

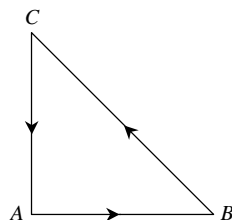
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1. The physical quantities not having same dimensions are

- (1) Speed and $(\mu_0 \epsilon_0)^{-1/2}$ (2) Torque and work
(3) Momentum and Planck's constant (4) Stress and Young's modules

Sol. (3) Momentum $[P] = [MLT^{-1}]$ and Plank 's constant $[h] = [ML^2T^{-1}]$

2. Three forces starts acting simultaneously on a particle moving with velocity \vec{v} . These forces are represented in magnitude and direction by the three sides of a triangle ABC (as shown). The particle will now move with velocity



- (1) \vec{v} remaining unchanged (2) Less than \vec{v}
(3) Greater than \vec{v} (4) \vec{v} in the direction of the largest force BC

Sol. (1) Net force on the particle is zero so the \vec{v} remains unchanged

3. The coordinates of a moving particle at any time 't' are given by $x = \alpha t^3$ and $y = \beta t^3$. The speed of the particle at time 't' is given by

- (1) $\sqrt{\alpha^2 + \beta^2}$ (2) $3t \sqrt{\alpha^2 + \beta^2}$ (3) $3t^2 \sqrt{\alpha^2 + \beta^2}$ (4) $t^2 \sqrt{\alpha^2 + \beta^2}$

Sol. (3) $v_x = \frac{dx}{dt} = 3\alpha t^2$ and $v_y = 3\beta t^2$

$$\text{So, } v = \sqrt{v_x^2 + v_y^2} = 3t^2 \sqrt{\alpha^2 + \beta^2}$$

4. A car, moving with a speed of 50 km/hr, can be stopped by brakes after at least 6 m. If the same car is moving at a speed of 100 km/hr, the minimum stopping distance is

- (1) 6m (2) 12m (3) 18m (4) 24m

Sol. (4) $v^2 = u^2 - 2as \Rightarrow s \propto u^2$ [as $v = 0$ and $a = \text{constant}$]

In the problem the speed of car is doubled so minimum stopping distance will becomes four times

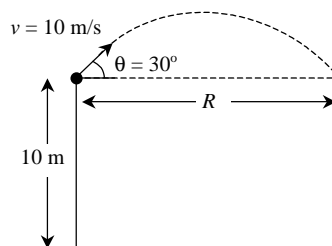
$$s = 4 \times 6m = 24m.$$

5. A boy playing on the roof of a 10m high building throws a ball with a speed of 10 m/s at an angle of 30° with the horizontal. How far from the throwing point will the ball be at the height of 10m from the ground ?

$$[g = 10 \text{ m/s}^2, \sin 30^\circ = \frac{1}{2}, \cos 30^\circ = \frac{\sqrt{3}}{2}]$$

- (1) 8.66 m (2) 5.20 m (3) 4.33 m (4) 2.60 m

Sol. (1) Simply we have to calculate the range of ball $R = \frac{v^2 \sin 2\theta}{g} = \frac{(10)^2 \sin(2 \times 30)}{10} = 5\sqrt{3} = 8.66 \text{ m}$



6. The displacement of a particle varies according to the relation $x = 4(\cos \pi t + \sin \pi t)$. The amplitude of the particle is

(1) 8 (2) -4 (3) 4 (4) $4\sqrt{2}$

Sol. (4) For $x = a \cos \omega t + b \sin \omega t$, resultant amplitude $= \sqrt{a^2 + b^2}$ so for given relation Amplitude $= \sqrt{4^2 + 4^2} = 4\sqrt{2}$

7. Consider the following two statements:

A. Linear momentum of a system of particles is zero

B. Kinetic energy of a system of particles is zero

Then,

(1) A implies B and B implies A (2)

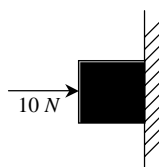
A does not imply B and B does not imply A

(3) A implies B but B does not imply A

(4) A does not imply B but B implies A

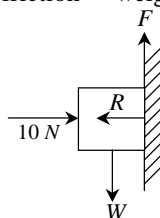
Sol. (4) If the kinetic energy of a system is zero then the Linear momentum necessarily be zero but if the linear momentum of a system is zero then it is not necessary that its kinetic energy necessarily be zero. Because Linear momentum is a vector quantity where as kinetic energy is a scalar quantity.

8. A horizontal force of 10 N is necessary to just hold a block stationary against a wall. The coefficient of friction between the block and the wall is 0.2. The weight of the block is



(1) 2 N (2) 20 N (3) 50 N (4) 100 N

Sol. (1) For critical condition \Rightarrow force of friction = weight $\Rightarrow F = W \Rightarrow \mu R = W$ $0.2 \times 10 = W \Rightarrow W = 2$ Newton.



9. A marble block of mass 2 kg lying on ice when given a velocity of 6 m/s is stopped by friction in 10s. Then the coefficient of friction is

(1) 0.01 (2) 0.02 (3) 0.03 (4) 0.04

Sol. () Wrong question

10. A light spring balance hangs from the hook of the other light spring balance and a block of mass M kg hangs from the former one. Then the true statement about the scale reading is

(1) Both the scales read $M/2$ kg each

(2) Both the scales read M kg each

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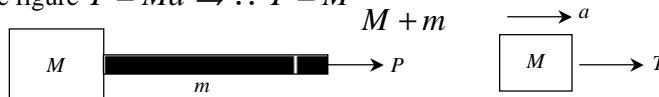
- (3) The scale of the lower one reads M kg and of the upper one zero
 (4) The reading of the two scales can be anything but the sum of the reading will be M kg

Sol. (2)

11. A block of mass M is pulled along a horizontal frictionless surface by a rope of mass m . If a force P is applied at the free end of the rope, the force exerted by the rope on the block is

- (1) $\frac{PM}{M+m}$ (2) $\frac{Pm}{M+m}$ (3) $\frac{Pm}{M-m}$ (4) P

Sol. (1) FBD of M is shown in the figure $T = Ma \Rightarrow \therefore T = M \frac{P}{M+m}$



12. A spring balance is attached to the ceiling of a lift. A man hangs his bag on the spring and the spring reads 49 N , when the lift is stationary. If the lift moves downward with an acceleration of 5 m/s^2 , the reading of the spring balance will be

- (1) 49 N (2) 24 N (3) 74 N (4) 15 N

Sol. (2) When the lift is stationary $R = mg \Rightarrow 49 = m \times 9.8 \Rightarrow m = 5\text{ kg}$

When the lift is moving downward with an acceleration $R = m(9.8 - a) \Rightarrow R = 5(9.8 - 5) = 24\text{ N}$

13. When a U^{238} nucleus originally at rest, decays by emitting an alpha particle having a speed ' u ', the recoil speed of the residual nucleus is

- (1) $-\frac{4u}{238}$ (2) $\frac{4u}{238}$ (3) $-\frac{4u}{234}$ (4) $\frac{4u}{234}$

Sol. (4) Initial momentum of the system = Mass \times velocity of nucleus = $238 \times 0 = 0$

Final momentum of the system = Momentum of α particle + Momentum of residual nucleus = $4u + 234v$

By equating $4u + 234v = 0 \Rightarrow \vec{v} = -\frac{4u}{234}$. But speed = $\frac{4u}{234}$

14. A body is moved along a straight line by a machine delivering a constant power. The distance moved by the body in time ' t ' is proportional to

- (1) $t^{1/2}$ (2) $t^{3/4}$ (3) $t^{3/2}$ (4) $t^{1/4}$

Sol. (3) $P = Fv = mav = m \frac{v}{t} v = \frac{mv^2}{t} = \frac{ms^2}{t^3} \Rightarrow s^2 \propto t^3 \Rightarrow s \propto t^{3/2}$ [P and m are constant]

15. A rocket with a lift-off mass $3.5 \times 10^4\text{ kg}$ is blasted upwards with an initial acceleration of 10 m/s^2 . Then the initial thrust of the blast is

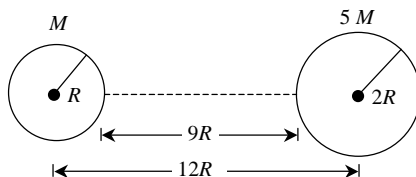
- (1) $1.75 \times 10^5\text{ N}$ (2) $3.5 \times 10^5\text{ N}$ (3) $7.0 \times 10^5\text{ N}$ (4) $14.0 \times 10^5\text{ N}$

Sol. (3) Initial thrust must be $m(g + a) = 3.5 \times 10^4(10 + 10) = 7 \times 10^5\text{ Newton}$.

16. Two spherical bodies of mass M and $5M$ and radii R and $2R$ respectively 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 just before collision is

- (1) $1.5 R$ (2) $2.5 R$ (3) $4.5 R$ (4) $7.5 R$

Sol. (4) Suppose distance travelled by masses M and $5M$ towards each other are d and d' respectively (before collision). Since position of cm always remains unchanged so



$$M \times d = 5M \times d' \Rightarrow d = 5d' \text{ and } d + d' = 9R \Rightarrow d + \frac{d}{5} = 9R \Rightarrow d = 7.5R$$

17. A particle performing uniform circular motion has angular momentum L . If its angular frequency is doubled and its kinetic energy halved, then the new angular momentum is

- (1) $\frac{L}{2}$ (2) $\frac{L}{4}$ (3) $2L$ (4) $4L$

Sol. (2) $E = \frac{1}{2} L \omega \therefore L \propto \frac{E}{\omega}$ so if its angular frequency is doubled and its kinetic energy is halved then new angular momentum will become $\frac{1}{4}$ times.

