SOLUTIONS & ANSWERS FOR KERALA ENGINEERING ENTRANCE EXAMINATION-2018 – Paper I
VERSION – A1

[PHYSICS & CHEMISTRY]

1. Ans: The total displacement of the particle is zero

Sol: Positive area of $\int vdt$ = negative area of $-\int vdt$

$\Delta S = 0$

2. Ans: 5

Sol: $g = \frac{4\pi\ell}{T^2}$

$$\frac{\Delta g}{g}\times 100 = \frac{\Delta \ell}{\ell}\times 100 + \frac{2\Delta T}{T}\times 100$$

$$1.1 = \frac{0.05}{50}\times 100 + 2\times\frac{\Delta T}{1}\times 100$$

$$1 = 2\times\frac{\Delta T}{1}\times 100$$

$$\Delta T = \frac{1}{200}$$

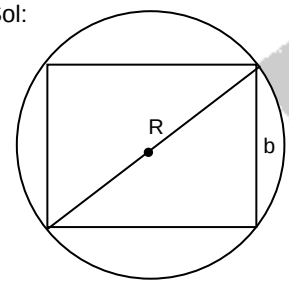
$= 5$ m s

$$\Delta T = \frac{1}{200}\ s$$

$= 5$ m s

3. Ans: No option

Sol:



$2R = \sqrt{2}b$

$$R = \frac{b}{\sqrt{2}}$$

$b = \sqrt{2}R$

$M' \propto b^2$

$M \propto \pi R^2$

$$\frac{M'}{M} = \frac{b^2}{\pi R^2} = \frac{b^2 2}{\pi b^2} = \frac{2}{\pi}$$

$$M' = \frac{2M}{\pi}$$

$$\frac{M' b^2}{6} = \left(\frac{2M}{\pi}\right)\frac{2R^2}{6} = \frac{Ma^2}{6}$$

$$R^2 = \frac{\pi a^2}{4}$$

$$R = \frac{\sqrt{\pi}a}{2}$$

No option

4. Ans: 0.025 mm

Sol: 1 MSD $= \frac{300}{600} = \frac{1}{2}$ mm

1 VSD $= \frac{19\times 0.5}{20}$ mm $= \frac{19}{40}$ mm

LC $= \frac{1}{2} - \frac{19}{40} = \frac{1}{40}$ mm

5. Ans: $\sqrt{3\frac{k}{m}}$

Sol: $V = \frac{Kx^2}{2} + \frac{\lambda}{x}$

$$F = -\frac{dV}{dx} = -\left[\frac{K2x}{2} - \frac{\lambda}{x^2}\right]$$

$$= \frac{\lambda}{x^2} - Kx \qquad \text{---(1)}$$

For equilibrium

$$\Rightarrow \frac{\lambda}{x^2} = Kx \Rightarrow x^3 = \frac{\lambda}{K} \qquad \text{---(2)}$$

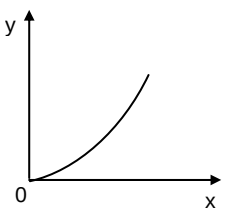
$$\frac{dF}{dx} = -\frac{2\lambda}{x^3} - K \quad \text{(using (2))}$$

$$= -\frac{2\lambda}{\left(\frac{\lambda}{K}\right)} - K = -3\ K$$

$dF = -3K(dx)$

$$\Rightarrow \text{SHM} \Rightarrow \omega = \sqrt{\frac{3K}{m}}$$

6. Ans:



Sol: $\bar{r}_1 = t\hat{i} - t^3\hat{j} + 2t^2\hat{k}$

$\bar{r}_2 = t\hat{i} - t^3\hat{j} - t^2\hat{k}$

$$\bar{r}_{cm} = \frac{m(\bar{r}_1) + 2m\bar{r}_2}{m + 2m}$$

$$= \frac{\bar{r}_1 + 2\bar{r}_2}{3}$$

$= t\hat{i} - t^3\hat{j}$

$x = t$ ---(1)

$y = t^3$ ---(2)

$y = x^3$

7. Ans: 3 : 1

Sol: $g = \frac{GM}{R^2} = \frac{G\frac{4}{3}\pi R^3\rho}{R^2} \propto R\rho$

$\frac{g_A}{g_B} = \frac{R_A}{R_B} = \frac{3}{1}$

8. Ans: $\frac{\text{surface tension}}{\text{current}}$

Sol: Magnetic induction

$MT^{-2}A^{-1}$

$= \frac{\text{surface tension}}{\text{current}}$

9. Ans: Photoelectric effect

Sol: (GK)

