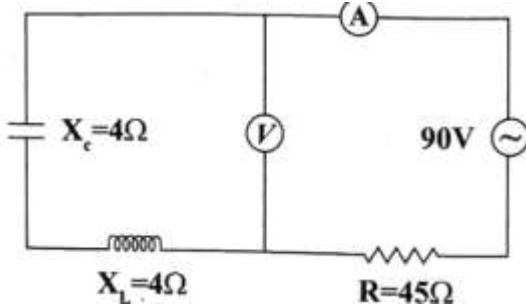


Physics

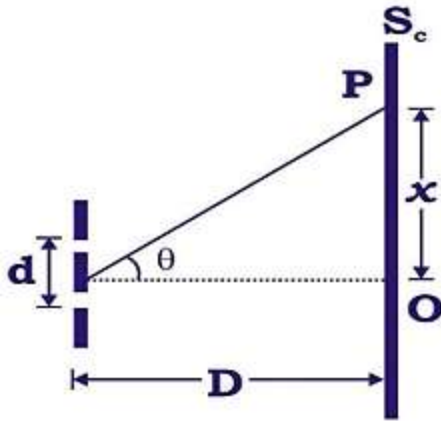
- The physical quantity which is measure in the unit of wbA^{-1} is
 (a) Self -inductance (b) Mutual inductance
 (c) Magnetic flux (d) Both A and B
- What will be the reading in the voltmeter and ammeter of the circuit shown?



- (a) 90 V, 2 A (b) 0V, 2 A
 (c) 90 V, 1 A (d) 0 V, 1 A

- LC osillations are similar and analogous to the mechanical oscillations of a block attached to a spring. The electrical equivalent of the force constant of the spring is
 (a) reciprocal of capacitive reactance
 (b) capacitive reactance
 (c) reciprocal of capacitance
 (d) capacitance
- In an oscillating LC circuit, $L = 3.00\text{mH}$ and $C = 2.70\mu\text{F}$. At $t = 0$ the charge on the capacitor is zero and the current is 2.00 A . The maximum charge that will appear on the capacitor will be
 (a) $1.8 \times 10^{-5}\text{C}$ (b) $18 \times 10^{-5}\text{C}$
 (c) $9 \times 10^{-5}\text{C}$ (d) $90 \times 10^{-5}\text{C}$
- Suppose that the electric field amplitude of electromagnetic wave is $E_0 = 120\text{NC}^{-1}$ and its frequency if $f = 50\text{MHz}$. Then which of the following value is incorrectly computed?
 (a) Magnetic field amplitude is 400 nT .
 (b) Angular frequency of EM wave is $\pi \times 10^8\text{rad/s}$
 (c) Propagation constant (angular wave number) is 2.1rad/m
 (d) Wavelength of EM wave is 6 m .
- The source of electromagnetic wave can be a charge.
 (a) Moving with a constant velocity
 (b) Moving in a circular orbit
 (c) At rest
 (d) Moving parallel to the magnetic field
- In refraction, light waves are bent on passing from one medium to second medium because, in the second medium.
 (a) frequency is different

- (b) speed is different
- (c) coefficient of elasticity is different
- (d) amplitude is smaller
8. If the refractive index from air to glass is $\frac{3}{2}$ and that from air to water is $\frac{4}{3}$, then the ratio of focal lengths of a glass lens in water and in air is
 (a) 1: 2 (b) 2: 1
 (c) 1: 4 (d) 4: 1
9. Two thin biconvex lenses have focal lengths f_1 and f_2 . A third thin biconcave lens has focal length of f_3 . If the two biconvex lenses are in contact, the total power of the lenses is P_1 . If the first convex lens is in contact with the third lens, the total power is P_2 . If the second lens is in contact with the third lens, the total power is P_3 then
 (a) $P_1 = \frac{f_1 f_2}{f_1 - f_2}$, $P_2 = \frac{f_1 f_3}{f_3 - f_1}$ and $P_3 = \frac{f_2 f_3}{f_3 - f_2}$
 (b) $P_1 = \frac{f_1 - f_2}{f_1 f_2}$, $P_2 = \frac{f_3 - f_1}{f_3 + f_1}$ and $P_3 = \frac{f_3 - f_2}{f_2 f_3}$
 (c) $P_1 = \frac{f_1 - f_2}{f_1 f_2}$, $P_2 = \frac{f_3 - f_1}{f_1 f_3}$ and $P_3 = \frac{f_3 - f_2}{f_2 f_3}$
 (d) $P_1 = \frac{f_1 + f_2}{f_1 f_2}$, $P_2 = \frac{f_3 - f_1}{f_1 f_3}$ and $P_3 = \frac{f_3 - f_2}{f_2 f_3}$
10. The size of the image of an object, which is at infinity, as formed by a convex lens of focal length 30 cm is 2 cm. If a concave lens of focal length 20 cm is placed between the convex lens and the image at a distance of 26 cm from the lens, the new size of the image is :
 (a) 1.25 cm (b) 2.5 cm
 (c) 1.05 cm (d) 2 cm
11. A slit of width 'a' is illuminated by red light of wavelength $6500\text{\AA}$. If the first diffraction minimum falls at 30° , then the value of 'a' is
 (a) 6.5×10^{-4} mm (b) 1.3 micron
 (c) $3250\text{\AA}$ (d) 2.6×10^{-4} cm
12. Which of the statements are correct with reference to single slit diffraction pattern?
 (i) Fringes are of unequal width
 (ii) Fringes are of equal width
 (iii) Light energy is conserved
 (iv) Intensities of all bright fringes are equal
 (a) (i) and (iii) (b) (i) and (iv)
 (c) (ii) and (iv) (d) (ii) and (iii)
13. In the Young's double slit experiment a monochromatic source of wavelength λ is used. The intensity of light passing through each slit is I_0 . The intensity of light reaching the screen S_C at a point P, a distance X from O is given by (Take $d \ll D$)



- (a) $I_0 \cos^2 \left(\frac{\pi D}{\lambda d} x \right)$ (b) $4I_0 \cos^2 \left(\frac{\pi d}{\lambda D} x \right)$
 (c) $I_0 \sin^2 \left(\frac{\pi d}{2\lambda D} x \right)$ (d) $4I_0 \cos \left(\frac{\pi d}{2\lambda D} x \right)$

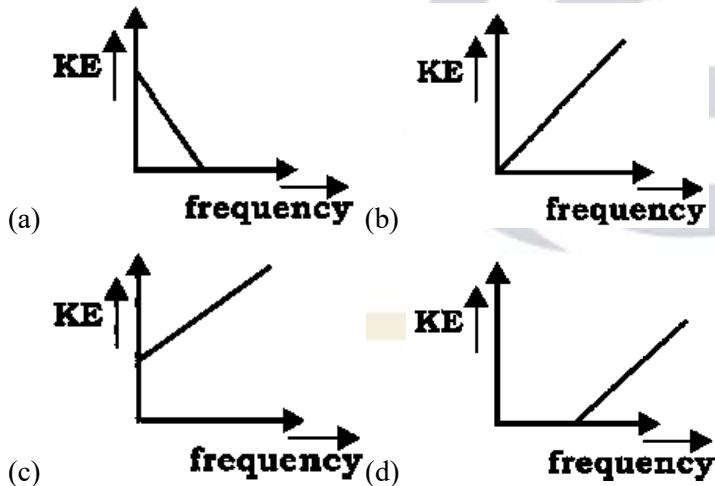
14. The work function of a metal is 1 eV. Light of wavelength $3000\text{\AA}$ is incident on this metal surface. The velocity of emitted photoelectrons will be

- (a) 10 ms^{-1} (b) $1 \times 10^3 \text{ ms}^{-1}$
 (c) $1 \times 10^4 \text{ ms}^{-1}$ (d) $1 \times 10^6 \text{ ms}^{-1}$

15. A proton moving with a momentum P_1 has a kinetic energy $\frac{1}{8}$ th of its rest mass energy. Another light photon having energy equal to the kinetic energy of the possesses a momentum P_2 . Then the ratio $\frac{P_1 - P_2}{P_1}$ is equal to

- (a) 1 (b) $\frac{1}{4}$
 (c) $\frac{1}{2}$ (d) $\frac{3}{4}$

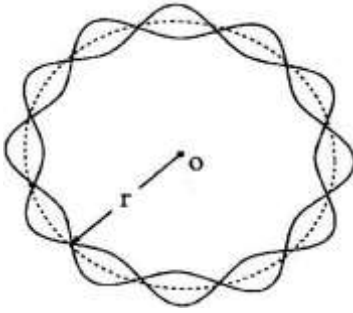
16. According to Einstein's photoelectric equation to the graph between kinetic energy of photoelectrons ejected and the frequency of incident radiation is



17. Energy of an electron in the second orbit of hydrogen atom is E_2 . The energy of electron in the third orbit of He^+ will be

- (a) $\frac{9}{16} E_2$ (b) $\frac{16}{9} E_2$
 (c) $\frac{3}{16} E_2$ (d) $\frac{16}{3} E_2$

18. The figure shows standing de Broglie waves due to the revolution of electron in a certain orbit of hydrogen atom. Then the expression for the orbit radius is (all notations have their usual meanings)

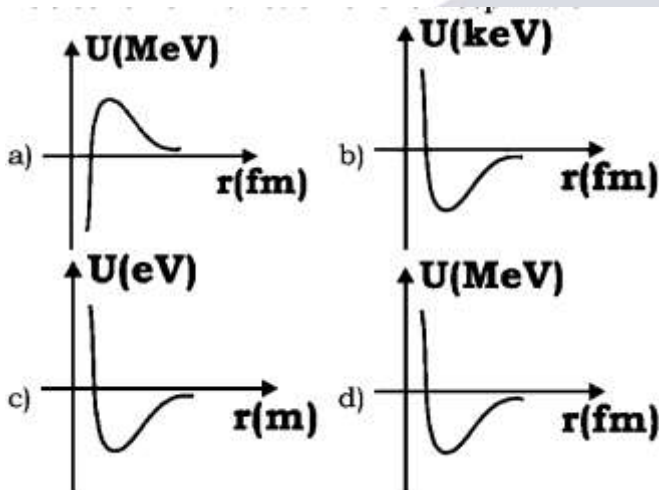


- (a) $\frac{h^2 \epsilon_0}{\pi m e^2}$ (b) $\frac{4h^2 \epsilon_0}{\pi m e^2}$
 (c) $\frac{9 h^2 \epsilon_0}{\pi m e^2}$ (d) none

19. An electron in an excited state of Li^{2+} ion has angular momentum $\frac{3h}{2\pi}$. The de Broglie wavelength of electron in this state is $P\pi a_0$ (where a_0 = Bohr radius). The value of P is

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

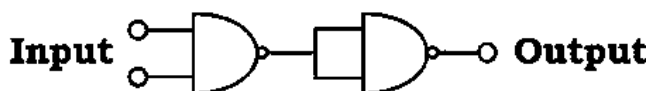
20. Which graph in the following diagram correctly represents the potential energy of a pair of nucleons as a function of their separation?



21. In a nuclear reactor heavy nuclei is not used as moderators because

- (a) They will break up
 (b) Elastic collision of neutrons with heavy nuclei will not slow them down
 (c) The net weight of the reactor would be unbearably high
 (d) Substance with heavy nuclei do not occur in liquid or gaseous state at room temperature

22. The circuit given represents which of the logic operations?



- (a) OR (b) AND
 (c) NOT (d) NOR

23. Identify the incorrect statement:

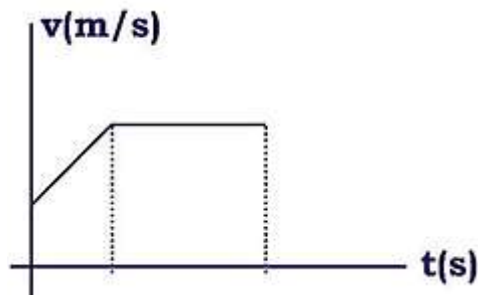
- (a) when a P-N junction diode is forward biased, the width of the depletion region decreases.