18. Let F be the force acting on a particle having position vector \vec{r} and \vec{T} be the torque of this force about the origin. Then

- (1) $\vec{r} \cdot \vec{T} = 0$ and $\vec{F} \cdot \vec{T} = 0$ (2) $\vec{r} \cdot \vec{T} = 0$ and $\vec{F} \cdot \vec{T} \neq 0$
 (3) $\vec{r} \cdot \vec{T} \neq 0$ and $\vec{F} \cdot \vec{T} = 0$ (4) $\vec{r} \cdot \vec{T} \neq 0$ and $\vec{F} \cdot \vec{T} \neq 0$

Sol. (1) $\vec{T} = \vec{r} \times \vec{F}$ we know that T is perpendicular to both r and F
 So $\vec{r} \cdot \vec{T} = 0$ and $\vec{F} \cdot \vec{T} = 0$

19. A circular disc X of radius R is made from an iron plate of thickness t , and another disc Y of radius $4R$ is made from an iron plate of thickness $\frac{1}{4}t$. Then the relation between the moment of inertia I_X and I_Y is

- (1) $I_Y = 64 I_X$ (2) $I_Y = 32 I_X$ (3) $I_Y = 16 I_X$ (4) $I_Y = I_X$

Sol. (1) Moment of inertia of circular disc $I = \frac{1}{2} \rho \pi R^4 t \Rightarrow I \propto R^4 t$ (where ρ = density, R = Radius, t = thickness)

$$\frac{I_Y}{I_X} = \left(\frac{R_2}{R_1} \right)^4 \left(\frac{t_2}{t_1} \right) \Rightarrow (4)^4 \left(\frac{1}{4} \right) \Rightarrow I_Y = 64 I_X$$

20. The time period of a satellite of earth is 5 hours. If the separation between the earth and the satellite is increased to 4 times the previous value, the new time period will become

- (1) 20 hours (2) 10 hours (3) 80 hours (4) 40 hours

Sol. (4) $T \propto R^{3/2} \Rightarrow T_2 = T_1 \left(\frac{R_2}{R_1} \right)^{3/2} = T_1 (4)^{3/2} = 8 \times T_1 = 8 \times 5 = 40$ hours.

21. The escape velocity for a body projected vertically upwards from the surface of earth is 11 km/s. If the body is projected at an angle of 45° with the vertical, the escape velocity will be

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- (1) $\frac{11}{\sqrt{2}}$ km/s (2) $11\sqrt{2}$ km/s (3) 22 km/s (4) 11 km/s

Sol. (4) Escape velocity does not depend on angle of projection $v_e = \sqrt{\frac{2GM}{R}}$

- 22.** A mass M is suspended from a spring of negligible mass. The spring is pulled a little and then released so that the mass executes SHM of time period T . If the mass is increased by m , the time period becomes $\frac{5T}{3}$. Then the ratio of

$\frac{m}{M}$ is

- (1) $\frac{5}{3}$ (2) $\frac{3}{5}$ (3) $\frac{25}{9}$ (4) $\frac{16}{9}$

Sol. (4) First case $T = 2\pi\sqrt{\frac{M}{K}}$ (1) Second case

$$\frac{5T}{3} = 2\pi\sqrt{\frac{M+m}{K}} \quad \text{..... (2)}$$

By comparing above two equations $\frac{m}{M} = \frac{16}{9}$.

- 23.** A spring of spring constant 5×10^3 N/m is stretched initially by 5 cm from the unstretched position. Then the work required to stretch it further by another 5 cm is

- (1) 6.25 N-m (2) 12.50 N-m (3) 18.75 N-m (4) 25.00 N-m

Sol. (3) Work done = $\frac{1}{2}K(x_2^2 - x_1^2) = \frac{1}{2} \times 5 \times 10^3 (10^2 - 5^2) \times 10^{-4} = 18.75 \text{ N-m}$

- 24.** A wire suspended vertically from one of its ends is stretched by attaching a weight of 200 N to the lower end. The weight stretches the wire by 1 mm. Then the elastic energy stored in the wire is

- (1) 0.1 J (2) 0.2 J (3) 10 J (4) 20 J

Sol. (1) $U = \frac{1}{2}Fx = \frac{1}{2} \times 200 \times 10^{-3} = 0.1 \text{ J}$

- 25.** A body executes simple harmonic motion. The potential energy (P.E.), the kinetic energy (K.E.) and total energy (T.E.) are measured as a function of displacement x . Which of the following statements is true ?

- (1) P.E. is maximum when $x = 0$ K.E. is maximum when $x = 0$
(3) T.E. is zero when $x = 0$ (4) K.E. is maximum when x is maximum

Sol. (2) Kinetic Energy is maximum at mean position $KE = \frac{1}{2}m\omega^2(a^2 - x^2)$

$$KE_{\max} = \frac{1}{2}m\omega^2a^2 \text{ (when } x = a \text{ i.e., mean position)}$$

- 26.** The length of a simple pendulum executing simple harmonic motion is increased by 21%. The percentage increase in the time period of the pendulum of increased length is

- (1) 10 % (2) 11 % (3) 21 % (4) 42 %

Sol. (1) $T = 2\pi\sqrt{\frac{l}{g}} \Rightarrow T \propto \sqrt{l} \Rightarrow \frac{T_2}{T_1} = \sqrt{\frac{l_2}{l_1}} = \sqrt{\frac{l_1 + 0.21l_1}{l_1}} \Rightarrow T_2 = T_1\sqrt{1.21} \Rightarrow T_2 = 1.1 T_1 = T_1 + 10\%$

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27. Two particles A and B of equal masses are suspended from two massless springs of spring constants k_1 and k_2 , respectively. If the maximum velocities, during oscillation, are equal, the ratio of amplitudes of A and B is

(1) $\frac{k_1}{k_2}$ (2) $\sqrt{\frac{k_1}{k_2}}$ (3) $\frac{k_2}{k_1}$ (4) $\sqrt{\frac{k_2}{k_1}}$

Sol. (4) $(v_{\max})_A = (v_{\max})_B \Rightarrow a_A \omega_A = a_B \omega_B \Rightarrow a_A \sqrt{\frac{k_A}{m_A}} = a_B \sqrt{\frac{k_B}{m_B}} \quad [m_A = m_B \text{ given}]$

$$a_A \sqrt{k_1} = a_B \sqrt{k_2} \Rightarrow \frac{a_A}{a_B} = \sqrt{\frac{k_2}{k_1}}$$

28. A metal wire of linear mass density of 9.8 g/m is stretched with a tension of 10 kg weight between two rigid supports 1 metre apart. The wire passes at its middle point between the poles of a permanent magnet, and it vibrates in resonance when carrying an alternating current of frequency n . The frequency n of the alternating source is

(1) 25 Hz (2) 50 Hz (3) 100 Hz (4) 200 Hz

- Sol.** (2) In condition of resonance frequency of A.C. will be equal to natural frequency of wire

$$n = \frac{1}{2l} \sqrt{\frac{T}{\mu}} = \frac{1}{2 \times 1} \sqrt{\frac{10 \times 9.8}{9.8 \times 10^{-3}}} = \frac{100}{2} = 50 \text{ Hz}$$

29. The displacement y of a wave travelling in the x -direction is given by $y = 10^{-4} \sin \left(600t - 2x + \frac{\pi}{3} \right)$ metres, where x is expressed in metres and t in seconds. The speed of the wave-motion, in ms^{-1} , is

(1) 200 (2) 300 (3) 600 (4) 1200

Sol. (2) $y = a \sin (\omega t - kx + \phi)$ in above equation wave velocity $v = \frac{\omega}{k}$

So by comparing this with given equation $\omega = 600$, $k = 2$ so $v = 300 \text{ m/s}$

30. A tuning fork of known frequency 256 Hz makes 5 beats per second with the vibrating string of a piano. The beat frequency decreases to 2 beats per second when the tension in the piano string is slightly increased. The frequency of the piano string before increasing the tension was

(1) $256 + 5 \text{ Hz}$ (2) $256 + 2 \text{ Hz}$ (3) $256 - 2 \text{ Hz}$ (4) $256 - 5 \text{ Hz}$

- Sol.** (4) Frequency of tuning fork = 256 Hz it gives 5 beats with piano so probable frequency of piano will be 251 or 261 Hz and when the tension is increased the frequency of piano will also increase ($n \propto \sqrt{T}$) and if it again sounded with fork. Number of beats are decreasing it means the original frequency of piano string was 251 Hz.

