DATE : 10/05/2018

Question Booklet Version

22

Aakash
Medical | IIT-JEE | Foundations
(Divisions of Aakash Educational Services Pvt. Ltd.)

Regd. Office : Aakash Tower, 8, Pusa Road, New Delhi-110005
Ph.: 011-47623456 Fax : 011-47623472

Time : 1 Hour 30 Min.

Total Marks : 100

Answers & Solutions
for MHT CET-2018

Paper-II
(Physics & Chemistry)

Instruction for Candidates

1. This question booklet contains 100 Objective Type Questions (Single Best Response Type) in the subjects of Physics (50) and Chemistry (50).
2. The question paper and OMR (Optical Mark Reader) Answer Sheets are issued to examinees separately at the beginning of the examination session.
3. Choice and sequence for attempting questions will be as per the convenience of the candidate.
4. Read each question carefully.
5. Determine the correct answer from out of the four available options given for each question.
6. Each answer with correct response shall be awarded **one (1) mark**. There is **no Negative Marking**. If the examinee has marked two or more answers or has done scratching and overwritting in the Answer Sheet in response to any question, or has marked the circles inappropriately *e.g.*, half circle, dot, tick mark, cross etc. mark/s shall NOT be awarded for such answer/s, as these may not be read by the scanner. Answer sheet of each candidate will be evaluated by computerized scanning method only (Optical Mark Reader) and there will not be any manual checking during evaluation or verification.
7. Rough work should be done only on the blank space provided in the Question Booklet. **Rough work should not be done on the Answer Sheet**.
8. The required mathematical tables (Log etc.) are provided within the Question Booklet.

PHYSICS

1. Two metal wires P and Q of same length and material are stretched by same load. Their masses are in the ratio $m_1 : m_2$. The ratio of elongations of wire P to that of Q is

(A) $m_1^2 : m_2^2$ (B) $m_2^2 : m_1^2$

(C) $m_2 : m_1$ (D) $m_1 : m_2$

Answer (C)

Sol. $\Delta L = \frac{FL}{AY}$

$\Delta L = \frac{FL^2}{VY}$

$\Delta L = \frac{FL^2\rho}{Ym}$

$$\boxed{\frac{\Delta L_1}{\Delta L_2} = \frac{m_2}{m_1}}$$

2. Let $x = \left[\frac{a^2b^2}{c}\right]$ be the physical quantity. If the percentage error in the measurement of physical quantities a, b and c is 2, 3 and 4 percent respectively then percentage error in the measurement of x is

(A) 7%

(B) 14%

(C) 21%

(D) 28%

Answer (B)

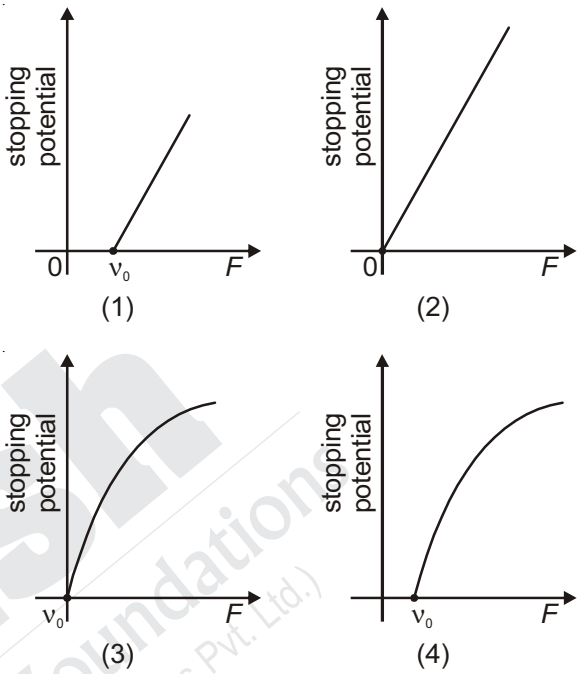
Sol. $x = \frac{a^2b^2}{C}$

$$\frac{\Delta x}{x} = \frac{2\Delta a}{a} + \frac{2\Delta b}{b} + \frac{\Delta c}{c}$$

$$= 2\times2 + 2\times3 + 4$$

$$\boxed{\frac{\Delta x}{x} = 14\%}$$

3. Following graphs show the variation of stopping potential corresponding to the frequency of incident radiation (F) for a given metal. The correct variation is shown in graph (ν_0 = Threshold frequency)

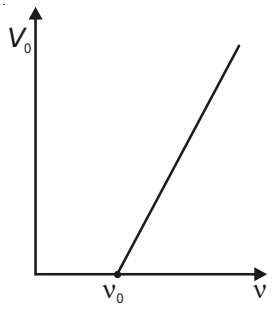


(A) (1) (B) (2)

(C) (3) (D) (4)

Answer (A)

Sol. $h\nu = h\nu_0 + e\nu_0 \Rightarrow V_0 = \frac{h\nu - h\nu_0}{e}$



4. In compound microscope, the focal length and aperture of the objective used is respectively

(A) Large and large

(B) Large and small

(C) Short and large

(D) Short and small

Answer (D)

Sol. Focal length $\rightarrow$ short

aperture $\rightarrow$ small

5. The energy of an electron having de-Broglie wavelength λ is (h = Planck's constant, m = mass of electron)

(A) $\frac{h}{2m\lambda}$ (B) $\frac{h^2}{2m\lambda^2}$

(C) $\frac{h^2}{2m^2\lambda^2}$ (D) $\frac{h^2}{2m^2\lambda}$

Answer (B)

Sol. $E = \frac{1}{2}mV^2 \Rightarrow E = \frac{1}{2}\frac{m^2V^2}{m}$

$mV = \frac{h}{\lambda} \Rightarrow E = \frac{1}{2}\frac{h^2}{\lambda^2 m}$ $\boxed{E = \frac{h^2}{2m\lambda^2}}$

6. If numerical aperture of a microscope is increased then its

(A) resolving power remains constant

(B) resolving power becomes zero

(C) limit of resolution is decreased

(D) limit of resolution is increased

Answer (C)

7. In amplitude modulation

(A) amplitude remains constant but frequency changes

(B) both amplitude and frequency do not change

(C) both amplitude and frequency change

(D) amplitude of the carrier wave changes according to information signal

Answer (D)

Sol. Amplitude of carrier wave depends on information signal.