- (b) when a P – N junction diode is reverse biased, the barrier potential increases
- (c) a photon diode is operated in the reverse bias
- (d) an LED is a lightly doped P-N junction diode which emits spontaneous radiation of forward biasing.

24. Three photodiodes D_1 , D_2 and D_3 are made of semiconductors having band gaps of 2.5 eV, 2 eV and 3 eV respectively. Which one will be able to detect light of wavelength 600 nm?

- (a) D_1 only
- (b) both D_1 and D_3
- (c) D_2 only
- (d) All the three diodes

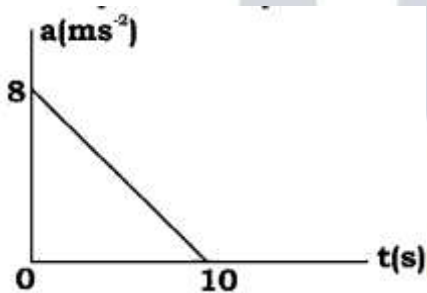
25. For a body moving along a straight line, the following v-t graph is obtained.



According to the graph, the displacement during

- (a) Uniform acceleration is greater than that during uniform motion
- (b) Uniform acceleration is less than that during uniform motion
- (c) Uniform acceleration is equal to that during uniform motion
- (d) Uniform motion zero

26. A particle starts from rest. Its acceleration 'a' versus time 't' is shown in the figure. The maximum speed of the particle will be:



- (a) 80 ms^{-1}
- (b) 40 ms^{-1}
- (c) 18 ms^{-1}
- (d) 2 ms^{-1}

27. The maximum range of a gun on horizontal plane is 16 km. If $g = 10 \text{ ms}^{-2}$, then muzzle velocity of a shell is

- (a) 160 ms^{-1}
- (b) $200\sqrt{2} \text{ ms}^{-1}$
- (c) 400 ms^{-1}
- (d) 800 ms^{-1}

28. The trajectory of projectile is

- (a) Semicircle
- (b) An ellipse

(c) A parabola always

(d) A parabola in the absence of air resistance

29. For a projectile motion, the angle between the velocity and acceleration is minimum and acute at

- (a) Only one point (b) Two points
(c) Three points (d) Four points

30. A particle starts from the origin at $t = 0$ s with a velocity of $10\hat{j}\text{ms}^{-1}$ and move in the $x - y$ plane with a constant acceleration of $(8\hat{j} + 2\hat{j})\text{ms}^{-2}$. At an instant when the x -coordinate of the particle is 16 m, y -coordinate of the particle is:

- (a) 16 m (b) 28 m
(c) 36 m (d) 24 m

31. A coin placed on a rotating turn table just slips if it is placed at a distance of 4 cm from the centre. If the angular velocity of the turn table is doubled it will just slip at a distance of

- (a) 1 cm (b) 2 cm
(c) 4 cm (d) 8 cm

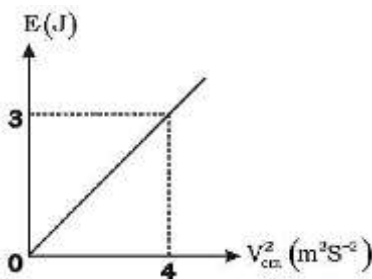
32. A 1 kg ball moving at 12 ms^{-1} collides with a 2 kg ball moving in opposite direction at 24 ms^{-1} . If the coefficient of restitution is $\frac{2}{3}$, the their velocities after the collision are

- (a) $-4\text{ ms}^{-1}, -28\text{ ms}^{-1}$
(b) $-28\text{ ms}^{-1}, -4\text{ ms}^{-1}$
(c) $4\text{ ms}^{-1}, 28\text{ ms}^{-1}$
(d) $28\text{ ms}^{-1}, 4\text{ ms}^{-1}$

33. A ball hits the floor and rebounds after an inelastic collision. In this case

- (a) The momentum of the ball is conserved
(b) The mechanical energy of the ball is conserved
(c) The total momentum of the ball and the earth is conserved
(d) The total mechanical energy of the ball and the earth is conserved

34. In figure E and V_{cm} represent the total energy and speed of centre of mass of an object of mass 1 kg in pure rolling. The object is:



- (a) Sphere (b) Ring
(c) Disc (d) Hollow Cylinder

35. Two bodies of masses 8 kg are placed at the vertices A and B of an equilateral triangle ABC. A third body of mass 2 kg is placed at the centroid G of the triangle. If $AG = BG = CG = 1$ m, where should a fourth body of mass 4 kg be placed so that the resultant force on the 2 kg body is zero?

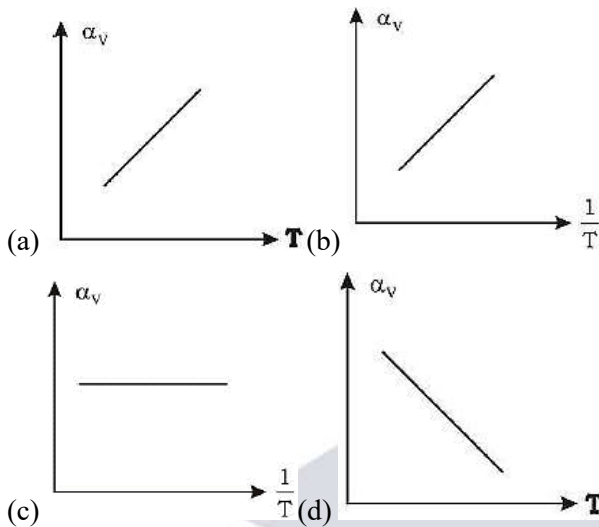
- (a) At C
(b) At a point P on the line CG such that $PG = \frac{1}{\sqrt{2}}$ m
(c) At a point P on the line CG such that $PG = 0.5$ m

(d) At a point P on the line CG such that $PG = 2 \text{ m}$

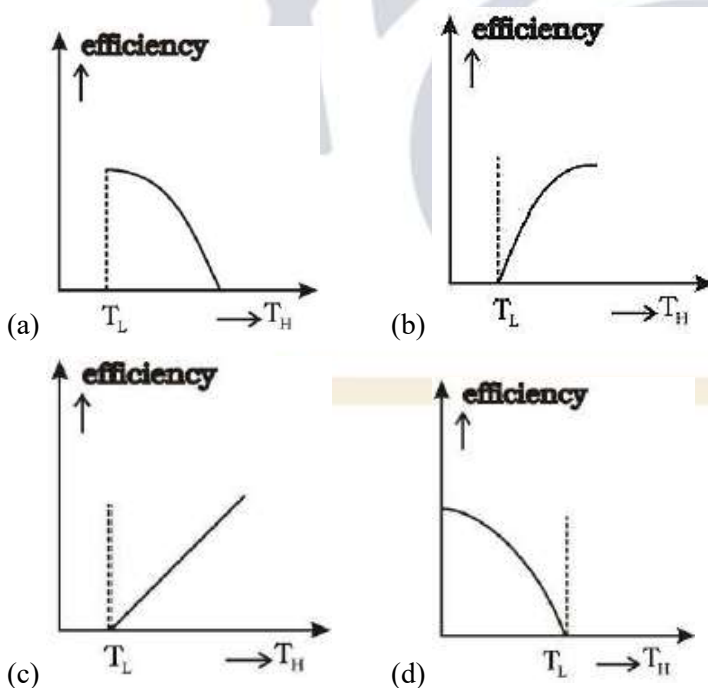
36. Two capillary tubes P and Q are dipped vertically in water. The height of water level in capillary tube P is $\frac{2^{\text{rd}}}{3}$ of the height in capillary tube Q. The ratio of their diameter is ____

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

37. Which of the following curves represent the variation of coefficient of volume expansion of an ideal gas at constant pressure?



38. A number of cannot engines are operated at identical cold reservoir temperatures (T_L). However, their hot reservoir temperatures are kept different. A graph of the efficiency of the engines versus hot reservoir temperature (T_H) is plotted. The correct graphical representation is



39. A gas mixture contains monoatomic and diatomic molecules of 2 moles each. The mixture has a total internal energy of (symbols have usual meanings)

- (a) $3RT$ (b) $5RT$
(c) $8RT$ (d) $9RT$

40. A pendulum oscillates simple harmonically and only if

(i) The size of the bob of pendulum is negligible in comparison with the length of the pendulum

(ii) The angular amplitude is less than 10°

- (a) Both i and ii are correct
- (b) Both i and ii are incorrect
- (c) Only i is correct
- (d) Only ii is correct

41. To propagate both longitudinal and transverse waves, a material must have

- (a) Bulk and shear moduli
- (b) Only bulk modulus
- (c) Only shear modulus
- (d) Young's and Bulk modulus

42. A copper rod AB of length l is rotated about end A with a constant angular velocity ω . The electric field at a distance x from the axis of rotation is

- (a) $\frac{m\omega^2 x}{e}$
- (b) $\frac{m\omega x}{el}$
- (c) $\frac{mx}{\omega^2 l}$
- (d) $\frac{me}{\omega^2 x}$

43. Electric field due to infinite, straight uniformly charged wire varies with distance 'r' as

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

44. A 2 - gram object, located in a region of uniform electric field $\vec{E} = (300\text{NC}^{-1})\hat{i}$ carries a charge Q . The object released from rest at $x = 0$, has a kinetic energy of 0.12 J at $x = 0.5$ m. Then Q is

- (a) $400\mu\text{C}$
- (b) $-400\mu\text{C}$
- (c) $800\mu\text{C}$
- (d) $-800\mu\text{C}$

45. If a slab of insulating material (conceptual). 4×10^{-3} m thick is introduced between the plates of a parallel plate capacitor, the separation between the plates has to be increased by 3.5×10^{-3} m to restore the capacity to original value. The dielectric constant of the material will be

- (a) 6
- (b) 8
- (c) 10
- (d) 12

46. Eight drops of mercury of equal radii combine to form a big drop. The capacitance of a bigger drop as compared to each smaller drop is

- (a) 2 times
- (b) 8 times
- (c) 4 times
- (d) 16 times

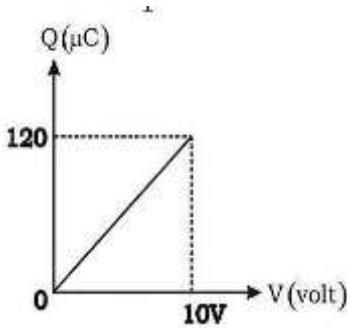
47. Which of the statements is false in the case of polar molecules?

- (a) Centers of positive and negative charges are separated in the absence of external electric field.
- (b) Centers of positive and negative charges are separated in the presence of external electric field.
- (c) Do not possess permanent dipole moments
- (d) Ionic molecule HCl is the example of polar molecule.

48. An electrician requires a capacitance of $6\mu\text{F}$ in a circuit across a potential difference of 1.5 kV. A large number of $2\mu\text{F}$ capacitors which can withstand a potential difference of not more than 500 V are available. The minimum number of capacitors required for the purpose is

- (a) 3
- (b) 9
- (c) 6
- (d) 27

49. In figure, charge on the capacitor is plotted against potential difference across the capacitor. The capacitance and energy stored in the capacitor are respectively.

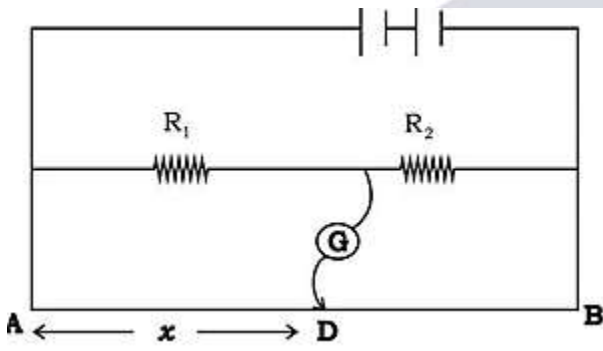


- (a) $12\mu\text{F}$, $1200\mu\text{J}$ (b) $12\mu\text{F}$, $600\mu\text{J}$
(c) $24\mu\text{F}$, $600\mu\text{J}$ (d) $24\mu\text{F}$, $1200\mu\text{J}$

50. A wire of resistance 3Ω is stretched to twice its original length. The resistance of the new wire will be

- (a) 1.5Ω (b) 3Ω
(c) 6Ω (d) 12Ω

51. In the given arrangement of experiment on metre bridge, if AD corresponding to null deflection of the galvanometer is X, what would be its value if the radius of the wire AB is doubled?



