PACE IIT | MEDICAL

ANDHERI / BORIVALI / DADAR / THANE / POWAI / CHEMBUR / NERUL / KHARGHAR

SUBJECT : PAPER II – PHYSICS & CHEMISTRY

Instruction to 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. Candidate should carefully read the instructions printed on the Question Booklet and Answer Sheet and make the correct entries on the Answer Sheet. As Answer Sheets are designed to suit the OPTICAL MARK READER (OMR) SYSTEM, special care should be taken to mark appropriate entries/answers correctly. Special care should be taken to fill QUESTION BOOKLET VERSION, SERIAL No. and Roll No. accurately. The correctness of entries has to be cross-checked by the invigilators. The candidate must sign on the Answer Sheet and Question Booklet.
5. Read each question carefully.
6. Determine the correct answer from out of the four available options given for each question.
7. Fill the appropriate circle completely like this •, for answering the particular question, with Black ink ball point pen only, in the OMR Answer Sheet.
8. 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 overwriting 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.
9. Use of whitener or any other material to erase/hide the circle once filled is not permitted. Avoid overwriting and/or striking of answers once marked.
10. 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.
11. The required mathematical tables (Log etc.) are provided within the Question Booklet.
12. Immediately after the prescribed examination time is over, the Answer sheet is to be returned to the Invigilator. Confirm that both the Candidate and Invigilator have signed on question booklet and answer sheet.
13. No candidate is allowed to leave the examination hall till the examination session is over.

1. A ceiling fan rotates about its own axis with some angular velocity. When the fan is switched off, the angular velocity becomes $\left(\frac{1}{4}\right)^{th}$ of the original in time 't' and 'n' revolutions are made in that time. The number of revolutions made by the fan during the time interval between switch off and rest are (Angular retardation is uniform)

(A) $\frac{4n}{15}$ (B) $\frac{8n}{15}$ (C) $\frac{16n}{15}$ (D) $\frac{32n}{15}$

Sol. (C)

$$\frac{w_0}{4} = w_0 - \alpha t_1 ----(1)$$

$$2\pi n = w_0 t_1 - \frac{1}{2}\alpha t_1^2 ---(2)$$

$$0 = w_0 - \alpha t_2 ------(3)$$

$$2\pi n_2 = w_0 t_2 - \frac{1}{2}\alpha t_2^2 ----(4)$$

$$n_2 = \frac{16n}{15}$$

2. A disc of moment of inertia $'I_1'$ is rotating in horizontal plane about an axis passing through a centre and perpendicular to its palne with constant angular speed $'\omega_1'$. Another disc of moment of inertia $'I_2'$ having zero angular speed is placed coaxially on a rotating disc. Now both the discs are rotating with constant angular sped $'\omega_2'$. The energy lost by the initial rotating disc is

(A) $\frac{1}{2}\left[\frac{I_1+I_2}{I_1I_2}\right]\omega_1^2$ (B) $\frac{1}{2}\left[\frac{I_1I_2}{I_1-I_2}\right]\omega_1^2$ (C) $\frac{1}{2}\left[\frac{I_1-I_2}{I_1I_2}\right]\omega_1^2$ (D) $\frac{1}{2}\left[\frac{I_1I_2}{I_1+I_2}\right]\omega_1^2$

Sol. (D)

From angular momentum cons.

$$I_1 w_1 = (I_1 + I_2) w_2 ----(1)$$

$$\text{Energy loss} = \frac{1}{2} I_1 w_1^2 - \frac{1}{2}(I_1 + I_2) w_2^2$$

$$= \frac{1}{2}\left(\frac{I_1 I_2}{I_1 + I_2}\right)\omega_1^2$$

3. A particle performs linear S.H.M. At a particular instant, velocity of the particle is 'u' and acceleration is $'\alpha'$ while at another instant velocity is 'v' and acceleration is $'\beta'(0 < \alpha < \beta)$. The distance between the two position is

(A) $\frac{u^2 - v^2}{\alpha + \beta}$ (B) $\frac{u^2 + v^2}{\alpha + \beta}$ (C) $\frac{u^2 - v^2}{\alpha - \beta}$ (D) $\frac{u^2 + v^2}{\alpha - \beta}$

Sol. (A)

$v = w\sqrt{a^2 - x^2}$

$a = w^2 x$

so

$u^2 = w^2\left(a^2 - x_1^2\right) - - - (1)$

$\alpha = w^2 x_1 - - - - - - (2)$

$v^2 = w^2\left(a^2 - x_2^2\right) - - (3)$

$\beta = w^2 x_2 - - - - - - (4)$

so

$\left(x_2 - x_1\right) = \dfrac{u^2 - v^2}{\alpha + \beta}$

4. The observer is moving with velocity 'v_0' towards the stationary source of sound and then after crossing moves away from the source with velocity 'v_0'. Assume that the medium through which the sound waves travel is at rest. If 'v' is the velocity of sound and 'n' is the frequency emitted by the source then the difference between apparent frequencies heard by the observer is

(A) $\dfrac{2nv_0}{v}$ (B) $\dfrac{nv_0}{v}$ (C) $\dfrac{v}{2nv_0}$ (D) $\dfrac{v}{nv_0}$

Sol. **(A)**

$f_1 = \left(\dfrac{v - v_0}{v}\right)n$

$f_2 = \left(\dfrac{v + v_0}{v}\right)n$

$f_2 - f_1 = \dfrac{2v_0}{v}n$

5. A metal rod of length 'L' and cross-sectional area 'A' is heated through 'T' °C. What is the force required to prevent the expansion of the rod lengthwise?
[Y = Young's modulus of the material of rod, α = coefficient of linear expansion]

(A) $\dfrac{YA\alpha T}{(1-\alpha T)}$ (B) $\dfrac{YA\alpha T}{(1+\alpha T)}$ (C) $\dfrac{(1-\alpha T)}{YA\alpha T}$ (D) $\dfrac{(1+\alpha T)}{YA\alpha T}$

Sol. **(B)**

$\dfrac{F}{A} = Y\dfrac{\Delta L}{L}$

$\Rightarrow F = \dfrac{YA(L_0\alpha T)}{L_0(1+\alpha T)} = \dfrac{YA\alpha T}{1+\alpha T}$

6. The frequencies for series limit of Balmer and Paschen series respectively are 'υ_1' and 'υ_3'. If frequency of first line of Balmer series is 'υ_2' then the relation between 'υ_1', 'υ_2' and 'υ_3' is