8. If M_z = magnetization of a paramagnetic sample, B = external magnetic field, T = absolute temperature, C = curie constant then according to Curie's law in magnetism, the correct relation is

(A) $M_z = \frac{T}{CB}$ (B) $M_z = \frac{CB}{T}$

(C) $C = \frac{M_zB}{T}$ (D) $C = \frac{T^2}{M_zB}$

Answer (B)

Sol. $M_z = \frac{CB}{T}$

9. An electron of stationary hydrogen atom jumps from 4th energy level to ground level. The velocity that the photon acquired as a result of electron transition will be (h = Planck's constant, R = Rydberg's constant, m = mass of photon)

(A) $\frac{9Rh}{16m}$ (B) $\frac{11hR}{16m}$

(C) $\frac{13hR}{16m}$ (D) $\frac{15hR}{16m}$

Answer (D)

Sol. $\frac{1}{\lambda} = R\left\{\frac{1}{1^2} - \frac{1}{4^2}\right\}$

$\Rightarrow \frac{1}{\lambda} = R \times \frac{15}{6}$

$mV = \frac{h}{\lambda} \Rightarrow mV = h \times \frac{15}{16}R$

$\boxed{V = \frac{15}{16}\frac{hR}{m}}$

10. A metal wire of density 'ρ' floats on water surface horizontally. If it is NOT to sink in water then maximum radius of wire is proportional to (T = surface tension of water, g = gravitational acceleration)

(A) $\sqrt{\frac{T}{\pi\rho g}}$ (B) $\sqrt{\frac{\pi\rho g}{T}}$

(C) $\frac{T}{\pi\rho g}$ (D) $\frac{\pi\rho g}{T}$

Answer (A)

Sol. $T \times 2L = Mg$

$\Rightarrow T \times 2L = \rho Vg \Rightarrow T \times 2L = L \times A\,\rho g$

$\Rightarrow T \times 2L = L \times \pi r^2 \rho g$

$\Rightarrow r = \sqrt{\frac{2T}{\pi\rho g}}$ $r \propto \sqrt{\frac{T}{\pi\rho g}}$

11. In a capillary tube having area of cross-section A, water rises to a height h. If cross-sectional area is reduced to $\frac{A}{9}$, the rise of water in the capillary tube is

(A) $4h$ (B) $3h$

(C) $2h$ (D) h

Answer (B)

Sol. $2\pi R\cos\theta\ T = mg$

$R \propto m \Rightarrow R^2 \propto m^2$

$\Rightarrow R^2 \propto A^2h^2$

$\Rightarrow A \propto A^2h^2$

$\Rightarrow Ah^2 = K$

$\Rightarrow A \times h^2 = \frac{A}{9}h'^2 \Rightarrow \boxed{3h = h'}$

12. With forward biased mode, the p-n junction diode

(A) is one in which width of depletion layer increases

(B) is one in which potential barrier increases

(C) acts as closed switch

(D) acts as open switch

Answer (C)

Sol. When diode is forward biased it acts as closed switch.

13. An alternating electric field of frequency 'ν' is applied across the dees (radius R) of a cyclotron to accelerate protons (mass m). The operating magnetic field 'B' used and K.E. of the proton beam produced by it are respectively (e = charge on proton)

(A) $\frac{2\pi m\nu}{e} \cdot 2\pi^2 m\nu^2 R^2$

(B) $\frac{2\pi^2 m\nu}{e^2}, 4\pi^2 m\nu^2 R^2$

(C) $\frac{\pi m\nu}{e}, \pi^2 m\nu^2 R^2$

(D) $\frac{2\pi^2 m^2\nu^2}{e}, 2\pi^2 m^2\nu^2 R^2$

Answer (A)

Sol. $\nu = \frac{qB}{2\pi m} \Rightarrow B = \frac{2\pi m\nu}{q} \Rightarrow \boxed{B = \frac{2\pi m\nu}{e}}$

$KE = \frac{1}{2}mv^2 \Rightarrow KE = \frac{1}{2}\frac{(mV)^2}{m} \Rightarrow KE = \frac{1}{2}\frac{(qBR)^2}{m}$

$KE = \frac{1}{2}\frac{4\pi^2 m^2\nu^2 R^2}{m}$

$\boxed{KE = 2\pi^2 mR^2\nu^2}$

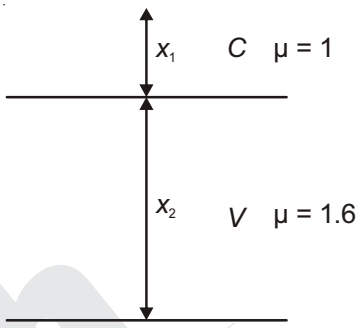
14. A ray of light is incident normally on a glass slab of thickness 5 cm and refractive index 1.6. The time taken to travel by a ray from source to surface of slab is same as to travel through glass slab. The distance of source from the surface is

(A) 4 cm (B) 8 cm

(C) 12 cm (D) 16 cm

Answer (B)

Sol.



$t = \frac{x_1}{C} = \frac{x_2}{V} \Rightarrow x_1 = x_2\frac{C}{V}$

Now $Cx_1 = 1.6 \times V \Rightarrow \frac{C}{V} = 1.6$

$\Rightarrow x_1 = x_2 \times 1.6 \Rightarrow x_1 = 5 \times 1.6$

$\Rightarrow \boxed{x_1 = 8\text{ cm}}$

15. A string is vibrating in its fifth overtone between two rigid supports 2.4 m apart. The distance between successive node and antinode is

(A) 0.1 m (B) 0.2 m

(C) 0.6 m (D) 0.8 m

Answer (B)

Sol. Fifth overtone → 6 hormonic

$\therefore$ string will have 6 loops

Let distance between a node and antinode be ℓ

$\therefore\ 12\ell = 2.4\text{m} \Rightarrow \boxed{\ell = 0.2\text{ m}}$

16. n number of waves are produced on a string in 0.5 second. Now the tension in the string is doubled (Assume length and radius constant), the number of waves produced in 0.5 second for the same harmonic will be

(A) n (B) $\sqrt{2}n$

(C) $\frac{n}{\sqrt{2}}$ (D) $\frac{n}{\sqrt{2}}$

Answer (B)

Sol. $\nu \propto \sqrt{T} \Rightarrow \frac{n_1}{n_2} = \sqrt{\frac{T_1}{T_2}}$

$\Rightarrow \quad n_2 = ? \quad T_2 = 2T_1$ and $n_1 = n$

$\Rightarrow \quad \frac{n}{n_2} = \sqrt{\frac{T_1}{2T_1}} \Rightarrow \boxed{n_2 = \sqrt{2}n}$

17. The increase in energy of a metal bar of length L and cross-sectional area A when compressed with a load M along its length is

(Y = Young's modulus of the material of metal bar)

(A) $\frac{FL}{2AY}$ (B) $\frac{F^2L}{2AY}$

(C) $\frac{FL}{AY}$ (D) $\frac{F^2L^2}{2AY}$

Answer (B)

Sol. Energy $= \frac{1}{2}$ stress × strain × volume

$= \frac{1}{2}\frac{(\text{stress})^2}{Y}$ volume

$= \frac{1}{2}\frac{\left(\frac{F}{A}\right)^2}{Y} \times LA$

$\boxed{E = \frac{F^2L}{2AY}}$

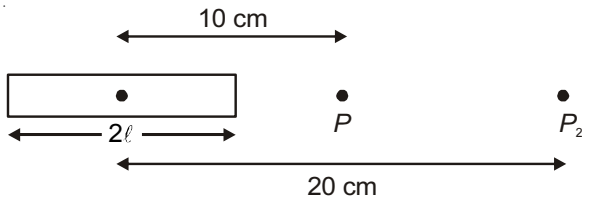
18. The ratio of magnetic fields due to a bar magnet at the two axial points P_1 and P_2 which are separated from each other by 10 cm is 25 : 2. Point P_1 is situated at 10 cm from the centre of the magnet. Magnetic length of the bar magnet is (Points P_1 and P_2 are on the same side of magnet and distance of P_2 from the centre is greater than distance of P_1 from the centre of magnet)

(A) 5 cm (B) 10 cm

(C) 15 cm (D) 20 cm

Answer (B)

Sol.