31. A carnot engine takes 3×10^6 cal. of heat from a reservoir at 627°C , and gives it to a sink at 27°C . The work done by the engine is

(1) Zero (2) $4.2 \times 10^6 \text{ J}$ (3) $8.4 \times 10^6 \text{ J}$ (4) $16.8 \times 10^6 \text{ J}$

Sol. (3) $\frac{T_2}{T_1} = \frac{Q_2}{Q_1} \Rightarrow \frac{300}{900} = \frac{Q_2}{3 \times 10^6} \Rightarrow Q_2 = 10^6 \text{ cal.}$

$$\text{Work done} = Q_1 - Q_2 = 3 \times 10^6 - 10^6 = 2 \times 10^6 \text{ cal} = 2 \times 4.2 \times 10^6 \text{ J} = 8.4 \times 10^6 \text{ J}$$

32. "Heat cannot by itself flow from a body at lower temperature to a body at higher temperature: is a statement of consequence of

(1) First law of thermodynamics (2) Second law of thermodynamics
(3) Conservation of momentum (4) Conservation of mass

- Sol.** (2)

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33. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its absolute temperature. The ratio C_p / C_v for the gas is

- (1) $\frac{3}{2}$ (2) $\frac{4}{3}$ (3) 2 (4) $\frac{5}{3}$

Sol. (1) Adiabatic law $P^{1-\gamma} T^\gamma = \text{constant}$ $P \propto T^{\gamma/\gamma-1}$ given that $P \propto T^3 \therefore \frac{\gamma}{\gamma-1} = 3 \Rightarrow \gamma = \frac{3}{2}$

34. Which of the following parameters does not characterize the thermodynamic state of matter?

- (1) Volume (2) Temperature (3) Pressure (4) Work

Sol. (4)

35. According to Newton's law of cooling, the rate of cooling of a body is proportional to $(\Delta\theta)^n$, where $\Delta\theta$ is the difference of the temperature of the body and the surroundings, and n is equal to

- (1) One (2) Two (3) Three (4) Four

Sol. (1)

36. The earth radiates in the infra-red region of the spectrum. The spectrum is correctly given by

- (1) Wien's law (2) Rayleigh Jeans law
(3) Planck's law of radiation (4) Stefan's law of radiation

Sol. (3)

37. To get three images of a single object, one should have two plane mirrors at an angle of

- (1) 30° (2) 60° (3) 90° (4) 120°

Sol. (3) By using $n = \left(\frac{360}{\theta} - 1 \right) \Rightarrow 3 = \frac{360}{\theta} - 1 \Rightarrow \theta = 90^\circ$

38. Consider telecommunication through optical fibres. Which of the following statements is not true?

- (1) Optical fibres may have homogeneous core with a suitable cladding
(2) Optical fibres can be of graded refractive index
(3) Optical fibres are subject to electromagnetic interference from outside
(4) Optical fibres have extremely low transmission

Sol. (3)

39. The image formed by an objective of a compound microscope is

- (1) Virtual and enlarged (2) Virtual and diminished (3) Real and diminished (4) Real and enlarged

Sol. (4)

40. To demonstrate the phenomenon of interference, we require two sources which emit radiation

- (1) Of the same frequency and having a defined phase relationship
(2) Of nearly the same frequency
(3) Of the same frequency
(4) Of different wavelengths

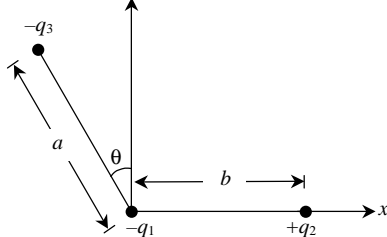
Sol. (1)

41. Dimensions of $\frac{1}{\mu_0 \epsilon_0}$, where symbols have their usual meaning, are

- (1) $[L T^{-1}]$ (2) $[L^{-1} T]$ (3) $[L^{-2} T^2]$ (4) $[L^2 T^{-2}]$

Sol. (4)

42. Three charges $-q_1$, $+q_2$ and $-q_3$ are placed as shown in the figure. The x -component of the force on $-q_1$ is proportional to



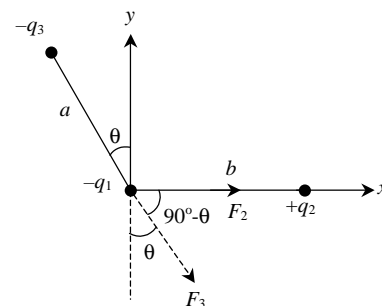
- (1) $\frac{q_2}{b^2} - \frac{q_3}{a^2} \sin \theta$ (2) $\frac{q_2}{b^2} - \frac{q_3}{a^2} \cos \theta$ (3) $\frac{q_2}{b^2} + \frac{q_3}{a^2} \sin \theta$ (4) $\frac{q_2}{b^2} + \frac{q_3}{a^2} \cos \theta$

Sol. (3) Component to net force acting along x -axis is

$$F_x = F_2 + F_3 \cos(90^\circ - \theta)$$

$$F_x = k \frac{q_1 q_2}{b^2} + k \frac{q_1 q_3}{a^2} \sin \theta$$

$$F_x = k q_1 \left[\frac{q_2}{b^2} + \frac{q_3}{a^2} \sin \theta \right] \Rightarrow F_x \propto \left[\frac{q_2}{b^2} + \frac{q_3}{a^2} \sin \theta \right]$$



43. A thin spherical conducting shell of radius R has a charge q . Another charge Q is placed at the centre of the shell. The electrostatic potential at a point P a distance $\frac{R}{2}$ from the centre of the shell is

- (1) $\frac{(q+Q)}{4\pi\epsilon_0 R} \cdot 2$ (2) $\frac{2Q}{4\pi\epsilon_0 R}$ (3) $\frac{2Q}{4\pi\epsilon_0 R} - \frac{2q}{4\pi\epsilon_0 R}$ (4) $\frac{2Q}{4\pi\epsilon_0 R} + \frac{q}{4\pi\epsilon_0 R}$

Sol. (4) Net potential at P

$$V = \frac{1}{4\pi\epsilon_0} \left[\frac{Q}{\left(\frac{R}{2}\right)} + \frac{1}{4\pi\epsilon_0} \cdot \frac{q}{R} \right] \Rightarrow V = \frac{2Q}{4\pi\epsilon_0 R} + \frac{q}{4\pi\epsilon_0 R}$$

44. If the electric flux entering and leaving an enclosed surface respectively is ϕ_1 and ϕ_2 , the electric charge inside the surface will be

- (1) $(\phi_1 + \phi_2)\epsilon_0$ (2) $(\phi_2 - \phi_1)\epsilon_0$ (3) $(\phi_1 + \phi_2)/\epsilon_0$ (4) $(\phi_2 - \phi_1)/\epsilon_0$

Sol. (2) Electric flux entering the surface (ϕ_1) taken negative while flux leaving the surface (ϕ_2) taken positive and

$$\text{according to Gauss Law } \phi_{\text{Total}} = \frac{1}{\epsilon_0} (Q_{\text{enclosed}}) \Rightarrow Q_{\text{enclosed}} = \phi_{\text{Total}} \times \epsilon_0 \Rightarrow Q_{\text{enclosed}} = (\phi_2 - \phi_1) \times \epsilon_0$$

45. The work done is placing a charge of 8×10^{-18} coulomb on a condenser of capacity 100 micro-farad is

- (1) 32×10^{-32} joule (2) 16×10^{-32} joule (3) 3.1×10^{-26} joule (4) 4×10^{-10} joule

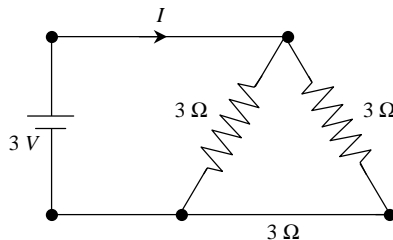
Sol. (1) By using $W = \frac{Q^2}{2C} \Rightarrow W = \frac{(8 \times 10^{-18})^2}{2 \times 100 \times 10^{-6}} = 32 \times 10^{-32} J$

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46. A sheet of aluminium foil of negligible thickness is introduced between the plates of a capacitor. The capacitance of the capacitor
- (1) Increases (2) Decreases (3) Remains unchanged (4) Becomes infinite

Sol. (3) By using $C' = \frac{\epsilon_0 A}{d-t}$. It $t \approx$ negligible, then $C' = \frac{\epsilon_0 A}{d}$

47. A 3 volt battery with negligible internal resistance is connected in a circuit as shown in the figure. The current, I , in the circuit will be



- (1) $1/3A$ (2) $1A$ (3) $1.5A$ (4) $2A$

Sol. (3) $R_{eq} = \frac{(3+3) \times 3}{(3+3)+2} = 2\Omega \therefore i = \frac{3}{2} = 1.5A$

48. An ammeter reads upto 1 ampere. Its internal resistance is 0.81 ohm. To increase the range to 10 A the value of the required shunt is

- (1) 0.09Ω (2) 0.03Ω (3) 0.3Ω (4) 0.9Ω

Sol. (1) By using $\frac{i}{i_g} = 1 + \frac{G}{S} \Rightarrow \frac{10}{1} = 1 + \frac{0.81}{S} \Rightarrow S = 0.09\Omega$

49. The length of a wire of a potentiometer is 100 cm, and the e.m.f. of its standard cell is E volt. It is employed to measure the e.m.f. of a battery whose internal resistance is 0.5Ω . If the balance point is obtained at $l = 30$ cm from the positive end, the e.m.f. of the battery is

- (1) $\frac{30E}{100}$
 (2) $\frac{30E}{100.5}$
 (3) $\frac{30E}{(100-0.5)}$
 (5) $\frac{30(E-0.5i)}{100}$, where i is the current in the potentiometer wire