- (a) X (b) $\frac{X}{4}$
(c) 4 X (d) 2 X

52. A copper wire of length 1 m and uniform cross sectional area $5 \times 10^{-7} \text{ m}^2$ carries a current of 1 A.

Assuming that there are 8×10^{28} free electrons per m^3 in copper, how long will an electron take to drift from one end of the wire to the other?

- (a) $0.8 \times 10^3 \text{ S}$ (b) $1.6 \times 10^3 \text{ S}$
(c) $3.2 \times 10^3 \text{ S}$ (d) $6.4 \times 10^3 \text{ S}$

53. Consider an electrical conductor connected across a potential difference V. Let Δq be a small charge moving through it in time Δt . If I is the electric current through it,

- (i) the kinetic energy of the charge increases by $IV \Delta t$.
(ii) the electric potential energy of the charge decreases by $IV \Delta t$.
(iii) the thermal energy of the conductor increases by $IV \Delta t$.

Then the correct statements is/are

- (a) (i) (b) (i), (ii)
(c) (i) and (iii) (d) (ii), (iii)

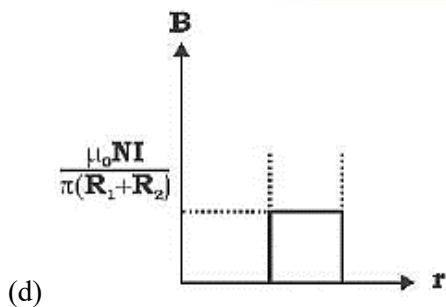
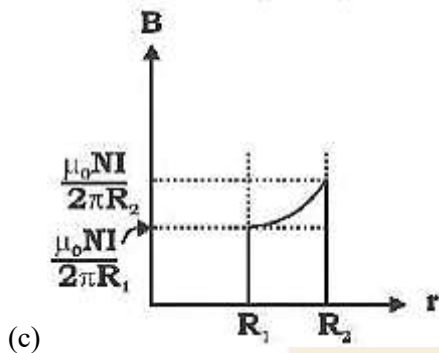
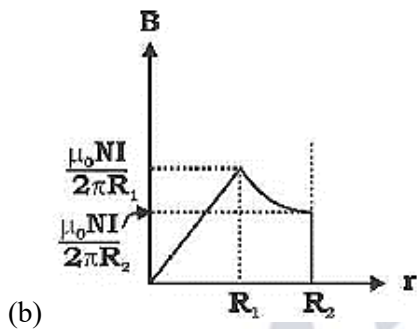
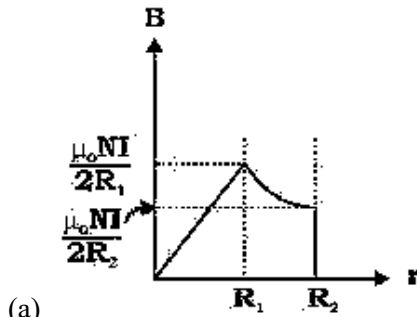
54. A strong magnetic field is applied on a stationary electron. Then the electron

- (a) Moves in the direction of the field
(b) Moves in an opposite direction of the field
(c) Remains stationary
(d) Starts spinning

55. Two parallel wires in free space are 10 cm apart and each carries a current of 10 A in the same direction. The force exerted by one wire on the other [per unit length] is

- (a) $2 \times 10^{-4} \text{ Nm}^{-1}$ [attractive]
- (b) $2 \times 10^{-7} \text{ Nm}^{-1}$ [attractive]
- (c) $2 \times 10^{-4} \text{ Nm}^{-1}$ [repulsive]
- (d) $2 \times 10^{-7} \text{ Nm}^{-1}$ [repulsive]

56. A toroid with thick windings of N turns has inner and outer radii R_1 and R_2 respectively. If it carries certain steady current I , the variation of the magnetic field due to the toroid with radial distance is correctly graphed in



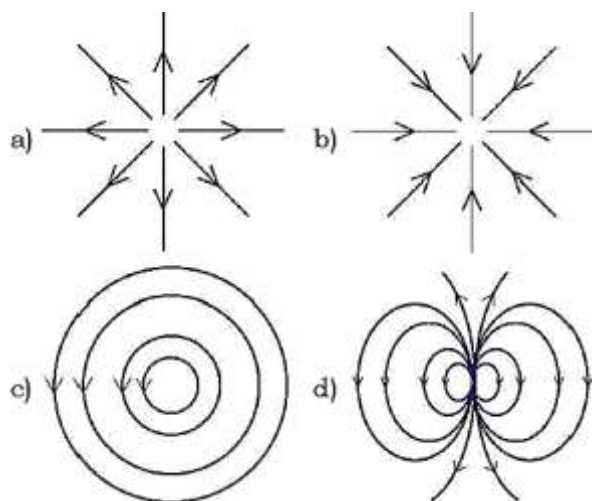
57. A tightly wound long solenoid has ' n ' turns per unit length, a radius ' r ' and carries a current I . A particle having charge ' q ' and mass ' m ' is projected from a point on the axis in a direction perpendicular to the axis. The maximum speed of the particle for which the particle does not strike the solenoid is

- (a) $\frac{\mu_0 n I q r}{m}$ (b) $\frac{\mu_0 n I q r}{2 m}$
 (c) $\frac{\mu_0 n I q r}{4 m}$ (d) $\frac{\mu_0 n I q r}{8 m}$

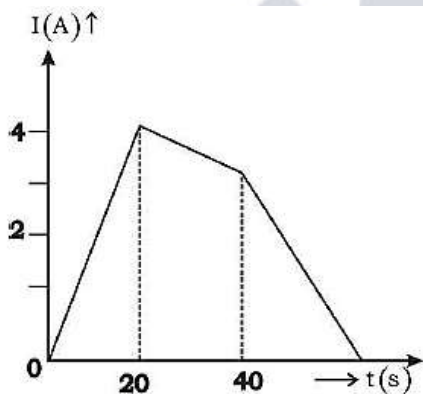
58. Earth's magnetic field always has a horizontal component except at

- (a) equator (b) magnetic poles
 (c) a latitude of 60° (d) an altitude of 60°

59. Which of the field pattern given below is valid for electric field as well as for magnetic field?



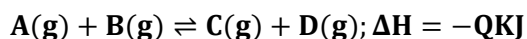
60. The current following through an inductance coil of self-inductance 6 mH at different time instants is as shown. The emf induced between $t = 20$ s and $t = 40$ s is nearly



- (a) 2×10^{-2} V (b) 3×10^{-4} V
 (c) 4×10^{-3} V (d) 30×10^2 V

Chemistry

61. For the reaction



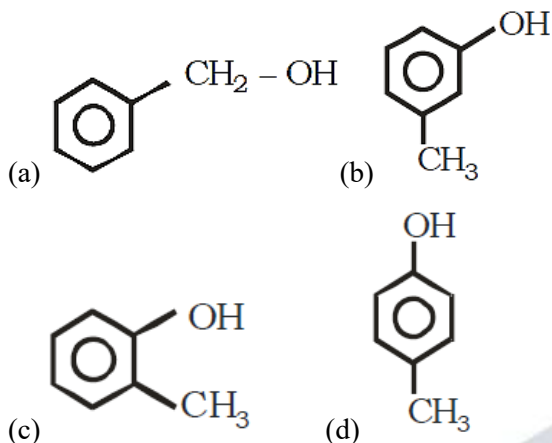
The equilibrium constant cannot be disturbed by

- (a) Addition of A (b) Addition of D
 (c) Increasing of pressure (d) Increasing of temperature

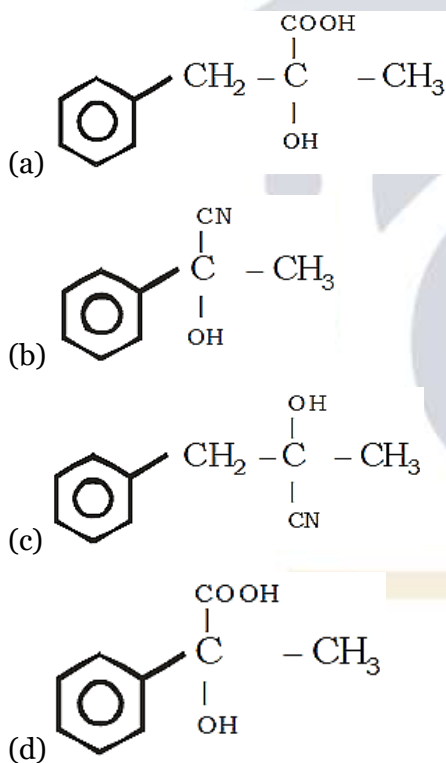
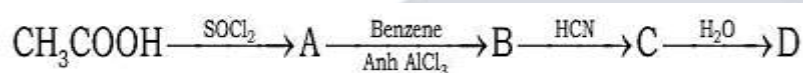
62. An organic compound 'X' on treatment with PCC in dichloromethane gives the compound Y. Compound 'Y' reacts with I_2 and alkali to form yellow precipitate of triiodomethane. The compound X is

- (a) CH_3CHO (b) CH_3COCH_3
 (c) $\text{CH}_3\text{CH}_2\text{OH}$ (d) CH_3COOH

63. A compound 'A' ($\text{C}_7\text{H}_8\text{O}$) is insoluble in NaHCO_3 solution but dissolve in NaOH and give a characteristic colour with neutral FeCl_3 solution. When treated with Bromine water compound 'A' forms the compound B with the formula $\text{C}_7\text{H}_5\text{OBr}_3$. 'A' is



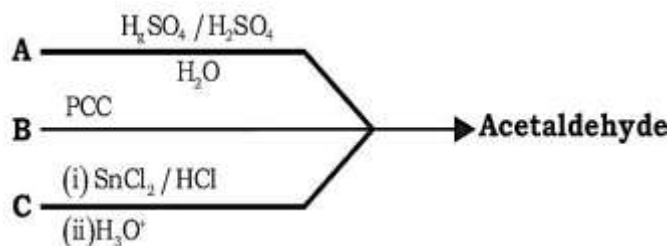
64. In set of reactions, identify D



65. K_a values for acids H_2SO_3 , HNO_2 , CH_3COOH and HCN are respectively 1.3×10^{-2} , 4×10^{-4} , 1.8×10^{-5} and 4×10^{-10} , which of the above acids produces stronger conjugate base in aqueous solution ?

- (a) H_2SO_3 (b) HNO_2
 (c) CH_3COOH (d) HCN

66.



A, B and C respectively are

- (a) ethanol, ethane nitrile and ethyne
- (b) ethane nitrile, ethanol and ethyne
- (c) ethyne, ethanol and ethane nitrile
- (d) ethyne, ethane nitrile and ethanol

67. The reagent which can do the conversion $\text{CH}_3\text{COOH} \rightarrow \text{CH}_3 - \text{CH}_2 - \text{OH}$ is

- (a) LiAlH_4 / ether
- (b) H_2 , Pt
- (c) NaBH_4
- (d) Na and $\text{C}_2\text{H}_5\text{OH}$

68.