$\frac{B_1}{B_2} = \frac{\frac{x_1}{\left(x_1^2 - \ell^2\right)^2}}{\frac{x_2}{\left(x_2^2 - \ell^2\right)^2}} \Rightarrow \frac{B_1}{B_2} = \left[\frac{x_2^2 - \ell^2}{x_1^2 - \ell^2}\right]^2 \times \frac{x_1}{x_2}$

$\Rightarrow \quad \frac{25}{2} = \frac{10}{2}\left[\frac{x_2^2 - \ell^2}{x_1^2 - \ell^2}\right]^2 \Rightarrow \pm 5 = \frac{x_2^2 - \ell^2}{x_1^2 - \ell^2}$

$\Rightarrow \quad 5 = \frac{x_2^2 - \ell^2}{x_1^2 - \ell^2} \Rightarrow 5x_1^2 - 5\ell^2 = x_2^2 - \ell^2$

$\Rightarrow \quad 4\ell^2 = 5x_1^2 - x_2^2 \Rightarrow 4\ell^2 = 5 \times 100 - 400$

$\boxed{\ell = 5 \text{ cm}}$

$\boxed{2\ell = 10 \text{ cm}}$

19. A satellite is revolving in a circular orbit at a height h above the surface of the earth of radius R. The speed of the satellite in its orbit is one-fourth the escape velocity from the surface of the earth. The relation between h and R is

(A) $h = 2R$ (B) $h = 3R$

(C) $h = 5R$ (D) $h = 7R$

Answer (D)

Sol. $\frac{GMm}{(R+h)^2} = \frac{mV^2}{(R+h)}$

$V = \frac{v_e}{4} = \frac{\sqrt{2g\,R}}{4} = \frac{1}{4}\sqrt{\frac{2GM}{R^2}R}$

$\boxed{V = \frac{1}{4}\sqrt{\frac{2GM}{R}}}$

$\therefore \quad \frac{GMm}{(R+h)} = m\frac{1}{16} \times \frac{2Gm}{R}$

$8R = R = h \Rightarrow \boxed{7R = h}$

20. A pipe closed at one end has length 83 cm. The number of possible natural oscillations of air column whose frequencies lie below 1000 Hz are (velocity of sound in air = 332 m/s)

(A) 3 (B) 4

(C) 5 (D) 6

Answer (C)

Sol. $\nu_0 = \frac{V}{4L} \Rightarrow \nu_0 = \frac{332}{83 \times 4 \times 10^{-2}}$

$\boxed{\nu_0 = 100 \text{ Hz}}$

$\nu_1 = 300$ Hz, $\nu_2 = 500$ Hz

$\nu_3 = 700$ Hz, $\nu_4 = 900$ Hz

five natural frequency.

21. If $\vec{A} = 3\hat{i} - 2\hat{j} + \hat{k}, \vec{B} = \hat{i} - 3\hat{j} + 5\hat{k}$ and $\vec{C} = 2\hat{i} + \hat{j} - 4\hat{k}$ form a right angled triangle then out of the following which one is satisfied?

(A) $\vec{A} = \vec{B} + \vec{C}$ and $A^2 = B^2 + C^2$

(B) $\vec{A} = \vec{B} + \vec{C}$ and $B^2 = A^2 + C^2$

(C) $\vec{B} = \vec{A} + \vec{C}$ and $B^2 = A^2 + C^2$

(D) $\vec{B} = \vec{A} + \vec{C}$ and $A^2 = B^2 + C^2$

Answer (B)

Sol. $A^2 = 3^2 + 2^2 + 1^2 \Rightarrow A^2 = 14$

$B^2 = 1^2 + 3^2 + 5^2 \Rightarrow B^2 = 35$

$C^2 = 2^2 + 1^2 + 4^2 \Rightarrow C^2 = 21$

$\therefore A^2 + C^2 = B^2$ and $\vec{A} = \vec{B} + \vec{C}$.

22. A square frame *ABCD* is formed by four identical rods each of mass *m* and length *l*. This frame is in X-Y plane such that side *AB* coincides with X-axis and side *AD* along Y-axis. The moment of inertia of the frame about X-axis is

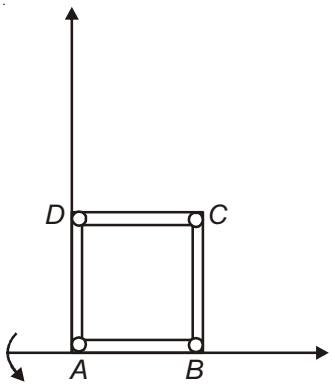
(A) $\frac{5ml^2}{3}$ (B) $\frac{2ml^2}{3}$

(C) $\frac{4ml^2}{3}$ (D) $\frac{ml^2}{12}$

Answer (A)

Sol. $I = I_{AB} + I_{BC} + I_{CD} + I_{DA}$

$I = 0 + \frac{ML^2}{3} + ML^2 + \frac{ML^2}{3}$



$\boxed{I = \frac{5}{3}ML^2}$

23. A unit vector is represented as $\left(0.8\hat{i} + b\hat{j} + 0.4\hat{k}\right)$. Hence the value of *b* must be

(A) 0.4

(B) $\sqrt{0.6}$

(C) 0.2

(D) $\sqrt{0.2}$

Answer (D)

Sol. $\sqrt{0.8^2 + b^2 + 0.4^2} = 1$

$\Rightarrow 0.64 + b^2 + 1.6 = 1 \Rightarrow b^2 = 1 - 0.8$

$b^2 = 0.20 \Rightarrow \boxed{b = \sqrt{0.2}}$

24. Magnetic susceptibility for a paramagnetic and diamagnetic materials is respectively

(A) small, positive and small, positive

(B) large, positive and small, negative

(C) small, positive and small, negative

(D) large, negative and large, positive

Answer (C)

Sol. Paramagnetic – $X \rightarrow$ small and positive

Dimagnetic – $X \rightarrow$ small and negative

25. A mass is suspended from a vertical spring which is executing S.H.M. of frequency 5 Hz. The spring is unstretched at the highest point of oscillation. Maximum speed of the mass is [acceleration due to gravity $g = 10$ m/s^2]

(A) 2π m/s (B) π m/s

(C) $\frac{1}{2\pi}$ m/s (D) $\frac{1}{\pi}$ m/s

Answer (D)

Sol. $m\omega^2 A = mg$

$\omega A = \frac{g}{\omega}$

$v_{max} = \frac{10}{2\pi 5}$

$= \frac{1}{\pi}$ ms^{-1}

26. When source of sound moves towards a stationary observer, the wavelength of sound received by him

(A) decreases while frequency increases

(B) remains the same whereas frequency increases

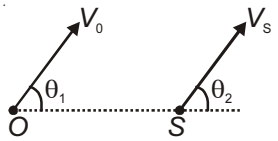
(C) increases and frequency also increases

(D) decreases while frequency remains the same

Answer (A)

Sol. $\nu = \left(\frac{V \pm V_0 \cos\theta_1}{V \pm V_s \cos\theta_2}\right)\nu_0$

$\nu = \left(\frac{V}{V - V_s}\right)\nu_0$



$\therefore$ ν increases

$V = n\lambda$

$\therefore$ wavelength decreases.

