

PHYSICS

- Light of frequency 10^{15} Hz falls on a metal surface of work function 2.5 eV . The stopping potential of photoelectrons (in V) is
 (a)1.6 (b)2.5
 (c)4.1 (d)6.6
- A proton accelerated through a potential V has de-Broglie wavelength λ . Then, the de-Broglie wavelength of an α -particle, when accelerated through the same potential V is
 (a) $\frac{\lambda}{2}$ (b) $\frac{\lambda}{\sqrt{2}}$
 (c) $\frac{\lambda}{2\sqrt{2}}$ (d) $\frac{\lambda}{8}$
- Consider a thin spherical shell of radius R consisting of uniform surface charge density s. The electric field at a point of distance x from its centre and outside the shell is
 (a)inversely proportional to s
 (b)directly proportional to x^2
 (c)directly proportional to R
 (d)inversely proportional to x^2
- An electron of an atom transits from n_1 to n_2 . In which of the following maximum frequency of photon will be emitted?
 (a) $n_1 = 1$ to $n_2 = 2$
 (b) $n_1 = 2$ to $n_2 = 1$
 (c) $n_1 = 2$ to $n_2 = 6$
 (d) $n_1 = 6$ to $n_2 = 2$
- Two protons are kept at a separation of $40\text{\AA}$. F_n is the nuclear force and F_e is the electrostatic force between them. Then,
 (a) $F_n \ll F_e$ (b) $F_n = F_e$
 (c) $F_n \gg F_e$ (d) $F_n = F_e$
- Two radioactive materials X_1 and X_2 have decay constant 5λ and λ , respectively. If initially they have the same number of nuclei, then the ratio of the number of nuclei of X_1 to that X_2 will be $1/e$ after a time
 (a) $1/4\lambda$ (b) e/λ
 (c) λ (d) $\frac{1}{2}\lambda$
- The Poisson's ratio of a material is 0.1 . If the longitudinal strain of a rod of this material is 10^{-3} , then the percentage change in the volume of the rod will be
 (a)0.008% (b)0.08%
 (c)0.8% (d)8%
- A satellite can be in a geostationary orbit around a planet if it is at a distance R from the centre of the planet. If the planet starts rotating about its axis with double the angular velocity, then to make the satellite geostationary, its orbital radius should be
 (a)2R (b) $\frac{R}{2}$
 (c) $\frac{R}{2^{1/3}}$ (d) $\frac{R}{4^{1/3}}$
- When a p – n junction diode is connected in forward bias, its barrier potential
 (a)decreases and less current flows in the circuit
 (b)decreases and more current flows in the circuit
 (c)increases and more current flows in the circuit
 (d)decreases and no current flows in the circuit
- Ground waves have wavelength
 (a)less than that of sky waves
 (b)greater than that of sky waves

- (c) less than that of space waves
(d) equal to that of space waves
11. A ball floats on the surface of water in a container exposed to the atmosphere. When the container is covered and the air is partially removed, then the ball
- (a) rises
(b) gets immersed more in water
(c) remains immersed at its former depth
(d) may rise or sink
12. A frame made of metallic wire enclosing a surface area A is covered with a soap film. If the area of the frame of metallic wire is reduced by 50%, then the energy of the soap film will be changed by
- (a) 100% (b) 75%
(c) 50% (d) 25%
13. A compound slab is made of two parallel plates of copper and brass of the same thickness and having thermal conductivities in the ratio 4: 1. The free face of copper is at 0°C . The temperature of the interface is 20°C . What is the temperature of the free face of brass?
- (a) 0°C (b) 20°C
(c) 40°C (d) 100°C
14. 1 mm^3 of a gas is compressed at 1 atmospheric pressure and temperature 27°C to 627°C . What is the final pressure under adiabatic condition? (γ for the gas = 15)
- (a) $27 \times 10^5\text{ N/m}^2$ (b) $80 \times 10^5\text{ N/m}^2$
(c) $36 \times 10^5\text{ N/m}^2$ (d) $56 \times 10^5\text{ N/m}^2$
15. If sink is at a temperature of -39°C and source at 0°C , then efficiency will be
- (a) 39.4% (b) 14.2%
(c) 35.2% (d) 45.5%
16. Which of the following laws of Physics is valid across all domains of nature?
- (a) Newton's law of motion
(b) Conservation of momentum
(c) Conservation of energy
(d) All of the above
17. A particle of mass m is moving in a horizontal circle of radius R under a centripetal force equal to $-\frac{A}{R^2}$ ($A = \text{constant}$). The total energy of the particle is
- (a) $\frac{A}{R}$ (b) $-\frac{A}{R}$
(c) $\frac{A}{2R}$ (d) $-\frac{A}{2R}$
18. A force of 20 N is applied on a body of mass 5 kg resting on a horizontal plane. The body gains a kinetic energy of 10 J after it moves a distance 2 m. The frictional force is
- (a) 10 N (b) 15 N
(c) 20 N (d) 30 N
19. A body under the action of a force $\mathbf{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$, acquires an acceleration of 1 m/s^2 . The mass of this body must be
- (a) 10 kg (b) 20 kg
(c) $10\sqrt{2}\text{ kg}$ (d) $2\sqrt{10}\text{ kg}$
20. A body of mass 1000 kg is moving horizontally with a velocity 50 m/s. A mass of 250 kg is added. Find the final velocity.
- (a) 40 m/s (b) 20 m/s
(c) $30\sqrt{2}\text{ m/s}$ (d) 50 m/s
21. Equal volumes of two gases, having their densities in the ratio of 1: 16 exert equal pressures on the walls of two containers. The ratio of their rms velocities $\left(\frac{c_1}{c_2}\right)$

