicylic acid II Benzoic acid, III Ascorbic acid, IV Phenol

(A) I, II, III and IV
(B) I, II and III
(C) I and III
(D) II and IV

219. What is the product formed in the following reaction?



(A) $CHCl_3$

(B) 

(C) CH_3CHO

(D) 

220. Which of the following reagent does not convert propanone to propane?

(A) Zn-Hg/HCl
(B) NH_2-NH_2/KOH
(C) HS-CH_2-CH_2-SH, Raney Ni
(D) $NaBH_4$

221. Arrange the following $^+CH_3$, CH_4 and $^-CH_3$ in order of increasing H-C-H bond angles

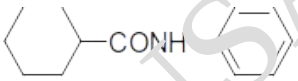
(A) $\bar{C}H_3 < CH_4 < \overset{+}{C}H_3$

(B) $\bar{C}H_3 < \overset{+}{C}H_3 < CH_4$

(C) $\overset{+}{C}H_3 < CH_4 < \bar{C}H_3$

(D) $\bar{C}H_4 < CH_3 \approx \overset{+}{C}H_3$

222. IUPAC name of the below compound is



(A) *N*-Phenylcyclohexanecarboxamide
(B) *N*-Cyclohexylbenzamide
(C) *N*-Phenylcyclohexylmethanamide
(D) *N*-Cyclohexyl-*N*-phenylmethanamide

223. Arrange *n*-pentane (I), isopentane (II) and neopentane (III) in the decreasing order of their boiling point.

(A) III>II>I
(B) I>II>III
(C) II>III>I
(D) III>I>II

224. Which of the following reagent is not useful for direct oxidation of toluene to benzaldehyde?

(A) CrO_2Cl_2/CCl_4
(B) MnO_2/CCl_4
(C) Alkaline $KMnO_4$

(D) $Cl_2/h\nu$ followed by treatment with $Cu(NO_3)_2$

225. The material used by dentists in root canals is

(A) gutta-percha
(B) neoprene
(C) ebonite
(D) dynel

226. A polymer sample is made up of 30% molecules of mass 20,000, 40% of 30,000 and the rest mass of 60,000. Its number average molecular mass is

(A) 36,000
(B) 46,000
(C) 50,000
(D) 3,60,000

227. False statement about synthetic detergents is:

(A) It has a non-polar organic part and a polar group
(B) It is a surface active reagent
(C) It is not easily biodegradable
(D) It is a sodium salt of fatty acid

228. The transition metal ion present in vitamin B_{12} is

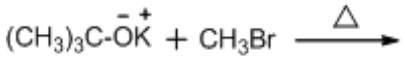
(A) Mg^{2+}
(B) Fe^{2+}
(C) Zn^{2+}
(D) Co^{2+}

229. Which of the following reactions would give the best yield of t-butylmethyl ether?

(A) $(CH_3)_3C\text{-}OH + CH_3OH \xrightarrow[140\ ^\circ C]{H_2SO_4}$

(B) $(CH_3)_3C\text{-}Br + CH_3O^-Na^+ \xrightarrow{\Delta}$

(C) $(CH_3)_3C\text{-}Br + CH_3CH \xrightarrow{\Delta}$

(D) 

230. The Cannizzaro's reaction is not given by

(A) CCl_3CHO

(B) $(CH_3)_3C\text{-}CHO$

(C) $H\text{-}CHO$

(D) CD_3CHO

231. When *p*-nitrobenzenesulphonic acid and picric acid are treated with $NaHCO_3$, the gases released respectively are

(A) SO_2, NO_2
(B) NO_2, NO
(C) NO_2, H_2
(D) CO_2, CO_2

232. The following reaction is known as

$$R\text{-}CH_2Br + AgF \xrightarrow[\triangle]{\text{ethylene glycol}} R\text{-}CH_2F + AgBr$$

(A) Finkelstein reaction
(B) Swarts reaction
(C) Darzen reaction
(D) Hunsdiecker reaction