27. The deflection in galvanometer falls to $\left(\frac{1}{4}\right)^{th}$ when it is shunted by 3 Ω. If additional shunt of 2 Ω is connected to earlier shunt, the deflection in galvanometer falls to

(A) $\frac{1}{2}$ (B) $\left(\frac{1}{3}\right)^{rd}$

(C) $\left(\frac{1}{4}\right)^{th}$ (D) $\left(\frac{1}{8.5}\right)^{th}$

Answer (D)

Sol. $\frac{I_G}{I} = \frac{S}{S+G}$

$\Rightarrow$ G = 9 Ω

$\therefore \frac{I_G}{I} = \frac{\frac{6}{5}}{\frac{6}{5}+9} = \left(\frac{1}{8.5}\right)^{th}$

28. A body is thrown from the surface of the earth with velocity u m/s. The maximum height in m above the surface of the earth upto which it will reach is (R = radius of earth, g = acceleration due to gravity)

(A) $\frac{u^2R}{2gR-u^2}$ (B) $\frac{2u^2R}{gR-u^2}$

(C) $\frac{u^2R^2}{2gR^2-u^2}$ (D) $\frac{u^2R}{gR-u^2}$

Answer (A)

Sol. $\frac{1}{2}mu^2 - \frac{GMm}{R} = 0 - \frac{GMm}{R+r}$

$\boxed{r = \frac{u^2 \cdot R}{2gR-u^2}}$

29. A series combination of N_1 capacitors (each of capacity C_1) is charged to potential difference 3V. Another parallel combination of N_2 capacitors (each of capacity C_2) is charged to potential difference V. The total energy stored in both the combinations is same. The value of C_1 in terms of C_2 is

(A) $\frac{C_2N_1N_2}{9}$ (B) $\frac{C_2N_1^2N_2^2}{9}$

(C) $\frac{C_2N_1}{9N_2}$ (D) $\frac{C_2N_2}{9N_1}$

Answer (A)

Sol. $U_1 = \frac{1}{2}\frac{C_1}{N_1}\left[9V^2\right]$

$U_2 = \frac{1}{2}C_2\left[N_2 \cdot V^2\right]$

30. Heat energy is incident on the surface at the rate of 1000 J/min. If coefficient of absorption is 0.8 and coefficient of reflection is 0.1 then heat energy transmitted by the surface in 5 minutes is

(A) 100 J (B) 500 J

(C) 700 J (D) 900 J

Answer (B)

Sol. $a + r + t = 1$

$t = 0.1$

$\therefore$ Energy transmitted = 500 J

31. A sphere of mass m moving with velocity v collides head-on on another sphere of same mass which is at rest. The ratio of final velocity of second sphere to the initial velocity of the first sphere is (e is coefficient of restitution and collision is inelastic)

(A) $\frac{e-1}{2}$ (B) $\frac{e}{2}$

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

Answer (C)

Sol. $e = \frac{V_2' - V_1'}{V_1 - V_2}$

$\boxed{\frac{V_2'}{V_1} = \frac{1+e}{2}}$

32. For a particle performing linear S.H.M., its average speed over one oscillation is (a = amplitude of S.H.M. n = frequency of oscillation)

(A) 2 an (B) 4 an

(C) 6 an (D) 8 an

Answer (B)

Sol. $V_{avg} = \frac{4A}{T}$

$\boxed{V_{avg} = 4an}$

33. An ideal transformer converts 220 V a.c. to 3.3 kV a.c. to transmit a power of 4.4 kW. If primary coil has 600 turns, then alternating current in secondary coil is

(A) $\frac{1}{3}$ A (B) $\frac{4}{3}$ A

(C) $\frac{5}{3}$ A (D) $\frac{7}{3}$ A

Answer (B)

Sol. $\frac{I_1}{I_2} = \frac{N_2}{N_1}$

$\frac{20}{I_2} = \frac{9000}{600}$

$I_2 = \frac{4}{3}$ A

34. A conducting wire has length L_1 and diameter d_1. After stretching the same wire length becomes L_2 and diameter d_2. The ratio of resistances before and after stretching is

(A) $d_2^4 : d_1^4$ (B) $d_1^4 : d_2^4$

(C) $d_2^2 : d_1^2$ (D) $d_1^2 : d_2^2$

Answer (A)

Sol. $\frac{R_1}{R_2} = \frac{d_2^4}{d_1^4}$

35. The molar specific heat of an ideal gas at constant pressure and constant volume is C_p to C_v is γ then C_v =

(A) $\frac{1-\gamma}{1+\gamma}$ (B) $\frac{1+\gamma}{1-\gamma}$

(C) $\frac{\gamma-1}{R}$ (D) $\frac{R}{\gamma-1}$

Answer (D)

Sol. $\frac{C_p}{C_v} = \gamma$

$C_p - C_v = R$

$C_v = \frac{R}{\gamma-1}$

36. The path length of oscillation of simple pendulum of length 1 metre is 16 cm. Its maximum velocity is ($g = \pi^2$ m/s^2)

(A) 2π cm/s (B) 4π cm/s

(C) 8π cm/s (D) 16π cm/s

Answer (C)

Sol. $V_{max} = A.\omega$

$= A\frac{2\pi}{T}$

$= 8\pi$ cm/s

37. A vessel completely filled with water has holes A and B at depths h and $3h$ from the top respectively. Hole A is a square of side L and B is circle of radius r. The water flowing out per second from both the holes is same. Then L is equal to

(A) $r^{\frac{1}{2}}(\pi)^{\frac{1}{2}}(3)^{\frac{1}{2}}$ (B) $r.(\pi)^{\frac{1}{4}}(3)^{\frac{1}{4}}$

(C) $r.(\pi)^{\frac{1}{2}}(3)^{\frac{1}{4}}$ (D) $r^{\frac{1}{2}}(\pi)^{\frac{1}{3}}(3)^{\frac{1}{2}}$

Answer (C)

Sol. $V_1.A_1 = V_2.A_2$

$\sqrt{2gh}.L^2 = \sqrt{6gh}.\pi r^2$

$L = (3)^{\frac{1}{4}}.(\pi)^{\frac{1}{2}}.r$

38. A transistor is used as a common emitter amplifier with a load resistance 2 kΩ. The input resistance is 150 Ω. Base current is changed by 20 μA which results in a change in collector currently by 1.5 mA. The voltage gain of the amplifier is

(A) 900 (B) 1000

(C) 1100 (D) 1200

Answer (B)

Sol. $V_g = I_g.R_g$

$V_g = \frac{I_C}{I_B}.\frac{R_O}{R_{in}}$

$V_g = 1000$

39. A disc has mass M and radius R. How much tangential force should be applied to the rim of the disc so as to rotate with angular velocity ω in time t?