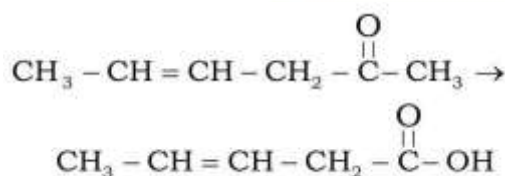
A and C are

- (a) Identical
- (b) Position isomers
- (c) Functional
- (d) Optical isomers

69. Which of the following is not true for oxidation?

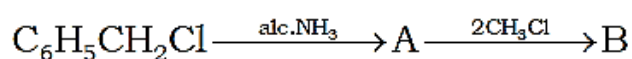
- (a) addition of oxygen
- (b) addition of electronegative element
- (c) removal of hydrogen
- (d) removal of electronegative element

70. Which is the most suitable reagent for the following conversion?



- (a) Tollen's reagent
- (b) Benzoyl peroxide
- (c) I_2 and NaOH solution with subsequent acidification
- (d) Sn and NaOH solution

71.



The product B is

- (a) N, N-Dimethyl phenyl methanamine
- (b) N, N-Dimethyl benzenamine
- (c) N-Benzyl-N-methyl methanamine
- (d) phenyl-N-N-dimethyl methanamine

72. The method by which aniline cannot be prepared is

- (a) Nitration of benzene followed by reduction with Sn and con. HCl
- (b) Degradation of benzamide with bromine in alkaline solution
- (c) Reduction of nitrobenzene with H_2/Pd is ethanol
- (d) Potassium salt of phthalimide treated with chlorobenzene followed by the hydrolysis with aqueous NaOH solution

73. Permanent hardness cannot be removed by

- (a) Using washing soda
- (b) Calgon's method
- (c) Clark's method
- (d) Ion exchange method

74. A hydrocarbon A(C_4H_8) on reaction with HCl gives a compound B(C_4H_9Cl) which on reaction with 1 mol of NH_3 gives compound C($C_4H_{10}N$). On reacting with $NaNO_2$ and HCl followed by treatment with water, compound C yields an optically active compound D. The is

- (a)
$$\begin{array}{c} CH_2-CH_3 \\ | \\ H_3C-C-H \\ | \\ Cl \end{array}$$

(b)
$$\begin{array}{c} CH_2-CH_3 \\ | \\ H_3C-C-H \\ | \\ OH \end{array}$$

(c)
$$\begin{array}{c} CH_2-CH_3 \\ | \\ H_3C-C-H \\ | \\ NH_2 \end{array}$$

(d)
$$\begin{array}{c} CH_2-CH_3 \\ | \\ H_3C-C-H \\ | \\ H \end{array}$$

75. RNA and DNA are chiral molecules, their chirality is due to the presence of

- (a) D-sugar component
- (b) L-sugar component
- (c) Chiral bases
- (d) Chiral phosphate ester unit

76. The property of the alkaline earth metals that increases with their atomic number is

- (a) Ionisation enthalpy
- (b) Electronegativity
- (c) Solubility of their hydroxide in water
- (d) Solubility of their sulphate in water

77. Primary structure in a nucleic acid contains bases as GATGC ... The chain which is complementary to this chain is

- (a) G G T G A (b) T G A A G....
- (c) C T A C G. (d) T T T A G....

78. In the detection of II group acid radical, the salt containing chloride is treated with concentrated sulphuric acid, the colourless gas is liberated. The name of the gas is

- (a) Hydrogen chloride gas (b) Chlorine gas
- (c) Sulphur dioxide gas (d) Hydrogen gas

79. The number of six membered and five membered rings in Buckminster Fullerece respectively is

- (a) 20,12 (b) 12,20
- (c) 14,18 (d) 14,11

80. In chrysoberyl, a compound containing Beryllium, Aluminium and oxygen, oxide ions form cubic close packed structure. Aluminium ions occupy $\frac{1}{4}$ th of octahedral voids. The formula of the compound is

- (a) BeAlO_4 (b) BeAl_2O_4
- (c) Be_2AlO_2 (d) BeAlO_2

81. The correct statement regarding defects in solid is

- (a) Frenkel defect is a vacancy defect
- (b) Schottky defect is a dislocation defect
- (c) Trapping of an electron in the lattice leads to the formation of F -centre
- (d) Schottky defect has no effect on density

82. A metal crystallises in BCC lattice with unit cell edge length of 300 pm and density 6.15gcm^{-3} . The molar mass of the metal is

- (a) 50 g mol^{-1} (b) 60 g mol^{-1}
- (c) 40 g mol^{-1} (d) 70 g mol^{-1}

83. Henry's law constant for the solubility of N_2 gas in water at 298 K is $1.0 \times 10^5\text{ atm}$. The mole fraction of N_2 in air is 0.8 The number of moles of N_2 from air dissolved in 10 moles of water at 298 K and 5 atm pressure is

- (a) 4.0×10^{-4} (b) 4.0×10^{-5}
- (c) 5.0×10^{-4} (d) 4.0×10^{-6}

84. A pure compound contains 2.4 g of C, 1.2×10^{23} atoms of H, 0.2 moles of oxygen atoms. Its empirical formula is

- (a) C_2HO (b) $\text{C}_2\text{H}_2\text{O}_2$
- (c) CH_2O (d) CHO

85. Choose the correct statement

- (a) K_H value is same for a gas in any solution
- (b) Higher the K_H value more the solubility of gas
- (c) K_H value increases on increasing the temperature of the solution

(d) Easily liquefiable gases usually has lesser K_H values

86. The K_H value (K bar) of Argon (I), Carbondioxide (II) formuldehyde (III) and methane (IV) are respectively 40.3, 167, 1.83×10^{-5} and 0.413 at 298 K . The increasing order of solubility of gas in liquid is

- (a) I < II < IV < III (b) III < IV < II < I
(c) I < III < II < IV (d) I < IV < II < III

87. The vapour pressure of pure liquids A and B are 450 and 700 mm of Hg at 350 K respectively. If the total vapour pressure of the mixture is 600 mm of Hg , the composition of the mixture in the solution is

- (a) $x_A = 0.4, x_B = 0.6$
(b) $x_A = 0.6, x_B = 0.4$
(c) $x_A = 0.3, x_B = 0.7$
(d) $x_A = 0.7, x_B = 0.3$

88. Consider the following electrodes



$E^\circ_{\text{Zn}/\text{Zn}^{2+}} = -0.76 \text{ V}$ electrode potentials of the above electrodes in volts are in the order

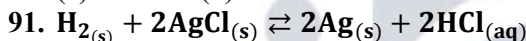
- (a) $P > S > R > Q$ (b) $S > R > Q > P$
(c) $Q > R > S > P$ (d) $P > Q > R > S$

89. The number of angular and radial nodes in 3 p orbital respectively are

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

90. The resistance of 0.01 m KCl solution at 298 K is 1500Ω . If the conductivity of 0.01 m KCl solution at 298 K is $0.1466 \times 10^{-3} \text{ S cm}^{-1}$. The cell constant of the conductivity cell in cm^{-1} is

- (a) 0.219 (b) 0.291
(c) 0.301 (d) 0.194



E°_{cell} at 25°C for the cell is 0.22 V . The equilibrium constant at 25°C is

- (a) 2.8×10^7 (b) 5.2×10^8
(c) 2.8×10^5 (d) 5.2×10^4

92. For a reaction $A + 2 B \rightarrow \text{Products}$, when concentration of B alone is increased half- life remains the same. If concentration of A alone is doubled, rate remains the same. The unit of rate constant for the reaction is

- (a) S^{-1} (b) $\text{Lmol}^{-1} \text{S}^{-1}$
(c) $\text{molL}^{-1} \text{S}^{-1}$ (d) atm^{-1}

93. The third ionisation enthalpy is highest in

- (a) Alkali metals (b) Alkaline earth metals
(c) Chalcogens (d) Pnictogens

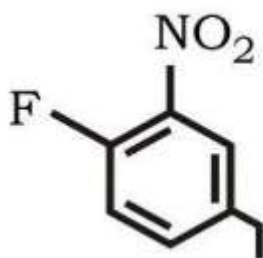
94. If the rate constant for a first order reaction is k , the time(t) required for the completion of 99% of the reaction is given by

- (a) $t = \frac{4.606}{k}$ (b) $t = \frac{2.303}{k}$
(c) $t = \frac{0.693}{k}$ (d) $t = \frac{6.909}{k}$

95. The rate of a gaseous reaction is given by the expression $k[A][B]^2$. If the volume of vessel is reduced to one half of the initial volume, the reaction rate as compared to original rate is

- (a) $\frac{1}{16}$ (b) $\frac{1}{8}$
(c) 8 (d) 16

96. The correct IUPAC name of



- (a) 4-Ethyl-1-Fluoro-2-nitrobenzene
- (b) 1-Ethyl-4-Fluoro-3-nitrobenzene
- (c) 3-Ethyl-6-Fluoronitrobenzene
- (d) 5-Ethyl-2-Fluoronitrobenzene

97. Higher order (> 3) reactions are rare due to

- (a) Shifting of equilibrium towards reactants due to elastic collisions
- (b) Loss of active species on collision
- (c) Low probability of simultaneous collision of all reacting species
- (d) Increase in entropy as more molecules are involved

98. Arrange benzene, n-hexane and ethyne in decreasing order of their acidic behaviour

- (a) Benzene > n-hexane > ethyne
- (b) n-hexane > Benzene > ethyne
- (c) ethyne > n-hexane > Benzene
- (d) ethyne > Benzene > n-hexane

99. A colloidal solution is subjected to an electric field than colloidal particles move towards anode. The amount of electrolytes of BaCl_2 , AlCl_3 and NaCl required to coagulate the given colloid is in the order

- (a) $\text{NaCl} > \text{BaCl}_2 > \text{AlCl}_3$
- (b) $\text{BaCl}_2 < \text{AlCl}_3 > \text{NaCl}$
- (c) $\text{AlCl}_3 = \text{NaCl} = \text{BaCl}_2$
- (d) $\text{AlCl}_3 > \text{BaCl}_2 > \text{NaCl}$

100. Which of the following is an incorrect statement?

- (a) Hydrogen bonding is stronger than dispersion forces
- (b) Sigma bonds are stronger than π -bonds
- (c) Ionic bonding is non-directional
- (d) σ -electrons are referred to as mobile electrons

101. Zeta potential is

- (a) Potential required to bring about coagulation of a colloidal sol.
- (b) Potential required to give the particle a speed of 1 cm S^{-1}
- (c) Potential difference between fixed charged layer and the diffused layer having opposite charges
- (d) Potential energy of the colloidal particles.

102. Which of the following compound on heating gives N_2O ?

- (a) $Pb(NO_3)_2$ (b) NH_4NO_3
(c) NH_4NO_2 (d) $NaNO_3$

103. Which of the following property is true for the given sequence?

$NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$?

