MATHEMATICS

1. If the equation $x^2 + 2(k + 3)x + 12k = 0$ has equal roots, then $k =$
(a) 1 or 3
(b) 3
(c) 2 or 3
(d) 2.

2. If $f: R \to R, f(x) = \dfrac{3\dot{x} - 5}{4}$, then $f^{-1}(x)$ is equal to
(a) $\dfrac{5x - 3}{4}$
(b) $\dfrac{3x + 5}{4}$
(c) $\dfrac{4x - 5}{3}$
(d) $\dfrac{4x + 5}{3}$.

3. If the sum of $1^2 + (1^2 + 2^2) + \dots m$ terms $= \dfrac{m(m + 1)}{6} k$ then k is equal to
(a) $(m + 2)$
(b) $\dfrac{2m + 1}{2}$
(c) $\dfrac{(m + 1)(m + 2)}{2}$
(d) $\dfrac{m + 2}{2}$.

4. The value of $\sqrt{\dfrac{1}{3}(\sqrt{27} + \sqrt{15})}$ is
(a) $\pm 3^{-1/4} \left(\sqrt{\dfrac{5}{2}} + \sqrt{\dfrac{1}{2}} \right)$
(b) $\pm \left(\sqrt{\dfrac{5}{2}} + \sqrt{\dfrac{1}{2}} \right)$
(c) $\pm 2^{1/4} \left(\sqrt{\dfrac{5}{2}} + \sqrt{\dfrac{1}{2}} \right)$
(d) $\pm 3^{-1/4} \left(\sqrt{\dfrac{3}{2}} + \sqrt{\dfrac{1}{2}} \right)$.

5. The sum of all numbers formed taking all the digits {1, 2, 3, 4} is
(a) 151338
(b) 155518
(c) 153318
(d) 153138.

6. In the expansion of $(1 + x)^{40}$, the coefficient of $(3r + 1)^{\text{th}}$ term is equal to coefficient of $(7r + 11)^{\text{th}}$ term, then $r =$
(a) 1
(b) 2
(c) 3
(d) 4.

7. The coefficient of x^{10} in $\dfrac{x}{(x - 2)(x - 1)}$ is
(a) 15/16
(b) 65/1296
(c) 16/15
(d) 56/65.

8. If $A = \begin{bmatrix} 4 & 2 \\ -1 & 1 \end{bmatrix}$, then $(2I - A)(A - 3I)$ is
(a) 1
(b) -1
(c) O_2
(d) A^{-1}.

9. If $\begin{vmatrix} x - 4 & 2x - 6 & 3x - 8 \\ x - 8 & 2x - 18 & 3x - 32 \\ x - 16 & 2x - 54 & 3x - 128 \end{vmatrix} = 0$, then $x^2 =$
(a) 16
(b) 36
(c) 49
(d) 64.

10. If $[1 \quad x \quad 0] \begin{bmatrix} 1 & 1 & 1 \\ 2 & 2 & 2 \\ 3 & 3 & 3 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ x \end{bmatrix} = 0$, then $x =$
(a) 2 or 14
(b) -2 or $x = -1/2$
(c) 2 or 16
(d) -2 or 16.

11. The value of $\lim\limits_{x \to 0} e^{-4} \left(\dfrac{1 + x}{1 - x} \right)^{1/x}$ is equal to
(a) e^2
(b) e^4
(c) 1
(d) e^{-4}.

12. $\lim\limits_{x \to 0} \dfrac{5^x + 4^x - 2^x - 1}{5x}$ is equal to
(a) 1/5
(b) 1
(c) 0
(d) $\log x$.

13. $f(x) = \dfrac{2x^2 + 3}{5}$, for $-\infty < x \le 1$
  $= 6 - 5x$, for $1 < x < 3$
  $= x - 3$, for $3 \le x < 8$, then
(a) f is continuous at $x = 1$, $x = 3$
(b) f is discontinuous at $x = 1$, $x = 3$
(c) f is continuous at $x = 1$, discontinuous at $x = 3$
(d) f is discontinuous at $x = 1$, continuous at $x = 6$.

14. $\dfrac{d}{dx} \left[2 \cot^{-1} \left(\dfrac{\sqrt{1 + \sin x} + \sqrt{1 - \sin x}}{\sqrt{1 + \sin x} - \sqrt{1 - \sin x}} \right) \right] =$
(a) 1
(b) 0
(c) $-1/2$
(d) 1/2.

15. If $x^{\log x} = y^x$ and $\dfrac{dy}{dx} = \dfrac{2y \log x + k \log y}{x^2}$, then $k =$
(a) xy
(b) $2x$
(c) $-2x$
(d) none of these.

16. The value of differentiation of $\tan^{-1} x$ with respect to $\tan^{-1} \left(\dfrac{\sqrt{1 + x^2} - 1}{x} \right)$ is k. Then $k/2$ is
(a) 1/2
(b) 1
(c) 2
(d) -1.

17. The sub normals at any point of the curve $y = x^n$ is constant. Then $n =$
(a) 1   (b) 1/2   (c) 0.75   (d) –1.

18. The percentage increase in the volume of the cube when its side increases 1/4 % is
(a) 0.25   (b) 0.5   (c) 0.75   (d) 1.

19. The period T and length l are increasing at the same rate is $T = 2\pi \sqrt{l/g}$. Then the length l in terms of π and g is
(a) π/g (b) πg (c) πg^2 (d) π^2/g.

20. $\int \dfrac{dt}{(e^t + e^{-t})^2} =$
(a) $\frac{1}{4}$ sech$t$ (b) $\frac{1}{4}$ tanh$t$
(c) $\frac{1}{4}$ coth$t$ (d) $\frac{1}{4}$ sinh$t$.