(A) $\frac{MR\omega}{4t}$ (B) $\frac{MR\omega}{2t}$

(C) $\frac{MR\omega}{t}$ (D) $MR\,\omega\,t$

Answer (B)

Sol. $\Delta L = \tau.\Delta t$

$\tau = \frac{\Delta L}{\Delta t}$

$\tau = \frac{I\omega}{t}$

$\tau = \frac{\frac{1}{2}MR^2\omega}{t}$

$\tau = \frac{MR^2\omega}{2t} \Rightarrow \frac{MR\omega}{2t}$

40. A circular coil carrying current I has radius R and magnetic field at the centre is B. At what distance from the centre along the axis of the same coil, the magnetic field will be $\frac{B}{8}$?

(A) $R\sqrt{2}$ (B) $R\sqrt{3}$

(C) $2R$ (D) $3R$

Answer (B)

Sol. $B' = \frac{B}{8}$

$\frac{\mu_0 IR^2}{2(R^2+x^2)^{3/2}} = \frac{\mu_0 I}{2R}.\frac{1}{8}$

$x = R\sqrt{3}$

41. Two light waves of intensities I_1 and I_2 having same frequency pass through same medium at a time in same direction and interfere. The sum of the minimum and maximum intensities is

(A) $(I_1 + I_2)$ (B) $2(I_1 + I_2)$

(C) $\left(\sqrt{I_1}+\sqrt{I_2}\right)$ (D) $\left(\sqrt{I_1}-\sqrt{I_2}\right)$

Answer (B)

Sol. $I_{max} + I_{min}$

$\left(\sqrt{I_1}+\sqrt{I_2}\right)^2+\left(\sqrt{I_1}-\sqrt{I_2}\right)^2 = 2(I_1 + I_2)$

42. An alternating voltage $e = 200\sqrt{2}\sin(100t)$ volt is connected to 1 μF capacitor through a.c. ammeter. The reading of ammeter is

(A) 5 mA (B) 10 mA

(C) 15 mA (D) 20 mA

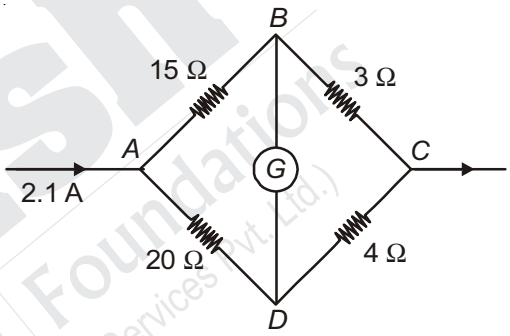
Answer (D)

Sol. $I = \frac{V_{RMS}}{X_C}$ $X_C = \frac{1}{\omega C} = 10^4$

$I = \frac{200}{10^4}$

I = 20 mA

43. In the following network, the current flowing through 15 Ω resistance is



(A) 0.8 A (B) 1.0 A

(C) 1.2 A (D) 1.4 A

Answer (C)

Sol. This is a Wheatstone bridge

$I' = \frac{I.R_2}{R_1+R_2} = 1.2$ A

44. The angle made by incident ray of light with the reflecting surface is called

(A) glancing angle

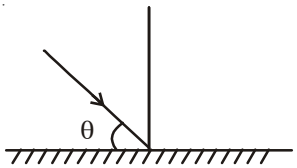
(B) angle of incidence

(C) angle of deviation

(D) angle of refraction

Answer (A)

Sol.



$\theta \rightarrow$ glancing angle

45. In non-uniform circular motion, the ratio of tangential to radial acceleration is (r = radius of circle, v = speed of the particle, α = angular acceleration)

(A) $\frac{\alpha^2 r^2}{v}$ (B) $\frac{\alpha^2 r}{v^2}$

(C) $\frac{\alpha r^2}{v^2}$ (D) $\frac{v^2}{r^2\alpha}$

Answer (C)

Sol. $\frac{a_t}{a_r} = \frac{\alpha r}{\frac{v^2}{r}}$

$\frac{a_t}{a_r} = \frac{r^2\alpha}{v^2}$

46. The moment of inertia of a ring about an axis passing through the centre and perpendicular to its plane is I. It is rotating with angular velocity ω. Another identical ring is gently placed on it so that their centres coincide. If both the rings are rotating about the same axis then loss in kinetic energy is

(A) $\frac{I\omega^2}{2}$ (B) $\frac{I\omega^2}{4}$

(C) $\frac{I\omega^2}{6}$ (D) $\frac{I\omega^2}{8}$

Answer (B)

Sol. $\Delta K = \frac{1}{2} I_1.\omega^2 - \frac{1}{2} I_f.\omega^2$

Using C.O.A.M

$I' = 2I'\omega'$

$\omega = \omega/2$

$\therefore \quad \Delta K = \frac{1}{2} I\omega^2 - \frac{1}{2}(2I)\frac{\omega^2}{4^2} = \frac{1}{2}\left[I\omega^2 - \frac{I\omega^2}{2}\right]$

$\therefore \quad \Delta K = \frac{I\omega^2}{4}$

47. A bomb at rest explodes into 3 parts of same mass. The momentum of two parts is $-3P\hat{i}$ and $2P\hat{j}$ respectively. The magnitude of momentum of the third part is

(A) P (B) $\sqrt{5}P$

(C) $\sqrt{11}P$ (D) $\sqrt{13}P$

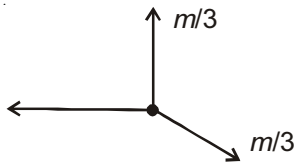
Answer (D)

Sol. $\vec{P}_3 + \vec{P}_1 + \vec{P}_2 = 0$

$\vec{P}_3 = +3P\hat{i} - 2P\hat{j}$

$|\vec{P}_3| = \sqrt{9P^2 + 4P^2}$

$= \sqrt{13P^2}$



48. In a photocell, frequency of incident radiation is increased by keeping other factors constant ($\nu > \nu_0$), the stopping potential

(A) decreases

(B) increases

(C) becomes zero

(D) first decreases and then increases

Answer (B)

Sol. Stopping potential increases

49. A mass attached to one end of a string crosses topmost point on a vertical circle with critical speed. Its centripetal acceleration when string becomes horizontal will be (g = gravitational acceleration)

(A) g (B) $3g$

(C) $4g$ (D) $6g$

Answer (B)

Sol. $v = \sqrt{3gR}$

$\frac{v^2}{R} = 3g$

50. The expression for electric field intensity at a point outside uniformly charged thin plane sheet is (d is the distance of point from plane sheet)

(A) independent of d

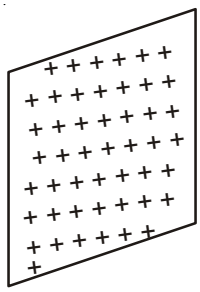
(B) directly proportional to $\sqrt{d}$

(C) directly proportional to d

(D) directly proportional to $\frac{1}{\sqrt{d}}$

Answer (A)

Sol.