- (a) Reducing property (b) Thermal stability
(c) Bond angle (d) Acidic character

104. The correct order of boiling point in the following compounds is

- (a) $HF > H_2O > NH_3$ (b) $H_2O > HF > NH_3$
(c) $NH_3 > H_2O > HF$ (d) $NH_3 > HF > H_2O$

105. XeF_6 on partial hydrolysis gives a compound X, which has square pyramidal geometry 'X' is

- (a) XeO_3 (b) XeO_4
(c) $XeOF_4$ (d) $XeO_2 F_2$

106. A colourless, neutral, paramagnetic oxide of Nitrogen 'P' on oxidation gives reddish brown gas Q. Q on cooling gives colourless gas R. R on reaction with P gives blue solid S. Identify P, Q, R, S respectively

- (a) N_2O NO NO N_2 N_2
(b) N_2ONON_2 N_2O_4 N_2O_3
(c) NONONO N_2O_4 N_2O_3
(d) NONON N_2O_4 N_2O_5

107. Which of the following does not represent property stated against it?

- (a) $CO^{+2} < Fe^{+2} < Mn^{+2}$ - Ionic size
(b) $Ti < V < Mn$ - Number of oxidation states
(c) $Cr^{+2} < Mn^{+2} < Fe^{+2}$ - Paramagnetic behaviour
(d) $Sc > Cr > Fe$ - Density

108. Which one of the following is correct for all elements from Sc to Cu?

- (a) The lowest oxidation state shown by them is +2
(b) 4s orbital is completely filled in the ground state
(c) 3d orbital is not completely filled in the ground state
(d) The ions in +2 oxidation states are paramagnetic

109. When the absolute temperature of ideal gas is doubled and pressure is halved, the volume of gas

- (a) will be half of original volume
(b) will be 4 times the original volume
(c) will be 2 times the original volume
(d) will be $1/4^{th}$ times the original volume

110. Which of the following pairs has both the ions coloured in aqueous solution? [Atomic numbers of

[Sc = 21, Ti = 22, Ni = 28, Cu = 29, Mn = 25]

- (a) Sc^{3+} , Mn^{2+} (b) Ni^{2+} , Ti^{4+}
(c) Ti^{3+} , Cu^+ (d) Mn^{2+} , Ti^{3+}

111. For the crystal field splitting in octahedral complexes,

- (a) the energy of the e_g orbitals will decrease by $(3/5)\Delta_0$ and that of the t_{2g} will increase by $(2/5)\Delta_0$
(b) the energy of the e_g orbitals will increase by $(3/5)\Delta_0$ and that of the t_{2g} will decrease by $(2/5)\Delta_0$
(c) the energy of the e_g orbitals will increase by $(3/5)\Delta_0$ and that of the t_{2g} will increase by $(2/5)\Delta_0$

(d) the energy of the e_g orbitals will decrease by $(3/5)\Delta_0$ and that of the t_{2g} will decrease by $(2/5)\Delta_0$

112. Peroxide effect is observed with the addition of HBr but not with the addition of HI to unsymmetrical alkene because

- (a) H-I bond is stronger than H – Br and is not cleaved by the free radical
- (b) H-I bond is weaker than H – Br bond so that iodine free radicals combine to form iodine molecules
- (c) Bond strength of HI and HBr are same but free radicals are formed in HBr
- (d) All of these

113. The IUPAC name of $[\text{Co}(\text{NH}_3)_5(\text{CO}_3)]\text{Cl}$ is

- (a) Pentaamminecarbonatocobalt (III) Chloride
- (b) Carbonatopentamminecobalt (III) Chloride
- (c) Pentaamminecarbonatocobaltate (III) Chloride
- (d) Pentaammine cobalt (III) Carbonate Chloride

114. Homoleptic complexes among the following are

(A) $\text{K}_3[\text{Al}(\text{C}_2\text{O}_4)_3]$, (B) $[\text{CoCl}_2(\text{en})_2]^+$

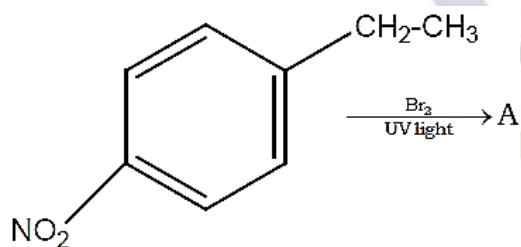
(C) $\text{K}_2[\text{Zn}(\text{OH})_4]$

- (a) A only
- (b) A and B only
- (c) A and C only
- (d) C only

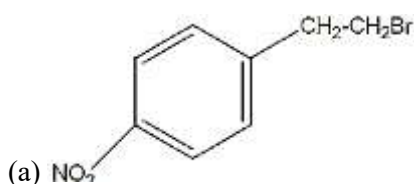
115. The correct order for wavelengths of light absorbed in the complex ions $[\text{CoCl}(\text{NH}_3)_5]^{2+}$, $[\text{Co}(\text{NH}_3)_6]^{3+}$ and $[\text{Co}(\text{CN})_6]^{3-}$ is

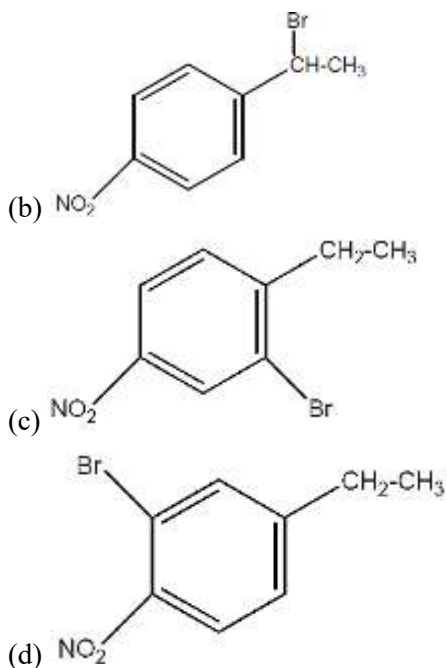
- (a) $[\text{CoCl}(\text{NH}_3)_5]^{2+} > [\text{Co}(\text{NH}_3)_6]^{3+} > [\text{Co}(\text{CN})_6]^{3-}$
- (b) $[\text{Co}(\text{NH}_3)_6]^{3+} > [\text{Co}(\text{CN})_6]^{3-} > [\text{CoCl}(\text{NH}_3)_5]^{2+}$
- (c) $[\text{Co}(\text{CN})_6]^{3-} > [\text{CoCl}(\text{NH}_3)_5]^{2+} > [\text{Co}(\text{NH}_3)_6]^{3+}$
- (d) $[\text{Co}(\text{NH}_3)_6]^{3+} > [\text{CoCl}(\text{NH}_3)_5]^{2+} > [\text{Co}(\text{CN})_6]^{3-}$

116.



The compound A (major product) is

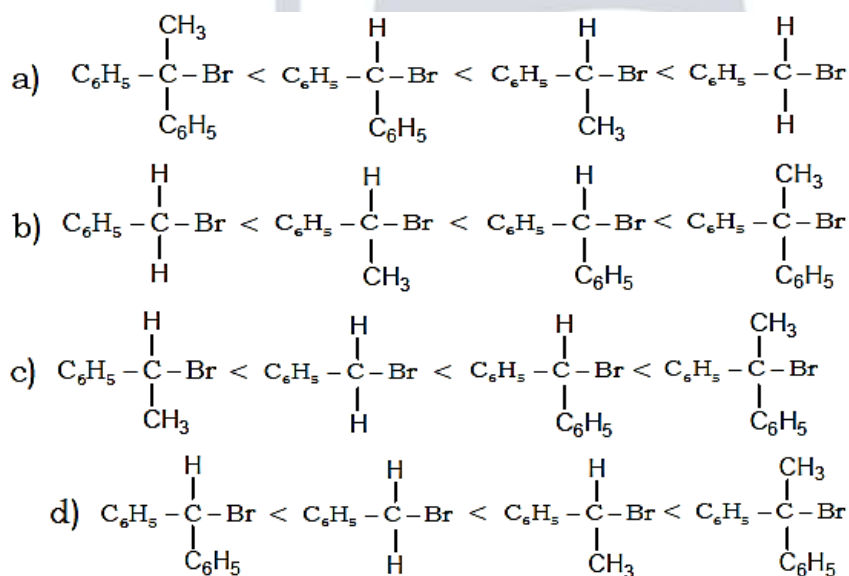




117. Bond enthalpies of A_2 , B_2 and AB are in the ratio 2 : 1 : 2. If bond enthalpy of formation of AB is -100KJmol^{-1} . The bond enthalpy of B_2 is

- (a) 100KJmol^{-1} (b) 50KJmol^{-1}
(c) 200KJmol^{-1} (d) 150KJmol^{-1}

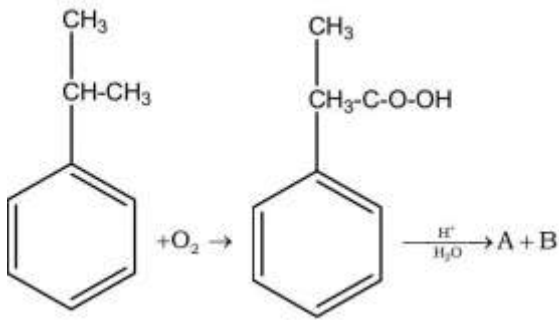
118. The order of reactivity of the compounds $C_6H_5CH_2Br$, $C_6H_5CH(C_6H_5)Br$, $C_6H_5CH(CH_3)Br$ and $C_6H_5C(CH_3)(C_6H_5)Br$ in S_N^2 reaction is



119. The major product of the following reaction is $CH_2 = CH - CH_2 - OH \xrightarrow[\text{Excess}]{HBr}$ Product

- (a) $CH_3 - CHBr - CH_2Br$
(b) $CH_2 = CH - CH_2Br$
(c) $CH_3 - CHBr - CH_2 - OH$
(d) $CH_3 - CHOH - CH_2OH$

120.



The product 'A' gives white precipitate when treated with bromine water. The product 'B' is treated with Barium hydroxide to give the product C. The compound C is heated strongly to form product D. The product D is

- (a) 4-Methylpent-3-en-2-one
- (b) But-2 enal
- (c) 3-Methylpent-3-en-2-one
- (d) 2-Methylbut-2-enal

Mathematics

121. The equation of the line joining the points $(-3, 4, 11)$ and $(1, -2, 7)$ is

- (a) $\frac{x+3}{2} = \frac{y-4}{3} = \frac{z-11}{4}$
- (b) $\frac{x+3}{-2} = \frac{y-4}{3} = \frac{z-11}{2}$
- (c) $\frac{x+3}{-2} = \frac{y+4}{3} = \frac{z+11}{4}$
- (d) $\frac{x+3}{2} = \frac{y+4}{-3} = \frac{z+11}{2}$

122. The angle between the lines whose direction cosines are $\left(\frac{\sqrt{3}}{4}, \frac{1}{4}, \frac{\sqrt{3}}{2}\right)$ and $\left(\frac{\sqrt{3}}{4}, \frac{1}{4}, -\frac{\sqrt{3}}{2}\right)$ is

- (a) π
- (b) $\frac{\pi}{2}$
- (c) $\frac{\pi}{3}$
- (d) $\frac{\pi}{4}$

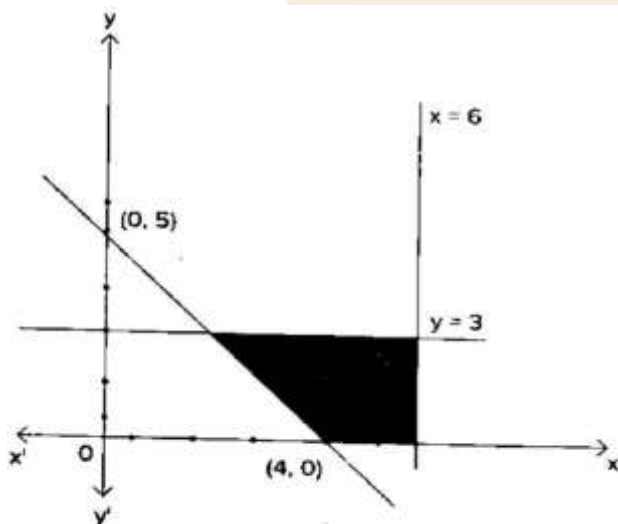
123. If a plane meets the coordinate axes at A, B and C in such a way that the centroid of triangle ABC is at the point $(1, 2, 3)$ then the equation of the plane is

- (a) $\frac{x}{1} + \frac{y}{2} + \frac{z}{3} = 1$
- (b) $\frac{x}{3} + \frac{y}{6} + \frac{z}{9} = 1$
- (c) $\frac{x}{1} + \frac{y}{2} + \frac{z}{3} = \frac{1}{3}$
- (d) $\frac{x}{1} - \frac{y}{2} + \frac{z}{3} = -1$

124. The area of the quadrilateral ABCD when $A(0, 4, 1)$ $B(4, 5, 0)$ and $D(2, 6, 2)$ is equal to

- (a) 9 sq. units
- (b) 18 sq. units
- (c) 27 sq. units
- (d) 81 sq. units

125. The shaded region is the solution set of the inequalities



- (a) $5x + 4y \geq 20, x \leq 6, y \geq 3, x \geq 0, y \geq 0$
 (b) $5x + 4y \leq 20, x \leq 6, y \leq 3, x \geq 0, y \geq 0$
 (c) $5x + 4y \geq 20, x \leq 6, y \leq 3, x \geq 0, y \geq 0$
 (d) $5x + 4y \geq 20, x \geq 6, y \leq 3, x \geq 0, y \geq 0$