21. $\int e^t \left(\dfrac{t}{1+t^2} \right) dt =$
(a) $\dfrac{e^t}{1+t}$ (b) $\dfrac{e^t}{1+t^2}$
(c) $\dfrac{-1}{1+t^2}$ (d) $\dfrac{-e^t}{1+t}$.

22. $\int 9^{9^{9^x}} dx$ is equal to
(a) $\dfrac{9^{9^x}}{\log 9}$ (b) $\dfrac{9^{9^x}}{(\log 9)^2}$
(c) $\dfrac{9^{9^{9^x}}}{(\log x)^3}$ (d) $\dfrac{9^{9^{9^x}}}{(\log 9)^3}$.

23. $\int \dfrac{dx}{\cos(x-a)\cos(x-b)} = \dfrac{1}{p} \log q$, then $(p, q) =$
(a) $\sin(b-a)\dfrac{\sec(x-a)}{\sec(x-b)}$ (b) $\sin(a-b)\dfrac{\cos(x-a)}{\cos(x-b)}$
(c) $\sin(b+a)\dfrac{\sec(x-a)}{\sec(x-b)}$ (d) $\sin(a-b)\dfrac{\sec(x-a)}{\sec(x-b)}$.

24. Area of the region bounded by the curves $y = \sqrt{5-x^2}$ and $y = |x-1|$ is
(a) $\dfrac{5\pi-2}{4}$ (b) $\dfrac{5\pi+2}{4}$
(c) $\dfrac{3\pi-2}{4}$ (d) $\dfrac{3\pi+2}{4}$.

25. $\lim\limits_{n\to\infty} \sum\limits_{r=1}^{n-1} \sqrt{\dfrac{n+r}{n^2(n-r)}} =$
(a) $\dfrac{\pi}{2}$ (b) $\dfrac{\pi+1}{2}$
(c) $\dfrac{\pi+2}{2}$ (d) $\dfrac{\pi-2}{2}$.

26. If $\bar{a} = 3\hat{i} + 2\hat{j}$, $\bar{b} = 2\hat{i} + 2\hat{j} + \hat{k}$, $\bar{c} = 5\hat{i} - \hat{j} + \hat{k}$ then the unit vector $|\bar{a} + \bar{b} + \bar{c}|$ in opposite direction is

(a) $\hat{i}$ (b) $-\hat{i}$ (c) $-\hat{j}$ (d) $\hat{j}$.

27. The projection of the vector $\hat{i} - 2\hat{j} + \hat{k}$ on the vector $4\hat{i} - 4\hat{j} + 7\hat{k}$ is
(a) 17/9   (b) 19/9   (c) 7/3   (d) 1/9.

28. If θ is the angle between the vectors $\hat{i} + \hat{j}$ and $\hat{j} + \hat{k}$, then $\theta =$
(a) $\pi/2$ (b) $\pi/3$ (c) $\pi/4$ (d) $\pi/6$.

29. The non-zero vectors $\bar{a}, \bar{b}, \bar{c}$ holds $|(\bar{a} \cdot \bar{b}) \cdot \bar{c}| = |\bar{a}||\bar{b}||\bar{c}|$ if
(a) $\bar{a} \cdot \bar{b} = 0$, $\bar{b} \cdot \bar{c} = 0$ (b) $\bar{b} \cdot \bar{c} = 0$, $\bar{c} \cdot \bar{a} = 0$
(c) $\bar{c} \cdot \bar{a} = 0$, $\bar{a} \cdot \bar{b} = 0$
(d) $\bar{a} \cdot \bar{b} = \bar{b} \cdot \bar{c} = \bar{c} \cdot \bar{a} = 0$.

30. If $\bar{a} = \hat{i} + \hat{j} - \hat{k}$, $\bar{b} = 2\hat{i} + 3\hat{j} + 2\hat{k}$, $\bar{c} = -\hat{i} + \hat{j} + 3\hat{k}$ then the volume of tetrahedron is
(a) 1 sq. unit   (b) 2 sq. unit
(c) 3 cubic unit   (d) 4 cubic unit.

31. The value of $\dfrac{\sec x + \tan x - 1}{\tan x - \sec x + 1}$, if $\csc 2x = 2$ is
(a) 0   (b) 1   (c) 2   (d) 3.

32. The value of $\csc 20° \cdot \csc 40° \cdot \csc 60° \cdot \csc 80°$ is
(a) 3/16   (b) 16/3
(c) 5/16   (d) 16/5.

33. If $\cot A \cot B = 2$, $\cos A \cos B = 2/3$, then $\cos(A + B) =$
(a) 1/3   (b) 2/3
(c) 1/5   (d) 2/5.

34. The value of $\tan\left(2\tan^{-1}\dfrac{1}{5} - \dfrac{\pi}{4}\right)$ is equal to
(a) –5/12   (b) 5/12
(c) –7/17   (d) 7/17.

35. In a triangle ABC, $\sum r \cos A/2 =$
(a) Δ (b) $2S$ (c) S (d) $3S$.

36. In a triangle ABC, $\dfrac{1}{bc} + \dfrac{1}{ca} + \dfrac{1}{ab} = \dfrac{k}{2}$, then $k =$
(a) R (b) r (c) Rr (d) $1/Rr$.

37. Square root of $-3 - 4i$ is
(a) $\pm (1 + 2i)$ (b) $\pm (1 - 2i)$
(c) $\pm (-1 - 2i)$ (d) $\pm (2 + i)$.

38. Find the value of $\log(-\theta)$ and hence the value of $\log(-10\theta)$.
(a) πi (b) $1 + \pi i$
(c) $1 - \pi i$ (d) $-1 - \pi i$.

39. The area of a triangle formed by the complex numbers $2 + i$, $-2 - i$, $1 + i$ in the Argand diagram is
(a) 1 square units
(b) 2 square units
(c) 3 square units
(d) 1/2 square units.