$E = \frac{\sigma}{2\varepsilon_0}$

Independent.

CHEMISTRY

51. Which among the following elements of group-2 exhibits anomalous properties?

(A) Be (B) Mg

(C) Ca (D) Ba

Answer (A)

Sol. Be is second group element which show diagonal relationship with third group element (Aluminium)

52. Excess of ammonia with sodium hypochloride solution in the presence of glue or gelatine gives

(A) $NaNH_2$ (B) NH_2NH_2

(C) N_2 (D) NH_4Cl

Answer (B)

Sol. $2NH_3 + NaOCl \rightarrow NH_2{-}NH_2 + NaCl + H_2O$

53. What is the density of solution of sulphuric acid used as an electrolyte in lead accumulator?

(A) 1.5 gmL^{-1} (B) 1.2 gmL^{-1}

(C) 1.8 gmL^{-1} (D) 2.0 gmL^{-1}

Answer (B)

Sol. The sulphuric solution which is used in lead accumulator has density 1.2 gmL^{-1}.

54. Which of the following polymers is used to manufacture clothes for firefighters?

(A) Thiokol (B) Kevlar

(C) Nomex (D) Dynel

Answer (C)

Sol. Normex is best known polymer used to manufacture clothes for firefighters.

55. Which element is obtained in the pure form by van Arkel method?

(A) Aluminium (B) Titanium

(C) Silicon (D) Nickel

Answer (B)

Sol. Van-arkel method used for purification of titanium.

56. Which among the group - 15 elements does NOT exists as tetra atomic molecule?

(A) Nitrogen (B) Phosphorus

(C) Arsenic (D) Antimony

Answer (A)

Sol. Only Nitrogen is the 15^{th} group element which exist as diatomic molecules ($\ddot{N}\equiv\ddot{N}$).

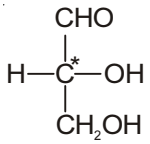
57. Identify the monosaccharide containing only one asymmetric carbon atom in its molecule.

(A) Ribulose (B) Ribose

(C) Erythrose (D) Glyceraldehyde

Answer (D)

Sol.



Glyceraldehyde has only one asymmetrical carbon.

58. Identify the oxidation states of titanium (Z = 22) and copper (Z = 29) in their colourless compounds.

(A) Ti^{3+}, Cu^{2+} (B) Ti^{2+}, Cu^{2+}

(C) Ti^{4+}, Cu^{1+} (D) Ti^{4+}, Cu^{2+}

Answer (C)

Sol. They contain empty and fully filled d-orbitals.

$_{22}Ti^{+4} \rightarrow 3d^0 4s^0$	$_{29}Cu \rightarrow 3d^{10} 4s^1$
$n = 0$	$Cu^{+1} \rightarrow 3d^{10} 4s^0$
	$n = 0$

59. Arenes on treatment with chlorine in presence of ferric chloride as a catalyst undergo what type of reaction?

(A) Electrophilic substitution

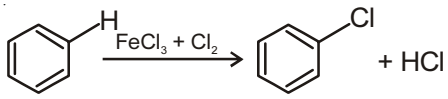
(B) Nucleophilic subsitution

(C) Electrophilic addition

(D) Nucleophilic addition

Answer (A)

Sol.



Electrophilic substitution reaction

60. In case of R, S configuration the group having highest priority is

(A) $-NO_2$ (B) $-NH_2$

(C) –CN (D) –OH

Answer (D)

Sol. –OH is highest priority group.

61. Two moles of an ideal gas are allowed to expand from a volume of 10 dm^3 to 2 m^3 at 300 K against a pressure of 101.325 KPa. Calculate the work done.

(A) –201.6. kJ (B) 13.22 kJ

(C) –810.6 kJ (D) –18.96. kJ

Answer (A)

Sol. $W = -P_{ext}(\Delta V)$

$W = -1(2000 - 10)$

$W = -1 \times 1990$

$W = -1990$ L atm

$W = -201.6$ kJ (1 L atm = 101.3 J)

62. In which among the following solids, Schottky defect is NOT observed?

(A) ZnS (B) NaCl

(C) KCl (D) CsCl

Answer (A)

Sol. ZnS do not show Schottky defect.

63. What are the products of auto-photolysis of water?

(A) H_2 and O_2 (B) Steam

(C) H_3O^+ and OH^- (D) Hydrogen peroxide

Answer (C)

Sol. $2H_2O \xrightarrow[\text{Auto-photolysis}]{} OH^- + H_3O^+$

64. Bauxite, the ore of aluminium, is purified by which process?

(A) Hoope's process (B) Hall's process

(C) Mond's process (D) Liquation process

Answer (B)

Sol. The Hall–Héroult process applied at industrial seal occur at 930°C to 975°C and produce 99.85% pure Aluminium.

65. Phenol in presence of sodium hydroxide reacts with chloroform to form salicylaldehyde. The reaction is known as

(A) Kolbe's reaction

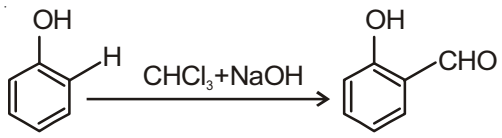
(B) Reimer-Tiemann reaction

(C) Stephen reaction

(D) Etard reaction

Answer (B)

Sol.



Reimer-Tiemann reaction

66. Lactic acid and glycollic acid are the monomers used for preparation of polymer

(A) Nylon-2-nylon-6 (B) Dextron

(C) PHBV (D) Buna-N

Answer (B)

Sol. Dextron is polymer of lactic acid and glycollic acid.

67. What is the geometry of water molecule?

(A) Distorted tetrahedral

(B) Tetrahedral

(C) Trigonal planer

(D) Diagonal

Answer (A)

Sol. $H_2\ddot{O} \longrightarrow sp^3$, bp = 2

lp = 2

Geometry - distorted tetrahedral

68. With which halogen the reactions of alkanes are explosive?

(A) Fluorine (B) Chlorine

(C) Bromine (D) Iodine

Answer (A)

Sol. Reaction of fluorine with alkane is explosive due to high electronagativity and smaller size.