- (a) 1: 8 (b) 8: 1
(c) 1: 4 (d) 4: 1
22. A gaseous mixture consists of 16 g of helium and 16 g of oxygen. The ratio C_p/C_v of the mixture is
(a) 1.4 (b) 1.54
(c) 1.59 (d) 1.62
23. A particle executes a linear SHM with an amplitude of 4 cm . At the mean position the velocity of the particle is 10 cm/s. What is the displacement of the particle when its speed becomes 5 cm/s ?
(a) $2(\sqrt{3})$ cm (b) $2(\sqrt{5})$ cm
(c) $\sqrt{5}$ cm (d) $\sqrt{3}$ cm
24. The equation of a progressive wave can be given by $y = 15\sin(660\pi t - 0.02\pi x)$ cm. The frequency of the wave is
(a) 330 Hz (b) 342 Hz
(c) 365 Hz (d) 660 Hz
25. A source of sound gives 5 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 5 beats per second. What is frequency of the source?
(a) 95 s^{-1} (b) 105 s^{-1}
(c) 100 s^{-1} (d) 205 s^{-1}
26. A charge of 0.8 C is divided into two charges Q_1 and Q_2 . These are kept at a separation of 30 cm . The force on Q_1 is maximum when
(a) $Q_1 = Q_2 = 0.4\text{C}$
(b) $Q_1 = 0.8\text{C}$, Q_2 negligible
(c) Q_1 negligible, $Q_2 = 0.8\text{C}$
(d) $Q_1 = 0.2\text{C}$, $Q_2 = 0.6\text{C}$
27. An electric dipole has a pair of equal and opposite point charges q and $-q$ separated by a distance $2x$. The axis of the dipole is defined as
(a) direction from positive charge to negative charge
(b) direction from negative charge to positive charge
(c) perpendicular to the line joining the two charges drawn at the centre and pointing upward direction
(d) perpendicular to the line joining the two charges at the centre and pointing downward direction
28. An electric dipole is placed in a uniform electric field with the dipole axis making an angle θ with the direction of the electric field. The orientation of the dipole for stable equilibrium is
(a) $\frac{\pi}{6}$ (b) $\frac{\pi}{3}$
(c) 0 (d) $\frac{\pi}{2}$
29. Two point charges $A = +3\text{nC}$ and $B = +1\text{nC}$ are placed 5 cm apart in air. The work done to move charge B towards A by 1 cm is
(a) $20 \times 10^{-7} \text{ J}$ (b) $1.35 \times 10^{-7} \text{ J}$
(c) $27 \times 10^{-7} \text{ J}$ (d) $121 \times 10^{-7} \text{ J}$
30. The potential energies associated with four orientations of an electric dipole in an electric field are
(i) $-5U_0$ (ii) $-7U_0$
(iii) $3U_0$ (iv) $5U_0$
where U_0 is positive. Rank the orientations according to the angle between the electric dipole moment and electric field E , greatest first
(a) (i), (ii), (iii), (iv) (b) (ii), (iii), (i), (iv)
(c) (iv), (iii), (i), (ii) (d) (iv), (i), (iii), (ii)
31. Suppose refractive index μ is given as $\mu = A + \frac{B}{\lambda^2}$, where A and B are constants and λ is wavelength, then dimensions of B are same as that of

- (a) wavelength (b) volume
(c) pressure (d) area

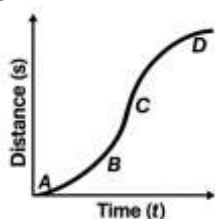
32. If voltage $V = (200 \pm 8)V$ and current $I = (20 \pm 05)A$, then the percentage error in resistance R is

- (a) 5.2% (b) 25%
(c) 3% (d) 6.5%

33. A body is projected vertically upwards. The times corresponding to height h , while ascending and while descending are t_1 and t_2 , respectively. Then, the velocity of projection is (g is acceleration due to gravity)

- (a) $\frac{g\sqrt{t_1 t_2}}{2}$ (b) $\frac{g(t_1 + t_2)}{2}$
(c) $g\sqrt{t_1 t_2}$ (d) $\frac{gt_1 t_2}{t_1 + t_2}$

34. A particle shows distance-time curve as given in this figure. The maximum instantaneous velocity of the particle is around the point



- (a) D (b) A
(c) B (d) C

35. A fluid is in streamline flow across a horizontal pipe of variable area of cross-section. For this which of the following statements is correct?

- (a) Velocity of fluid is maximum at narrowest part.
(b) Pressure of the fluid is maximum at widest part.
(c) Both (a) and (b)
(d) Neither (a) nor (b)

36. Two capacitors C_1 and C_2 are charged to 120 V and 200 V, respectively. When they are connected in parallel, it is found that potential on each one of them is zero. Therefore,

- (a) $5C_1 = 3C_2$ (b) $3C_1 = 5C_2$
(c) $3C_1 + 5C_2 = 0$ (d) $9C_1 = 4C_2$

37. Point out the right statements about the validity of Kirchhoff's junction rule,

- (a) it is based on conservation of charge.
(b) outgoing currents add up and are equal to incoming currents at a junction.
(c) bending or reorienting the wire does not change the validity of Kirchhoff's junction rule.
(d) All of the above

38. Four particles each of the mass m are placed at the corners of a square of side length l . The radius of gyration of the system about an axis perpendicular to the square and passing through its centre is

- (a) $\frac{l}{\sqrt{2}}$ (b) $\frac{l}{2}$
(c) l (d) $\sqrt{2}l$

39. A steel wire of length 4.7 m and cross-sectional area $3.0 \times 10^{-5} \text{ m}^2$ stretches by the same amount as a copper wire of length 3.5 m and cross-sectional area of $4.0 \times 10^{-5} \text{ m}^2$ under a given load. What is the ratio of Young's modulus of steel to that of copper?