40. If $3x + 2y - 1 = 0$ is a tangent to a hyperbola $\dfrac{x^2}{16} - \dfrac{y^2}{9} = 1$, then the point of contact is
(a) (24, 9)
(b) (−24, 9)
(c) (24, −9)
(d) (1, 1).

41. The centre, radius of the circle
$$r^2 - 8r\cos\left(\theta - \frac{\pi}{3}\right) + 12 = 0 \text{ is}$$
(a) $\left[\left(4, \dfrac{\pi}{3}\right), 2\right]$
(b) $\left[\left(2, \dfrac{\pi}{3}\right), 2\right]$
(c) $\left[\left(4, \dfrac{\pi}{3}\right), 1\right]$
(d) $\left[\left(4, \dfrac{\pi}{3}\right), 3\right]$.

42. The line $x - y + k = 0$ is normal to the ellipse $\dfrac{x^2}{9} + \dfrac{y^2}{16} = 1$, then $k =$
(a) 7/5
(b) 5/7
(c) 2/5
(d) 5/2.

43. The equation of the circle whose radius is 3 and touches internally with another circle $x^2 + y^2 - 2x + 4y - 6 = 0$ at (−2, 2) is
(a) $\left(x + \dfrac{1}{5}\right)^2 + \left(y + \dfrac{2}{5}\right)^2 = 9$
(b) $\left(x - \dfrac{1}{5}\right)^2 + \left(y - \dfrac{2}{5}\right)^2 = 9$
(c) $\left(x + \dfrac{1}{5}\right)^2 + \left(y - \dfrac{2}{5}\right)^2 = 9$
(d) $\left(x - \dfrac{1}{5}\right)^2 + \left(y + \dfrac{2}{5}\right)^2 = 9$.

44. The radical centre of the circle $x^2 + y^2 + 4x + 7 = 0$, $2x^2 + 2y^2 + 3x + 5y + 9 = 0$ and $x^2 + y^2 + y = 0$ is
(a) (−2, −1)
(b) (−2, 1)
(c) (2, −1)
(d) (2, 1).

45. The angles between the circle
$x^2 + y^2 - 2x - 6y - 39 = 0$ and
$x^2 + y^2 + 10x - 4y + 20 = 0$ is
(a) $\pi/6$
(b) $\pi/2$
(c) $2\pi/3$
(d) $2\pi/6$.

46. The equation to pair of lines perpendicular to $x^2 + 3xy + 2y^2 = 0$ and passing through (−1, −1) is
(a) $x^2 + 3xy + 2y^2 - x + y = 0$
(b) $x^2 - 3xy + 2y^2 - x + y = 0$
(c) $x^2 - 3xy - 2y^2 + x - y = 0$
(d) $x^2 - 3xy + 2y^2 + x + y = 0$.

47. The line $x + y - 2 = 0$ cuts the axes at A and B, then the incentre of triangle AOB is
(a) $\left(\dfrac{1}{2}, \dfrac{1}{2}\right)$
(b) $\left(\dfrac{1}{\sqrt{2}}, \dfrac{1}{\sqrt{2}}\right)$
(c) $\left(\dfrac{2}{2+\sqrt{2}}, \dfrac{2}{2+\sqrt{2}}\right)$
(d) (2, 2).

48. A and B are two variable points on x and y axes such that $OA + OB = 1/2$. Then the locus of the foot of the perpendicular from the origin on the line AB is
(a) $2(x^2 + y^2)(x + y) - xy = 0$
(b) $2(x^2 + y^2)(x + y) + xy = 0$
(c) $2(x^2 + y^2)(x + y) - 2xy = 0$
(d) $2(x^2 + y^2)(x + y) + 2xy = 0$.

49. If p, q, r are in A.P. then the line $px + qy + r = 0$ passes through a fixed point
(a) (1, 2)
(b) (−1, 2)
(c) (1, −2)
(d) (−1, −2).

50. If the axes are rotated through an angles 30° in the anticlockwise direction and the point is $(4, 2\sqrt{3})$ in the new system, the formal point is
(a) $(2, 2\sqrt{3})$
(b) $(5, \sqrt{3})$
(c) $(\sqrt{3}, 3)$
(d) $(\sqrt{3}, 5)$.

51. The locus of a point which is equidistant from $(a + b, a - b)$ and $(a - b, a + b)$ is
(a) $x + y = 0$
(b) $x - y = 0$
(c) $x^2 - y^2 = 0$
(d) $x^2 + y^2 = 0$.

52. If (5, 1) is a circumcentre and (7, 5) is the centroid of a triangle, then its orthocentre is
(a) (3, −3)
(b) (−3, 3)
(c) (4, −4)
(d) (−2, 2).

53. In a triangle ABC, D (1, 2) and F (2, 3) are the mid points of BC and AB respectively. If C is (4, 4) then area of the triangle ABC is
(a) 1 sq. units
(b) 2 sq. units
(c) 4 sq. units
(d) 6 sq. units.

54. The angle between the asymptotes of the hyperbola $2x^2 - 4y^2 = 1$ is
(a) $\pi/2$
(b) $\pi/3$
(c) $\pi/4$
(d) $\pi/6$.

55. The equation to the common tangent to the circle $x^2 + y^2 = 32$ and the parabola $y^2 = 16x$ is

(a) $x - y + 8 = 0$ (b) $x + y + 8 = 0$
(c) $x = 8y$ (d) $x + 8y = 0$.

56. The radius of any circle touching both the lines $3x + 4y - 1 = 0$ and $6x + 8y + 1 = 0$ is
(a) 3/10   (b) 3/20
(c) 1/5   (d) 2/5.