(A) $\upsilon_1 - \upsilon_2 = \upsilon_3$ (B) $\upsilon_1 + \upsilon_3 = \upsilon_2$ (C) $\upsilon_1 + \upsilon_2 = \upsilon_3$ (D) $\upsilon_1 - \upsilon_3 = 2\upsilon_1$

Sol. **(C)**

$h\upsilon_1 = E_2 \quad h\upsilon_3 = E_3$

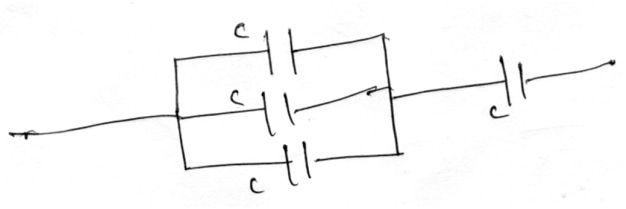
$h\upsilon_2 = E_3 - E_2$

$\upsilon_2 = \upsilon_3 - \upsilon_1$

7. When three capacitors of equal capacities are connected in parallel and one of the same capacity is connected in series with its combination. The resultant capacity is $3.75\mu F$. The capacity of each capacitor is

(A) $5\mu F$ (B) $6\mu F$ (C) $7\mu F$ (D) $8\mu F$

Sol. (A)



$\frac{1}{3c} + \frac{1}{c} = \frac{1}{3.75} \Rightarrow c = 5\mu F$

8. Sensitivity of moving coil galvanometer is 's'. If a shunt of $\left(\frac{1}{8}\right)^{th}$ fo the resistance of galvanometer is connected to moving coil galvanometer, its sensitivity becomes

(A) $\frac{s}{3}$ (B) $\frac{s}{6}$ (C) $\frac{s}{9}$ (D) $\frac{s}{12}$

Sol. **(C)**

When we will add shunt of $\frac{R}{8}$ current will increase to (9I). So the final sensitivity = $\frac{s}{9}$

9. Two unknown resistances are connected in two gaps of a meter bridge. The null point is obtained at 40 cm from left end. A 30 Ω resistance is connected in series with the smaller of the two resistances, the null point shifts by 20 cm to the right end. The value of smaller resistance in Ω is

(A) 12 (B) 24 (C) 36 (D) 48

Sol. **(B)**

$\frac{x}{y} = \frac{2}{3} - - - - - (1)$

$\frac{x+30}{y} = \frac{3}{2} - - - (2)$

$\Rightarrow 60 + 2x = 3y$

$\Rightarrow 60 + 2x = 3 \cdot \frac{3x}{2}$

$\Rightarrow x = 24$

10. In Fraunhofer diffraction pattern, slit width is 0.2 mm and screen is at 2 m away from the lens. If wavelength of light used is 5000Å then the distance between the first minimum on either side of the central maxim8um is (θ is mall and measured in radian)

(A) 10^{-1} m (B) 10^{-2} m (C) 2×10^{-2} m (D) 2×10^{-1} m

Sol. **(B)**

$$\beta=\frac{2\lambda D}{d}=\frac{2(5000)10^{-10}\cdot(2)}{(0.2)10^{-3}}$$

$$=10^{-2}$$

11. A solid sphere of mass 2 kg is rolling on a frictionless horizontal surface with velocity 6m/s. It collides on the free end of an ideal spring whose other end is fixed. The maximum compression produced in the spring will be (Force constant of the spring = 36 N/m)

(A) $\sqrt{14}$ m (B) $\sqrt{2.8}$ m (C) $\sqrt{1.4}$ m (D) $\sqrt{0.7}$ m

Sol. **(B)**

$$\frac{1}{2}I\omega^2+\frac{1}{2}m\upsilon^2=kx^2$$

$$\Rightarrow\frac{1}{2}\left(\frac{2}{5}MR^2\right)\frac{v^2}{R^2}+\frac{1}{2}mv^2=\frac{1}{2}kx^2$$

$$x=\sqrt{2.8}\text{ m}$$

12. A flywheel at rest is to reach an angular velocity of 24 rad/s in 8 second with constant angular acceleration. The total angle turned through during this interval is

(A) 24 rad (B) 48 rad (C) 72 rad (D) 96 rad

Sol. **(D)**

$$\omega=\omega_0+\alpha t$$

$$24=0+\alpha(8)$$

$$\Rightarrow\alpha=3\,\text{rad}/\text{sec}^2$$

$$\theta=\omega_0 t+\frac{1}{2}\alpha t^2$$

$$=0+\frac{1}{2}\cdot3(1)^2=96\,\text{rad}$$

13. Two uniform wires of the same material are vibrating under the same tension. If the first overtone of the first wire is equal to the second overtone of the second wire and radius of the first wire is twice the radius of the second wire then the ratio of the lengths of the first wire to second wire is

(A) $\frac{1}{3}$ (B) $\frac{1}{4}$ (C) $\frac{1}{5}$ (D) $\frac{1}{6}$

Sol. **(A)**

$$f = \frac{1}{2\ell}\sqrt{\frac{T}{\mu}} = \frac{1}{2\ell}\sqrt{\frac{T}{\rho(\pi r^2)}}$$

$$2f_1 = 3f_2$$

$$= 2.\frac{1}{2\ell_1}\sqrt{\frac{T}{\rho\pi(2r^2)}} = 3.\frac{1}{2\ell_2}\sqrt{\frac{T}{\rho\pi r^2}}$$

$$\Rightarrow \frac{\ell_1}{\ell_2} = 1/3$$

14. When one end of the capillary is dipped in water, the height of water column is 'h'. The upward force of 105 dyne due to surface tension is balanced by the force due to the weight of water column. The inner circumference of the capillary is
(Surface tension of water = $7\times10^{-2}\ N/m$)
(A) 1.5 cm (B) 2 cm (C) 2.5 cm (D) 3 cm

Sol. **(A)**

$$T(2\pi r) = F$$

$$\Rightarrow (7\times10^{-2})(2\pi r) = 105\times10^{-5}$$

$$2\pi r = 1.5cm$$

15. For a rigid diatomic molecule, universal gas constant R = nCp where 'Cp' is the molar specific heat at constant pressure and 'n' is a number. Hence n is equal to
(A) 0.2257 (B) 0.4 (C) 0.2857 (D) 0.3557

Sol. **(C)**

$$C_p = \frac{7}{2}R ----(1)\ (\text{for dia} - \text{atomic})$$

$$R = n\ C_p ----(2)\ [\text{given}]$$

$$\text{Hence, } n = \frac{2}{7} = 0.285$$

16. On a photosensitive material, When frequency of incident radiation is increased by 30%, kinetic energy of emitted photoelectrons increases from 0.4 eV to 0.9 eV. The work function of the surface is
(A) 1 eV (B) 1.267 eV (C) 1.4 eV (D) 1.8 eV