10. Ans: 2

Sol: $I\omega = I'\frac{\omega}{2}$

$I' = 2I$

$I' = mR^2 + 2MR^2$

$I = mR^2$

$mR^2 + 2MR^2 = 2mR^2$

$2M = m \Rightarrow \frac{m}{M} = 2$

11. Ans: $\frac{\ell n2}{20}$

Sol: $\frac{dv}{dt} = -kv$

$\frac{dv}{v} = -kdt$

$\ell nv\Big|_{v_1}^{v_2} = -\int kdt$

$\Rightarrow \ell n\ \frac{v_1}{v_2} = kt = k10$

$v_1 = 10\ m\ s^{-1}$

$\frac{1}{2}\times 1\times v_2^{\ 2} = \frac{1}{2}\times\frac{1}{2}\times 1\times 100$

$v_2 = \frac{10}{\sqrt{2}} \Rightarrow \ell n\frac{v_1}{v_2} = \ell n\sqrt{2} = \frac{1}{2}\ell n2$

$\Rightarrow k = \frac{1}{20}\ell n2$

12. Ans: perpendicular to the velocity

Sol: Uniform circular motion

13. Ans: $v^2 = u^2 + 2aS$

Sol: $v^2 = u^2 + 2aS$

$\frac{1}{2}mv^2 = \frac{1}{2}mu^2 + maS$

$E_F = E_0 + FS = E_0 +$ work done

14. Ans: $\alpha^2T^2 + 4\pi^2v^2$

Sol: $v = A\omega\cos\omega t$

$a = -A\omega^2\sin\omega t$

$a^2T^2 = A^2\omega^4\sin^2\omega tT^2$

$= A^2\omega^2\sin^2\omega t \times \frac{4\pi^2}{T^2}\times T^2$

$= A^2\omega^2\sin^2\omega t\ 4\pi^2$

$\Rightarrow 4\pi^2v^2 = A^2\omega^2\cos^2\omega t \times 4\pi^2$

$\Rightarrow a^2T^2 + 4\pi^2v^2$

$= A^2\omega^2 4\pi^2 =$ constant

15. Ans: $\frac{Y}{dg}$

Sol: For extension due to self weight

Stress $= \frac{Mg}{2a}$; $\frac{\Delta L}{L} = \frac{0.5L}{L} = 0.5$

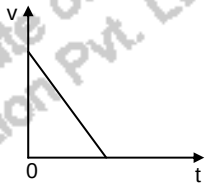
a = (cross section area)

$\Rightarrow \frac{Mg}{2a(0.5)} = Y$

$\Rightarrow \frac{Ldag}{a} = Y$

$L = \frac{Y}{dg}$

16. Ans:



Sol: Theoretical

17. Ans: 1 : 1

Sol: $\frac{V}{2}\rho_w g = V\rho_p g$

$\rho_p = \frac{\rho_w}{2}$

$\frac{2}{3}V\frac{3}{4}\rho_w g = V\rho_Q g$

$\frac{V\rho_w g}{2} = V\rho_Q g$

$\rho_Q = \frac{\rho_w}{2} \Rightarrow$ Ratio 1 : 1

18. Ans: 160

Sol: $f_0 = \frac{v}{4L} = \frac{320}{4\times 1} = 80$ Hz

Harmonic 240, 400, 560, 720

160 not included

19. Ans: at x = 1 m, y_1 and y_2 always cancel

Sol: At x = 1 m

$y = \dfrac{5}{(3-4t)^2+2}$

$y_2 = \dfrac{-5}{(3+4t-6)^2+2}$

$= \dfrac{-5}{(4t-3)^2+2}$

They cancel each other

20. Ans: $\sin(x-t)$

Sol: $v_P = \dfrac{\omega}{k} = \dfrac{1}{1}$ for A only

21. Ans: $1 : k^2$

Sol: $\dfrac{U_A}{U_B} \Rightarrow \dfrac{k_A}{U_A} = \dfrac{K_B}{U_B} = \dfrac{K_A+U_A}{U_A} = \dfrac{K_B+U_B}{U_B}$

$\dfrac{T_A}{U_A} = \dfrac{T_B}{U_B} = \dfrac{T_A}{T_B} = \dfrac{U_A}{U_B} = \dfrac{1}{K^2}$