Sol. (1) By using $E' = xl$ (E' = unknown emf, x = potential gradient) $\Rightarrow E' = \frac{E}{100} \times 30$

50. The length of a given cylindrical wire is increased by 100%. Due to the consequent decrease in diameter the change in the resistance of the wire will be

- (1) 300 % (2) 200 % (3) 100 % (4) 50 %

Sol. (1) By using $\frac{R_1}{R_2} = \left(\frac{l_1}{l_2}\right)^2 \Rightarrow$ If $l_1 = 100$ then $l_2 = 200 \Rightarrow \frac{R_1}{R_2} = \left(\frac{100}{200}\right)^2 \Rightarrow R_2 = 4R_1$

$$\text{So \% increase in resistance} = \frac{4R_1 - R_1}{R_1} \times 100 = 300 \%$$

51. A strip of copper and another of germanium are cooled from room temperature to 80 K. The resistance of
- (1) Each of these increases
 - (2) Each of these decreases
 - (3) Copper strip increases and that of germanium decreases
 - (4) Copper strip decreases and that of germanium increases

Sol. (4) For conductors **resistance** \propto **temperature** while for semiconductors **resistance** $\propto \frac{1}{\text{temperature}}$

52. A 220 volt, 1000 watt bulb is connected across a 110 volt mains supply. The power consumed will be
- (1) 1000 watt
 - (2) 750 watt
 - (3) 500 watt
 - (4) 250 watt

Sol. (4) By using $P_{\text{consumed}} = \left(\frac{V_A}{V_R} \right)^2 \times P_R = \left(\frac{110}{220} \right)^2 \times 1000 = 250 \text{ watt}$

53. The thermo e.m.f of a thermo-couple is $25 \mu V / ^\circ C$ at room temperature. A galvanometer of 40 ohm resistance, capable of detecting current as low as $10^{-5} A$, is connected with the thermocouple. The smallest temperature difference that can be detected by this system is
- (1) $20^\circ C$
 - (2) $16^\circ C$
 - (3) $12^\circ C$
 - (4) $8^\circ C$

Sol. (2) According to ohm's law $V = iR$ so here if temperature difference is $\Delta \theta$ then

$$25 \times 10^{-6} \times \Delta \theta = 10^{-5} \times 40 \Rightarrow \Delta \theta = 16^\circ C$$

54. The negative Zn pole of a Daniell cell, sending a constant current through a circuit, decreases in mass by 0.13 g in 30 minutes. If the electrochemical equivalent of Zn and Cu are 32.5 and 31.5 respectively, the increase in the mass of the positive Cu pole in this time is
- (1) 0.242 g
 - (2) 0.180 g
 - (3) 0.141 g
 - (4) 0.126 g

Sol. (4) By using $\frac{m_1}{m_2} = \frac{z_1}{z_2} \Rightarrow m_{cu} = m_{zn} \times \frac{z_{cu}}{z_{zn}} = 0.13 \times \frac{31.5}{32.5} = 0.126 \text{ g}$

55. A thin rectangular magnet suspended freely has a period of oscillation equal to T . Now it is broken into two equal halves (each having half of the original length) and one piece is made to oscillate freely in the same field. If its period of oscillation is T' , the ratio $\frac{T'}{T}$ is

- (1) $\frac{1}{4}$
- (2) $\frac{1}{2\sqrt{2}}$
- (3) $\frac{1}{2}$
- (4) 2

Sol. (3) By using $T' = \frac{T}{n} \Rightarrow \frac{T'}{T} = \frac{1}{n} \Rightarrow \frac{T'}{T} = \frac{1}{2}$

56. A particle of mass M and charge Q moving with velocity \vec{v} describes a circular path of radius R when subjected to a uniform transverse magnetic field of induction B . The work done by the field when the particle completes one full circle is

- (1) $BQ \times 2\pi R$
- (2) $\left(\frac{M v^2}{R} \right) 2\pi R$
- (3) Zero
- (4) $BQ \times 2\pi R$

Sol. (3)

57. A particle of charge -16×10^{-18} coulomb moving with velocity 10 ms^{-1} along the x -axis enters a region where a magnetic field of induction B is along the y -axis, and an electric field of magnitude 10^4 V/m is along the negative z -axis. If the charged particle continues moving along the x -axis, the magnitude of B is

- (1) 10^{-3} Wb/m^2 (2) 10^3 Wb/m^2 (3) 10^5 Wb/m^2 (4) 10^{16} Wb/m^2

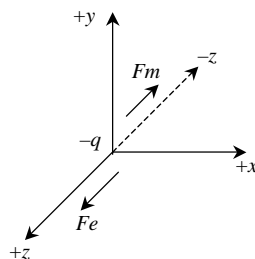
Sol. (2) Since particle is passing undeviated

$$\text{i.e., } (F_m) = (F_e)$$

$$\Rightarrow qvB = qE$$

$$\Rightarrow B = \frac{E}{v}$$

$$\Rightarrow B = \frac{10^4}{10} = 10^3 \text{ Wb/m}^2$$



58. Curie temperature is the temperature above which

- (1) A paramagnetic material becomes ferromagnetic
(2) A ferromagnetic material becomes paramagnetic
(3) A paramagnetic material becomes diamagnetic
(4) A ferromagnetic material becomes diamagnetic

Sol. (2)

59. A magnetic needle lying parallel to a magnetic field requires W units of work to turn it through 60° . The torque needed to maintain the needle in this position will be

- (1) $2W$ (2) $\sqrt{3} W$ (3) W (4) $\frac{\sqrt{3}}{2} W$

Sol. (2) Work done in deflecting magnetic needle through an angle θ $W = MB (1 - \cos \theta)$ and torque in this position

$$\tau = MB \sin \theta$$

$$\text{so } W = MB (1 - \cos 60^\circ) \Rightarrow W = \frac{MB}{2} \quad \dots (1)$$

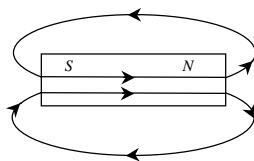
$$\text{and } \tau = MB \sin 60^\circ \Rightarrow \tau = \frac{\sqrt{3}MB}{2} \quad \dots (2)$$

$$\text{from equation (1)} \Rightarrow \tau = \sqrt{3} W$$

60. The magnetic lines of force inside a bar magnet

- (1) Are from south-pole to north-pole of the magnet
(2) Are from north-pole to south-pole of the magnet
(3) Do not exist
(4) Depend upon the area of cross-section of the bar magnet

Sol. (1)



61. Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon

- (1) The currents in the two coils
- (2) The rates at which currents are changing in the two coils
- (3) Relative position and orientation of the two coils
- (4) The materials of the wires of the coils

Sol. (3)

62. The core of any transformer is laminated so as to

- (1) Increase the secondary voltage
- (2) Reduce the energy loss due to eddy currents
- (3) Make it light weight
- (4) Make it robust and strong

Sol. (2)

63. When the current changes from $+2\text{ A}$ to -2 A in 0.05 second, an e.m.f. of 8 V is induced in a coil. The coefficient of self-induction of the coil is

- (1) 0.1 H
- (2) 0.2 H
- (3) 0.4 H
- (4) 0.8 H

Sol. (1) By using $e = -L \frac{di}{dt} \Rightarrow 8 = -L \frac{(-2-2)}{0.05} \Rightarrow L = 0.1\text{ H}$

64. In an oscillating LC circuit the maximum charge on the capacitor is Q . The charge on the capacitor when the energy is stored equally between the electric and magnetic field is

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

Sol. (4) In LC circuit energy stored in inductor at any instant $U_m = \frac{q_0^2}{2C} \cos^2 \omega t$ and energy stored at any instant in

capacitor $U_e = \frac{q_0^2}{2C} \sin^2 \omega t$ where $q_0 =$ maximum charge on capacitor

when $U_e = U_m$ i.e., $\frac{q_0^2}{2C} \cos^2 \omega t = \frac{q_0^2}{2C} \sin^2 \omega t \Rightarrow \omega t = \frac{\pi}{4}$

Also we know charge at any instant across the capacitor $q = q_0 \cos \omega t$ i.e., $q = q_0 \times \cos \frac{\pi}{4}$

$\Rightarrow q = \frac{q_0}{\sqrt{2}} = \frac{Q}{\sqrt{2}}$ ($q_0 =$ maximum charge $= Q$)

65. Which of the following radiations has the least wavelength ?

- (1) X-rays
- (2) γ -rays
- (3) β -rays
- (4) α -rays

Sol. (2)

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66. Two identical photo-cathodes receive light of frequencies f_1 and f_2 . If the velocities of the photo electrons (of mass m) coming out are respectively v_1 and v_2 , then

$$(1) \quad v_1 - v_2 = \left[\frac{2h}{m} (f_1 - f_2) \right]^{1/2} \quad (2)$$

$$v_1^2 - v_2^2 = \frac{2h}{m} (f_1 - f_2)$$

$$(3) \quad v_1 + v_2 = \left[\frac{2h}{m} (f_1 + f_2) \right]^{1/2} \quad (4)$$

$$v_1^2 + v_2^2 = \frac{2h}{m} (f_1 + f_2)$$

Sol. (2) $hf_1 = \phi_0 + \frac{1}{2}mv_1^2$ (1) and $hf_2 = \phi_0 + \frac{1}{2}mv_2^2$ (2)