Sol. **(B)**

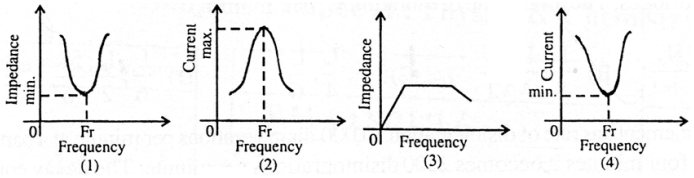
$$h\upsilon = W + 0.4 ----(1)$$

$$1.3h\upsilon = W + 0.9 ---(2)$$

$$\text{from (1) and (2)}$$

$$W = 1.267\,eV$$

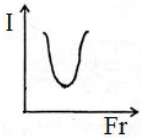
17. Out of the following graphs, which graph shows the correct relation (graphical representation) for LC parallel resonant circuit?



(A) (1) (B) (2) (C) (3) (D) (4)

Sol. **(B)**

$X_C = X_L$ at resource frequency I is min. $\therefore$ current is maxi.



18. According to de-Broglie hypothesis, the wavelength associated with moving electgron of mass 'm' is 'λ_e'. Using mass energy relation and Planck's quantum theory, the wavelength associated with photon is 'λ_p'. If the energy (E) of electron and photon is same then relation between 'λ_e' and 'λ_p' is

(A) $\lambda_p \alpha \lambda_e$ (B) $\lambda_p \alpha \lambda_e^2$ (C) $\lambda_p \alpha \sqrt{\lambda_e}$ (D) $\lambda_p \alpha \frac{1}{\lambda_e}$

Sol. **(B)**

$$\frac{hc}{\lambda_p} = E_p$$

$$\frac{h}{mv} = \frac{h}{\sqrt{2mE_e}}$$

$$\lambda_{e^2} = \frac{h^2}{2mE_e}$$

$$E_e \propto \frac{1}{\lambda_{e^2}}$$

$$\lambda_{e^2} \propto \lambda_p$$

19. A jparallel plate air capacitor has capacity 'C' farad, potential 'V' volt and energy 'E' joule. When the gap between the plates is completely filled with dielectric

(A) both V and E increase (B) both V and E decrease

(C) V decreases, E increases (D) V increases, E decreases

Sol. **(B)**

$$C = \frac{\varepsilon_0 A}{d}$$

$$C_k = \frac{k\varepsilon_0 A}{d}$$

$\theta = CV$

C is increasing, V will deasease

20. The resistivity of potentiometer wire is 40×10^{-8} ohm – metre and its area of cross-section is $8\times10^{-6}\ m^2$. If 0.2 ampere current is flowing through the wire, the potential gradient of the wire is

(A) $10^{-1}\ V/m$ (B) $10^{-2}\ V/m$ (C) $10^{-3}\ V/m$ (D) $10^{-4}\ V/m$

Sol. **(B)**

$$K=\frac{V}{L}=\frac{IR}{L}=\frac{I\rho}{A}=\frac{0.2\times40\times10^{-8}}{8\times10^{-6}}=10^{-2}$$

21. An ideal gas has pressure 'P', volume 'V' and absolue temperature T. If 'm' is the mass of each molecule and 'K' is the Boltzmann constant then density of the gas is

(A) $\frac{Pm}{KT}$ (B) $\frac{KT}{Pm}$ (C) $\frac{Km}{PT}$ (D) $\frac{PK}{Tm}$

Sol. **(A)**

$$PM=\rho RT$$

$$\frac{PM}{N_A}=\rho\frac{R}{N_A}T$$

$$PM=\rho KT$$

$$\rho=\frac{PM}{KT}$$

22. A big water drop is formed by the combination of 'n' small water drops of equal radii. The ratio of the surface energy of 'n' drops to the surface energy of big drop is

(A) $n^2:1$ (B) $n:1$ (C) $\sqrt{n}:1$ (D) $\sqrt[3]{n}:1$

Sol. **(D)**

$$\frac{4}{3}\pi R^3=n\frac{4}{3}\pi r^3$$

$$R^3=nr^3$$

$$\frac{E_1}{E_2}=\frac{n\left(T\times2\pi r^2\right)}{\left(T\times4\pi R^2\right)}=\frac{nr^2}{R^2}=n\left(\frac{1}{n}\right)^{2/3}=\frac{n^{1/3}}{1}=\frac{\sqrt{n}}{1}$$

23. The ratio of binding energy of a satellite at rest on earth's surface to the binding energy of a satellite of same mass revolving around the earth at a height 'h' above the earth's surface is
(R = radius of the earth)

(A) $\frac{2(R+h)}{R}$ (B) $\frac{R+h}{2R}$ (C) $\frac{R+h}{R}$ (D) $\frac{R}{R+h}$

Sol. **(A)**

$$\left(\text{Binding Energy}\right)_1 = \left|\frac{-GM_em}{R}\right| = \frac{GM_em}{R}$$

$$\left(\text{Binding Energy}\right)_2 = \left|\frac{-GM_em}{R+h} + \frac{1}{2}m\,\text{Verbital}^2\right|$$

$$= \left|\frac{-GM_em}{R+h} + \frac{GM_em}{2(R+h)}\right| = \frac{GM_em}{2(R+h)}$$

$$\frac{BE_1}{BE_2} = \frac{2(R+h)}{R}$$

24. A particle performing S.H.M. starts from equilibrium position and its time period is 16 second. After 2 seconds its velocity is π m/s . Amplitude of oscillation is $\left(\cos 45° = \frac{1}{2}\right)$

(A) $2\sqrt{2}$ m (B) $4\sqrt{2}$ m (C) $6\sqrt{2}$ m (D) $8\sqrt{2}$ m

Sol. **(D)**

$X = A\sin(wt)$

$$\text{at } t = 2 \quad x = A\sin\left(\frac{2\pi}{16}\times 2\right) = \frac{A}{\sqrt{2}} \quad \text{also } T = \frac{2\pi}{16} = \frac{\pi}{8}$$

$$v = \omega\sqrt{A^2 - x^2} = \frac{\omega A}{\sqrt{2} = \pi}$$

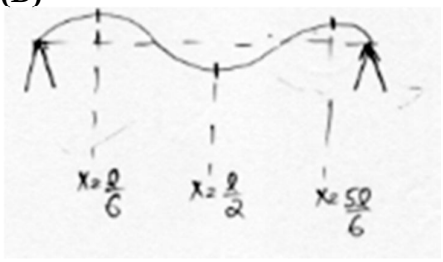
$$\frac{\pi A}{8\sqrt{2}} = \pi$$

$$A = 8\sqrt{2}\text{ m}$$

25. In a sonometer experiment, the string of length 'L' under tension vibrates in second overtone between two bridges. The amplitude of vibration is maximum at