57. Which of the following is false?
(a) $\lfloor m \ \lfloor n$ divides $\lfloor m + n$
(b) If n is a +ve integer, then $\left(\lfloor n\right)^{n+1}$ divides $\lfloor n^2$
(c) $2, 6, 10 \ldots (4n - 6)(4n - 2)$ is divisible by $\lfloor n$
(d) The product of r integers is always divisible by $\lfloor r$.

58. The G.C.D. of 364 and 462 is
(a) 3   (b) 11   (c) 14
(d) 7.

59. Which of the following statements is false?
(a) $98 \equiv -7 (\bmod 3)$ (b) $67 \equiv 2 (\bmod 5)$
(c) $123 \equiv -4 (\bmod 7)$ (d) $240 \equiv 9 (\bmod 11)$.

60. The negation of the proposition "if a quadrilateral is a square, then it is a rhombus" is
(a) If a quadrilateral is not a square, then it is a rhombus
(b) If a quadrilateral is a square, then it is not a rhombus
(c) A quadrilateral is a square and it is not a rhombus
(d) A quadrilateral is not a square and it is a rhombus.

PHYSICS

61. Dimensions of light year is
(a) LT^{-1} (b) T
(c) L (d) LT

62. 2 kg of water at 60°C is mixed with 1 kg of water at 30°C kept in a vessel of heat capacity 200 Jk^{-1}. The specific heat of water is 4, 200 J kg^{-1} K^{-1}. Then the final temparature is nearly
(a) 45°C   (b) 50°C
(c) 55°C   (d) 35°C

63. The minimum refractive index of a right-angled prism to turn a beam of light falling normally on its one face is
(a) $\dfrac{3}{2}$ (b) $\dfrac{1}{\sqrt{2}}$
(c) $\sqrt{2}$ (d) none of these

64. A person swimming at the bottom of a swimming pool looks up to the diving board. The board
(a) Appears nearer
(b) Appears at the correct position

(c) Appears further
(d) Is not seen at all

65. There are three laws of Newton for motion namely first, second and third law, we can derive
(a) Second and third law from the first law
(b) First and second law from third law
(c) Third and first law from the second law
(d) All the laws are independent of each other

66. The length of wire is increased by 1 mm on the application of given load. In a wire of same material but of length and radius twice that of the first, on application of the same load extension produced is
(a) 2mm   (b) 4 mm
(c) 0.5 mm   (d) 0.25 mm

67. A car accelerates from rest at a constant rate α for some time, after which it declerates at a constnt rate β and comes to rest. If the total time elapsed is t, the maximum velocity acquired by the car will be
(a) $\dfrac{\alpha + \beta}{\alpha\beta} t$ (b) $\dfrac{\alpha^2 - \beta^2}{\alpha\beta} t$
(c) $\dfrac{\alpha\beta}{\alpha + \beta} t$ (d) $\dfrac{\alpha^2 + \beta^2}{\alpha\beta} t$

68. Dimensional formula for angular momentum is
(a) ML^2T^{-1} (b) MLT^{-1}
(c) ML^3T^{-1} (d) ML^3T^{-2}

69. An ideal gas of N molecules occupies a volume V. The average kinetic energy per molecule is u. If P denotes the pressure of the gas, then
(a) $P = 2u/3$
(b) P is independent of u
(c) $P = 2Nu/3V$
(d) P cannot be determined from the data

70. The co-efficient of linear expansion of brass and steel are α_1 and α_2. If we take a brass rod of length l_1 and steel rod of length l_2 at 0°C, their difference in length $(l_1 - l_1)$ will remain the same at any temperture if
(a) $\alpha_1 l_2 = \alpha_2 l_1$ (b) $\alpha_1^2 l_2 = \alpha_2^2 l_1$
(c) $\alpha_1 l_2^2 = \alpha_1^2 = \alpha_2 l_1^2$ (d) $\alpha_1 l_1 = \alpha_2 l_2$

71. The thermo-electric power P of a thermocouple is given by
(a) $P = a\theta + b\theta^2$ (b) $P = a\theta^2 + b\theta^3$
(c) $P = a + 2b\theta$ (d) none of these

72. The SI unit of self-induction is
(a) Faraday   (b) Maxwell

(c) Henry   (d) Tesla

73. A six volt battery is connected with a resistance. A current of 2 amperes flows for 4 minutes. Which of the following statements is wrong?
(a) Resistance is 3 Ω
(b) Heat produced is 12 joules
(c) Power consumed is 12 Watts
(d) Charge flowed is 480 coulombs

74. The relation connecting deflection θ, current I and reduction factor K of a tangent galvanometer is
(a) $I = K \sin \theta$ (b) $I = K \tan \theta$
(c) $I = K \cos \theta$ (d) $I = K \cot \theta$

75. A unit cube of copper
(a) Same R and same σ
(b) Same R and different σ
(c) Different R and different σ
(d) Same σ and different R

76. At very low temperature, a semi-conductor becomes
(a) Conductor   (b) Superconductor
(c) Insulator   (d) Inductor

77. The resistance of a shunt which should be connected across a galvanometer of resistance $2100 \, \Omega$, so that only 5% of current passes through it is
(a) $220.5 \, \Omega$ (b) $55.27 \, \Omega$
(c) $110.5 \, \Omega$ (d) $95.27 \, \Omega$

78. A magnet is suspended from a spring and while it oscillates, the magnet moves in and out of a coil which is connected to a galvanometer G. Then, as the magnet oscillates
(a) G shows deflection to the left and right with constant amplitude
(b) G shows no defelection
(c) G shows deflection on one side
(d) G shows deflection to the left and right, but the amplitude decreases steadily

79. The susceptibility of a ferromagnetic material is K is $27°C$; its susceptibility will be 0.5 at temperature
(a) $600°C$ (b) $54°C$
(c) $237°C$ (d) $327°C$

80. The ratio of the magnetic induction to the intensity of the magnetising field is called
(a) Absolute permeability (b) Susceptibility
(c) Relative permeability (d) Retenivity