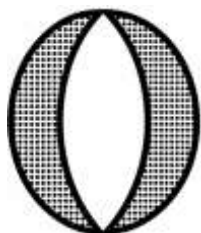
- (a) 1.8: 1 (b) 2.8: 1
(c) 3.8: 1 (d) 4.8: 1

40. The masses of 200 g and 300 g are attached to the 20 cm and 70 cm marks of a light meter rod, respectively. The moment of inertia of the system about an axis passing through 50 cm mark is

- (a) 0.15 kg m^2 (b) 0.036 kg m^2
(c) 0.3 kg m^2 (d) Zero

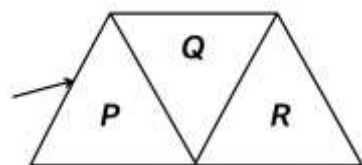
41. Two spherical bodies of masses M and $5M$ and radii R and $2R$ are released in free space with initial separation between their centres equal to $12R$. If they attract each other due to gravitational force only, then the distance covered by the smaller body before collision is
 (a) $25R$ (b) $45R$
 (c) $7.5R$ (d) $1.5R$
42. If $P = Q = R = 10\Omega$ and $S = 20\Omega$, then what resistance should be joined with S to balance the Wheatstone's network?
 (a) Join a resistance of 10Ω in series with S
 (b) Join a resistance of 10Ω in parallel with S
 (c) Join a resistance of 20Ω in parallel with S
 (d) Join a resistance of 20Ω in series with S
43. To the potentiometer wire of length L and 10Ω resistance, a battery of emf 2.5 V and a resistance R are connected in series. If a potential difference of 1 V is balanced across $L/2$ length, the value of R in Ω will be
 (a) 1 (b) 1.5
 (c) 2 (d) 2.5
44. An electron moves with speed of $2 \times 10^5\text{ m/s}$ along the positive x -direction in a magnetic field $B = (\hat{i} - 4\hat{j} - 3\hat{k})\text{ T}$. The magnitude of the force (in N) experienced by the electron is
 (a) 1.18×10^{-13} (b) 1.28×10^{-13}
 (c) 1.6×10^{-13} (d) 1.72×10^{-13}
45. A horizontal overhead power line carries a current of 90 A in East to West direction. What is the magnitude and direction of the magnetic field due to the current, 1.5 m below the line?
 (a) $1.2 \times 10^{-5}\text{ T}$, towards South
 (b) $1.2 \times 10^{-5}\text{ T}$, towards North
 (c) $1.2 \times 10^{-5}\text{ T}$, towards East
 (d) $1.2 \times 10^{-5}\text{ T}$, towards West
46. A moving coil galvanometer has 28 turns and area of coil is $4 \times 10^{-2}\text{ m}^2$. If the magnetic field is 0.2 T , then to increase the sensitivity by 25% without changing area and field, the number of turns should be changed to
 (a) 24 (b) 35
 (c) 60 (d) 54
47. The intensity of magnetic field due to an isolated pole of strength m_p at a point distant r from it will be
 (a) m_p/r^2 (b) $m_p r^2$
 (c) r^2/m_p (d) m_p/r
48. The particle that cannot be accelerated by a cyclotron is
 (a) proton (b) α -particle
 (c) electron (d) deuteron nucleus
49. The angle which the total magnetic field of earth makes with the surface of the earth is called
 (a) declination
 (b) magnetic meridian
 (c) geographic meridian
 (d) inclination
50. The angle of dip of at a place where horizontal and vertical components of earth's magnetic field are equal is
 (a) 45° (b) 30°
 (c) 0° (d) 60°
51. A coil of wire of a certain radius has 100 turns and a self inductance of 15 mH . The self inductance of a second similar coil of 500 turns will be

- (a) 75 mH (b) 375 mH
(c) 15 mH (d) None of the above
52. A coil of 100 turns carries a current of 5 mA and creates a magnetic flux of 10^{-5} Wb. The inductance is
(a) 0.2 mH (b) 2.0 mH
(c) 0.02 mH (d) None of these
53. In step-up transformer, relation between number of turns in primary (N_p) and number of turns in secondary (N_s) coils is
(a) N_s is greater than N_p
(b) N_p is greater than N_s
(c) N_s is equal to N_p
(d) $N_p = 2N_s$
54. For a series L – C – R circuit at resonance, which statement is not true?
(a) Wattless current is zero.
(b) Power factor is zero.
(c) Peak energy stored by a capacitor = peak energy stored by an inductor.
(d) Average power = apparent power.
55. Which of the following has/have zero average value in a plane electromagnetic wave?
(a) Electric field (b) Magnetic field
(c) Both (a) and (c) (d) Magnetic energy
56. A convex lens is made of 3 layers of glass of 3 different materials as in the figure.



A point object is placed on its axis. The number of images of the object are

- (a) 3 (b) 4
(c) 1 (d) 2
57. A ray of light suffers minimum deviation in equilateral prism P. Additional prisms Q and R of identical shape and of same material as that of P are now combined as shown in figure. The ray will now suffer

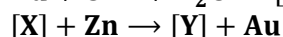
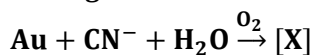


- (a) greater deviation
(b) no deviation
(c) same deviation as before
(d) total internal reflection
58. Two identical light waves, propagating in the same direction, have a phase difference δ . After they superpose the intensity of the resulting wave will be proportional to
(a) $\cos \delta$ (b) $\cos(\delta/2)$
(c) $\cos^2(\delta/2)$ (d) $\cos^2 \delta$
59. A plastic sheet (refractive index = 1.6) covers one slit of a double slit arrangement for the Young's experiment. When the double slit is illuminated by monochromatic light (wavelength = $5867 \text{ \AA}$), the centre of the screen appears dark rather than bright. The minimum thickness of the plastic sheet to be used for this to happen is
(a) $3300 \text{ \AA}$ (b) $6600 \text{ \AA}$
(c) $2062 \text{ \AA}$ (d) $5500 \text{ \AA}$

60. A particle starts moving from point $(2, 10, 1)$. Displacement for the particle is $8\hat{i} - 2\hat{j} + \hat{k}$. The final coordinates of the particle is
- (a) $(10, 8, 2)$ (b) $(8, 10, 2)$
 (c) $(2, 10, 8)$ (d) $(8, 2, 10)$