A) $\frac{L}{3}, \frac{2L}{3}, \frac{5L}{6}$ B) $\frac{L}{8}, \frac{L}{4}, \frac{L}{2}$ C) $\frac{L}{2}, \frac{L}{4}, \frac{L}{6}$ D) $\frac{L}{6}, \frac{L}{2}, \frac{5L}{6}$

Sol. **(D)**



26. A radioactive element has rate of disintegration 10,000 disintegrations per minute at a particular instant. After four minutes it becomes 2500 disintegrations paer minute. The decay constant per minute is

A) $0.2\log_e^2$ B) $0.5\log_e^2$ C) $0.6\log_e^2$ D) $0.8\log_e^2$

Sol. **(B)**

$$10000 \xrightarrow[t_{1/2}]{} 5000 \xrightarrow[t_{1/2}]{} 2500$$

$$2t_{1/2} = 4$$

$t_{1/2} = 2$

$t_{1/2} = \frac{\ln 2}{\lambda}$

$\lambda = 0.5 \ln 2$

27. When the same monochromatic ray of light travels through glass slab and through water, the number of waves in glass slab of thickness 6 cm is same as in water column of height 7 cm. If refractive index of glass is 1.5 then refractive index of water is

A) 1.258 B) 1.269 C) 1.286 D) 1.310

Sol. (C)

$v^1 = \frac{v}{\mu}$

$\lambda^1 = \frac{\lambda}{\mu}$

$\frac{6}{\lambda_1} = \frac{7}{\lambda_2}$

$\frac{1.5 \times 6}{\lambda} = \frac{7}{\lambda}$

$\mu = \frac{1.5 \times 6}{7} = 1.286$

28. If the electron in hydrogen atom jumps form second Bohr orbit to ground state and difference between energies of the two states is radiated in the form of photons. If the work function of the material is 4.2 eV then stopping potential is [Energy of electron in n^{th} orbit = $\frac{13.6}{n^2}$eV]

A) 2 Ev B) 4 eV C) 6 eV D) 8 eV

Sol. (C)

$E = \frac{13.6 z^2}{n^2}$

$E_1 - E_2 = -13.6\left(\frac{1}{4} - \frac{1}{1}\right)$

$= 13.6 \times \frac{3}{6}$

$eV = \frac{nC}{\lambda} = \phi$

$= 13.6 \times \frac{3}{4} - 4.2$

$= 10.2 - 4.2$

$= 6$ eV

29. The magnetic moment of electron due to orbital motion is proportional to (n = principal quantum number)

A) $\frac{1}{n^2}$ B) $\frac{1}{n}$ C) n^2 D) n

Sol. Magnetic moment α

30. Photodiode is a device
A) which is always operated in reverse bias
B) which is always operated in forward bias
C) in which photo current is independent of intensity of incident radiation
D) which may be operated in forward or reverse bias

Sol. **(A)**
Theoretical

31. a wheel of moment of inertia 2 Kg m^2 is rotating about an axis passing through centre and perpendicular to its plane at a speed 60 rad/s. Due to friction, it comes to rest in 5 minutes. The angular momentum of the wheel three minutes before it stops rotating is
A) 24 Kg m^2/s B) 48 Kg m^2/s C) 72 Kg m^2/s D) 96 Kg m^2/s

Sol. **(C)**

$$Z = \frac{dL}{dt} = \frac{I_1\omega_1 - I_2\omega_2}{t}$$

$$Z_1 = \frac{2(60-0)}{5}$$

$$Z_1 = \frac{2(60-\omega)}{2}$$

$$Z_1 = Z_2$$

$$\frac{2\times 60}{5} = \frac{2\times 60 - L}{2}$$

48 120 – L
L = 120 – 48
= 72

32. The equation of the progressive wave is $Y = 3\sin\left[\pi\left(\frac{t}{3}-\frac{x}{5}\right)+\frac{\pi}{4}\right]$ where x and y are in metre and time in second. Which of the following is correct ?
A) velocity V = 1.5 m/s B) amplitude A = 3 cm
C) frequency F = 0.2 Hz D) wavelength λ = 10 m

Sol. **(D)**

$$K = \frac{x}{5} \qquad \omega = \frac{z}{3}$$

$$\lambda = \frac{2z}{K} = 10 \qquad f - \frac{\omega}{2z} = \frac{1}{6}$$

33. Two spherical black bodies have radii 'r_2' and 'r_1'. Their surface temperatures are 'T_1' and 'T_2'. If they radiate same power then $\frac{r_2}{r_1}$ is

A) $\frac{T_1}{T_2}$ B) $\frac{T_2}{T_1}$ C) $\left(\frac{T_1}{T_2}\right)^2$ D) $\left(\frac{T_2}{T_1}\right)^2$

Sol. **(C)**

$P_1 = e\sigma A_1 T_1^4 = P_2 = e\sigma A_2 T_2^4$

$r_1^2 \cdot T_1^4 = r_2^2 \cdot T_2^4$

$\frac{r_2}{r_1} = \left(\frac{T_1}{T_2}\right)^2$

34. The closed and open organ pipes have same length. When they are vibrating simultaneously in first overtone, produce three beats. The length of open pipe is made $\frac{1}{3}^{rd}$ and closed pipe is made three times the original, the number of beats produced will be

A) 8 B) 14 C)17 D) 20

Sol. **(C)**

$f_1 = \frac{3V}{4L}$ $f_2 - f_1 = \frac{V}{4L} = 3$

$f_2 = \frac{V}{L}$ $\Rightarrow \frac{V}{L} = 12$

$f_2^1 = \frac{V}{2L/3} = \frac{3V}{2L}$

$f_2^1 - f_1^1 = \left(\frac{3}{2} - \frac{1}{12}\right)\frac{V}{L} = \frac{17}{12} \times 12 = 17$

35. A lift of mass 'm' is connected to a rope which is moving upward with maximum acceleration 'a'. For maximum safe stress, the elastic limit of the rope is 'T'. The minimum diameter of the rope is (g = gravitational acceleration)