22. Ans: $e^{\omega t}$, $\omega > 0$

Sol: $C \Rightarrow x = e^{\omega t}$

$\dfrac{dx}{dt} = \omega e^{\omega t}$

$\dfrac{d^2x}{dt^2} = \omega^2 e^{\omega t} = \omega^2 x$

$a \propto x$

23. Ans: 0 J

Sol: $\int F dt = 0$

$\Delta p = 0$

$\Delta E = 0$

24. Ans: $\sqrt{2}$

Sol: $v = \sqrt{\dfrac{T}{\mu}}$

$= \sqrt{\dfrac{\sigma a}{\rho a}} = \sqrt{\dfrac{\sigma}{\rho}}$

$v_1 \propto \sqrt{\sigma_1}$

$v_2 \propto \sqrt{2\sigma_1}$

$v_2 = \sqrt{2} v_1$

25. Ans: 5 mm

Sol: Radius of the new bubble

$r = \sqrt{r_1^2 + r_2^2}$

$= \sqrt{3^2+4^2}$

$= \sqrt{9+16} = 5\text{mm}$

26. Ans: 8 A

Sol: $E_C = \dfrac{1}{2} CV^2$

$= \dfrac{1}{2} \times 80 \times 10^{-6} \times 200^2$

$= 1.6$

$\dfrac{1}{2} LI^2 = 1.6 \Rightarrow I^2 = \dfrac{3.2}{0.05} = 64$

$I = 8$ A

27. Ans: 3

Sol: $2\cos\dfrac{t}{2}.2\sin(1000t).\cos\dfrac{t}{2}$

$= 2\cos\dfrac{t}{2}\left(\sin\left(1000t+\dfrac{t}{2}\right)+\sin\left(1000t-\dfrac{t}{2}\right)\right)$

$= 2\cos\dfrac{t}{2}.(\sin(1000.5t))+\sin(999.5t)$

$= 2\cos\dfrac{t}{2}.\sin(1000.5t)+2\cos\dfrac{t}{2}.\sin(999.5t)$

$\sin(1001t) + 2\sin(1000t) + \sin(999t)$

Combination of 3 S.H.M

28. Ans: $\dfrac{n}{2}$

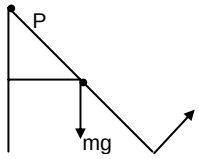
Sol: Theoretical

$n_1 = \dfrac{v}{2\ell}$

$n_2 = \dfrac{v}{4\ell} = \dfrac{n_1}{2}$

29. Ans: $\dfrac{mg}{2}\sin\theta$

Sol:



Torque about pivot

$mg\dfrac{L}{2}\sin\theta = FL$

$F = \dfrac{mg\sin\theta}{2}$

30. Ans: $\sqrt{6}m_0$

Sol: $E = m_0c^2\left[\dfrac{1}{\sqrt{1-\dfrac{v^2}{c^2}}}-1\right] = 2m_0c^2$ (data)

$$\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = 3 \Rightarrow$$

$M = m_0\sqrt{2r} = \sqrt{6}m_0$

31. Ans: $\varepsilon_0 = M^{-1} L^{-3} T^4 A^2$

Sol: (Theoretical)

32. Ans: 0.3

Sol: $y = 0.6 \times 10^{-3} \sin(500t - 0.05x)$

$v_P = A\omega = 0.6 \times 10^{-3} \times 500$

$= 0.3$

33. Ans: 6.3

Sol: $200\{\sin(4\pi \times 10^{10})t + \sin(4\pi \times 10^{15})t\}$

$\omega_1 = 4\pi \times 10^{10}$ $\omega_2 = 4\pi \times 10^{15}$

$\upsilon_1 = \frac{4\pi \times 10^{10}}{2\pi}$ $\upsilon_2 = \frac{4\pi \times 10^{15}}{2\pi}$

υ_2 has maximum energy

$E = \frac{hc}{1.6 \times 10^{-19}}$

$= \frac{6.63 \times 10^{-34} \times 2 \times 10^{15}}{1.6 \times 10^{-19}} = 8.3$ eV