CHEMISTRY

61. During the extraction of gold the following reactions take place



X and Y are respectively

- (a) $[\text{Au}(\text{CN})_2]^-$ and $[\text{Zn}(\text{CN})_4]^{2-}$
 (b) $[\text{Au}(\text{CN})_4]^{3-}$ and $[\text{Zn}(\text{CN})_4]^{2-}$
 (c) $[\text{Au}(\text{CN})_4]^{2-}$ and $[\text{Zn}(\text{CN})_4]^{2-}$
 (d) $[\text{Au}(\text{CN})_2]^-$ and $[\text{Zn}(\text{CN})_6]^{4-}$
62. The number of gram molecules of chlorine in 6.02×10^{25} hydrogen chloride molecules is
- (a) 5 (b) 50
 (c) 100 (d) 10
63. Graphite is a soft solid lubricant extremely difficult to melt. The reason for this anomalous behaviour is that, graphite
- (a) has molecules of variable molecular masses like polymers.
 (b) has carbon atoms arranged in large plates of rings of strongly bound carbon atoms with weak interplate bonds.
 (c) is a non-crystalline substance.
 (d) is an allotropic form of carbon.
64. Paracetamol is a/an
- (a) antimalarial (b) antipyretic
 (c) analgesic (d) Both (b) and (c)
65. Which one of the following has maximum number of atoms of oxygen?
- (a) 2 g of water
 (b) 2 g of sulphur dioxide
 (c) 2 g of carbon dioxide
 (d) 2 g of carbon monoxide
66. Which one of the following shows functional isomerism?
- (a) CH_2Cl_2 (b) $\text{C}_2\text{H}_5\text{OH}$
 (c) C_3H_6 (d) C_2H_4
67. In the ionic equation, $\text{BiO}_3^- + 6\text{H}^+ + x\text{e}^- \rightarrow \text{Bi}^{3+} + 3\text{H}_2\text{O}$, the value of x is
- (a) 3 (b) 4
 (c) 2 (d) 6
68. Molarity of a given orthophosphoric acid solution is 3 M. Its normality is
- (a) 1 N (b) 3 N
 (c) 0.3 N (d) 9 N
69. Acidified sodium fusion extract on addition of ferric chloride solution gives blood red colouration which confirms the presence of
- (a) S (b) N
 (c) N and S (d) S and Cl
70. A body of mass 10 mg is moving with a velocity of 100 ms^{-1} . The wavelength of de-Broglie wave associated with it would be ($h = 6.63 \times 10^{-34} \text{ Js}$)
- (a) $6.63 \times 10^{-37} \text{ m}$ (b) $6.63 \times 10^{-31} \text{ m}$
 (c) $6.63 \times 10^{-34} \text{ m}$ (d) $6.63 \times 10^{-35} \text{ m}$

71. Mg^{2+} is isoelectronic with
 (a) Ca^{2+} (b) Na^+
 (c) Zn^{2+} (d) Cu^{2+}
72. Gram molecular volume of oxygen at STP is
 (a) 11200 cm^3 (b) 22400 cm^3
 (c) 5600 cm^3 (d) 3200 cm^3
73. Presence of halogen in organic compounds can be detected using
 (a) Beilstein's test (b) Kjeldahl test
 (c) Duma's test (d) Liebig's test
74. The electronic configuration of Cr^{3+} is
 (a) $[\text{Ar}]3d^5 4s^1$ (b) $[\text{Ar}]3d^2 4s^1$
 (c) $[\text{Ar}]3d^3 4s^0$ (d) $[\text{Ar}]3d^4 4s^2$
75. The mass of a metal, with equivalent mass 31.75, which would combine with 8 g of oxygen is
 (a) 31.75 (b) 3.175
 (c) 8 (d) 1
76. Benzene reacts with chlorine in sunlight to give a final product
 (a) $\text{C}_6\text{H}_5\text{Cl}$ (b) C_6Cl_6
 (c) $\text{C}_6\text{H}_6\text{Cl}_6$ (d) CCl_4
77. In the periodic table metals usually used as catalysts belong to
 (a) s-block (b) p-block
 (c) d-block (d) f-block
78. Dalton's law of partial pressures is applicable to which one of the following systems?
 (a) $\text{CO} + \text{H}_2$ (b) $\text{H}_2 + \text{Cl}_2$
 (c) $\text{NO} + \text{O}_2$ (d) $\text{NH}_3 + \text{HCl}$
79. The general formula of a cycloalkene is
 (a) $\text{C}_n\text{H}_{2n+2}$ (b) $\text{C}_n\text{H}_{2n-2}$
 (c) C_nH_{2n} (d) C_nH_n
80. In acetylene molecule, between the carbon atoms there are
 (a) three σ -bonds
 (b) two σ and one π -bonds
 (c) one σ and two π -bonds
 (d) three π -bonds
81. Denatured alcohol is
 (a) rectified spirit
 (b) undistilled ethanol
 (c) rectified spirit + methanol + naphtha
 (d) ethanol + methanol
82. During the formation of a chemical bond
 (a) energy decreases
 (b) energy increases
 (c) energy of the system does not change
 (d) electron-electron repulsion becomes more than the nucleus-electron attraction
83. One mole of oxygen at 273 K and one mole of sulphur dioxide at 546 K are taken in two separate containers, then
 (a) kinetic energy of $\text{O}_2 >$ kinetic energy of SO_2
 (b) kinetic energy of $\text{O}_2 <$ kinetic energy of SO_2
 (c) kinetic energy of both are equal
 (d) None of the above

84. +I-effect is shown by

- (a) $-\text{NO}_2$ (b) $-\text{Cl}$
(c) $-\text{Br}$ (d) $-\text{CH}_3$

85. Formation of coloured solution is possible, when metal ion in the compound contains

- (a) paired electrons
(b) unpaired electrons
(c) lone pair of electrons
(d) None of the above

86. Which of the following is an intensive property?

- (a) Temperature (b) Surface tension
(c) Viscosity (d) All of the above

87. Hofmann's bromamide reaction is to convert

- (a) amine to amide (b) amide to amine
(c) alcohol to acid (d) acid to alcohol

88. IUPAC name of $\text{Na}_3[\text{Co}(\text{NO}_2)_6]$ is

- (a) sodium cobaltonitrite
(b) sodium hexanitrito cobaltate (III)
(c) sodium hexanitro cobaltate (III)
(d) sodium hexanitrito cobaltate (II)