A) $\left[\frac{2m(g+a)}{\pi T}\right]^{\frac{1}{2}}$ B) $\left[\frac{4m(g+a)}{\pi T}\right]^{\frac{1}{2}}$ C) $\left[\frac{m(g+a)}{\pi T}\right]^{\frac{1}{2}}$ D) $\left[\frac{m(g+a)}{2\pi T}\right]^{\frac{1}{2}}$

Sol. **(B)**

Elastic limit = $\frac{F}{A} = T$

$\frac{m(g+a)}{A} = T$

$\frac{m(g+a)}{\frac{\pi d^2}{4}} = T$

$d = \sqrt{\frac{4m(g+a)}{\pi T}}$

36. In series LCR circuit R = 18Ω and impedance is 33Ω. An r.m.s. voltage 220 V is applied across the circuit. The true power consumed in a.c. circuit is

A) 220 W B) 400 W C) 600 W D) 800 W

Sol. **(D)**

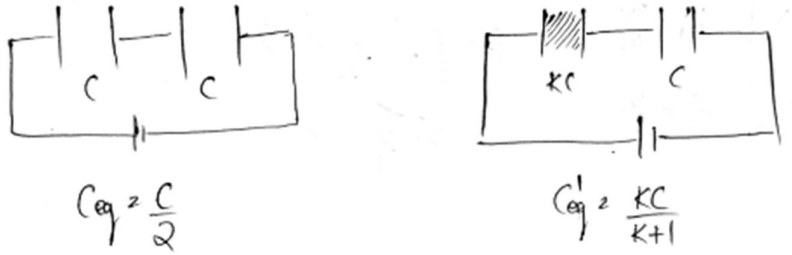
$$i_{rm} = \frac{V_{rm}}{z} = \frac{220}{33} = \frac{20}{3}$$

$$D = i_{rm} \cdot V_{rm} \cdot \cos\theta = \frac{20}{3} \times 220 \times \frac{18}{33} = 800W$$

37. Two parallel plate air capacitors of same capacity 'C' are connected in series to a battery of emf 'E'. Then one of the capacitors is completely filled with dielectric material of constant 'K'. The change in the effective capacity of the series combination is

A) $\frac{C}{2}\left[\frac{K-1}{K+1}\right]$ B) $\frac{2}{C}\left[\frac{K-1}{K+1}\right]$ C) $\frac{C}{2}\left[\frac{K-1}{K+1}\right]$ D) $\frac{C}{2}\left[\frac{K-1}{K+1}\right]^2$

Sol. **(A)**



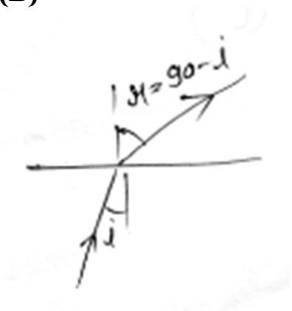
$$\Delta C = C'_{eq} - C_{eq} = \left(\frac{K}{K+1} - \frac{1}{2}\right)C$$

$$= \left(\frac{K-1}{K+1}\right)\frac{C}{2}$$

38. The polarising angle for transparent medium is 'θ'm '*v*' is the speed of light in that medium. Then the relation between 'θ' and '*v*' is (c = velocity of light in air)

A) $\theta = \tan^{-1}\left(\frac{v}{c}\right)$ B) $\theta = \cot^{-1}\left(\frac{v}{c}\right)$ C) $\theta = \sin^{-1}\left(\frac{v}{c}\right)$ D) $\theta = \cos^{-1}\left(\frac{v}{c}\right)$

Sol. **(B)**



$$\mu \sin i = \mu \sin i(90 - i)$$

$$\mu \sin i = \mu \cos i$$

$$\tan\theta = \frac{C}{V}$$

$$\theta = \tan^{-1}\left(\frac{C}{V}\right) = \cot^{-1}\left(\frac{V}{C}\right)$$

39. Two identical light waves having phase difference 'ϕ' propagate in same direction. When they superpose, the intensity of resultant wave is proportional to

A) $\cos^2\phi$ B) $\cos^2 \phi/2$ C) $\cos^2 \phi/3$ D) $\cos^2 \phi/4$

Sol. (B)

$I - I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\theta$ $\quad\quad$ $\cos^2\theta = 1 - 2\sin^2\theta$

$= 2I_0[1+\cos\theta]$ $\quad\quad$ $\cos^2\theta = 2\cos^2\theta - 1$

$= 2I_0\left[2\cos^2 \theta/2\right]$ $\quad\quad$ $1 + \cos^2\theta = 2\cos^2\theta$

$= 4I_0 \cos^2 \theta/2$

40. For a transistor, α_{dc} and β_{dc} are the current ratios, then the value of $\frac{\beta_{dc} - \alpha_{dc}}{\alpha_{dc} \cdot \beta_{dc}}$ is

A) 1 B) 1.5 C) 2 D) 2.5

Sol. (A)

$$\alpha_{dc} = \frac{I_C}{I_E} \;\&\; \beta_{dc} = \frac{I_C}{I_B}$$

$$\frac{1}{\alpha_{dc}} = \frac{1}{\beta_{dc}} = \frac{I_E}{I_C} - \frac{I_B}{I_C}$$

$$= \frac{\beta_{dc} - \alpha_{dc}}{\alpha_{dc}\beta_{dc}} = \frac{I_E - I_B}{I_C} = 1$$

41. Two coils P and Q are kept near each other. When no current flows through coil P and current increases in coil Q at the rate 10 A/s, the e.m.f. in coil P is 15 m V. when coil Q carries no current and current of 1.8A flows through coil P, the magnetic flux linked with the coil Q is

A) 1.4mWb B) 2.2 mWb C) 2.7 mWb D) 2.9 mWb

Sol. (C)

$\phi_P = Mi_Q$

$$Enf_{(P)} = \frac{d\phi_P}{dt} = \frac{Mdi_Q}{dt}$$

$$15mV = M\left(\frac{10A}{sec}\right)$$

M = 1.5 m Henry

42. In Young's double slit experiment, in an interference pattern second minimum is observed exactly in front of one slit. The distance between the two coherent sources is 'd' and the distance between source and screen is 'D'. The wavelength of light source used is

A) $\frac{d^2}{D}$ B) $\frac{d^2}{2D}$ C) $\frac{d^2}{3D}$ D) $\frac{d^2}{4D}$

Sol. (C)