233. Benzene diazonium chloride on treatment with H_3PO_2 in the presence of cuprous ions gives

(A) Phenol
(B) Aniline
(C) Benzene
(D) Chlorobenzene

234. A compound is formed by two elements M and N. The element N forms ccp and M atom occupies 1/3 of the tetrahedral voids. The formula of the compound is

(A) M_3N
(B) M_2N_2
(C) M_2N_3

(D) MN

235. An element with molar mass 2.7×10^{-2} kg mol^{-1} forms a cubic unit cell with edge length 407pm. If the density is 2.7×10^{3} kg m^{-3}, the nature of the cubic unit cell is

(A) fcc
(B) ccp
(C) simple cubic
(D) bcc

236. In a solid lattice, the cation has left a lattice site and is located at an interstitial position. The lattice defect is

(A) n-type
(B) p-type
(C) Schottky defect
(D) Frenkel defect

237. The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is 1500 Ω. What is the cell constant if the conductivity of 0.001 M KCl solution at 298 K is 0.146 × 10-3 Scm-1

(A) 0.119 cm^{-1}
(B) 0.109 cm^{-1}
(C) 0.129 cm^{-1}
(D) 0.139 cm^{-1}

238. An iron wire is immersed in a solution containing $ZnSO_4$ and $NiSO_4$. When the concentration of each salt is 1 M, predict which of the following reaction is likely to proceed

Given E0 (Zn^{+2}/Zn) = -0.76 V

E0 (Fe^{+2}/Fe) = -0.44 V and

E0 (Ni^{+2}/Ni) = -0.25 V

(A) Iron reduces Zn^{+2} ions
(B) Zn^{+2} reduces Iron ions
(C) Iron reduces Ni^{+2} ions
(D) Ni^{+2} reduces Iron ions

239. The amount of silver (At mass 108) deposited from a solution of silver nitrate when a current of 965 coulombs was passed is,

(A) 10.8 g
(B) 1.08 g
(C) 0.108 g
(D) 1.08×10^3 g

240. Which of the following statements are not correct regarding rate of catalyst in a chemical reaction?

i. Changes the ΔH of the reaction

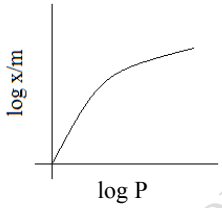
ii. Decrease the activation energy for the forward and backward reaction equally

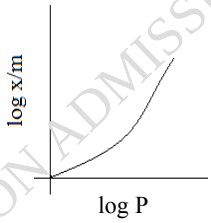
iii. Provides a new path of higher activation energy

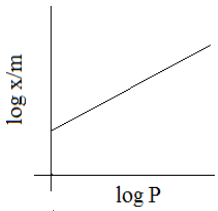
iv. Increases the average kinetic energy of reacting molecules

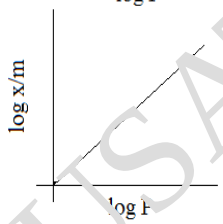
(A) (i) and (ii)
(B) (i) and (iii)
(C) (i) and (iv)
(D) (ii) and (iii)

241. Which of the following curve is in accordance with Freundlich adsorption isotherm?

(A) 

(B) 

(C) 

(D) 

242. Freshly prepared precipitate sometimes gets converted to colloidal solution by

(A) coagulation
(B) diffusion
(C) electrolysis
(D) peptisation

243. Ammonia and oxygen react at high temperature as;

$4NH_{3\,(g)} + 5O_{2\,(g)} \qquad 4NO_{(g)} + 6H_2O_{(g)}$

In an experiment rate of formation of NO is 3×10^{-3} mol L^{-1} s^{-1}. Calculate rate of disappearance of ammonia.