69. Calculate the work done during combustion of 0.138 kg of ethanol, $C_2H_5OH_{(l)}$ at 300 K.

(Given : R = 8.314 Jk^{-1} mol^{-1}, Molar mass of ethanol = 46 g mol^{-1})

(A) –7482 J

(B) 7482 J

(C) –2494 J

(D) 2494 J

Answer (B)

Sol. $W = -P_{ext}\,\Delta V$

$W = -\Delta nRT$ $(P\Delta V = \Delta nRT)$

$$= \frac{138}{46} \times 8.314 \times 300$$

$= 7482$ J

70. Slope of the straight line obtained by plotting $\log_{10}k$ against 1/T represents what term?

(A) $-E_a$ (B) $-2.303\,E_a/R$

(C) $-E_a/2.303R$ (D) $-E_a/R$

Answer (C)

Sol. $K = Ae^{-E_a/RT}$

$$\log_{10}K = \frac{-E_a}{2.303R}\frac{1}{T} + \log_{10}A$$

$y = mx + c$

$$\text{Hence slope} = \frac{-E_a}{2.303R}$$

71. A certain reaction occurs in two steps as

(i) $2SO_{2(g)} + 2NO_{2(g)} \rightarrow 2SO_{3(g)} + 2NO_{(g)}$

(ii) $2NO_{(g)} + O_{2(g)} \rightarrow 2NO_{2(g)}$

In the reaction,

(A) $NO_{2(g)}$ is intermediate

(B) $NO_{(g)}$ is intermediate

(C) $NO_{(g)}$ is catalyst

(D) $O_{2(g)}$ is intermediate

Answer (B)

Sol. $NO_{(g)}$ is intermediate.

72. Which among the following equations represents the first law of thermodynamics under isobaric conditions?

(A) $\Delta U = q_P - P_{ex}\,\Delta V$ (B) $q_V = \Delta U$

(C) $\Delta U = W$ (D) $W = -q$

Answer (A)

Sol. For isobaric process $\Delta P = 0$

$$\boxed{\Delta U = q_P - P_{ex}.\Delta V}$$

73. During galvanization of iron, which metal is used for coating iron surface?

(A) Copper (B) Zinc

(C) Nickel (D) Tin

Answer (B)

Sol. Galvanization is process in which coating of Zn on surface of iron.

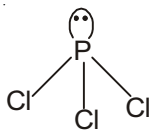
74. Formation of PCl_3 is explained on the basis of what hybridisation of phosphorus atom?

(A) sp^2 (B) sp^3

(C) sp^3d (D) sp^3d^2

Answer (B)

Sol. $PCl_3 \rightarrow sp^3$



75. Identify the element that forms amphoteric oxide.

(A) Carbon (B) Zinc

(C) Calcium (D) Sulphur

Answer (B)

Sol. Zinc form amphoteric oxide (ZnO).

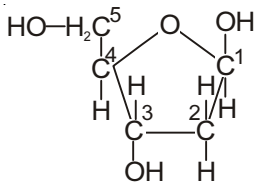
76. Which carbon atom of deoxy Ribose sugar in DNA does **NOT** contain  bond?

(A) C_5 (B) C_3

(C) C_2 (D) C_1

Answer (C)

Sol.



Deoxyribose

C_2 – doesn't contain  .

77. Which of the following carboxylic acids is most reactive towards esterification?

(A) $(CH_3)_3CCOOH$ (B) $(CH_3)_2CHCOOH$

(C) CH_3CH_2COOH (D) $(C_2H_5)_2CHCOOH$

Answer (C)

Sol. Order of reactivity of carboxylic acid towards esterification.

$R_3C - COOH < R_2 - CH - COOH < R - CH_2 - COOH < CH_3\,COOH < HCOOH$

$CH_3 - CH_2 - COOH$ is most reactive towards esterification.

78. Molarity is

(A) The number of moles of solute present in 1 dm^3 volume of solution

(B) The number of moles of solute dissolved in 1 kg of solvent

(C) The number of moles of solute dissolved in 1 kg of solution

(D) The number of moles of solute dissolved in 100 dm^3 volume of solution

Answer (A)

Sol. Molarity. The number of moles of solute present in 1 dm^3 volume of solution.

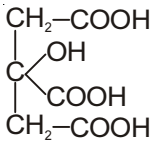
79. Which of the following is a tricarboxylic acid?

(A) Citric acid (B) Malonic acid

(C) Succinic acid (D) Malic acid

Answer (A)

Sol. Tricarboxylic acid is citric acid.



80. What is the number of donor atoms in dimethylglyoximato ligand?

(A) 1 (B) 2

(C) 3 (D) 4

Answer (B)

Sol. Dimethylglyoximato ligand (DMG) contains two donor atom.

81. Identify the product 'C' in the following reaction.

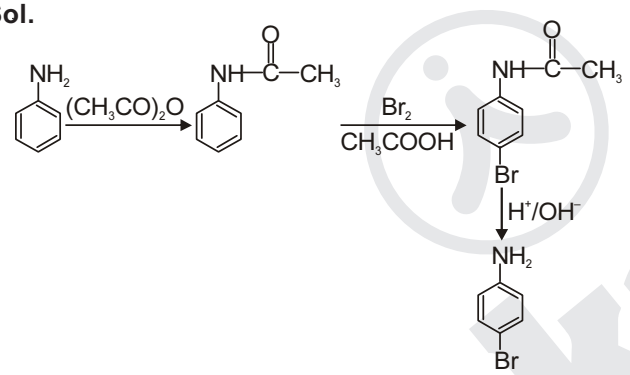
$$\text{Aniline} \xrightarrow[\text{Pyridine}]{(CH_3CO)_2O} A \xrightarrow[CH_3COOH]{Br_2} B \xrightarrow{H^+ \text{ or } OH^-} C$$

(A) Acetanilide (B) p – Bromoacetanilide

(C) p – Bromoaniline (D) o – Bromoaniline

Answer (C)

Sol.



82. Identify the functional group that has electron donating inductive effect.

(A) – COOH (B) – CN

(C) $-CH_3$ (D) $-NO_2$

Answer (C)

Sol. $-CH_3$ has electron donating effect.

83. Which among the following metals crystallise as a simple cube?

(A) Polonium (B) Iron

(C) Copper (D) Gold

Answer (A)

Sol. Polonium - Simple cubic

Iron - B.C.C. or H.C.P.

Copper - C.C.P.

Gold - C.C.P.

84. Which among the following oxoacids of phosphorus shows a tendency of disproportionation?

(A) Phosphinic acid (H_3PO_2)

(B) Orthophosphoric acid (H_3PO_4)

(C) Phosphonic acid (H_3PO_3)

(D) Pyrophosphoric acid ($H_4P_2O_7$)

Answer (C)

Sol. $4\overset{+3}{H_3}\overset{}{P}O_3 \rightarrow \overset{-3}{P}H_3 + 3\overset{+5}{H_3}\overset{}{P}O_4$

H_3PO_3 shows a tendency of disproportionations reaction.