89. Thermodynamic standard conditions of temperature and pressure are

- (a) 0°C and 1 atm
(b) 273 K and 101.3 kPa
(c) 298 K and 1 atm
(d) 0°C and 101.3 kPa

90. How many chiral carbon atoms are present in 2, 3, 4-trichloropentane?

- (a) 3 (b) 2
(c) 1 (d) 4

91. The number of unidentate ligands in the complex ion is called

- (a) EAN
(b) coordination number
(c) primary valency
(d) oxidation number

92. $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \xrightleftharpoons{\text{V}_2\text{O}_5}$ is an example for

- (a) irreversible reaction
(b) heterogeneous catalysis
(c) homogeneous catalysis
(d) neutralisation reaction

93. The amino acid which is not optically active is

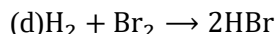
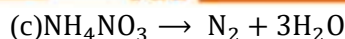
- (a) glycine (b) alanine
(c) serine (d) lactic acid

94. For a stable molecule the value of bond order must be

- (a) negative
(b) positive
(c) zero
(d) there is no relationship between stability and bond order

95. Which one of the following is a second order reaction?

- (a) $\text{CH}_3\text{COOCH}_3 + \text{NaOH} \rightarrow \text{CH}_3\text{COONa} + \text{H}_2\text{O}$
(b) $\text{H}_2 + \text{Cl}_2 \xrightarrow{\text{Sunlight}} 2\text{HCl}$



96. According to Baeyer's strain theory which is highly stable?

(a)cyclohexane (b)cycloheptane

(c)cyclopentane (d)cyclobutane

97. The number of antibonding electron pairs in O_2^{2-} molecular ion on the basis of molecular orbital theory is [Atomic number of O is 18]

(a)2 (b)3

(c)4 (d)5

98. Hydroxyl ion concentration of 1 M HCl is

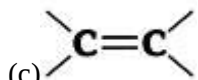
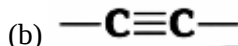
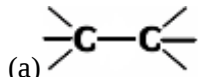
(a) $1 \times 10^{-14} \text{ mol dm}^{-3}$

(b) $1 \times 10^{-1} \text{ mol dm}^{-3}$

(c) $1 \times 10^{-13} \text{ mol dm}^{-3}$

(d) $1 \times 10^1 \text{ mol dm}^{-3}$

99. Geometrical isomerism is shown by



(d) None of these

100. The oxidation state of iron in $\text{K}_4[\text{Fe}(\text{CN})_6]$ is,

(a)2 (b)3

(c)4 (d)1

101. In which of the following process, a maximum increase in entropy is observed?

(a) dissolution of salt in water

(b) condensation of water

(c) sublimation of naphthalene

(d) melting of ice

102. Decomposition of benzene diazonium chloride by using $\text{Cu}_2\text{Cl}_2/\text{HCl}$ to form chlorobenzene is

(a) Cannizzaro's reaction

(b) Kolbe's reaction

(c) Sandmeyer's reaction

(d) Raschig's reaction

103. Which complex cannot ionise in solution?

(a) $[\text{Pt}(\text{NH}_3)_6]\text{Cl}_4$

(b) $\text{K}_2[\text{Pt}(\text{F}_6)]$

(c) $\text{K}_4[\text{Fe}(\text{CN})_6]$

(d) $[\text{CoCl}_3(\text{NH}_3)_3]$

104. Considering the reaction, $\text{C(s)} + \text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)} + 393.5 \text{ kJ}$

The signs of ΔH , ΔS and ΔG respectively are

(a) -, +, -

(b) -, -, -

(c) -, +, +

(d) +, -, -

105. The product formed when hydroxylamine condenses with a carbonyl compound is called

(a) hydrazine

(b) hydrazine

(c) oxime

(d) hydrazide

106. Which of the following forms a colourless solution in aqueous medium?

(a) Ti^{3+}

(b) Sc^{3+}

(c) V^{3+}

(d) Cr^{3+}

107. When a sulphur sol is evaporated, sulphur is obtained. On mixing with water, sulphur sol is not formed.

The sol is

(a) hydrophilic

(b) hydrophobic

(c) reversible

(d) lyophilic

108. An alkyl halide reacts with alcoholic ammonia in a sealed tube, the product formed will be
 (a) a primary amine
 (b) a secondary amine
 (c) a tertiary amine
 (d) a mixture of all the three
109. When conc. H_2SO_4 is heated with P_2O_5 , the acid is converted into
 (a) sulphur
 (b) sulphur dioxide
 (c) sulphur trioxide
 (d) a mixture of sulphur dioxide and sulphur trioxide
110. Entropy of the universe is
 (a) continuously increasing
 (b) continuously decreasing
 (c) zero
 (d) constant
111. Which of the following salts on being dissolved in water gives $\text{pH} > 7$ at 25°C ?
 (a) NH_4CN (b) NH_4Cl
 (c) KNO_3 (d) KCN
112. The reagent used in Clemmenson's reduction is
 (a) alc. KOH
 (b) aq. KOH
 (c) $\text{Zn} - \text{Hg} / \text{conc. HCl}$
 (d) conc. H_2SO_4
113. When KBr is dissolved in water, K^+ ions are
 (a) oxidized (b) reduced
 (c) hydrolysed (d) hydrated
114. The noble gas mixture is cooled in a coconut bulb at 173 K. The gases that are not adsorbed are
 (a) He and Ne (b) Ar and Kr
 (c) He and Xe (d) Ne and Xe
115. The volume of 10 N and 4 N HCl required to make 1 litre of 7 N HCl are
 (a) 0.75 litre of 10 N HCl and 0.25 litre of 4 N HCl
 (b) 0.80 litre of 10 N HCl and 0.20 litre of 4 N HCl
 (c) 0.60 litre of 10 N HCl and 0.40 litre of 4 N HCl
 (d) 0.50 litre of 10 N HCl and 0.50 litre of 4 N HCl
116. A metal present in insulin is
 (a) copper (b) iron
 (c) zinc (d) aluminium
117. Carbon forms two oxides which have different compositions. The equivalent mass of which remains constant?
 (a) Carbon
 (b) Oxygen
 (c) Neither carbon nor oxygen
 (d) Both carbon and oxygen
118. Maximum number of molecules of CH_3I that can react with a molecule of CH_3NH_2 are
 (a) 1 (b) 2
 (c) 4 (d) 3
119. Ellingham diagram represents a graph of
 (a) ΔG vs T (b) ΔG° vs T
 (c) ΔS vs p (d) ΔG vs T