126. Given that A and B are two events such that $P(B) = \frac{3}{5}, P\left(\frac{A}{B}\right) = \frac{1}{2}$ and $P(A \cup B) = \frac{4}{5}$ then $P(A) =$

- (a) $\frac{3}{10}$ (b) $\frac{1}{2}$
 (c) $\frac{1}{5}$ (d) $\frac{3}{5}$

127. If A, B and C are three independent events such that $P(A) = P(B) = P(C) = P$ then P (at least two of A, B, C occur) =

- (a) $P^3 - 3P$ (b) $3P - 2P^2$
 (c) $3P^2 - 2P^3$ (d) $3P^2$

128. Two dice are thrown. If it is known that the sum of numbers on the dice was less than 6 the probability of getting a sum as 3 is

- (a) $\frac{1}{18}$ (b) $\frac{5}{18}$
 (c) $\frac{1}{5}$ (d) $\frac{2}{5}$

129. A car manufacturing factory has two plants X and Y. Plant X manufactures 70% of cars and plant Y manufactures 30% of cars. 80% of cars at plant X and 90% of cars at plant Y are rated as standard quality. A car is chosen at random and is found to be standard quality. The probability that it has come from plant X is

- (a) $\frac{56}{73}$ (b) $\frac{56}{84}$
 (c) $\frac{56}{83}$ (d) $\frac{56}{79}$

130. In a certain town 65% families own cell phones; 15000 families own scooter and 15% families own both. Taking into consideration that the families own at least one of the two, the total number of families in the town is

- (a) 20000 (b) 30000
 (c) 40000 (d) 50000

131. A and B are non-singleton sets and $n(A \times B) = 35$. If $B \subset A$ then ${}^{n(A)}C_{n(B)} =$

- (a) 28 (b) 35
 (c) 42 (d) 21

132. Domain of $f(x) = \frac{x}{1-|x|}$ is

- (a) $R - [-1, 1]$ (b) $(-\infty, 1)$
 (c) $(-\infty, 1) \cup (0, 1)$ (d) $R - \{-1, 1\}$

133. The value of $\cos 1200^\circ + \tan 1485^\circ$ is

- (a) $\frac{1}{2}$ (b) $\frac{3}{2}$
 (c) $-\frac{3}{2}$ (d) $-\frac{1}{2}$

134. The value of $\tan 1^\circ \tan 2^\circ \tan 3^\circ \dots \tan 89^\circ$ is

- (a) 0 (b) 1
 (c) $\frac{1}{2}$ (d) -1

135. If $\left(\frac{1+i}{1-i}\right)^x = 1$ then

- (a) $x = 4n + 1; n \in \mathbb{N}$ (b) $x = 2n + 1; n \in \mathbb{N}$
 (c) $x = 2n; n \in \mathbb{N}$ (d) $x = 4n; n \in \mathbb{N}$

136. The cost and revenue functions of a product are given by $c(x) = 20x + 4000$ and $R(x) = 60x + 2000$ respectively where x is the number of items produced and sold. The value of x to earn profit is

- (a) > 50 (b) > 60
 (c) > 80 (d) > 40

137. A student has to answer 10 questions, choosing at least 4 from each of the parts A and B. If there are 6 questions in part A and 7 in part B, then the number of ways can the student choose 10 questions is

- (a) 256 (b) 352
(c) 266 (d) 426

138. If the middle term of the A.P is 300 then the sum of its first 51 terms is

- (a) 15300 (b) 14800
(c) 16500 (d) 14300

139. The equation of straight line which passes through the point $(a \cos^3 \theta, a \sin^3 \theta)$ and perpendicular to $x \sec \theta + y \csc \theta = a$ is

- (a) $\frac{x}{a} + \frac{y}{a} = a \cos \theta$
(b) $x \cos \theta - y \sin \theta = a \cos 2\theta$
(c) $x \cos \theta + y \sin \theta = a \cos 2\theta$
(d) $x \cos \theta - y \sin \theta = -a \cos 2\theta$

140. The mid points of the sides of triangle are $(1, 5, -1)(0, 4, -2)$ and $(2, 3, 4)$ then centroid of the triangle

- (a) $(1, 4, 3)$ (b) $(1, 4, \frac{1}{3})$
(c) $(-1, 4, 3)$ (d) $(\frac{1}{3}, 2, 4)$

141. Consider the following statements:

Statement 1:

$\lim_{x \rightarrow 1} \frac{ax^2 + bx + c}{cx^2 + bx + a}$ is 1 (where $a + b + c \neq 0$)

Statement 2: $\lim_{x \rightarrow -2} \frac{\frac{1}{x} + \frac{1}{x+2}}{\frac{x}{x+2}}$ is $\frac{1}{4}$

- (a) Only statement 2 is true
(b) Only statement 1 is true
(c) Both statements 1 and 2 are true
(d) Both statements 1 and 2 are false

142. If a and b are fixed non-zero constants, then the derivative of $\frac{a}{x^4} - \frac{b}{x^2} + \cos x$ is $ma + nb - p$ where

- (a) $m = 4x^3; n = \frac{-2}{x^3}; p = \sin x$
(b) $m = \frac{-4}{x^5}; n = \frac{2}{x^3}; p = \sin x$
(c) $m = \frac{-4}{x^5}; n = \frac{-2}{x^3}; p = -\sin x$
(d) $m = 4x^3; n = \frac{2}{x^3}; p = -\sin x$

143. The Standard Deviation of the numbers 31, 32, 33..... 46, 47 is

- (a) $\sqrt{\frac{17}{12}}$ (b) $\sqrt{\frac{47^2 - 1}{12}}$
(c) $2\sqrt{6}$ (d) $4\sqrt{3}$

144. If $P(A) = 0.59, P(B) = 0.30$ and $P(A \cap B) = 0.21$ then $P(A' \cap B') =$

- (a) 0.11 (b) 0.38
(c) 0.32 (d) 0.35

145. $f: R \rightarrow$ defined by $f(x) =$

$$\begin{cases} 2x; x > 3 \\ x^2; 1 < x \leq 3 \end{cases} \text{ then } f(-2) + f(3) + f(4) \text{ is}$$

$$\begin{cases} 3x; x \leq 1 \end{cases}$$

- (a) 14 (b) 9
(c) 5 (d) 11

146. Let $A = \{x: x \in \mathbb{R}; x \text{ is not a positive integer}\}$

Define $f: A \rightarrow \mathbb{R}$ as $f(x) = \frac{2x}{x-1}$, then f is

- (a) injective but not surjective
(b) surjective but not injective
(c) bijective
(d) neither injective nor surjective

147. The function $f(x) = \sqrt{3}\sin 2x - \cos 2x + 4$ is one-one in the interval

- (a) $\left[\frac{-\pi}{6}, \frac{\pi}{3}\right]$ (b) $\left[\frac{\pi}{6}, \frac{-\pi}{3}\right]$
(c) $\left[\frac{-\pi}{2}, \frac{\pi}{2}\right]$ (d) $\left[\frac{-\pi}{6}, \frac{-\pi}{3}\right]$

148. Domain of the function $f(x) = \frac{1}{\sqrt{[x^2] - [x] - 6}}$ where $[x]$ is greatest integer $\leq x$ is

- (a) $(-\infty, 2) \cup [4, \infty]$ (b) $(-\infty, -2) \cup [3, \infty]$
(c) $[-\infty, -2] \cup [4, \infty]$ (d) $[-\infty, 2] \cup [3, \infty]$

149. $\cos \left[\cot^{-1}(-\sqrt{3}) + \frac{\pi}{6} \right] =$

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

150. $\tan^{-1} \left[\frac{1}{\sqrt{3}} \sin \frac{5\pi}{2} \right] \sin^{-1} \left[\cos \left(\sin^{-1} \frac{\sqrt{3}}{2} \right) \right] =$

- (a) 0 (b) $\frac{\pi}{6}$
(c) $\left(\frac{\pi}{6}\right)^2$ (d) π

151. If $A = \begin{bmatrix} 1 & -2 & 1 \\ 2 & 1 & 3 \end{bmatrix}$ $B = \begin{bmatrix} 2 & 1 \\ 3 & 2 \\ 1 & 1 \end{bmatrix}$ then $(AB)'$ is equal to

- (a) $\begin{bmatrix} -3 & -2 \\ 10 & 7 \end{bmatrix}$ (b) $\begin{bmatrix} -3 & 10 \\ -2 & 7 \end{bmatrix}$
(c) $\begin{bmatrix} -3 & 7 \\ 10 & 2 \end{bmatrix}$ (d) $\begin{bmatrix} -3 & 7 \\ 10 & -2 \end{bmatrix}$

152. Let M be 2×2 symmetric matrix with integer entries, then M is invertible if

- (a) the first column of M is the transpose of second row of M
(b) the second row of M is the transpose of first column of M
(c) M is diagonal matrix with non-zero entries in the principal diagonal
(d) The product of entries in the principal diagonal of M is the product of entries in the other diagonal

153. If A and B are matrices of order 3 and $|A| = 5$, $|B| = 3$ then $|3AB|$ is

- (a) 425 (b) 405
(c) 565 (d) 585

154. If A and B are invertible matrices then which of the following is not correct?

- (a) $\text{adj } A = |A|A^{-1}$
(b) $\det(A^{-1}) = [\det(A)]^{-1}$
(c) $(AB)^{-1} = B^{-1}A^{-1}$
(d) $(A+B)^{-1} = B^{-1} + A^{-1}$

155. If $f(x) = \begin{vmatrix} \cos x & 1 & 0 \\ 0 & 2\cos x & 3 \\ 0 & 1 & 2\cos x \end{vmatrix}$ then $\lim_{x \rightarrow \pi} f(x) =$

(a) -1 (b) 1
(c) 0 (d) 3

156. If $x^3 - 2x^2 - 9x + 18 = 0$ and $A = \begin{vmatrix} 1 & 2 & 3 \\ 4 & x & 6 \\ 7 & 8 & 9 \end{vmatrix}$ then the maximum value of A is

(a) 96 (b) 36
(c) 24 (d) 120

157. At $x = 1$, the function $f(x) = \begin{cases} x^3 - 1 & 1 < x < \infty \\ x - 1 & -\infty < x \leq 1 \end{cases}$ is

- (a) continuous and differentiable
(b) continuous and non-differentiable
(c) discontinuous and differentiable
(d) discontinuous and non-differentiable

158. If $y = (\cos x^2)^2$, then $\frac{dy}{dx}$ is equal to

- (a) $-4x \sin 2x^2$ (b) $-x \sin x^2$
(c) $-2x \sin 2x^2$ (d) $-x \cos 2x^2$

159. For constant a , $\frac{d}{dx}(x^x + x^a + a^x + a^a)$ is

- (a) $x^x(1 + \log x) + ax^{a-1}$
(b) $x^x(1 + \log x) + ax^{a-1} + a^x \log a$
(c) $x^x(1 + \log x) + a^a(1 + \log x)$
(d) $x^x(1 + \log x) + a^a(1 + \log a) + ax^{a-1}$

160. Consider the following statements:

Statement 1: If $y = \log_{10} x + \log_e x$ then $\frac{dy}{dx} = \frac{\log_{10} e}{x} + \frac{1}{x}$

Statement 2: If $\frac{d}{dx}(\log_{10} x) = \frac{\log x}{\log 10}$ and $\frac{d}{dx}(\log_e x) = \frac{\log x}{\log e}$

- (a) Statement 1 is true; Statement 2 is false
(b) Statement 1 is false; statement 2 is true
(c) Both statements 1 and 2 are true
(d) Both statements 1 and 2 are false

161. If the parametric equation of curve is given by $x = \cos \theta + \log \tan \frac{\theta}{2}$ and $y = \sin \theta$, then the points for which $\frac{dy}{dx} = 0$ are given by