81. The electric flux of a surface enclosing an electric dipole is
(a) Maximum   (b) Zero
(c) Maximum or zero   (d) None of these

82. The line joining the places of equal declination is called
(a) Isoclinic   (b) Isogonic
(c) Agonic   (d) Isodynamic

83. An example of a ferromagnetic substance is
(a) Aluminium   (b) Gold
(c) Nickel   (d) Copper

84. The unit of magnetic induction is
(a) A/m   (b) Weber
(c) Am   (d) Tesla

85. Light waves can be polarized because they
(a) Have high frequencies
(b) Are transverse
(c) Have short wavelength
(d) Can be reflected

86. Which one of the following is more monochromatic?
(a) Mercury light   (b) Sodium light
(c) White light   (d) Neon light

87. Two monochromatic coherent point sources S_1 and S_2 are separated by a distance L. Each source emits light of wavelength λ, where $L >> \lambda$. The line $S_1 S_2$ when extended meets a screen perpendicular to it at point A. Select the correct statements (s) from the following
(a) The interference fringes on the screen are circular in shape
(b) The point A is an intensity maximum if $L = n \lambda$ (n = integer).
(c) The interference fringes on the screen are straight lines perpendicular of the lines $S_1 S_2 A$
(d) both (a) & (b)

88. A source of sound gives five beats per second, when sounded with another source of frequency $100 \, s^{-1}$. The second harmonic of the source, together with a source of frequency $205 s^{-1}$ gives five beats per second. What is the frequency of the source?
(a) $100 \, s^{-1}$ (b) $205 \, s^{-1}$
(c) $105 \, s^{-1}$ (d) $95 \, s^{-1}$

89. Two identical stringed instruments have a frequency of 100 Hz. The tension in one of them is increased by 1%. If they are now sounded together the number of beats produced is
(a) 1   (b) 4
(c) 8   (d) 2

90. The speed of sound in a gas is υ. The r.m.s. velocity of the gas molecule is c. The ratio of υ to c is
(a) $\dfrac{3}{\gamma}$ (b) $\dfrac{\gamma}{3}$
(c) $\sqrt{\dfrac{3}{\gamma}}$ (d) $\sqrt{\dfrac{\gamma}{3}}$

91. A source of frequency n gives 5 beat/s, when sounded with a source of frequency $200 \, s^{-1}$. The second harmonic $(2n)$ gives 10 beat/s, when sounded with a source of frequency $420 \, s^{-1}$. n is equal to
(a) $105 \, s^{-1}$
(b) $200 \, s^{-1}$
(c) $210 \, s^{-1}$
(d) $195 \, s^{-1}$

92. In a parallel arrangement if $(R_1 > R_2)$, then the power dissipated in resistance R_1 will be
(a) Less than R_2
(b) More than R_2
(c) Same as R_2
(d) None of these

93. A uniform insulating rod of length L moves with a velocity $\bar{\upsilon}$ in a magnetic field B where $\bar{\upsilon}$ is perpendicular to both L and B. The magnetic induction at the ends of the rod is given by
(a) $BL\upsilon$
(b) $2BL\upsilon$
(c) BL
(d) $B^2L\upsilon$

94. Energy required to store a current I in an inductor L is
(a) $1/2 \, (LI^2)$
(b) 0
(c) $1/2(IL^2)$
(d) IL^2

95. In an LCR circuit having $L = 8.0$ Henry, $C = 0.5 \mu F$ and $R = 100 \, \Omega$ in series the resonance frequency (in per second) is
(a) 600 radian
(b) 500 radian
(c) 600 Hertz
(d) 500 Hertz

96. L.C.R. represent the physical quantities inductance, capacitance and resistance respectively. The combinations which have the dimensions of frequency are
(a) $1/RC$
(b) C/L
(c) R/L
(d) None of these

97. The number of turns in the primary and secondary turns of a transformer are 1000 and 3000 respectively. If 80 volt A.C. is applied to the primary coil of the transformer, then the potential difference per turn of the secondary coil would be
(a) 240 volt
(b) 0.24 volt
(c) 2400 volt
(d) 0.08 volt

98. Frequency of light is 6×10^{15} Hz. Its wavelength in free space is
(a) 50 nm
(b) 60 nm
(c) 500 nm
(d) 600 nm

99. Which of the following is common for an electromagnetic spectrum?
(a) Energy
(b) Frequency
(c) Wavelength
(d) Velocity

100. A transistor is used as
(a) An oscillator
(b) A detector
(c) An amplifier
(d) All of these

101. Half-life of a radioactive sample is 200 days. Its decay constant is
(a) 138.6/day
(b) 3.465×10^{-3}/day
(c) 0.005/day
(d) 3.545×10^{-2}/day

102. In a p-type semi-conductor, with an increase in temperature
(a) The concentration of holes increases while that of conduction electrons remains constant
(b) The concentration of holes remains constant while that of conduction electron increases
(c) The concentration of holes increases while that of conduction electrons decreases
(d) The concentration of both holes and conduction electrons increases

103. Which one of the following will penetrate in glass slab?
(a) α-rays
(b) γ-rays
(c) β-rays
(d) X-rays

104. In Young's experiment, if the distance between the slits be halved and the distance between the slits and the screen be doubled then the fringe width will be
(a) Unchanged
(b) Double
(c) Half
(d) Four times

105. If magnification of a telescope in relaxed state is 19 and length of telescope is 100 cm, then calculate the focal length of objective and eye piece.
(a) $f_0 = 80$ cm and $f_e = 20$ cm
(b) $f_0 = 95$ cm and $f_e = 5$ cm
(c) $f_0 = 50$ cm and $f_e = 50$ cm
(d) $f_0 = 5$ cm and $f_e = 95$ cm