120. Identify the ore not containing iron

- (a) chalcopyrites (b) carnallite
(c) siderite (d) limonite

MATHEMATICS

121. $7^{2\log_7 5}$ is equal to

- (a) 5 (b) $\log_7 35$
(c) $\log_7 25$ (d) 25

122. In the group $(G \otimes_{15})$, where $G = \{3, 6, 9, 12\}$, $\otimes_{15}$ is multiplication modulo 15, the identity element is

- (a) 6 (b) 3
(c) 9 (d) 12

123. A group $(G, *)$ has 10 elements. The minimum number of elements of G , which are their own inverses is

- (a) 1 (b) 2
(c) 0 (d) 9

124. If $\mathbf{a}$ and $\mathbf{b}$ are vectors such that $|\mathbf{a} \times \mathbf{b}| = |\mathbf{a} - \mathbf{b}|$ then the angle between $\mathbf{a}$ and $\mathbf{b}$ is

- (a) 60° (b) 120°
(c) 30° (d) 90°

125. $\frac{3x^2+1}{x^2-6x+8}$ is equal to

- (a) $\frac{49}{2(x-4)} - \frac{13}{2(x-2)}$ (b) $3 + \frac{49}{2(x-4)} - \frac{13}{2(x-2)}$
(c) $\frac{49}{2(x-4)} + \frac{13}{2(x-2)}$ (d) $\frac{-49}{2(x-4)} + \frac{13}{2(x-2)}$

126. If $\mathbf{a} = 2\hat{i} + 3\hat{j} - \hat{k}$, $\mathbf{b} = \hat{i} + 2\hat{j} - 5\hat{k}$, $\mathbf{c} = 3\hat{i} + 5\hat{j} - \hat{k}$, then a vector perpendicular to $\mathbf{a}$ and in the plane containing $\mathbf{b}$ and $\mathbf{c}$ is

- (a) $17\hat{i} + 21\hat{j} - 123\hat{k}$
(b) $-17\hat{i} + 21\hat{j} - 97\hat{k}$
(c) $-17\hat{i} - 21\hat{j} - 97\hat{k}$
(d) $-17\hat{i} - 21\hat{j} + 97\hat{k}$

127. $\mathbf{OA}$ and $\mathbf{BO}$ are two vectors of magnitudes 5 and 6 respectively. If $\angle BOA = 60^\circ$, then $\mathbf{OA} \cdot \mathbf{OB}$ is equal to

- (a) 15 (b) 0
(c) $15\sqrt{3}$ (d) -15

128. A vector perpendicular to the plane containing the points $A(1, -1, 2)$, $B(2, 0, -1)$, $C(0, 2, 1)$ is

- (a) $8\hat{i} + 4\hat{j} + 4\hat{k}$ (b) $4\hat{i} + 8\hat{j} - 4\hat{k}$
(c) $\hat{i} + \hat{j} - \hat{k}$ (d) $3\hat{i} + \hat{j} + 2\hat{k}$

129. $\frac{1}{2 \cdot 5} + \frac{1}{5 \cdot 8} + \frac{1}{8 \cdot 11} + \dots + \frac{1}{(3n-1)(3n+2)} =$

- (a) $\frac{n}{6n+3}$ (b) $\frac{n}{6n-4}$
(c) $\frac{n+1}{6n+4}$ (d) $\frac{n}{6n+4}$

130. The ninth term of the expansion $\left(3x - \frac{1}{2x}\right)^8$ is

- (a) $-\frac{1}{512x^9}$ (b) $\frac{1}{512x^9}$
(c) $\frac{1}{256 \cdot x^8}$ (d) $-\frac{1}{256 \cdot x^8}$

131. If $A = \begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}$, $10B = \begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{bmatrix}$ and B is the inverse of A , then the value of α is

- (a) 0 (b) 2
(c) 4 (d) 5

132. If $A = \begin{bmatrix} 0 & x & 16 \\ x & 5 & 7 \\ 0 & 9 & x \end{bmatrix}$ is singular, then the possible values of x are

- (a) $0, 1, -1$ (b) $0, +12, -12$
(c) $0, 5, -5$ (d) $0, 4, -4$

133. If $A = \begin{bmatrix} 1 & -2 & 2 \\ 0 & 2 & -3 \\ 3 & -2 & 4 \end{bmatrix}$, then $A \cdot \text{adj}(A)$ is equal to

- (a) $\begin{bmatrix} 5 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & 5 \end{bmatrix}$ (b) $\begin{bmatrix} 5 & 1 & 1 \\ 1 & 5 & 1 \\ 1 & 1 & 5 \end{bmatrix}$
(c) $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ (d) $\begin{bmatrix} 8 & 0 & 0 \\ 0 & 8 & 0 \\ 0 & 0 & 8 \end{bmatrix}$

134. If $f: \mathbb{R} \rightarrow \mathbb{R}$ is defined by $f(x) = |x|$, then

- (a) $f^{-1}(x) = \frac{1}{|x|}$
(b) $f^{-1}(x) = -x$
(c) $f^{-1}(x) = \frac{1}{x}$
(d) The function $f^{-1}(x)$ does not exist.