Solving equation (1) and (2) we get $v_1^2 - v_2^2 = \frac{2h}{m} (f_1 - f_2)$

67. Which of the following cannot be emitted by radioactive substances during their decay ?

- (1) Electrons nuclei (2) Protons (3) Neutrinoes (4) Helium

Sol. (2)

68. A radioactive sample at any instant has its disintegration rate 5000 disintegrations per minute. After 5 minutes, the rate is 1250 disintegrations per minute. Then, the decay constant (per minute) is

- (1) $0.8 \ln 2$ (2) $0.4 \ln 2$ (3) $0.2 \ln 2$ (4) $0.1 \ln 2$

Sol. (2) $\lambda = \frac{\log_e \frac{A_1}{A_2}}{t} = \frac{\log_e \frac{5000}{1250}}{5} = 0.4 \ln 2$

69. A nucleus with $Z = 92$ emits the following in a sequence: $\alpha, \beta^-, \beta^-, \alpha, \alpha, \alpha, \alpha, \alpha, \beta^-, \beta^-, \alpha, \beta^+, \beta^+, \alpha$. The Z of the resulting nucleus is

- (1) 74 (2) 76 (3) 78 (4) 82

Sol. (3) Final $Z = 92 - 8 \times 2 + 4 \times 1 - 2 \times 1 = 78$

70. Which of the following atoms has the lowest ionization potential?

- (1) $^{16}_8\text{O}$ (2) $^{14}_7\text{N}$ (3) $^{133}_{55}\text{Cs}$ (4) $^{40}_{18}\text{Ar}$

Sol. (3)

71. The wavelengths involved in the spectrum of deuterium (^2_1D) are slightly different from that of hydrogen spectrum, because

- (1) The attraction between the electron and the nucleus is different in the two cases
(2) The size of the two nuclei are different
(3) The nuclear forces are different in the two cases
(4) The masses of the two nuclei are different

Sol. (4)

72. In the nuclear fusion reaction $^2_1\text{H} + ^3_1\text{H} \rightarrow ^4_2\text{He} + n$, given that the repulsive potential energy between the two nuclei is Na^+ , Ca^{2+} , Mg^{2+} the temperature at which the gases must be heated to initiate the reaction is nearly

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[Boltzmann's constant $k = 1.38 \times 10^{-23} \text{ J/K}$]

- (1) 10^9 K (2) 10^7 K (3) 10^5 K (4) 10^3 K

Sol. (1)

73. If the binding energy of the electron in a hydrogen atom is 13.6 eV , the energy required to remove the electron from the first excited state of Li^{++} is

- (1) 122.4 eV (2) 30.6 eV (3) 13.6 eV (4) 3.4 eV

Sol. (2) $E_i = \frac{13.6z^2}{n^2}$ here $n = 2$; $z = 3$ so $E_i = \frac{13.6 \times 3^2}{4} = 30.6 \text{ eV}$

74. The difference in the variation of resistance with temperature in a metal and a semiconductor arises essentially due to the difference in the

- (1) Variation of scattering mechanism with temperature
(2) Crystal structure
(3) Variation of the number of charge carriers with temperature
(4) Type of bonding

Sol. (3)

75. In the middle of the depletion layer of a reverse-biased p - n junction, the

- (1) Potential is zero (2) Electric field is zero
(3) Potential is maximum (4) Electric field is maximum

Sol. (4)

76. In Bohr series of lines of hydrogen spectrum, the third line from the red end corresponds to which one of the following inter-orbit jumps of the electron for Bohr orbits in an atom of hydrogen ?

- (1) $3 \rightarrow 2$ (2) $5 \rightarrow 2$ (3) $4 \rightarrow 1$ (4) $2 \rightarrow 5$

Sol. (2) IIIrd line of visible region of H_2 spectrum jumps from $5 \rightarrow 2$

77. The de Broglie wavelength of a tennis ball of mass 60 g moving with a velocity of $10 \text{ metres per second}$ is approximately

- (1) 10^{-33} metres (2) 10^{-31} metres (3) 10^{-16} metres (4) 10^{-25} metres

Sol. (1) $\lambda = \frac{h}{m.v} = \frac{6.626 \times 10^{-34}}{.06 \times 10} = 10^{-33} \text{ metres}$

78. The orbital angular momentum for an electron revolving in an orbit is given by $\sqrt{l(l+1)} \cdot \frac{h}{2\pi}$. This momentum for an s-electron will be given by

- (1) $+\frac{1}{2} \cdot \frac{h}{2\pi}$ (2) Zero (3) $\frac{h}{2\pi}$ (4) $\sqrt{2} \cdot \frac{h}{2\pi}$

Sol. (2) $mv\Omega = \frac{h}{2\pi} \sqrt{l(l+1)}$, thus for a 'S' orbital Angular momentum = 0

79. How many unit cells are present in a cube-shaped ideal crystal of NaCl of mass 1.00 g ? [Atomic masses : $\text{Na} = 23$, $\text{Cl} = 35.5$]

- (1) $2.57 \times 10^{21} \text{ unit cells}$ (2) $5.14 \times 10^{21} \text{ unit cells}$ (3) $1.28 \times 10^{21} \text{ unit cells}$ (4) $1.71 \times 10^{21} \text{ unit cells}$

Sol. (1) $NaCl = 58.5$ unit cell $\frac{6.023 \times 10^{23}}{4 \times 58.5}$

80. Glass is a

- (1) Micro-crystalline solid (2) Super-cooled liquid (3) Gel (4) Polymeric mixture

Sol. (2) Glass is a super cooled liquid.

81. Which one of the following statements is correct ?

- (1) Manganese salts give a violet borax bead test in the reducing flame
 (2) From a mixed precipitate of $AgCl$ and AgI , ammonia solution dissolves only $AgCl$
 (3) Ferric ions give a deep green precipitate on adding potassium ferrocyanide solution
 (4) On boiling a solution having K^+ , Ca^{2+} and HCO_3^- ions we get a precipitate of $K_2Ca(CO_3)_2$

Sol. (2) $AgCl$ dissolved in NH_3 solution when AgI is completely insoluble in NH_3 solution

82. According to the Periodic Law of elements, the variation in properties of elements is related to their

- (1) Atomic masses (2) Nuclear masses
 (3) Atomic numbers (4) Nuclear neutron-proton number ratios

Sol. (3) Factual

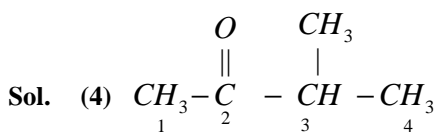
83. Graphite is a soft solid lubricant extremely difficult to melt. The reason for this anomalous behaviour is that graphite

- (1) Is a non-crystalline substance
 (2) Is an allotropic form of diamond
 (3) Has molecules of variable molecular masses like polymers
 (4) Has carbon atoms arranged in large plates of rings of strongly bound carbon atoms with weak interplate bonds

Sol. (4) Graphite has carbon atoms arranged in large plates of rings of strongly bond carbon atoms with weak interplate bonds.

84. The IUPAC name of $CH_3COCH(CH_3)_2$ is

- (1) Isopropylmethyl ketone (2) 2-methyl-3-butanone
 (3) 4-methylisopropyl ketone (4) 3-methyl-2-butanone



85. When $CH_2 = CH - COOH$ is reduced with $LiAlH_4$, the compound obtained will be

- (1) $CH_3 - CH_2 - COOH$ (2) $CH_2 = CH - CH_2OH$
 (3) $CH_3 - CH_2 - CH_2OH$ (4) $CH_3 - CH_2 - CHO$

Sol. (2) $CH_2 = CH - COOH \xrightarrow[2H]{LiAlH_4} CH_2 = CH_2 - CH_2 - OH + H_2O$

86. According to the kinetic theory of gases, in an ideal gas, between two successive collisions a gas molecule travels

- (1) In a circular path (2) In a wavy path
 (3) In a straight line path (4) With an accelerated velocity

Sol. (3) According to kinetic theory of gases molecules are moving in all direction in straight lines with very high velocity.

87. A reduction in atomic size with increase in atomic number is a characteristic of elements of

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- (1) High atomic masses series (2) d-block (3) f-block (4) Radioactive series

Sol. (3) f-block

88. The general formulas $C_nH_{2n}O_2$ could be for open chain

- (1) Diketones (2) Carboxylic acids (3) Diols (4) Dialdehydes

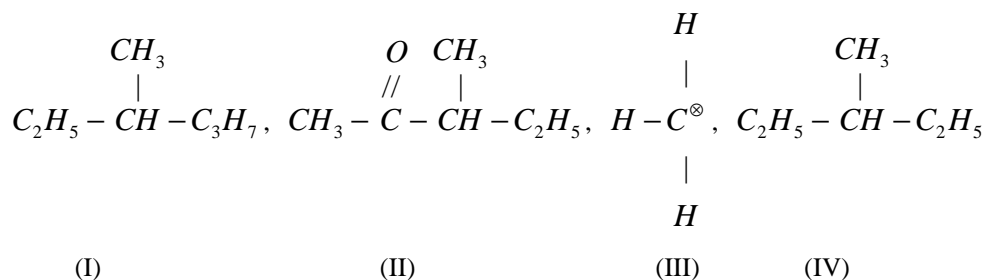
Sol. (2) General formula of carboxylic acid is $C_nH_{2n}O_2$.