Second minimum

$$y = \frac{3\beta}{2} = \frac{d}{2}$$

$$\frac{3,\gamma D}{d} = d$$

$$\lambda = \frac{d^2}{3D}$$

43. In communication system, the process of superimposing a low frequency signal on a high frequency wave is known as

A) Repeater B) Attenuation C) Modulation D) Demodulation

Sol. **(C)**

Modulation

44. A bar manget has length 3 cm, cross-sectional area 2 cm^2 and magnetic moment 3 Am^2. The intensity of magnetization of bar magnet is

A) 2×10^5 A/m B) 3×10^5 A/m C) 4×10^5 A/m D) 5×10^5 A/m

Sol. **(D)**

$$I = \frac{M}{V} = \frac{3A - m^2}{6\times10^{-6} m^3} = 0.5\times10^6 \, A/m = 15\times10^5 \, A/m$$

45. The magnetic flux near the axis and inside the air core solenoid of length 60 cm carrying current 'I' is

1.57×10^{-6} Wb. Its magnetic moment will be (cross-sectional area of a solenoid is very small as compared to its length, $\mu_0 = 4\pi\times10^{-7}$ SI unit)

A) 0.25A B) 0.50 A C) 0.75 A D) 1 A

Sol. **(C)**

$$M = NiA \;\&\; 'B' = \mu_o ni$$

$$\frac{1.57\times10^{-6}}{-A} = 4\pi\times10^{-7}\times\frac{N}{0.6}\times i$$

$$0.06\times\frac{\pi}{2}\times\frac{10^{-6}}{4\pi\times10^{-7}} = NiA$$

$$\frac{10}{8}\times.6 = NiA$$

$$.75 = M$$

46. The depth 'd' at which the value of acceleration due to gravity becomes $\frac{1}{n}$ times the value at the earth's surface is (R = radius of earth)

A) $d = R\left(\frac{n}{n-1}\right)$ B) $d = R\left(\frac{n-1}{2n}\right)$ C) $d = R\left(\frac{n-1}{n}\right)$ D) $d = R^2\left(\frac{n-1}{n}\right)$

Sol. **(C)**

$$\frac{g}{n} = g\left(1-\frac{d}{R}\right)$$

$$d = \left(1-\frac{1}{n}\right)R = \left(\frac{n-1}{n}\right)R$$

47. A particle is performing S.H.M. starting from extreme position. Graphical representation shows that, between displacement and acceleration, there is a phase difference of

A) 0 rad B) $\frac{\pi}{4}$ rad C) $\frac{\pi}{2}$ rad D) π rad

Sol. **(D)**

$180^o = \pi$ rad

48. The fundamental frequency of an air column in a pipe closed at one end is 100 Hz. If the same pipe is open at both the ends, the frequencies produced in Hz are
A) 100, 200, 300, 400, … B) 100, 300, 500, 700, …
C) 200, 300, 400, 500, … D) 200, 400, 600, 800, …

Sol. (D)

$$\frac{V}{4L} = 100 \Rightarrow \frac{V}{L} = 400$$

$$\frac{3V}{2L}, \frac{V}{L}, \frac{3V}{2L}, \frac{2V}{L}$$

= 200, 400, 600, 800, …

49. For a particle moving in vertical circle, the total energy at different positions along the path
A) is conserved B) increases C) decreases D) may increase or decrease

Sol. (A)
Conservation of energy

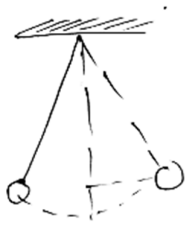
50. A simple pendulum of length 'L' has mass 'M' and it oscillates freely with amplitude 'A'. At extreme position, its potential energy is
A) $\frac{MgA^2}{2L}$ B) $\frac{MgA}{2L}$ C) $\frac{MgA^2}{L}$ D) $\frac{2MgA^2}{2L}$

Sol. (A)

$$\frac{1}{2}m\omega^2A^2 = mgh$$

$$\frac{1}{2}M\left(\frac{g}{\ell}\right)A^2$$

$$= \frac{MgA^2}{2\ell}$$



$$T = 2\pi\sqrt{\frac{\ell}{g}} = \frac{2\pi}{\omega}$$

$$\omega = \sqrt{\frac{g}{\ell}}$$

51. Which among the following equations represenXrrhefliu5 equation?

(A) $k = Ae^{E_a/RT}$ (B) $k = A.e^{RT/E_a}$ (C) $k = \frac{A}{e^{E_a/RT}}$ (D) $k = \frac{A}{e^{RT/E_a}}$

Sol. **(C)**

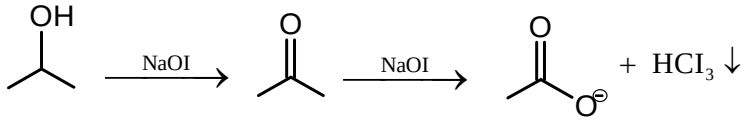
52. Which of the following compounds will give positive iodoform test?

(A) Isopropyl alcohol (B) Propionaldehyde

(C) Ethylphenyl ketone (D) Benzyl alcohol

Sol. **(A)**

Isopropyl alcohol



53. The first law of thermodynamics for isothermal process is

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

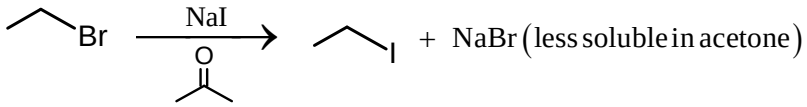
Sol. **(A)**

54. The conversion of ethyl bromide to ethyl iodide using sodium iodide and dry acetone, this reaction is known as

(A) Swarts reaction (B) Finkelstein reaction

(C) Sandmeyer reaction (D) Stephen reaction

Sol. **(B)**



55. What is the hybridization of carbon atoms in fullerene?

(A) SP^3 (B) SP (C) SP^2 (D) dSP^3

Sol. **(C)**

Sp^2

56. (+)2-Methylbutan1-ol and (–)2-Methylbutan-1-ol have different values for which property?

(A) Boiling point (B) Relative density (C) Refractive index (D) Specific rotation

Sol. **(D)**

Specific rotation ; there are enantiomers.

57. Which among the following is **NOT** a mineral of iron?

(A) Haematite (B) Magnesite (C) Magnetite (D) Siderite

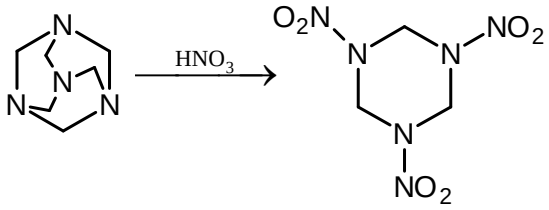
Sol. **(B)**

58. Nitration of which among the following compounds yields cyclonite?

(A) Formaldehyde (B) Benezaldehyde

(C) Urotropine (D) Acetaldehyde-ammonia

Sol. **(C)**



59. Calculate the work done during compression of 2 mol of an ideal gas from a volume of 1 m^3 to 10 dm^3 at 300 K against a pressure of 100 KPa.