- (a) $\theta = \frac{n\pi}{2}, n \in \mathbb{Z}$
(b) $\theta = (2n + 1)\frac{\pi}{2}, n \in \mathbb{Z}$
(c) $\theta = (2n + 1)\pi, n \in \mathbb{Z}$
(d) $\theta = n\pi, n \in \mathbb{Z}$

162. If $y = (x - 1)^2(x - 2)^3(x - 3)^5$ then $\frac{dy}{dx}$ at $x = 4$ is equal to

- (a) 108 (b) 54
(c) 36 (d) 516

163. A particle starts from rest and its angular displacement (in radians) is given by $\theta = \frac{t^2}{20} + \frac{t}{5}$. If the angular velocity at the end of $t = 4$ is k , then the value of k is
 (a) 0.6 (b) 5
 (c) 5 k (d) 3
164. If the parabola $y = \alpha x^2 - 6x + \beta$ passes through the point $(0, 2)$ and has its tangent at $x = \frac{3}{2}$ parallel to x axis, then
 (a) $\alpha = 2, \beta = -2$ (b) $\alpha = -2, \beta = 2$
 (c) $\alpha = 2, \beta = 2$ (d) $\alpha = -2, \beta = -2$
165. The function $f(x) = x^2 - 2x$ is strictly decreasing in the interval
 (a) $(-\infty, 1)$ (b) $(1, \infty)$
 (c) $\mathbb{R}$ (d) $(-\infty, \infty)$
166. The maximum slope of the curve $y = -x^3 + 3x^2 + 2x - 27$ is
 (a) 1 (b) 23
 (c) 5 (d) -23
167. $\int \frac{x^3 \sin(\tan^{-1}(x^4))}{1+x^8} dx$ is equal to
 (a) $\frac{-\cos(\tan^{-1}(x^4))}{4} + C$
 (b) $\frac{\cos(\tan^{-1}(x^4))}{4} + C$
 (c) $\frac{-\cos(\tan^{-1}(x^3))}{3} + C$
 (d) $\frac{\sin(\tan^{-1}(x^4))}{4} + C$
168. The value of $\int \frac{x^2 dx}{\sqrt{x^6 + a^6}}$ is equal to
 (a) $\log|x^3 + \sqrt{x^6 + a^6}| + c$
 (b) $\log|x^3 - \sqrt{x^6 + a^6}| + c$
 (c) $\frac{1}{3} \log|x^3 + \sqrt{x^6 + a^6}| + c$
 (d) $\frac{1}{3} \log|x^3 - \sqrt{x^6 + a^6}| + c$
169. The value of $\int \frac{xe^x dx}{(1+x)^2}$ is equal to
 (a) $e^x(1+x) + c$ (b) $e^x(1+x^2) + c$
 (c) $e^x(1+x)^2 + c$ (d) $\frac{e^x}{1+x} + c$
170. The value of $\int e^x \left[\frac{1+\sin x}{1+\cos x} \right] dx$ is equal to
 (a) $e^x \tan \frac{x}{2} + c$ (b) $e^x \tan x + c$
 (c) $e^x(1 + \cos x) + c$ (d) $e^x(1 + \sin x) + c$
171. If $I_n = \int_0^{\frac{\pi}{4}} \tan^n x dx$ where n is positive integer then $I_{10} + I_8$ is equal to
 (a) 9 (b) $\frac{1}{7}$
 (c) $\frac{1}{8}$ (d) $\frac{1}{9}$
172. The value of $\int_0^{4042} \frac{\sqrt{x} dx}{\sqrt{x} + \sqrt{4042-x}}$ is equal to
 (a) 4042 (b) 2021
 (c) 8084 (d) 1010
173. The area of the region bounded by $y = \sqrt{16 - x^2}$ and x -axis is
 (a) 8 square units (b) 20π square units
 (c) 16π square units (d) 256π square units
174. If the area of the Ellipse is $\frac{x^2}{25} + \frac{y^2}{\lambda^2} = 1$ is 20π square units, then λ is
 (a) ± 4 (b) ± 3
 (c) ± 2 (d) ± 1

175. Solution of Differential Equating $xdy - ydx = 0$ represents

- (a) A rectangular Hyperbola
- (b) Parabola whose vertex is at origin
- (c) Straight line passing through origin
- (d) A circle whose centre is origin

176. The number of solutions of $\frac{dy}{dx} = \frac{y+1}{x-1}$ when $y(1) = 2$ is

- (a) three
- (b) one
- (c) infinite
- (d) two

177. A vector $\vec{a}$ makes equal acute angles on the coordinate axis. Then the projection of vector $\vec{b} = 5\hat{i} + 7\hat{j} + \hat{k}$ on $\vec{a}$ is

- (a) $\frac{11}{15}$
- (b) $\frac{11}{\sqrt{3}}$
- (c) $\frac{4}{5}$
- (d) $\frac{3}{5\sqrt{3}}$

178. The diagonals of a parallelogram are the vectors $3\hat{i} + 6\hat{j} - 2\hat{k}$ and $-\hat{i} - 2\hat{j} - 8\hat{k}$ then the length of the shorter side of parallelogram is

- (a) $2\sqrt{3}$
- (b) $\sqrt{14}$
- (c) $3\sqrt{5}$
- (d) $\sqrt{29}$

179. If $\vec{a} \cdot \vec{b} = 0$ and $\vec{a} + \vec{b}$ makes an angle 60° with $\vec{a}$ then

- (a) $|\vec{a}| = 2|\vec{b}|$
- (b) $2|\vec{a}| = |\vec{b}|$
- (c) $|\vec{a}| = \sqrt{3}|\vec{b}|$
- (d) $\sqrt{3}|\vec{a}| = |\vec{b}|$

180. If the area of the parallelogram with $\vec{a}$ and $\vec{b}$ as two adjacent sides is 15 sq. units then the area of the parallelogram having $3\vec{a} + 2\vec{b}$ and $\vec{a} + 3\vec{b}$ as two adjacent sides in sq. units is

- (a) 45
- (b) 75
- (c) 105
- (d) 120

Biology

181. How many microsporangia are located at the corners of a typical bilobed anther of angiosperm?

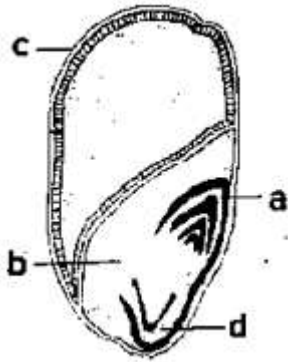
- (a) 2
- (b) 4
- (c) 8
- (d) 1

182. In Bryophytes & Pteridophytes the number of male gametes produced is several thousand times the number of female gametes produced.

Reason: Large number of male gametes fail to reach the female gametes during transport.

- (a) Assertion is correct but reason is incorrect.
- (b) Both Assertion and reason are correct.
- (c) Both Assertion and reason are incorrect.
- (d) Assertion is incorrect but reason is correct.

183. In the given diagram identify the parts labelled as a.b.c. and d.



- (a) a → Coleoptile, b → Scutellum, c → Pericarp, d → Coleorhiza
 (b) a → Coleoptile, b → Scutellum, c → Coleorhiza, d → Pericarp
 (c) a → Pericarp, b → Coleorhiza, c → Scutellum, d → Coleoptile
 (d) a → Coleorhiza, b → Coleoptile, c → Scutellum, d → Pericarp

184. Consider the following statements & choose the correct answer from the given options.

Statement 1: Innermost layer of microsporangium is tapetum.

Statement 2: Cells of tapetum possess dense cytoplasm more than one nucleus and nourishes developing pollen grains.

- (a) Both Statements 1&2 are incorrect.
 (b) Both Statements 1&2 are correct.
 (c) Statement 1 is correct & 2 is incorrect.
 (d) Statement 2 is correct & 1 is incorrect.

185. Identify the correct statement.

- (a) Only one megaspore present towards chalazal end remains functional.
 (b) 3 megaspore present towards chalazal end degenerate gradually.
 (c) Each megaspore mother cell, directly develops into a megaspore.
 (d) Each female gametophyte is 7-celled & 7-nucleated structure.

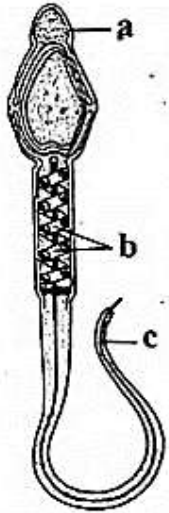
186. Which of the following aquatic plant does not show pollination by water?

- (a) Vallisneria (b) Hydrilla
 (c) Water hyacinth (d) Zostera

187. Which cell of the female gametophyte is involved in the formation of primary endosperm nucleus (PEN) after fertilization?

- (a) Antipodals (b) Synergids
 (c) Egg cell (d) Central cell

188. In the given diagram of human sperm, identify the functions of the labelled parts. a, b and c :



- (a) a → Helps in penetration of sperm into ovum.
 b → Helps in movement of sperm.
 c → Provides energy for the movement of sperms into the female reproductive tract.
- (b) a → Helps in penetration of sperm into ovum
 b → Provides energy for the movement of sperm
 c → Helps in movement of sperm
- (c) a → Helps in movement of sperm
 b → Helps in penetration of sperm into ovum
 c → Provides energy for the movement of sperms
- (d) a → Provides energy for the movement of sperm
 b → Helps in movement of sperm
 c → Helps in penetration of sperm into ovum

189. Select the correct path of flow of milk during breast feeding.

- (a) Mammary tubules → Mammary duct → Mammary ampulla → Lactiferous duct → Alveoli
 (b) Mammary tubules → Mammary duct → Lactiferous duct → Mammary ampulla → Alveoli
 (c) Alveoli → Mammary tubules → Mammary ampulla → Mammary duct → Lactiferous duct
 (d) Alveoli → Mammary tubules → Mammary duct → Mammary ampulla → Lactiferous duct

190. Under the influence of oxytocin which layer of the uterus exhibits strong contractions during parturition?

- (a) Endometrium (b) Myometrium
 (c) Perimetrium (d) Both (a) and (c)

191. Select the incorrect statement about contraceptives.

- (a) They are regular requirements for the maintenance of reproductive health.
 (b) They have a significant role in checking uncontrolled growth of population.
 (c) They are practised against a natural reproductive events like conception or pregnancy.
 (d) The possible ill-effects like nausea, abdominal pain; irregular menstrual bleeding or even breast cancer should not be totally ignored.

192. The method of directly injecting a sperm into ovum is called

- (a) GIFT (b) ZIFT
 (c) ICSI (d) IVF-ET

193. Match Column I with Column II and find the correct answer:

Column I	Column II
(1) Aneuploidy	p. Increase in whole set of chromosomes
(2) Monoploidy	q. Loss or gain of a chromosome
(3) Polyploidy	r. Two sets of chromosomes
(4) Diploidy	s. A single set of chromosomes

- (a) $1 - p^2 - q^3 - r^4 - s$
 (b) $1 - r^2 - p^3 - q^4 - s$
 (c) $1 - q^2 - s^3 - p^4 - r$
 (d) $1 - s^2 - r^3 - p^4 - q$

194. The genotype of a husband and wife are $I^A I^B$ & $I^A i$. Among the blood types of their children, how many different genotypes & phenotypes are possible?