106. If C is the critical angle for a medium and μ is its refractive index, then
(a) $\mu = \cot C$
(b) $\mu = \tan C$
(c) $\mu = \operatorname{cosec} C$
(d) $\mu = \sec C$

107. Which of the following relations hold good for refraction between a pair of media with i_1 and i_2 as angle of incidence and refraction and υ_1 and υ_2 as velocities of light in the media
(a) $\upsilon_1 \sin i_1 = \upsilon_2 \sin iv_2$
(b) $\upsilon_1 \cos i_1 = v_2 \cos i_2$
(c) $\upsilon_1 \operatorname{cosec} i_1 = \dot{\upsilon}_2 \operatorname{cosec} i_2$
(d) $\upsilon_1 \sec i_1 = v_2 \sec i_2$

108. A galvanometer of 25 ohms and having full scale deflection for a current and 10 milli amperes is changed into voltmeter of range 100 volts by connecting a resistance R in series with the galvanometer, the resistance R in ohms is
(a) 1000
(b) 975
(c) 10025
(d) 9975

109. A moving electric charge will produce
(a) Electric field only
(b) Magnetic field only
(c) Both electric and magnetic field
(d) No field

110. Two free parallel wires carrying currents in the opposite direction
(a) Attract each other
(b) Do not affect each other
(c) Repel each other
(d) Get rotated, to be perpendicular to each other

111. In the circuit given below the heat produced in the 5 ohm resistor due to the current flowing in its is 10 coulomb/sec. The heat generated in 4 ohm resistor is
(a) 1 calorie/sec
(b) 3 calories/sec
(c) 2 calories/sec
(d) 4 calories per sec
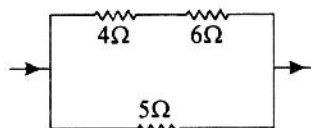
112. In the adjacent figure, when key K is opened, the reading of ammeter A will be
(a) 50 amp
(b) 2 amp
(c) 0.5 amp
(d) (10/9) amp
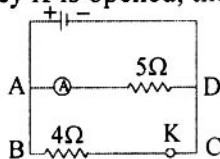
113. When cells are arranged in parallel
(a) The current capacity decreases
(b) The e.m.f. increases
(c) The current capacity increases
(d) The e.m.f. decreases

114. The maximum velocity of a particle executing S.H.M is 0.08 m/s. If its maximum acceleration is 0.32 m/s². Its period and amplitude are given by
(a) πsec, 0.01 m
(b) 2πsec, 0.02 m
(c) $\frac{\pi}{2}$ sec, 0.02 m
(d) $\frac{3\pi}{3}$ sec, 0.03 m

115. The equation of a transverse travelling wave on a string is $y = 2 \cos \pi (0.5x - 200t)$, where x and y are in cm and t in sec. Then the velocity of propagation of the wave is
(a) 200 cm/sec
(b) 0.5 cm/sec.
(c) 400 cm/sec
(d) 20 cm/sec.

116. Intensity of a sound wave depends on
(a) Amplitude but not on frequency
(b) Frequency but not on amplitude
(c) Amplitude and frequency both
(d) Neither amplitude nor frequency

117. Fundamental frequency of a closed organ pipe of length l is given by
(a) $\upsilon/2l$ hertz
(b) υ/l hertz
(c) $\upsilon/4l$ hertz
(d) $2\upsilon/l$ hertz

118. Condenser A has a capacity of 15 μF when it is filled with a medium of dielectric constant 15. Another condenser B has a capacity 1 μF with air between the plates. Both are charged separately by a battery of 100 V. After charging, both are connected in parallel without the battery and the dielectric material being removed. The common potential now is
(a) 400 V
(b) 1200 V
(c) 800 V
(d) 1600 V

119. For a given surface the Gauss's Law is stated as $\vec{E}.\vec{ds} = 0$. From this we can conclude that
(a) E is necessarily zero on the surface
(b) The total flux, through the surface, is zero
(c) E is perpendicular to the surface at every point
(d) The flux is only going out of the surface

120. When air is replaced by a dielectric medium of constant K, the maximum capacity of the condenser
(a) Remains unchanged
(b) Decreases K times
(c) Increases by K² times
(d) Increases K times

CHEMISTRY

121. The statement that is not correct for the periodical classification of elements is
(a) For transition elements the d-subshells are filled with electrons monatomically with increase in atomic number
(b) The properties of elements are the periodic functions of their atomic numbers
(c) The first ionisation energies of elements along a period vary in a regular manner with increase in atomic number
(d) Non-metallic elements are lesser in number than metallic elements.

122. The bond between two identical non-metal atoms has a pair of electrons
(a) Transferred fully from one atom to another
(b) Unequally shared between the two
(c) Equally shared between them
(d) With identical atoms

123. Which is not easily precipitated from aqueous solution?
(a) CO_3^{2-}
(b) SO_4^{2-}
(c) NO_3^-
(d) Cl^-

124. The number of d-electron in Fe^{2+} (at. no. of Fe = 26) is not equal to that of the

(a) d-electrons in Fe
(b) p-electrons in Ne (at. no.= 10)
(c) p-electrons in Cl^- (at. no. of Cl = 17)
(d) s-electron in Mg (at. no. = 12)

125. The compound with the highest boiling point is
(a) CH_3Br
(b) CH_3OH
(c) CH_3Cl
(d) CH_4

126. If the solubility product of $AgBrO_3$ and Ag_2SO_4 are 5.5×10^{-5} and 2×10^{-5} respectively, the relationship between the solubilities of these have correctly represented as
(a) $sAgBrO_3 \equiv s\,Ag_2SO_4$
(b) $sAgBrO_3 < sAg_2SO_4$
(c) $sAgBrO_3 = sAg_2SO_4$
(d) $sAgBrO_3 > sAg_2SO_4$