89. An ether is more volatile than an alcohol having the same molecular formula. This is due to

- (1) Dipolar character of ethers (2) Alcohols having resonance structures
(3) Inter-molecular hydrogen bonding in ethers (4) Inter-molecular hydrogen bonding in alcohols

Sol. (4) Due to inter molecular H_2 bond in alcohols. B.P. of Alcohols is much then ether.

90. Among the following four structures I to IV,



it is true that

- (1) All four are chiral compounds (2) Only I and II are chiral compounds
(3) Only III is a chiral compound (4) Only II and IV are chiral compounds

Sol. (2) Chiral C, is present in only I & II structure.

91. Which one of the following processes will produce hard water

- (1) Saturation of water with $CaCO_3$ (2) Saturation of water with $MgCO_3$
(3) Saturation of water with $CaSO_4$ (4) Addition of Na_2SO_4 to water

Sol. (3) $CaCl_2 \cdot CaSO_4 / MgCl_2 \cdot MgSO_4$

92. Which one of the following compounds has the smallest bond angle in its molecule

- (1) SO_2 (2) OH_2 (3) SH_2 (4) NH_3

Sol. (3)

93. Which one of the following pairs of molecules will have permanent dipole moments for both members ?

- (1) SiF_4 and NO_2 (2) NO_2 and CO_2 (3) NO_2 and O_3 (4) SiF_4 and CO_2

Sol. (3) NO_2 & O_3 is unsymmetry structure.

94. Which one of the following groupings represents a collection of isoelectronic species ? (At. nos. : Cs : 55, Br : 35)

- (1) Na^+ , Ca^{2+} , Mg^{2+} (2) N^{3-} , F^- , Na^+ (3) Be , Al^{3+} , Cl^- (4) Ca^{2+} , Cs^+ , Br

Sol. (2) No. of electron is 10 in N^{3-} , F^- , Na^+ , $N^{3-} = 7 + 3$, $F^- = 9 + 1$, $Na^+ = 11 - 1$

95. In the anion $HCOO^-$ the two carbon-oxygen bonds are found to be of equal length. What is the reason for it

- (1) Electronic orbitals of carbon atom are hybridised

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- (2) The $C=O$ bond is weaker than the $C-O$ bond
(3) The anion $HCOO^-$ has two resonating structures
(4) The anion is obtained by removal of a proton from the acid molecule

Sol. (3) $FaCl$

96. The pair of species having identical shapes for molecules of both species is

- (1) CF_4, SF_4 (2) XeF_2, CO_2 (3) BF_3, PCl_3 (4) PF_5, IF_5

Sol. (2) XeF_2 & CO_2 is linear structure

97. The atomic numbers of vanadium (V), chromium (Cr), manganese (Mn) and iron (Fe) are respectively 23, 24, 25 and 26. Which one of these may be expected to have the highest second ionization enthalpy ?

- (1) V (2) Cr (3) Mn (4) Fe

Sol. (2) Electronic configuration of Cr is $\uparrow\uparrow\uparrow\uparrow\uparrow$ $3d$ \uparrow $4s$ so due to half filled orbital I.P. is high of Cr.

98. Consider the reaction equilibrium, $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$; $\Delta H^\circ = -198 kJ$. On the basis of Le Chatelier's principle, the condition favourable for the forward reaction is

- (1) Lowering of temperature as well as pressure (2) Increasing temperature as well as pressure
(3) Lowering the temperature and increasing the pressure (4) Any value of temperature and pressure

Sol. (3) According to Le Chatelier's principle, lowering the temperature & increasing the pressure is favourable condition for the reaction.

99. What volume of hydrogen gas, at 273 K and 1 atm, pressure will be consumed in obtaining 21.6 g of elemental boron (atomic mass = 10.8) from the reduction of boron trichloride by hydrogen ?

- (1) 89.6 L (2) 67.2 L (3) 44.8 L (4) 22.4 L

Sol. (2) $2BCl_3 + 3H_2 \rightarrow 2B + 6HCl$

$$(3 \times 22.4L) \quad (2 \times 10.8)$$

100. For the reaction equilibrium $N_2O_4(g) \rightarrow 2NO_2(g)$, the concentrations of N_2O_4 and NO_2 at equilibrium are 4.8×10^{-2} and $1.2 \times 10^{-2} \text{ mol L}^{-1}$ respectively. The value of K_c for the reaction is

- (1) $3.3 \times 10^2 \text{ mol L}^{-1}$ (2) $3 \times 10^{-1} \text{ mol L}^{-1}$ (3) $3 \times 10^{-3} \text{ mol L}^{-1}$ (4) $3 \times 10^3 \text{ mol L}^{-1}$

Sol. (3) $K_c = \frac{[1.2 \times 10^{-2}]^2}{4.8 \times 10^{-2}} = 3 \times 10^{-3} \text{ mol L}^{-1}$

101. The solubility in water of a sparingly soluble salt B_2 is $1.0 \times 10^{-5} \text{ mol L}^{-1}$. Its solubility product number will be

- (1) 4×10^{-15} (2) 4×10^{-10} (3) 1×10^{-15} (4) 1×10^{-10}

Sol. (1) $K_p = 2S^2 \times S = 4S^3, 4 \times (1.0 \times 10^{-5})^3 = 4 \times 10^{-15}$

102. Then during electrolysis of a solution of $AgNO_3$, 9650 coulombs of charge pass through the electroplating bath, the mass of silver deposited in the cathode will be

- (1) 1.08 g (2) 10.8 g (3) 21.6 g (4) 108 g

Sol. (2) $Ag^+ \xrightarrow{+e^-} Ag$, 96500 C. will liberate silver = 108 gm

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9650 C. will liberate silver = 10.8 gm

- 103.** For the redox reaction $Zn(s) + Cu^{2+}(0.1M) \rightarrow Zn^{2+}(1M) + Cu(s)$ taking place in a cell, E_{cell}^0 is 1.10 volt.

$$E_{cell} \text{ for the cell will be } \left(2.303 \frac{RT}{F} = 0.0591 \right)$$

- (1) 2.14 volt (2) 1.80 volt (3) 1.07 volt (4) 0.82 volt

Sol. (3) $\varepsilon = \varepsilon^o - \frac{0.059}{n} \log \frac{(Zn^{++})}{(Cu^{++})}$

$$1.10 - \frac{0.059}{2} \log \frac{1}{0.1}$$

$$1.10 - 0.0295 \log 10 = 1.07 \text{ volt}$$

- 104.** A 0.2 molal aqueous solution of a weak acid the degree of ionization is 0.3. Taking k_f for water as 1.85, the freezing point of the solution will be nearest to

- (1) $-0.480^\circ C$ (2) $-0.360^\circ C$ (3) $-0.260^\circ C$ (4) $+0.480^\circ C$

Sol. (1) $H\alpha \longrightarrow H^+ + \alpha^-$

$$1 \quad \quad \quad - \quad \quad \infty$$

$$1-x \quad \quad x + x$$

$$= 1 - x + x + x = 1 + x$$

- 105.** The rate law for a reaction between the substances A and B is given by, $\text{Rate} = k[A]^n[B]^m$. On doubling the concentration of A and halving the concentration of B, the ratio of the new rate to the earlier rate of the reaction will be as

- (1) $\frac{1}{2^{(m+n)}}$ (2) $(m+n)$ (3) $(n-m)$ (4) $2^{(n-m)}$

Sol. (4) $2^4 \left(\frac{1}{2} \right)^m = 2^{n-m}$

- 106.** 25 ml of a solution of barium hydroxide on titration with a 0.1 molar solution of hydrochloric acid gave a litre value of 35 ml. The molarity of barium hydroxide solution was

- (1) 0.07 (2) 0.14 (3) 0.28 (4) 0.35

Sol. (2) $m_1 v_1 = m_2 v_2, m_1 = \frac{.1 \times 35}{25} = .14$

- 107.** The correct relationship between free energy change in a reaction and the corresponding equilibrium constant K_c is

- (1) $\Delta G = RT \ln K_c$ (2) $-\Delta G = RT \ln K_c$ (3) $\Delta G^o = RT \ln K_c$ (4) $-\Delta G^o = RT \ln K_c$

Sol. (4) $\Delta G^o = RT \ln K_c$ or $\Delta G^o = -RT \ln K_c$.

- 108.** If at 298 K the bond energies of C-H, C-C, C=C and H-H bonds are respectively 414, 347, 615 and 435 kJ mol⁻¹, the value of enthalpy change for the reaction $H_2C = CH_2(g) + H_2(g) \rightarrow H_3C - CH_3(g)$ at 298K will be

- (1) + 250 kJ (2) - 250 kJ (3) +125 kJ (4) -125 kJ

Sol. (4) $CH_2 = CH_2 + H_2 \longrightarrow CH_3 - CH_3$

$$\begin{array}{rcl}
 414 \times 4 & = & 1656 \\
 615 \times 1 & = & 615 \\
 435 \times 1 & = & 435 \\
 \hline
 & & 2706 \\
 \hline
 \Delta \epsilon & = & 2706 - 2831 = -125 \text{ kg}
 \end{array}$$

109. Enthalpy change for a reaction does not depend upon

- (1) The physical states of reactants and products
- (2) Use of different reactants for the same product
- (3) The nature of intermediate reaction steps
- (4) The differences in initial or final temperatures of involved substances

Sol. (3) According to Hess law, enthalpy change for a reaction does not depend on the nature of Intermediate reaction steps.