(A) –99 kJ (B) +99 kJ (C) +22.98 kJ (D) –22.98 kJ

Sol. **(B)**

$w = -Pext\ \Delta V = -100 \times \left(10^{-2} - 1\right) xn^3 = 99k\ Pam^3$

60. Which element among the following does form $P\pi - P\pi$ multiple bonds?

(A) Arsenic (B) Nitrogen (C) Phosphorus (D) Antimony

Sol. **(B)**

N_2 form $p\pi$ - $p\pi$ multiple bonds

61. The work done during combustion of 9×10^{-2} Kg of ethane, $C_2H_6(g)$ at 300 K is

(Given R = 8.314 J $deg^{-1}mol^{-1}$, atomic mass C = 12, H = 1)

(A) 6.236 kJ (B) –6.236 kJ (C) 18.71 kJ (D) –18.71 kJ

Sol. **(C)**

$C_2H_6(g) + \frac{7}{2}O_{21g} \rightarrow 2CO_2(g) + 3H_2O(\ell)$

$\Delta ng = 2 - \left(\frac{7}{2} + 1\right) = 2 - 4.5 = -2.5$

$\therefore w = -Pext\Delta V = -\Delta ng\, RT = -(-2.5) \times 8.314 \times 300$

$\therefore W = 6235.53\ mol^{-1}$

$\therefore n = \frac{9 \times 10^{-2} \times 10^3 g}{30} = 3moles;$ For 3 moles $w = 18.71$ KJ

62. What type of sugar molecule is present in DNA?

(A) D-3-deoxyribose (B) D-ribose

(C) D-2-deoxyribose (D) D-Glucopyranose

Sol. **(C)**

D-2-deoxyribose ; D-2-deoxyribose is a pressure to the DNA.

63. The Molality of solution containing 15.20 g of urea, (molar mass = 60) dissolved in 150 g of water is

(A) 1.689 mol kg^{-1} (B) 0.1689 mol kg^{-1}

(C) 0.5922 mol kg^{-1} (D) 0.2533 mol kg^{-1}

Sol. **(A)**

$\text{Molality} = \frac{\text{mole}}{\text{wt of solvent}(kg)}$

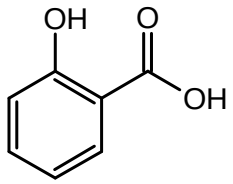
$= \frac{15.2}{60 \times \cdot 15} = 1.689$

64. The acid which contains both –OH and –COOH groups is

(A) phthalic acid (B) adipic acid (C) glutatic acid (D) salicylic acid

Sol. **(D)**

Salicyclic acid ;



65. Identify the compound in which phosphorus exists in the oxidation state of +1.

(A) Phosphonic acid (H_3PO_3) (B) Phosphinic acid (H_3PO_2)

(C) Pyrophosphorus acid $(H_4P_2O_5)$ (D) Orthophosphoric acid (H_3PO_4)

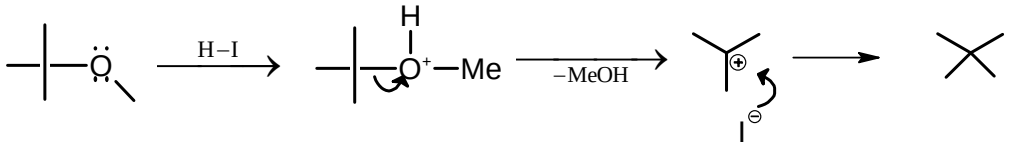
Sol. **(B)**

66. tert-butyl methyl ether on treatment with hydrogen iodide in cold gives

(A) tert-butyl iodide and methyl iodide (B) tert-butyl alcohol and methyl alcohol

(C) tert-butyl alcohol and methyl iodide (D) tert-butyl iodide and methyl alcohol

Sol. **(D)**



67. Name the process that is employed to refine aluminium.

(A) Hall's process (B) Mond process (C) Hoope's process (D) Serperck's process

Sol. **(C)**

68. The colour and magnetic nature of magnetic ion (MnO_4^{2-}) is

(A) green, paramagnetic (B) purple, diamagnetic

(C) green, diamagnetic (D) purple, paramagnetic

Sol. **(A)**

69. The osmotic pressure of solution containing 34.2 g of cane sugar (molar mass = 342 mol^{-1}) in 1L of solution at 20^oC is

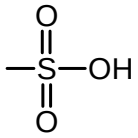
(A) 2.40 atm (B) 3.6 atm (C) 24 atm (D) 0.0024 atm

Sol. **(A)**

70. In assigning R–S configuration which among the following group has highest priority?

(A) $-SO_3H$ (B) –COOH (C) –CHO (D) $-C_6H_5$

Sol. **(A)**



71. Identify the weakest oxidizing agent among the following

(A) Li^+ (B) Na^+ (C) Cd^{2+} (D) I_2

Sol. **(A)**

Li^+ is the weakest oxidizing agent as $Li^{+1}_{(ar)}$ to $Li_{(s)}$ has most negative E^o value

72. The monomers used in preparation of dextron are

(A) lactic acid and glycolic acid

(B) 3-Hydroxy butanoic acid and 3-Hydroxy pentanoic acid

(C) styrene and 1, 3-Butadien

(D) hexamethylenediamine and adipic acid

Sol. **(A)**

Monomers are lactic acid and glycolic acid

73. Which among the following compounds does not act as a reducing agent?

(A) H_2O (B) H_2S (C) H_2Se (D) H_2Te

Sol. **(A)**

74. Which of the following processes is **NOT** used to preserve the food?

(A) Irradiation (B) Addition of salts

(C) Addition of heat (D) Hydration

Sol. **(D)**

75. In case of substituted aniline the group which decreases the basic strength is

(A) $-OCH_3$ (B) $-CH_3$ (C) $-NH_2$ (D) $-C_6H_5$

Sol. **(D)**

$-C_6H_5$ it is a with drawing group.

76. Which among the following equations represents the reduction reaction taking place in lead accumulator at positive electrode, while it is being used as a source of electrical energy?