(A) 3.6×10^{-3} mol L^{-1} s^{-1}
(B) 3.6×10^{-6} mol L^{-1} s^{-1}
(C) 0.36 mol L^{-1} s^{-1}
(D) 7.2×10^{3} mol L^{-1} s^{-1}

244. The average energy per molecule of a gas at a given temperature, T is

(A) $\frac{3}{2}RT$

(B) $\sqrt{\frac{3RT}{M}}$

(C) $\sqrt{\frac{3\left(\frac{R}{N_A}\right)T}{\pi M}}$

(D) $\frac{3}{2}kT$

245. The exothermic formation of ClF_3 is represented by the reaction
$Cl_2(g) + 3F_2(g) \rightarrow 2ClF_3(g)$ $\Delta H = -329$ kJ
Which of the following will increase the quantity of ClF3 in an equilibrium mixture of Cl_2, F_2 and ClF_3?

(A) Increasing temperature
(B) Removing Cl_2
(C) Increasing volume of the container
(D) Adding F_2

246. Which of the following options will be correct for the stage of half completion of the reaction A B.

(A) $\Delta G° = 0$
(B) $\Delta G° < 0$
(C) $\Delta G° > 0$
(D) $\Delta G° = -RT\ln 2$

247. A system gives out 30J of heat and does 75J of work. What is the internal energy change?

(A) +105J
(B) –105J
(C) +45J
(D) – 45J

248. For the reaction at 298K $2A + B \rightleftharpoons C$

$\Delta H = 40\ kJmol^{-1}$ and $\Delta S = 0.02\ kJmol^{-1}$. At what temperature will the reaction becomes spontaneous considering ΔH and ΔS to be constant over the temperature range,

(A) 20K
(B) 200°C
(C) 2000K
(D) 2000° C

249. Equilibrium constructs K_1 and K_2 for the following equilibria.

$NO(g) + \frac{1}{2}O_2(g) \rightleftharpoons NO_2(g)$ and $2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$ are related as

(A) $K_2 = 1/K_1$
(B) $K_2 = K_1^2$
(C) $K_2 = 1/K_1^2$
(D) $K_2 = K_1/2$

250. The pH of a solution increase from 1 to 2. The concentration of H^+ ion

(A) decreases
(B) increases
(C) remains the same
(D) becomes zero

B.TECH – ANSWER KEY (Page 1)

TEST CODE: 101

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5	D	30	B	55	B	80	A	105	B	130
6	A	31	C	56	B	81	A	106	B	131
7	A	32	C	57	D	82	D	107	A	132
8	B	33	D	58	D	83	D	108	B	133
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11	C	36	A	61	B	86	D	111	D	136
12	D	37	A	62	C	87	D	112	B	137
13	A	38	B	63	C	88	D	113	C	138
14	A	39	A	64	A	89	B	114	C	139
15	D	40	A	65	B	90	C	115	C	140
16	C	41	C	66	B	91	B	116	B	141
17	B	42	A	67	C	92	A	117	C	142
18	D	43	A	68	D	93	C	118	D	143
19	D	44	A	69	A	94	A	119	D	144
20	B	45	A	70	B	95	A	120	A	145
21	D	46	D	71	C	96	B	121	D	146
22	D	47	A	72	D	97	A	122	B	147
23	C	48	B	73	A	98	D	123	A	148
24	D	49	B	74	A	99	C	124	A	149
25	B	50	B	75	C	100	A	125	B	150

B.TECH SHIFT I - KEY (Page 2)

TEST CODE: 101

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D	154	B	179	A	204	A	229	D
B	155	C	180	D	205	B	230	D
D	156	B	181	B	206	D	231	D
A	157	B	182	B	207	D	232	B
C	158	C	183	B	208	B	233	C
C	159	B	184	C	209	D	234	C
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B	161	A	186	B	211	B	236	D
B	162	D	187	D	212	A	237	C
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A	164	C	189	B	214	D	239	B
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D	166	D	191	D	216	B	241	C
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D	168	D	193	D	218	B	243	A
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B	170	D	195	B	220	D	245	D
A	171	B	196	A	221	A	246	A
C	172	C	197	B	222	A	247	B
C	173	C	198	B	223	B	248	C
B	174	B	199	A	224	C	249	C
A	175	A	200	D	225	A	250	A