110. Pressure cooker reduces cooking time for food because

- (1) Heat is more evenly distributed in the cooking space
- (2) Boiling point of water involved in cooking is increased
- (3) The higher pressure inside the cooker crushes the food material
- (4) Cooking involves chemical changes helped by a rise in temperature

Sol. (2) B. pt of H_2O involved in cooking is increased.

111. Liquids A and B form an ideal solution,

- (1) The enthalpy of mixing is zero
- (2) The entropy of mixing is zero
- (3) The free energy of mixing is zero
- (4) The free energy as well as the entropy of mixing are each zero

Sol. (1) For Ideal solution $\Delta H_{\text{mixing}} = 0$

112. For the reaction system : $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$ volume is suddenly produced to half its value by increasing the pressure on it. If the reaction is of first order with respect to O_2 and second order with respect to NO , the rate of reaction will

- (1) Diminish to one-fourth of its initial value
- (2) Diminish to one-eighth of its initial value
- (3) Increase to eight times of its initial value
- (4) Increase to four times of its initial value

Sol. (3) $2NO + O_2 \longrightarrow 2NO_2$

$$R = k[NO]^2[O_2]$$

Volume is reduced to half conc. Is doubled

$$R = k[2NO]^2[2O_2]$$

$$R = 8k[NO]^2[O_2]$$

113. For a cell reaction involving a two-electron change, the standard e.m.f. of the cell is found to be 0.295 V at 25°C . The equilibrium constant of the reaction at 25°C will be

- (1) 1×10^{-10}
- (2) 29.5×10^{-2}
- (3) 10
- (4) 1×10^{10}

Sol. (4) $\Delta G = -nF\epsilon^\circ$

$$\Delta G = -2.303 RT \log K$$

$$nF\epsilon^{\circ} = 2.303 RT \log K$$

$$\log K = \frac{nF\epsilon^{\circ}}{2.303RT} = \frac{2 \times 96500 \times 0.295}{2.303 \times 8.314 \times 298}$$

$$\log K = 9.97 = K = 1 \times 10^{10}$$

114. In an irreversible process taking place at constant T and P and in which only pressure-volume work is being done, the change in Gibbs free energy (dG) and change in entropy (dS), satisfy the criteria

$$(1) (dS)_{V,E} < 0, (dG)_{T,P} < 0 \quad (2)$$

$$(dS)_{V,E} > 0, (dG)_{T,P} < 0$$

$$(3) (dS)_{V,E} = 0, (dG)_{T,P} = 0 \quad (4)$$

$$(dS)_{V,E} = 0, (dG)_{T,P} > 0$$

Sol. (2) $(dS)_{V,L} > 0, (dG)_{T,P} < 0$

115. Which one of the following characteristics is **not** correct for physical adsorption ?

- (1) Adsorption on solids is reversible
- (2) Adsorption increases with increase in temperature
- (3) Adsorption is spontaneous
- (4) Both enthalpy and entropy of adsorption are negative

Sol. (2) Physical, adsorption decreases with temperature

116. In respect of the equation $k = Ae^{-E_a/RT}$ in chemical kinetics, which one of the following statements is correct ?

- (1) k is equilibrium constant
- (2) A is adsorption factor
- (3) E_a is energy of activation
- (4) R is Rydberg's constant

Sol. (3) E_a is activation energy

117. Standard reduction electrode potentials of three metals A, B and C are respectively +0.5 V, -3.0V and -1.2 V. The reducing powers of these metals are

- (1) $B > C > A$
- (2) $A > B > C$
- (3) $C > B > A$
- (4) $A > C > B$

Sol. (1) $\begin{matrix} B > C > A \\ -3.0 & -1.2 & +0.5 \end{matrix}$

118. Which one of the following substances has the highest proton affinity ?

- (1) H_2O
- (2) H_2S
- (3) NH_3
- (4) PH_3

Sol. (3) NH_3 is stronger ligand than H_2O

119. Which one of the following is an amphoteric oxide

- (1) ZnO
- (2) Na_2O
- (3) SO_2
- (4) B_2O_3

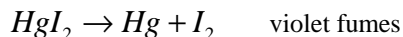
Sol. (1) ZnO is amphoteric & dissolved in both acid & base

120. A red solid is insoluble in water. However it becomes soluble if some KI is added to water. Heating the red solid in a test tube results in liberation of some violet coloured fumes and droplets of a metal appear on the cooler parts of the test tube. The red solid is

- (1) $(NH_4)_2Cr_2O_7$
- (2) HgI_2
- (3) HgO
- (4) Pb_3O_4

Sol. (2) $HgI_2 + 2KI \rightarrow K_2[HgI_4]$ soluble

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121. Concentrated hydrochloric acid when kept in open air sometimes produces a cloud of white fumes. The explanation for it is that

- (1) Concentrated hydrochloric acid emits strongly smelling HCl gas all the time
- (2) Oxygen in air reacts with the emitted HCl gas to form a cloud of chlorine gas
- (3) Strong affinity of HCl gas for moisture in air results in forming of droplets of liquid solution, which appears like a cloudy smoke
- (4) Due to strong affinity for water, concentrated hydrochloric acid pulls moisture of air towards itself. This moisture forms droplets of water and hence the cloud

Sol. (4) Factual

122. What may be expected to happen when phosphine gas is mixed with chlorine gas ?

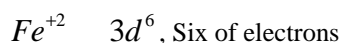
- (1) The mixture only cools down
- (2) PCl_3 and HCl are formed and the mixture warms up
- (3) PCl_5 and HCl are formed and the mixture cools down
- (4) $\text{PH}_3 \cdot \text{Cl}_2$ is formed with warming up

Sol. (2)

123. The number of d-electrons retained in Fe^{2+} (At. no. of $\text{Fe} = 26$) ion is

- (1) 3
- (2) 4
- (3) 5
- (4) 6

Sol. (4) $\text{Fe } 26 \quad 3d^6 4s^2$



124. What would happen when a solution of potassium chromate is treated with an excess of dilute nitric acid ?

- (1) Cr^{3+} and $\text{Cr}_2\text{O}_7^{2-}$ are formed
- (2) $\text{Cr}_2\text{O}_7^{2-}$ and H_2O are formed
- (3) CrO_4^{2-} is reduced to +3 state of Cr
- (4) CrO_4^{2-} is oxidized to +7 state of Cr

Sol. (2) $2\text{CrO}_4^{2-} + 2\text{H}^+ \xrightarrow[\text{Alkaline}]{\text{Acidic}} \text{Cr}_2\text{O}_7^{2-} + 2\text{H}_2\text{O}$

125. In the coordination compound, $\text{K}_4[\text{Ni}(\text{CN})_4]$ oxidation state of nickel is

- (1) -1
- (2) 0
- (3) +1
- (4) +2

Sol. (2) $\overset{+4}{\text{K}}_4 \overset{0}{[\text{Ni}(\text{CN})_4]} \overset{-4}{}$

126. Ammonia forms the complex ion $[\text{Cu}(\text{NH}_3)_4]^{2+}$ with copper ions in alkaline solutions but not in acidic solutions. What is the reason for it ?

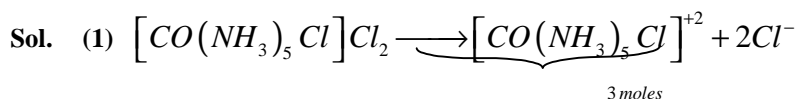
- (1) In acidic solutions hydration protects copper ions
- (2) In acidic solutions protons coordinate with ammonia molecules forming NH_4^+ ions and NH_3 molecules are not available
- (3) In alkaline solutions insoluble $\text{Cu}(\text{OH})_2$ is precipitated which is soluble in excess of any alkali
- (4) Copper hydroxide is an amphoteric substance

Sol. (2) $\text{NH}_3 + \text{H}^+ (\text{Acid}) \longrightarrow \text{NH}_4^+$; NH_3 not available as a ligand

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127. One mole of the complex compound $Co(NH_3)_5Cl_3$, gives 3 moles of ions on dissolution in water. One mole of the same complex reacts with two moles of $AgNO_3$ solution to yield two moles of $AgCl(s)$. The structure of the complex is

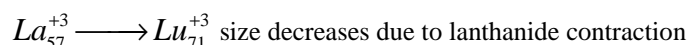
- (1) $[Co(NH_3)_5Cl] Cl_2$ (2) $[Co(NH_3)_3Cl_3] \cdot 2NH_3$
 (3) $[Co(NH_3)_4Cl_2] Cl \cdot NH_3$ (4) $[Co(NH_3)_4Cl] Cl_2 \cdot NH_3$



128. The radius of La^{3+} (Atomic number of $La = 57$) is 1.06 \AA . Which one of the following given values will be closest to the radius of Lu^{3+} (Atomic number of $Lu = 71$) ?