Maximum kinetic energy of photoelectron

$= 8.3 - 2 = 6.3$ eV

34. Ans: Proportional to n

Sol: $v \propto \frac{1}{n}$

$\lambda_d = \frac{h}{mv} \propto n$

35. Ans: I and IV only

Sol: (i) $Q > 0$ and $W = 0$

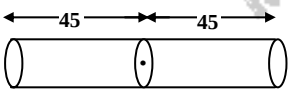
ΔU = +ve

(iv) $W \propto 0$ and $Q = 0$

ΔU = +ve

36. Ans: T = 375 K and P = 1.125 atm

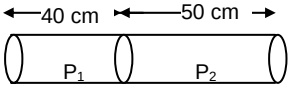
Sol:



$pV = nRT$

$1 \times 45 = nR \times 300$

$nR = \frac{45}{300}$ ---- (1)



$p_1 = p_2$

$\frac{nR \times 300}{40} = \frac{nR(T)}{50}$

$T = 375$ K

$p_1 = \frac{nRT}{V}$

$= nR \times \frac{300}{40}$

$= \frac{45}{300} \times \frac{300}{40}$

$= 1.25$ atm

37. Ans: 134

Sol: $nC_V \Delta T = \Delta\theta - \Delta W$

$n = 5$

$C_V = \frac{3}{2}R$

$\Delta\theta = +1500$

$\Delta W = 2500$

$\Delta T = \frac{\Delta\theta - \Delta W}{nC_V}$

$= \frac{1500 - 2500}{5 \times \frac{3}{2} \times 8.314}$

$= -16$

Final temperature = 150 – 16

= 134

38. Ans: 2v

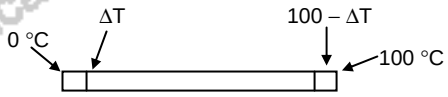
Sol: $v_{rms} = \sqrt{\frac{3RT}{M}}$

$\frac{v}{v'} = \sqrt{\frac{100}{400}}$

$v' = 2v$

39. Ans: 40

Sol:



Rate of heat flow through rod

= Rate of heat flow through water

$\frac{A \times (100 - 2\Delta T) \times 400}{0.5} = \frac{A \times \Delta T \times 0.4}{10^{-3}}$

$(100 - 2\Delta T)800 = \Delta T \times 400$

$200 - 4\Delta T = \Delta T$

$\Delta T = 40$

Temperature difference between ends of rod

$= 100 - 2 \times 40$

$= 20$ °C

Temperature gradient = $\frac{20}{0.5} = 40$

40. Ans: 175

Sol: $\eta = 1 - \frac{T_2}{T_1}$

$\frac{1}{2} = 1 - \frac{350}{T_1}$

$T_1 = 700$ K

$$0.6 = 1 - \frac{350}{700 + \Delta T}$$

$$\frac{350}{700 + \Delta T} = 0.4$$

$\Delta T = 175$ K

41. Ans: 171

Sol: $dq = nC_V\Delta T$

$$q = n\int_{100}^{T} C_V dT = n\int_{T}^{200} C_V dT$$

$$\int_{100}^{T} bT^3 dT = \int_{T}^{200} bT^3 dT$$

$$T^4\Big]_{100}^{T} = T^4\Big]_{T}^{200}$$

$T^4 - 100^4 = 200^4 - T^4$

$2T^4 = 200^4 + 100^4 = 100^4(2^4 + 1^4)$

$$T = \frac{100[17]^{1/4}}{2^{1/4}} \cong 170 \text{ K}$$

42. Ans: $p - \left(\frac{3}{2}\right)\rho v^2$

Sol: $$p + \frac{1}{2}\rho v^2 = p_1 + \frac{1}{2}\rho(2v)^2$$

$$p + \frac{1}{2}\rho v^2 - 2\rho v^2 = p_1$$

$$p_1 = p - \frac{3\rho v^2}{2}$$

43. Ans: $24\pi\sigma r^2$

Sol: $E = 2 \times \Delta A\, \sigma$

$= 2 \times (4\pi(2r)^2 - 4\pi r^2) \times \sigma$

$= 2 \times (4\pi \times 4r^2 - 4\pi r^2) \times \sigma$

$= 2 \times (12\pi r^2) \times \sigma$

$= 24\pi r^2\sigma$

44. Ans: Not in syllabus

45. Ans: Z = 82 ; A = 206

Sol: $^{238}_{92}U \xrightarrow{8\alpha} {}^{206}_{76}X \xrightarrow{6\beta} {}^{206}_{82}Y$