135. The value of $\begin{vmatrix} x & p & q \\ p & x & q \\ p & q & x \end{vmatrix}$ is

- (a) $(x-p)(x-q)(x+p+q)$
(b) $x(x-p)(x-q)$
(c) $pq(x-p)(x-q)$
(d) $(p-q)(x-q)(x-p)$

136. The number of common tangents to the circles $x^2 + y^2 = 4$ and $x^2 + y^2 - 6x - 8y - 24 = 0$ is,

- (a) 4 (b) 3
(c) 1 (d) 2

137. If $3x + y + k = 0$ is a tangent to the circle $x^2 + y^2 = 10$, the values of k are

- (a) ± 5 (b) ± 7
(c) ± 9 (d) ± 10

138. The negation of the proposition "If 2 is prime, then 3 is odd" is

- (a) 2 is prime and 3 is not odd.
(b) If 2 is not prime then 3 is not odd.
(c) If 2 is not prime then 3 is odd.
(d) 2 is not prime and 3 is odd.

139. The equation to two circles which touch the Y-axis at $(0, 3)$ and make an intercept of 8 units on X-axis are

- (a) $x^2 + y^2 \pm 6x - 10y + 9 = 0$
(b) $x^2 + y^2 \pm 10x - 6y + 9 = 0$
(c) $x^2 + y^2 + 10x \pm 6y + 9 = 0$
(d) $x^2 + y^2 - 8x \pm 10y + 9 = 0$

140. The orthocentre of the triangle with vertices $A(0, 0)$, $B(0, 3/2)$, $C(-5, 0)$ is

- (a) $(-5/2, 3/4)$ (b) $(5/2, 3/4)$
(c) $(0, 0)$ (d) $(-5, 3/2)$

141. $x^2 + y^2 - 6x - 6y + 4 = 0$, $x^2 + y^2 - 2x - 4y + 3 = 0$, $x^2 + y^2 + 2kx + 2y + 1 = 0$. If the Radical centre of the above three circles exists, then which of the following cannot be the value of k ?

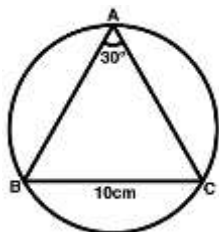
- (a) 1 (b) 2
(c) 4 (d) 5

142. If the circles $x^2 + y^2 - 2x - 2y - 7 = 0$ and $x^2 + y^2 + 4x + 2y + k = 0$ cut orthogonally, then the length of the common chord of the circles is
 (a) 2 (b) $12/\sqrt{13}$
 (c) 8 (d) 5
143. The coordinates of the foot of the perpendicular drawn from the point (3, 4) on the line $2x + y - 7 = 0$ is
 (a) (1, 5) (b) $(\frac{9}{5}, \frac{17}{5})$
 (c) (1, -5) (d) (-5, 1)
144. The area enclosed by the pair of lines $xy = 0$, the line $x - 4 = 0$ and $y + 5 = 0$ is
 (a) 10 sq units (b) 20 sq units
 (c) 0 sq units (d) $\frac{5}{4}$ sq units
145. If the area of the auxillary circle of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ ($a > b$) is twice the area of the ellipse, then the eccentricity of the ellipse is
 (a) $\frac{\sqrt{3}}{2}$ (b) $\frac{1}{\sqrt{2}}$
 (c) $\frac{1}{2}$ (d) $\frac{1}{\sqrt{3}}$
146. A graph G has m vertices of odd degree and 'n' vertices of even degree. Then which of the following statements is necessarily true?
 (a) $m + n$ is an even number
 (b) $m + n$ is an odd number
 (c) $m + 1$ is an odd number
 (d) $n + 1$ is an even number
147. If p is any point on the ellipse $\frac{x^2}{36} + \frac{y^2}{16} = 1$, and S and S' are the foci, then $PS + PS' =$
 (a) 8 (b) 4
 (c) 12 (d) 10
148. The value of $\sin \left[2\cos^{-1} \frac{\sqrt{5}}{3} \right]$ is
 (a) $\frac{2\sqrt{5}}{3}$ (b) $\frac{\sqrt{5}}{3}$
 (c) $\frac{2\sqrt{5}}{9}$ (d) $\frac{4\sqrt{5}}{9}$
149. If $\frac{x^2}{36} - \frac{y^2}{k^2} = 1$ is a hyperbola, then which of the following statements can be true?
 (a) (3, 1) lies on the hyperbola.
 (b) (-3, 1) lies on the hyperbola.
 (c) (5, 2) lies on the hyperbola.
 (d) (10, 4) lies on the hyperbola.
150. The focus of the parabola is
 (a) $(\frac{1}{3}, \frac{-3}{2})$ (b) $(\frac{-1}{3}, \frac{3}{2})$
 (c) $(\frac{1}{3}, \frac{-1}{2})$ (d) $(\frac{1}{3}, \frac{3}{2})$
151. The solution of $\tan^{-1}x + 2\cot^{-1}x = \frac{2\pi}{3}$ is
 (a) $\frac{1}{\sqrt{3}}$ (b) $-\frac{1}{\sqrt{3}}$
 (c) $\sqrt{3}$ (d) $-\sqrt{3}$
152. $\sin^2 175^\circ + \sin^2 725^\circ$ is equal to
 (a) $\tan^2 45^\circ$ (b) $\cos^2 90^\circ$
 (c) $\sin^2 45^\circ$ (d) $\cos^2 30^\circ$

153. The conjugate of the complex number $\frac{(1+i)^2}{1-i}$ is

- (a) $1 + i$ (b) $1 - i$
(c) $-1 - i$ (d) $-1 + i$

154. ABC is a triangle with $\angle A = 30^\circ$ and $BC = 10$ cm. The area of the circum circle of the triangle is



- (a) 5 sq cm (b) $100\pi \text{ sq cm}$
(c) $\frac{100\pi}{3} \text{ sq cm}$ (d) 25 sq cm

155. If $\sin 3\theta = \sin \theta$, how many solutions exist such that $-2\pi < \theta < 2\pi$?

- (a) 9 (b) 8
(c) 7 (d) 5

156. The imaginary part of i^i is

- (a) 1 (b) 0
(c) -1 (d) 2

157. The amplitude of $(1 + i)^5$ is

- (a) $\frac{-3\pi}{4}$ (b) $\frac{3\pi}{4}$
(c) $\frac{5\pi}{4}$ (d) $\frac{-5\pi}{4}$