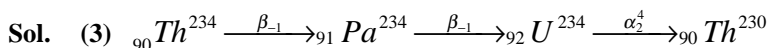
- (1) 1.60 \AA (2) 1.40 \AA (3) 1.06 \AA (4) 0.85 \AA

Sol. (4) $Lu^{+4} = 0.85 \text{ \AA}$



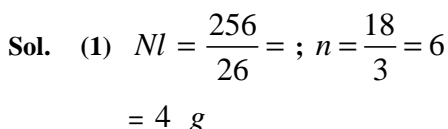
129. The radionuclide ${}_{90}^{234}Th$ undergoes two successive β -decays followed by one α -decay. The atomic number and the mass number respectively of the resulting radionuclide are

- (1) 92 and 234 (2) 94 and 230 (3) 90 and 230 (4) 92 and 230



130. The half-life of a radioactive isotope is three hours. If the initial mass of the isotope were 256 g , the mass of it remaining undecayed after 18 hours would be

- (1) 4.0 g (2) 8.0 g (3) 12.0 g (4) 16.0 g



131. Several blocks of magnesium are fixed to the bottom of a ship to

- (1) Keep away the sharks (2) Make the ship lighter
 (3) Prevent action of water and salt (4) Prevent puncturing by under-sea rocks

Sol. (3) Prevent action of water and salt

132. In curing cement plasters water is sprinkled from time to time. This helps in

- (1) Keeping it cool
 (2) Developing interlocking needle-like crystals of hydrated silicates
 (3) Hydrating sand and gravel mixed with cement
 (4) Converting sand into silicic acid

Sol. (2)

133. Which one of the following statements is **not** true ?

- (1) The conjugate base of $H_2PO_4^-$ is HPO_4^{2-}
 (2) $pH + pOH = 14$ for all aqueous solutions

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(3) The pH of $1 \times 10^{-8} M$ HCl is 8

(4) 96,500 coulombs of electricity when passed through a $CuSO_4$ solution deposits 1 gram equivalent of copper at the cathode

Sol. (3) pH of $10^{-8} M$ HCl is not 8 if it is between 6–7 or 6.96

134. The correct order of increasing basic nature for the bases NH_3 , CH_3NH_2 and $(CH_3)_2NH$ is

(1) $CH_3NH_2 < NH_3 < (CH_3)_2NH$ (2) $(CH_3)_2NH < NH_3 < CH_3NH_2$

(3) $NH_3 < CH_3NH_2 < (CH_3)_2NH$ (4) $CH_3NH_2 < (CH_3)_2NH < NH_3$

Sol. (3) $NH_3 < CH_3NH_2 < (CH_3)_2NH$

135. Butene-1 may be converted to butane by reaction with

(1) $Zn - HCl$ (2) $Sn - HCl$ (3) $Zn - Hg$ (4) Pd / H_2

Sol. (4) $CH_3 - CH_2 - CH = CH_2 + H_2 \xrightarrow{Pd} CH_3 - CH_2 - CH_2 - CH_3$

136. The solubilities of carbonates decrease down the magnesium group due to a decrease in

(1) Lattice energies of solids (2) Hydration energies of cations
(3) Inter-ionic attraction (4) Entropy of solution formation

Sol. (2) Due to decrease in hydration energy of cation & lattice energy remains almost unchanged.

137. During dehydration of alcohols to alkenes by heating with conc. H_2SO_4 the initiation step is

(1) Protonation of alcohol molecule (2) Formation of carbocation
(3) Elimination of water (4) Formation of an ester

Sol. (1) $H_2SO_4 \longrightarrow H^+ + HSO_4^-$; $C_2H_5OH + H^+ \xrightarrow[\text{of alcohol}]{\text{Protonation}} C_2H_5 - \overset{\oplus}{O} - H$ Protonated Alcohol.
 \downarrow
 H

138. Which one of the following nitrates will leave behind a metal on strong heating?

(1) Ferric nitrate (2) Copper nitrate (3) Manganese nitrate (4) Silver nitrate

Sol. (4) $2AgNO_3 \xrightarrow{\Delta} 2Ag + 2NO_2 + O_2$

139. When rain is accompanied by a thunderstorm, the collected rain water will have a pH value

(1) Slightly lower than that of rain water without thunderstorm
(2) Slightly higher than that when the thunderstorm is not there
(3) Uninfluenced by occurrence of thunderstorm
(4) Which depends on the amount of dust in air

Sol. (1) Due to acidic rain

140. Complete hydrolysis of cellulose gives

(1) D-fructose (2) D-ribose (3) D-glucose (4) L-glucose

Sol. (3) Cellulose is a polymer of β -D-glucose

141. For making good quality mirrors, plates of float glass are used. These are obtained by floating molten glass over a liquid metal which does not solidify before glass. The metal used can be

(1) Mercury (2) Tin (3) Sodium (4) Magnesium

Sol. (1) Hg

142. The substance **not** likely to contain $CaCO_3$ is

(1) A marble statue (2) Calcined gypsum (3) Sea shells (4) Dolomite

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Sol. (2) Calcined gypsum

143. The reason for double helical structure of DNA is operation of

- | | |
|--------------------------|-------------------------------|
| (1) Vander Waals' forces | (2) Dipole-dipole interaction |
| (3) Hydrogen bonding | (4) Electrostatic attractions |

Sol. (3) Hydrogen bonding

144. Bottles containing C_6H_5I and $C_6H_5CH_2I$ lost their original labels. They were labelled A and B for testing. A and B were separately taken in test tubes and boiled with $NaOH$ solution. The end solution in each tube was made acidic with dilute HNO_3 and then some $AgNO_3$ solution was added. Substance B, a yellow precipitate. Which one of the following statements is true for this experiment ?

- | | |
|---------------------|---|
| (1) A was C_6H_5I | (2) A was $C_6H_5CH_2I$ |
| (3) B was C_6H_5I | (4) Addition of HNO_3 was unnecessary |

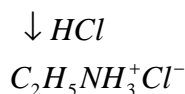
Sol. (1) Compound 'B' + $NaOH \xrightarrow{Boil} \text{Mixture} \longrightarrow \text{cooled}$
 Labile halogen \longleftarrow yellow $\xleftarrow{AgNO_3}$ mixture \longleftarrow dil HNO_3
ppt

Since $C_6H_5CH_2I$ has labile halogen. Hence it is C_6H_5I

145. Ethyl isocyanide on hydrolysis in acidic medium generates

- | | |
|--|--|
| (1) Ethylamine salt and methanoic acid | (2) Propanoic acid and ammonium salt |
| (3) Ethanoic acid and ammonium salt | (4) Methylamine salt and ethanoic acid |

Sol. (1) $C_2H_5-N \equiv C + 2H_2O \xrightarrow[HCl]{dil} C_2H_5-NH_2 + HCOOH$



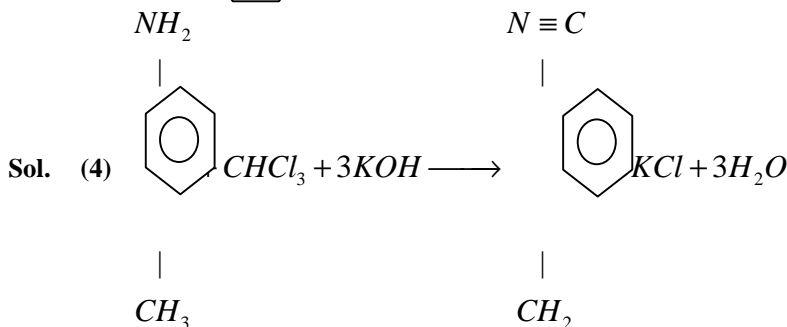
146. The internal energy change when a system goes from state A to B is 40 kJ / mole . If the system goes from A to B by a reversible path and returns to state A by an irreversible path what would be the net change in internal energy ?

- | | | | |
|---------------------|----------------------|-----------------------|----------|
| (1) 40 kJ | (2) $> 0 \text{ kJ}$ | (3) $< 40 \text{ kJ}$ | (4) Zero |
|---------------------|----------------------|-----------------------|----------|

Sol. (4) $A \xrightarrow{40} B$
 $A \xleftarrow{-40} B$
 $\Delta H = \text{zero}$

147. The reaction of chloroform with alcoholic KOH and p-toluidine forms

- | | |
|--|---------------------------------------|
| (1) $H_3C-\text{C}_6\text{H}_5$ | (2) $H_3C-\text{C}_6\text{H}_4-N_2Cl$ |
| (3) $H_3C-\text{C}_6\text{H}_4-NHCHCl_2$ | (4) $H_3C-\text{C}_6\text{H}_5$ |



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148. Nylon threads are made of

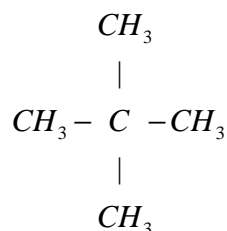
- (1) Polyvinyl polymer (2) Polyester polymer
(3) Polyamide polymer (4) Polyethylene polymer

Sol. (3) Polyamide polymer

149. On mixing a certain alkane with chlorine and irradiating it with ultraviolet light, it forms only one monochloroalkane. This alkane could be

- (1) Propane (2) Pentane (3) Isopentane (4) Neopentane

Sol. (4) Neo-pentane gives only mono chloro pentane because of only 1^0 hydrogen atoms



150. Which of the following could act as a propellant or rockets ?

- (1) Liquid hydrogen + liquid nitrogen (2) Liquid oxygen + liquid argon
(3) Liquid hydrogen + liquid oxygen (4) Liquid nitrogen + liquid oxygen

Sol. (3) Liquid hydrogen + liquid oxygen