(A) $Pb \rightarrow Pb^{2+}$ (B) $Pb^{4+} \rightarrow Pb$ (C) $Pb^{2+} \rightarrow Pb$ (D) $Pb^{4+} \rightarrow Pb^{2+}$

Sol. **(D)**

77. For which among the following equimolar aqueous solutions Van't Hoff factor has the lowest value?

(A) Aluminium Chloride (B) Potassium Sulphate

(C) Ammonium Chloride (D) Urea

Sol. **(D)**

78. The amino acid which is basic in nature is

(A) Histidine (B) Tyrosine (C) Proline (D) Valine

Sol. **(A)**
Histidine

79. Which element among the following does **NOT** form diatomic molecules?
(A) Argon (B) Oxygen (C) Nitrogen (D) Bromine

Sol. **(A)**

80. A molecule of Stachyose contains how many carbon atoms?
(A) 6 (B) 12 (C) 18 (D) 24

Sol. **(D)**
Stachyose is a tetrasaccharide $C_{24}H_{42}O_{11}$

81. Which of the following is used as antiseptic?
(A) Chloramphenicol (B) Bithional
(C) Cimetidine (D) Chlordiazepoxide

Sol. **(B)**
Bithional

82. In preparation of sulphuric acid from sulphur dioxide in lead chamber process. What substance is used as a catalyst?
(A) Malnganese dioxide (B) Vanadium pentoxide
(C) Nitric oxide (D) Raney Nickel

Sol. **(C)**

83. The correct charge on and co-ordination number of 'Fe' in $K_3\left[Fe(CN)_6\right]$ is
(A) +2, 4 (B) +3, 6 (C) +2, 6 (D) +3, 3

Sol. **(B)**

84. Which among the following reactions is an example of pseudo first order reaction?
(A) Inversion of cane sugar
(B) Decomposition of H_2O_2
(C) conversion of cyclopropane to propane
(D) Decomkposition of N_2O_5

Sol. **(A)**

85. The amine which reacts with p-toluenesulphonyl chloride to give a clear solution which on acidification gives insoluble compound is
(A) $C_2H_5NH_2$ (B) $(C_2H_5)_2NH$ (C) $(C_2H_5)_3N$ (D) $CH_3NHC_2H_5$

Sol. **(B)**

86. Which of the following statements is **INCORRECT** in case of Hofmann bromamidedegration?
(A) Reaction is useful for decreasing length of carbon chain by one carbon atom
(B) It gives tertiary amine
(C) It gives primary amine

(D) Aqueous or alcoholic KOH is used with bromine

Sol. **(B)**

H of mannbromamide degradation is only for the synthesis of primary amine

87. Which of the following statements is **INCORRECT** for pair of elements Zr–Hf?

(A) Both posses same number of valence electrons

(B) Both have identical atomic sizes

(C) Both have almost identical ionic radii

(D) Both of these belong to same period table

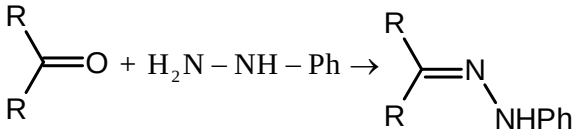
Sol. **(D)**

88. Aldehydes or ketons when treated with $C_6H_5 - NH - NH_2$, the product formed is

(A) semicarbazone (B) phenylphydrazone

(C) hydrazone (D) oxime

Sol. **(B)**



Phenyl hydrazone

89. Solubility of which among the following solids in water changes slightly with temperature?

(A) KNO_3 (B) $NaNO_3$ (C) KBr (D) NaBr

Sol. **(D)**

Solubilities of salts like KNO_3, $NaNO_3$ kBr etc. increase appreciably with temperature.

90. What is the quantity of hydrogen gas liberated when 46 g sodium reacts with excess ethanol? (Given At. Mass of Na = 23)

(A) 2.4×10^{-3}kg (B) 2.0×10^{-3}kg (C) 4.0×10^{-3}kg (D) 2.4×10^{-2}kg

Sol. **(B)**

91. What is the SI unit of conductivity?

(A) Sm (B) Sm^{-1} (C) Sm^{2} (D) Sm^{-2}

Sol. **(B)**

92. Which of the following is Baeyer's reagent?

(A) alkaline $KMnO_4$ (B) acidic $K_2Cr_2O_7$

(C) alkaline $Na_2Cr_2O_7$ (D) MnO_2

Sol. **(A)**

Alkaline $KMnO_4$

93. What is the chief constituent of Pyrex glass?

(A) B_2O_3 (B) SiO_2 (C) Al_2O_3 (D) Na_2O

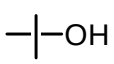
Sol. **(B)**

94. Which of the following compounds has lowest boiling point?

(A) n-butyl alcohol (B) isobutyl alcohol

(C) tert-butyl alcohol (D) sec-butyl alcohol

Sol. **(C)**



95. Identify the INVALID equation.

(A) $\Delta H = \sum H_{products} - \sum H_{reactants}$

(B) $\Delta H = \Delta U + P\Delta V$

(C) $\Delta H^{o}_{(reaction)} = \sum H^{o}_{(product\ bonds)} - \sum H^{o}_{(reactant\ bond)}$

(D) $\Delta H = \Delta U + \Delta nRT$

Sol. **(C)**

96. The rate constant for a first order reaction is $7.0\times10^{-4}S^{-1}$. If initial concentration of reactant is 0.080 M, what is the half life of reaction?

(A) 990 S (B) 79.2 S (C) 12375 S (D) $10.10\times10^{-4}S$

Sol. **(A)**

97. The polymer used in making handles of cookers and frying pans is

(A) Bakelite (B) nylon-2-nylon-6

(C) orlon (D) polyninyl chloride

Sol. **(A)**

bakelite

98. Which halogen has the highest value of negative electron gain enthalpy?

(A) Fluorine (B) Chlorine (C) Bromine (D) Iodine

Sol. **(B)**

99. What is the actual volume occupied by water molecules present in 20 cm^3 of water?

(A) 20 cm^3 (B) 10 cm^3 (C) 40 cm^3 (D) 24.89 cm^3

Sol. **(B)**

About half of the total volume occupied by water is empty

100. Which of following coordinates complexes is an exception to EAN rule?

(Given At. No. Pt = 78, Fe = 26, Zn = 30, Cu = 29)

(A) $\left[Pt\left(NH_3\right)_6\right]^{4+}$ (B) $\left[Fe\left(CN\right)_6\right]^{4-}$ (C) $\left[Zn\left(NH_3\right)_4\right]^{2+}$ (D) $\left[Cu\left(NH_3\right)_4\right]^{2+}$

Sol. **(D)**

EAN of $\left[Cu\left(NH_3\right)_4\right]^{2+}$ is '35' , the complex does not obey EAN rule