158. ABC is a triangle, G is the centroid, D is the mid-point of BC. If $A = (2, 3)$ and $G = (7, 5)$, then the point D is

- (a) $(\frac{19}{2}, 6)$ (b) $(\frac{9}{2}, 4)$
(c) $(8, \frac{13}{2})$ (d) $(\frac{11}{2}, \frac{11}{2})$

159. $\lim_{x \rightarrow 1} \frac{\tan(x^2 - 1)}{x - 1}$ is equal to

- (a) $\frac{1}{2}$ (b) 2
(c) $\frac{-1}{2}$ (d) -2

160. If $y = 2^{\log x}$, then $\frac{dy}{dx}$ is

- (a) $2^{\log x} \cdot \log 2$ (b) $\frac{2^{\log x}}{\log 2}$
(c) $\frac{2^{\log x} \log 2}{x}$ (d) $\frac{2^{\log x}}{x}$

161. If $\sec^{-1} \left(\frac{1+x}{1-y} \right) = a$, then $\frac{dy}{dx}$ is

- (a) $\frac{y+1}{x-1}$ (b) $\frac{y-1}{x+1}$
(c) $\frac{x-1}{y+1}$ (d) $\frac{x-1}{y-1}$

162. If $y = \cos^2 \frac{3x}{2} - \sin^2 \frac{3x}{2}$, then $\frac{d^2y}{dx^2}$ is

- (a) $9y$ (b) $-3\sqrt{1-y^2}$
(c) $3\sqrt{1-y^2}$ (d) $-9y$

163. If the function $f(x) = \begin{cases} \frac{1-\cos x}{x^2}, & \text{for } x \neq 0 \\ k, & \text{for } x = 0 \end{cases}$ is continuous at $x = 0$, then the value of k is

- (a) 0 (b) 1
(c) -1 (d) $1/2$

164. If $1, \omega, \omega^2$ are the cube roots of unity, then $(1 + \omega)(1 + \omega^2)(1 + \omega^4)(1 + \omega^8)$ is equal to

- (a) 0 (b) 1
(c) ω (d) ω^2

165. If $x^x = y^y$, then $\frac{dy}{dx}$ is

- (a) $-\frac{x}{y}$ (b) $-\frac{y}{x}$
(c) $\frac{1+\log x}{1+\log y}$ (d) $1 + \log\left(\frac{x}{y}\right)$

166. The point on the curve $y^2 = x$, the tangent at which makes an angle 45° with X-axis is

- (a) $(1/2, 1/4)$ (b) $(1/4, 1/2)$
(c) $(1/2, 1/2)$ (d) $(1/2, -1/2)$

167. The length of the subtangent to the curve $x^2y^2 = a^4$ at $(-a, a)$ is

- (a) $2a$ (b) $a/2$
(c) $a/3$ (d) a

168. The number of positive divisors of 252 is

- (a) 5 (b) 9
(c) 10 (d) 18

169. The remainder obtained when 5^{124} is divided by 124 is

- (a) 0 (b) 5
(c) 1 (d) 2

170. Which of the following is not a group with respect to the given operation?

- (a) The set of odd integers under addition.
(b) The set of even integers under addition.
(c) $\{1, -1\}$ under multiplication.
(d) $\{0\}$ under addition.

171. The range in which $y = -x^2 + 6x - 3$ is increasing, is

- (a) $x > 3$ (b) $x < 3$
(c) $5 < x < 6$ (d) $7 < x < 8$

172. The value of the integral $\int_0^{\pi/2} (\sin^{100} x - \cos^{100} x) dx$ is

- (a) $\frac{100!}{(100)^{100}}$ (b) $\frac{1}{100}$
(c) 0 (d) $-\frac{\pi}{100}$

173. OA and OB are two roads enclosing an angle of 120° . X and Y start from O at the same time. X travels along OA with a speed of 4 km/h and Y travels along OB with a speed of 3 km/h. The rate at which the shortest distance between X and Y is increasing after 1 hour is



- (a) 37 km/h (b) $\sqrt{37}$ km/h
(c) $\sqrt{13}$ km/h (d) 13 km/h

174. If $k \int_0^1 x \cdot f(3x) dx = \int_0^3 t \cdot f(t) dt$, then the value of k is

- (a) 3 (b) 9
(c) $1/3$ (d) $1/9$

175. The value of $\int \frac{1}{1+\cos 8x} dx$ is

- (a) $\frac{\tan 8x}{8} + C$ (b) $\frac{\tan 2x}{8} + C$
 (c) $\frac{\tan 4x}{8} + C$ (d) $\frac{\tan 4x}{4} + C$

176. The value of $\int e^x(x^5 + 5x^4 + 1) \cdot dx$ is

- (a) $e^x \cdot x^5 + e^x + C$ (b) $e^x \cdot x^5$
 (c) $5x^4 \cdot e^x$ (d) $e^{x+1} \cdot x^5 + C$

177. The value of $\int \frac{x^2+1}{x^2-1} dx$ is

- (a) $\log\left(\frac{x+1}{x-1}\right) + C$
 (b) $\log\left(\frac{x-1}{x+1}\right) + C$
 (c) $\log(x^2 - 1) + C$
 (d) $x + \log\left(\frac{x-1}{x+1}\right) + C$

178. The area bounded by the curve $x = 4 - y^2$ and the Y-axis is

- (a) 32 sq units (b) 16 sq units
 (c) $\frac{16}{3}$ sq units (d) $\frac{32}{3}$ sq units

179. The differential equation of the family of straight lines whose slope is equal to y-intercept is

- (a) $(x+1) \frac{dy}{dx} + y = 0$
 (b) $(x+1) \frac{dy}{dx} - y = 0$
 (c) $\frac{dy}{dx} = \frac{x+1}{y+1}$
 (d) $\frac{dy}{dx} = \frac{x-1}{y-1}$

180. The order and degree of the differential equation $\left[1 + \left(\frac{dy}{dx}\right)^5\right]^{\frac{1}{3}} = \frac{d^2y}{dx^2}$ are respectively

- (a) 2, 1 (b) 1, 5
 (c) 2, 3 (d) 2, 5