127. Which is not a Lewis acid?
(a) $SnCl_2$
(b) $MgCl_3$
(c) CCl_4
(d) $RMgX$

128. E° for a cell having, $Fe \rightarrow Fe^{2+} + 2e$; E° = 0.40 V
$Zn \rightarrow Zn^{2+} + 2e$; E° = 0.76 V
(a) 0.36 V
(b) −0.36 V
(c) −1.16 V
(d) 1.16 V

129. Calculate the volume of hydrogen at NTP obtained by passing a current of 0.4 ampere through acidified water for 30 minutes
(a) 0.836 litre
(b) 0.1672 litre
(c) 0.0432 litre
(d) 0.0836 litre

130. Which one is not an example of redox reaction?
(a) $HCl + H_2O \rightarrow H_3O^+ + Cl^-$
(b) $Cu^{2+} + Zn \rightarrow Zn^{2+} + Cu$
(c) $2H_2 + O_2 \rightarrow 2H_2O$
(d) $Cl_2 + 2H_2O + SO_2 \rightarrow 4H^+ + SO_4^{2-} + 2Cl^-$

131. The atomic weight of a metal (M) is 27 and its equivalent weight is 9, the formula of its chloride will be
(a) MCl_3
(b) MCl_9
(c) M_3Cl_4
(d) MCl

132. An atom of radium combines with two atoms of chlorine to form $RaCl_2$ molecule. The radioactivity $RaCl_2$
(a) One half of the same quantity Ra
(b) One third of the same quantity of Ra
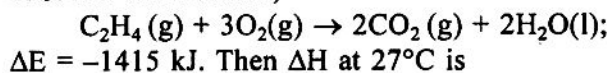(c) As much as that of the same quantity of Ra
(d) Zero

133. Total number of valency electrons in phosphonium ion PH_4^+ is
(a) 18
(b) 32
(c) 8
(d) 16

134. KE of one mole of He at 0°C is
(a) 84.43 cal
(b) 8.143 cal
(c) 819.0 cal
(d) none of these

135. For the reaction,
$$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l);$$
$\Delta E = -1415$ kJ. Then ΔH at 27°C is
(a) +140 kJ
(b) − 1420 kJ
(c) +1420 kJ
(d) −1410 kJ

136. If S^0 for H_2, Cl_2 and HCl are 0.13, 0.22 and 0.19 $kJK^{-1}mol^{-1}$ resepctively. The total change in standard entropy for the reaction $H_2 + Cl_2 \rightarrow 2HCl$ is
(a) $20\ JK^{-1}mol^{-1}$
(b) $40\ JK^{-1}mol^{-1}$
(c) $60\ JK^{-1}mol^{-1}$
(d) $30\ JK^{-1}mol^{-1}$

137. The resistivity of 0.5 N solution of an electrolyte in a conductivity cell was found to be 45 ohms. The equivalent conductance of the same solution is... if the electrodes in the cell are 2.2 cm part and have an area of $3.8\ cm^2$
(a) 15.75
(b) 30.75
(c) 33.75
(d) 25.73

138. Which one is an acidic salt
(a) K_2SO_4
(b) $NaHSO_3$
(c) Na_2SO_3
(d) Na_2SO_4

139. In the reaction $2A \rightarrow$ Products, concentration of A decreases from 0.5 mol $litre^{-1}$ to 0.5 mol $litre^{-1}$ in 10 minutes. The rate of reaction during this interval is
(a) $5M\ min^{-1}$
(b) $0.005M\ min^{-1}$
(c) $0.5M\ min^{-1}$
(d) $0.05M\ min^{-1}$

140. According to phase rule, if P = 3, C = 1, then F must be equal to
(a) 1
(b) 4
(c) 2
(d) zero

141. The values of observed and calculated molecular weights of silver nitrate are 92.64 and 170 respectively. The degree of dissociation of silver nitrate is
(a) 60.23%
(b) 83.5%
(c) 46.7%
(d) 60%

142. How many milli litre of 0.5 N $SnCl_2$ solution will reduce 600 ml of 0.1 N $HgCl_2$ to Hg_2Cl_2
(a) 60 ml
(b) 240 ml
(c) 120 ml
(d) 30 ml

143. A solution of sodium sulphate in water is electrolyzed using inert electrodes.
The products at the cathode and anode are respectively
(a) O_2, SO_2
(b) O_2, H_2
(c) O_2, Na
(d) H_2, O_2

144. Oxidation of thiosulphate ($S_2O_3^{2-}$) ions by iodine gives
(a) $S_2O_8^{2-}$
(b) SO_4^{2-}
(c) $S_4O_6^{2-}$
(d) SO_3^-

145. For preparing M/10 solution of H_2SO_4 in one litre we need H_2SO_4
(a) 0.009 g
(b) 49.0 g
(c) 4.8 g
(d) 9.8 g

146. The highest oxidation state is shown by the element with the electronic configuration in d-orbitals
(a) d^5
(b) d^3
(c) d^9
(d) d^2

147. If the energy released by burning 1 g of carbon is about 8000 cal (or approximately 3×10^{11} erg) then the amount of energy released by converting 1 g of carbon (or any other matter) completely to nuclear energy would be approximately equivalent to the energy produced by .....g of carbon
(a) 9×10^{20}
(b) 10^8
(c) 3×10^9
(d) 10^6

148. The frequency of first line of Balmer series in hydrogen atom is v_0. The frequency of corresponding line emitted by singly ionised helium atom is
(a) $v_0/4$
(b) $4v_0$
(c) $v_0/2$
(d) $2v_0$

149. The molar volume of helium is 51.4 litre at
(a) 100°C and 1.0 atm.
(b) 40°C and 0.5 atm.
(c) 25°C and 0.250 atm.
(d) 300°C and 1.5 atm.