85. What is the oxidation number of gold in the complex $[AuCl_4]^{1-}$?

(A) +4 (B) +3

(C) +2 (D) +1

Answer (B)

Sol. $[\overset{x}{Au}\overset{-1}{Cl_4}]^{-1}$

$x - 1 \times 4 = -1$

$x = +3$

86. In which substance does nitrogen exhibit the lowest oxidation state?

(A) Nitrogen gas (B) Ammonia

(C) Nitrous oxide (D) Nitric oxide

Answer (B)

Sol.

	O. N
N_2	0
NH_3	–3
N_2O	+1
HNO_3	+5

87. Which of the following is most reactive towards addition reaction of hydrogen cyanide to form corresponding cyanohydrin?

(A) Acetone (B) Formaldehyde

(C) Acetaldehyde (D) Diethylketone

Answer (B)

Sol. Aldehydes are more reactive than ketone for addition reaction of hydrogen cyanide.

* ERG decrease the reactivity so formaldehyde is most reactive.

88. The most basic hydroxide from following is

(A) $Pr(OH)_3$ (Z = 59) (B) $Sm(OH)_3$ (Z = 62)

(C) $Ho(OH)_3$ (Z = 67) (D) $La(OH)_3$ (Z = 57)

Answer (D)

Sol. $La(OH)_3$ is the most basic hydroxide as basicity decreases from $La(OH)_3$ to $Lu(OH)_3$.

89. What is the SI unit of density?

(A) g cm^{-3} (B) g m^{-3}

(C) kg m^{-3} (D) kg cm^{-3}

Answer (C)

Sol. SI unit of density kg/m^3.

90. Which of the following compounds does **NOT** undergo haloform reaction?

(A) $CH_3-\underset{\underset{OH}{|}}{CH}-CH_3$ (B) $CH_3-\overset{\overset{O}{\|}}{C}-CH_3$

(C) $C_2H_5-\underset{\underset{OH}{|}}{CH}-C_2H_5$ (D) $CH_3-\overset{\overset{O}{\|}}{C}-C_2H_5$

Answer (C)

Sol. The compound has $-\underset{\underset{OH}{|}}{CH}-CH_3$ or $-\overset{\overset{O}{\|}}{C}-CH_3$ group can give holoform reaction

$CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$ doesn't have this group so it will not give haloform test.

91. Which of the following is **NOT** a tranquilizer?

(A) Meprobamate (B) Equanil

(C) Chlordiazepoxide (D) Bromopheniramine

Answer (D)

Sol. Bromopheniramine is anti-allergic.

92. Conversion of hexane into benzene involves the reaction of

(A) Hydration (B) Hydrolysis

(C) Hydrogenation (D) Dehydrogenation

Answer (D)

Sol. Conversion of hexane into benzene involve the reaction of dehydrogenation.

$\underset{\text{Hexane}}{C_6H_{14}} \xrightarrow{-H_2} \underset{\text{Benzene}}{C_6H_6}$

93. The element that does **NOT** exhibit allotropy is

(A) Phosphorus (B) Arsenic

(C) Antimony (D) Bismuth

Answer (D)

Sol. Bismuth doesn't show allotropy.

94. Which of the following reactions is used to prepare aryl fluorides from diazonium salts and fluoroboric acid?

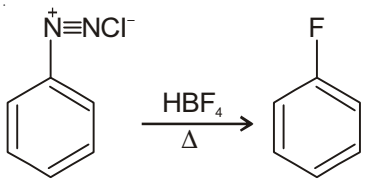
(A) Sandmeyer reaction

(B) Balz-Schiemann reaction

(C) Gattermann reaction

(D) Swarts reaction

Answer (B)

Sol. 

95. The correct relation between elevation of boiling point and molar mass of solute is

(A) $M_2 = \frac{K_b . W_2}{\Delta T_b . W_1}$ (B) $M_2 = \frac{K_b . W_1}{\Delta T_b . W_2}$

(C) $M_2 = \frac{\Delta T_b . K_b}{W_1 . W_2}$ (D) $M_2 = \frac{\Delta T_b . W_1}{K_b . W_2}$

Answer (A)

Sol. $\Delta T_b = K_b \times m$

$$\Delta T_b = K_b \times \frac{W_2}{M_2} \times \frac{1}{W_1}$$

$$\boxed{M_2 = \frac{K_b}{\Delta T_b} \times \frac{W_2}{W_1}}$$

96. Which symbol replaces the unit of atomic mass, amu?

(A) u (B) A

(C) M (D) n

Answer (A)

Sol. u-unified mass replaced atomic mass unit.

97. Which of the following compouds reacts immediately with Lucas reagent?

(A) CH_3CH_2OH (B) $CH_3CH_2CH_2OH$

(C) $CH_3-\underset{\underset{OH}{|}}{CH}-CH_3$ (D) $CH_3-\underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3$

Answer (D)

Sol. $R-OH + HCl \xrightarrow[ZnCl_2]{\text{Anhyd.}} R-Cl + H_2O$

Lucas reagent

Order of reactivity of alcohol with Lucas reagent.

$3° > 2° > 1°$

So, $CH_3-\underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_3$ react immediately.

98. What is the catalyst used for oxidation of SO_2 to SO_3 in lead chamber process for manufacture of sulphuric acid?

(A) Nitric oxide (B) Nitrous oxide

(C) Potassium iodide (D) Dilute HCl

Answer (A)

Sol. Lead chamber process : In this process a mixture SO_2, NO and air is treated with steam to obtain H_2SO_4, nitric oxide as a catalyst

$$2SO_2 + O_2 + 2H_2O \xrightarrow{NO} 2H_2SO_4$$

99. The number of moles of electrons passed when current of 2 A is passed through an solution of electrolyte for 20 minutes is

(A) 4.1×10^{-4} mol e^-

(B) 1.24×10^{-2} mol e^-

(C) 2.487×10^{-2} mol e^-

(D) 2.487×10^{-1} mol e^-

Answer (C)

Sol. $Q = i \times t$

$i = 2$

$t = 20 \times 60 = 1200$ s

$Q = 2400$ C

$Q = n \times e$

$$n = \frac{2400}{1.6\times10^{-19}} \quad (i.e., = 1.6\times10^{-19} C)$$

$n = 1.5 \times 10^{22}$ (n = no. of electrons)

$$\text{No. of moles of electrons} = \frac{1.5\times10^{22}}{6.022\times10^{23}}$$

$$= 2.487\times10^{-2} \text{mol } e^{-1}$$

100. The molarity of urea (molar mass 60 g mol^{-1}) solution by dissolving 15 g of urea in 500 cm^3 of water is

(A) 2 mol dm^{-3} (B) 0.5 mol dm^{-3}

(C) 0.125 mol dm^{-3} (D) 0.0005 mol dm^{-3}

Answer (B)

Sol. $W_2 = 15$ g

$V_{sol.} = 500\ cm^3$

$MW_2 = 60$ g mol^{-1}

$$M = \frac{W_2}{MW_2} \times \frac{1000}{V_{sol.}(\text{in } cm^3)}$$

$$M = \frac{15}{60} \times \frac{1000}{500}$$

$M = 0.5$ mol dm^{-3}

❑ ❑ ❑