- (a) 3 genotypes; 3 phenotypes
 (b) 4 genotypes; 3 phenotypes
 (c) 4 phenotypes; 3 genotypes
 (d) 4 phenotypes; 4 genotypes

195. What is the possible blood group of children whose parents are heterozygous for A&B blood groups?

- (a) A, B only (b) A, B, AB&O
 (c) AB only (d) A, B & AB only

196. Match the Column I with Column II:

Column I

Column II

- | | |
|--------------------------|----------------------------|
| (i) Autosomal trisomy | (p) Turner's Syndrome |
| (ii) Allosomal trisomy | (q) Mendelian disorder |
| (iii) Allosomal Monosomy | (r) Klinefelter's Syndrome |
| (iv) Cystic fibrosis | (s) Down's Syndrome |

i ii iii iv

- (a) p q r s
 (b) p q s r
 (c) s r q p
 (d) s r p q

197. Which among the following characters selected by Mendel in a pea plant is a recessive character?

- (a) Inflated (full) pod (b) Green pod colour
 (c) White flower (d) Axillary flower

198. Match the scientists of Column I with their contributions in Column II:

Column I

Column II

- | | |
|------------------------|--|
| (i) Griffith | (p) Lac operon |
| (ii) Jacob & Monad | (q) DNA is the genetic material |
| (iii) Meselson & Stahl | (r) Transforming principle |
| (iv) Hershey and Chase | (s) DNA replicates semi-conservatively |

i ii iii iv

- (a) p q r s
 (b) p s q r

(c) r p s q

(d) r q p s

199. In which region of the t-RNA molecule is the amino-acid binding site located?

- (a) 5' end (b) anticodon loop
(c) 3' end (d) None of the above

200. E. Coli fully labelled with ^{15}N is allowed to grow in ^{14}N medium. The two strands of DNA molecule of the first-generation bacteria have

- (a) Same density and resemble with their parent DNA
(b) Same density but do not resemble with their parent DNA
(c) Different density but do not resemble with their parent DNA
(d) Different density but resemble with their parent DNA

201. Experiments involving use of radioactive thymidine to detect distribution of newly synthesized DNA in the chromosome was performed on which plant?

- (a) Vicia faba (b) Pisum Sativum
(c) Cocos nucifera (d) Antirrhinum

202. If the sequence of nucleotides in a template strand of DNA is 3'-ATGCTTCCGAAT-5'. Write the sequence in the corresponding region of the transcribed m-RNA.

- (a) 5' - TAC GAA GGC CTT - 3'
(b) 5' - UAC GAA GGC UUA - 3'
(c) 3' - UAC GAA GGC UUA - 5'
(d) 3' - TAC GAA GGC CTT - 5'

203. Pneumonia is caused by

- (a) Streptococcus pneumonia
(b) Haemophilus influenzae
(c) Both (a) & (b)
(d) None

204. The development of quick immune response in a person infected with deadly microbes by administering preformed antibodies is

- (a) Active immunity
(b) Cell-mediated immunity
(c) innate immunity
(d) Passive immunisation

205. Which is the most feared property of malignant tumors?

- (a) Neoplasia
(b) Metastasis
(c) Rapid invasive growth
(d) Loss of contact inhibition

206. Identify the techniques useful in detecting the cancers of internal organs.

- (a) CT (b) MRI
(c) Radiography (d) All of the above

207. Which among the following plants is a source of drug which is native to America?

- (a) Papaver Somniferum
(b) Erythroxylum coca
(c) Cannabis sativa
(d) Atropa belladonna

208. The technology of biogas production was developed in India due to the efforts of

- (a) KVIC (b) IARI
(c) CDRI (d) Both a and b

209. Which among the following products of microbes is not obtained from fungi?

- (a) Penicillin (b) Statins
(c) Swiss cheese (d) Cyclosporin-A

210. Match the following:

Column I

- (i) Cyclosporin – A
(ii) Streptokinase
(iii) Statins
(iv) Penicillin

Column II

- (a) Clot busters
(b) b. Antibiotic
(c) Immuno suppressive agent
(d) Blood cholesterol lowering agent

i. ii iii iv

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

211. Taq polymerase that finds its application in PCR is obtained from

- (a) Thermus aquaticus
(b) Agrobacterium tumefaciens
(c) Bacillus thuringiensis
(d) Salmonella typhimurium

212. Rop-gene which codes for the proteins involved in the replication of the plasmid pBR322 in E. coli is located at restriction site of

- (a) Hind III (b) EcoRI
(c) Pvu II (d) BamH I

213. Rapid antigen test and RT-PCR are the two -diagnosis test for Covid-19 virus. PCR, a molecular diagnostic tool, stands for

- (a) Polymerase chain reaction
(b) Polymerase chain reagent
(c) Physiological chain reaction
(d) Physiological chain reagent

214. Which of the following diagnostic tools allows the detection of very low concentration of bacterium or viruses by amplifying their nucleic acid?

- (a) ELISA (b) PCR
(c) Autoradiography (d) r-DNA technology

215. Silencing of a gene could be achieved through the use of

- (a) Short interfering RNA (RNAi)
(b) Antisense RNA
(c) By both A & B
(d) None of the above

216. $\alpha - 1$ antitrypsin is

- (a) an antacid

- (b) an enzyme
- (c) used to treat emphysema
- (d) used to treat arthritis

217. Identify the correct statement/s from the following:

- (1) *Cuscuta* is a chlorophyllous endoparasite.
 - (2) The human liverfluke needs only one host to complete its life cycle.
 - (3) The life cycle of endoparasite is more complex due to their extreme specialisation.
 - (4) During the course of evolution the host bird's eggs have evolved to resemble the eggs of the parasitic bird.
- (a) 1,2,3 (b) 2,4
(c) Only 3 (d) 1, 3 and 4

218. Relate Column I with Column II with regard to predatory behaviour.

Column I

Column II

- | | |
|--------------------------|--------------------------|
| (1) <i>Calotropis</i> | p. Invertebrates |
| (2) <i>Pisaster</i> | q. Distasteful |
| (3) Monarch butterfly | r. Cryptically coloured |
| (4) Frogs | s. Cardioglycoside |
| (a) 1-s 2 - p 3 - r 4 - | (b) 1 - 2 - p 3 - q 4 -r |
| (c) 1 - q2 - s3 - p4 - p | (d) 1 - r2 - p3 - q4 - s |

219. Small mammals and birds are rarely found in polar regions. The reason is that

- (a) They have a larger surface area relative to their volume
- (b) They tend to gain heat very fast
- (c) They expend less energy to generate body heat
- (d) None of the above

220. Identify the incorrect statement.

- (a) CAM plants close their stomata during daytime
- (b) Seals have a thick layer of fat to reduce body heat
- (c) Lizards bask in the sun during winter
- (d) Tribes living in high altitude have the same RBC count as people living in the plains.

221. Population size keeps changing depending on different factor/s such as

- (a) Food availability(b) Predation pressure
- (c) Adverse weather(d) All of the above

222. Identify the incorrect statement.

- (1) Speciation is generally a function of time.
 - (2) Tropical environment is less seasonal, relatively more constant and predictable.
 - (3) Solar energy contributes to high productivity
 - (4) Temperate regions have remained relatively undisturbed for millions of years.
- (a) 1,2,3,4 (b) 2,3
(c) Only 4 (d) 3,4

223. The correct equation depicting species-area relationship is

- (a) $\log S = \log C + Z \log A$
- (b) $\log C = \log S + Z \log A$
- (c) $\log A = \log C + Z \log S$
- (d) $\log Z = \log C + S \log A$

224. Match Column I and Column II

Column I

Column II

- (1) Narrowly utilitarian argument
(2) Broadly utilitarian argument

- p. Conserving biodiversity for major ecosystem services.
q. Every species has an intrinsic value and moral duty to

pass our biological legacy in good order to future generation.

- (3) Ethical argument

- r. Receiving benefits like food, medicine & industrial products.

(a) 1 – p2 – q3 – r

(b) 1 – q2 – r3 – p

(c) 1 – r2 – p3 – q

(d) 1 – r2 – q3 – p

225. Identify the correct statement/s about ex situ conservation.

Advanced ex situ conservation includes

(i) Cryopreservation of gametes.

(ii) Plant tissue culture method.

(iii) Seed bank.

(iv) In vitro fertilisation.

(a) Only ii

(b) i & ii

(c) i, ii, iii, iv

(d) None of the above

226. The concept of "Contagium vivum fluidum" was given by

- (a) D. J. Ivanowsky (b) W. M. Stanley
(c) M.W. Beijerinck (d) R. H. Whittaker

227. Identify the odd one out.

- (a) Ustilago (b) Alternaria
(c) Colletotrichum (d) Trichoderma

228. The plant body having holdfast, stipe and frond is a characteristic of

- (a) Laminaria (b) Volvox
(c) Gelidium (d) Porphyra

229. Identify the correct statement/s regarding class aves.

(1) Forelimbs are modified into wings and hindlimbs are modified for walking and swimming.

(2) Heart is completely four-chambered.

(3) They are homeotherms.

(4) They are oviparous and development is direct.

(a) Both 1 and 3

(b) Both 1 and 4

(c) 1, 2 and 3

(d) All are correct

230. Epigynous flower is one in which

- (a) Ovary is superior and other floral parts are inferior
(b) Ovary is inferior and other floral parts are superior
(c) All the floral parts are at the same level
(d) None of the above

231. The following type of cell junction is not found in animal tissues

- (a) Adhering junction (b) Tight junction
(c) Gap junction (d) Loose junction

232. A bacterial flagellum is composed of

- (a) Filament, hook and basal body
(b) Vesicles, tubules and lamellae
(c) Pili, Fimbriae and filament
(d) Hook, tubules and Fimbriae

233. Match the compounds of Column I with their functions in Column II.

Column I

- (1) Trypsin
(2) GLUT – 4
(3) Collagen
(4) Antibody

- (a) 1 - s 2 - r 3 - q 4 - p
(c) 1 - 52 - r3 - p4 - q

Column II

- (p) Fights infectious agents
(q) Is an intercellular ground substance
(r) Works as an enzyme
(s) Enables glucose transport into cells.

- (b) 1 - r 2 - s 3 - p4 - q
(d) 1 - r2 - s3 - q4 - p

234. The correct sequence of events in prophase I is

- (a) Synapsis → Crossing over → Chiasmata → Terminalisation.
(b) Crossing over → Synapsis → Chiasmata → Terminalisation.
(c) Chiasmata → Synapsis → Crossing over → Terminalisation.
(d) Chiasmata → Crossing over → Synapsis → Terminalisation.

235. The enzyme that is not found in C_3 plants is

- (a) ATP synthase (b) RUBP carboxylase
(c) NADP reductase (d) PEP carboxylase

236. Match the location of the cell given in Column I with its function in Column II.

Column I

Column II

- | | |
|----------------------------------|----------------------------|
| (1) Mitochondrial matrix | (p) Kreb's cycle |
| (2) Cytoplasm | (q) ETC |
| (3) F_0 and F_1 | (r) Glycolysis |
| (4) Inner mitochondrial membrane | (s) ATP synthesis |
| (a) 1 - p 2 - r 3 - s 4 - q | (b) 1 - q 2 - s 3 - q4 - r |
| (c) 1 - r2 - q3 - p4 - s | (d) 1 - s2 - p3 - r4 - q |

237. Identify the incorrect statement/s.

- (1) Kinetin is a derivative of Adenine which is a pyrimidine.
(2) The technique of decapitation is widely used in tea plantations.
(3) Ethylene is a gaseous plant hormone.
(4) Use of GA_3 hastens the malting process in brewing industry.

ABA is a growth promoter.

- (a) 1,2,3,4 (b) Only 3
(c) 2, 3, 4 (d) 1 and 5

238. Calculate the cardiac output of an individual having 70 heart beats/min with a stroke volume of 55 ml.

- (a) 3750 ml (b) 125 ml
(c) 3850 ml (d) None of the above

239. In a standard ECG, one of the following functions of its components is not correctly interpreted.

- (a) P is the contraction of only left atria.
(b) QRS complex represents ventricular contraction.
(c) T is the end of systole.
(d) P is the contraction of both atria.

240. Match the hormones of Column I with its functions in Column II.

Column I

Column II

- | | |
|--------------------|---------------------|
| (1) Catecholamines | (p) Diurnal rhythm |
| (2) MSH | (q) Immune response |
| (3) Thymosins | (r) Pigmentation |
| (4) Melatonin | (s) Stress hormone |

(a) $1 - s^2 - r^3 - 4 - p$

(b) $1 - r^2 - q^3 - s^4 - p$

(c) $1 - q^2 - s^3 - r^4 - p$

(d) $1 - p^2 - q^3 - r_4^{-s}$