150. Cinnamic acid on decarboxylation gives
(a) Benzaldehyde
(b) Toluene
(c) Styrene
(d) Benzene

151. Benzene reacts with CH_3COCl in the presence of $AlCl_3$ to give
(a) $C_6H_5COCH_3$
(b) C_6H_5COCl
(c) $C_6H_5CH_3$
(d) C_6H_5Cl

152. Which will not go for diazotization
(a) $C_6H_5 \underset{NO_2}{\overset{NH_2}{<}}$
(b) $C_6H_5NH_2$
(c) $C_6H_5 \underset{CH_3}{\overset{NH_2}{<}}$
(d) $C_6H_5CH_2NH_2$

153. Hydrolysis of HCN give
(a) Formic acid
(b) Acetic acid
(c) Acetaldehyde
(d) Formaldehyde

154. Carbonyl compounds when treated with sodium bisulphate solution then generally a crystalline sodium bisulphite addition product is formed but which of the following carbonyl compound doesnot forms crystalline addition product
(a) $C_2H_5COC_2H_5$
(b) CH_3CHO
(c) CH_3COCH_3
(d) HCHO

155. Oxidation of allyl alcohol, $(CH_2 \equiv CH—CH_2OH)$ gives a mixture of oxalic acid and formic acid. If this oxidation is done in presence of bromine one would expect only
(a) Acrylic acid
(b) Formic acid
(c) Succinic acid
(d) Oxalic acid

156. What mass of isobutylene is obtained from 37g of tertiary butyl alcohol heating with 20% H_2SO_4 at 363 K, if the yield is 65%
(a) 18.2 g
(b) 16 g
(c) 22 g
(d) 20 g

157. Ethylene reacts with sulphur monochloride to give
(a) Ethylene chloride
(b) Phosgene
(c) Mustard gas
(d) None of these

158. Which statement is false?
(a) In benzene the C atoms are sp^2 hybridized
(b) Meta directing groups are deactivating groups
(c) Chlorination of methane follows an ionic mechanism
(d) Peroxide effect is applicable only for HBr and not for the other halogen halide.

159. The number of assymmetric carbon atoms in a molecule of glucose is
(a) 4
(b) 5
(c) 3
(d) 6

160. How many primary carbon atoms are there in the compound,

$$CH_3 \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}—CH_2—\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}—CH_3?$$
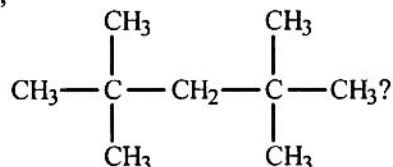
(a) 2
(b) 6
(c) 3
(d) 4

161. Wood's metal is an alloy of
(a) Zn
(b) Pb
(c) Sn
(d) Fe

162. The Van der Waal's forces are the greatest in
(a) Xenon
(b) Argon
(c) Krypton
(d) Neon

163. Weakest acid is
(a) HOI
(b) HOCl
(c) HOBr
(d) All have same strength

164. Which of the following is least acidic
(a) As_4O_{10}
(b) Na_2S
(c) $NaHSO_4$
(d) Na_2SO_4

165. A white precipitate obtained on hydrolysis of
(a) $AsCl_3$
(b) NCl_2
(c) $BiCl_3$
(d) PCl_5

166. To separate CO from CO_2 the mixture is passed through
(a) Ammonical Cu_2Cl_2 solution
(b) Conc. H_2SO_4
(c) Acidified $CuSO_4$ solution
(d) NaOH solution

167. A metal M of at. wt. 24 forms an oxide having 40% by wt. of O_2. The probability formulae of oxide is
(a) MO_2
(b) M_2O
(c) MO
(d) M_2O_3

168. IA group elements react violently with water and the solution becomes
(a) Basic
(b) Amphoteric
(c) Neutral
(d) Acidic

169. In the electro refining process, the impure metal is made of
(a) Anode
(b) Cathode
(c) Both
(d) None

170. The halogen which has the highest electron affinity is
(a) Iodine
(b) Chlorine
(c) Bromine
(d) Fluorine

171. A compound, X gives cyanohydrin with HCN and the cynohydrin on hydrolysis yields lactic acid. The compound X is
(a) HCHO
(b) C_2H_5CHO
(c) CH_3CHO
(d) CH_3COCH_3

172. Formaldehyde reacts with ammonia to give
(a) Amino methane
(b) Methyl amine
(c) Hexamethylene tetramine
(d) Formaldehyde ammonia

173. When acetone is distilled with conc. H_2SO_4 the product formed is
(a) Forone
(b) Mesityle sulphate
(c) Resin
(d) Mesitylene

174. Which of the following compounds will have least hindered rotation about carbon-carbon bond?
(a) 1, 1, 2, 2-Tetrachloroethylene.
(b) Acetylene
(c) Ethylene
(d) Hexachloroethane

175. Which of the following compounds is a hydrocarbon?
(a) Urea
(b) Ammonium Cyanate
(c) Benzene
(d) Phenol

176. The centric structure of benzene was proposed by
(a) Dewar
(b) Kekule
(c) Landenberg
(d) Armstrong and Bayer

177. Coal-tar is main source of
(a) Aromatic compounds
(c) Cycloalkanes
(d) Aliphatic compounds
(d) Heterocyclic compounds

178. The number of σ and π-bonds in a molecule of benzene is
(a) 6 σ and 9 π bonds
(b) 12 σ and 3 π bonds
(c) 9 σ and 3 π bonds
(d) 6 σ and 6 π bonds

179. According to Huckel's law, which is true?
(a) $(4n + 2)$ π electrons
(b) $(2n + 4)\pi$ electrons
(c) $(4n + 4\pi)$ electrons
(d) $(3n + 3\pi)$ electrons

180. Benzene is converted to toluene by
(a) Friedal Craft's reaction
(b) Wurtz reaction
(c) Grignard's reaction
(d) Perkin reaction