46. Ans: 75.4

Sol: $v = \omega R$

$= 0.4 \times 2\pi \times 15$

$= 6 \times 2\pi$

$= 37.68$ m s^{-1}

Speed of image

$= 2 \times 37.68$

$= 75.36 \cong 75.4$

47. Ans: 1.6×10^{-4} rad

Sol: $d\theta = \lambda$

$$\theta = \frac{\lambda}{d} = \frac{4000 \times 10^{-10}}{5 \times 10^{-3}}$$

$= 8 \times 10^{-5}$ rad

Angular separation

$= 2\theta = 2 \times 8 \times 10^{-5}$

$= 1.6 \times 10^{-4}$ rad

48. Ans: 90

Sol: $V = IR$

$$V = I \times \frac{\rho\ell}{A}$$

$$1 = \frac{5 \times 2.8 \times 10^{-8} \times \ell}{\pi\left(2 \times 10^{-3}\right)^2}$$

$$\ell = \frac{\pi \times 4 \times 10^{-6}}{5 \times 2.8 \times 10^{-8}}$$

$= 89.9$ m

≈ 90 m

49. Ans: $\left(5 + 2\sqrt{5}\right)\mu$F and $\left(5 - 2\sqrt{5}\right)\mu$F

Sol: $C_1 + C_2 = 10$

$$\frac{C_1C_2}{C_1 + C_2} = 0.5$$

$$\frac{C_1C_2}{10} = 0.5$$

$C_1C_2 = 5$

$$C_1 = \frac{5}{C_2}$$

$$C_2 + \frac{5}{C_2} = 10$$

$$\frac{C_2^2 + 5}{C_2} = 10$$

$C_2^2 + 5 = 10C_2$

$C_2^2 - 10C_2 + 5 = 0$

$$C_2 = \frac{10 \pm \sqrt{(10)^2 - 4 \times 5}}{2}$$

$$= \frac{10 \pm \sqrt{100 - 20}}{2}$$

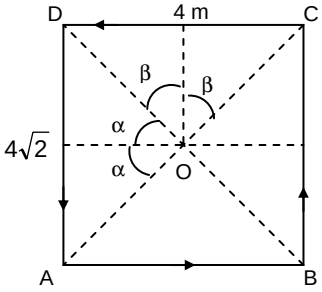
$$= \frac{10 \pm \sqrt{80}}{2} = 5 + 2\sqrt{5}$$

$C_1 = 10 - \left(5 + 2\sqrt{5}\right)$

$= 5 - 2\sqrt{5}$

50. Ans: 1.2×10^{-6} T

Sol:



$BD = \sqrt{\left(4\sqrt{2}\right)^2+4^2}$

$= \sqrt{16\times2+16}$

$= \sqrt{32+16}$

$= \sqrt{48}$

$= 4\sqrt{3}$

$OD = 2\sqrt{3}$

$\sin\alpha = \frac{2\sqrt{2}}{2\sqrt{3}} = \frac{\sqrt{2}}{\sqrt{3}}$

$\sin\beta = \frac{2}{2\sqrt{3}} = \frac{1}{\sqrt{3}}$

$B = 2\times\frac{\mu_0 I}{4.\pi.2}[2\sin\alpha]+2\times\frac{\mu_0 I}{4\pi2\sqrt{2}}[2\sin\beta]$

$= \frac{\mu_0 I}{4\pi}\left[2\sin\alpha+\sqrt{2}\sin\beta\right]$

$= \frac{4\pi\times10^{-7}}{4\pi}\times5\left[2\times\frac{\sqrt{2}}{\sqrt{3}}+\sqrt{2}\times\frac{1}{\sqrt{3}}\right]$

$= 10^{-7}\times5\left[\frac{2\sqrt{2}+\sqrt{2}}{\sqrt{3}}\right]$

$= 10^{-7}\times5\times\frac{3\sqrt{2}}{\sqrt{3}}$

$= 10^{-7}\times5\times\sqrt{6}$

$= 12.24\times10^{-7}$

$= 1.22\times10^{-6}$ T

51. Ans: –q

Sol: Net force on q is zero

$F_1 + F_2 = 0$

$\frac{1}{4\pi\varepsilon_0}\times\frac{2\times4q}{L^2}+\frac{1}{4\pi\varepsilon_0}\times\frac{Q\times q}{\left(\frac{L}{2}\right)^2}=0$

$\frac{4q^2}{L^2}+\frac{4Qq}{L^2}=0$

$q^2 = -Qq$

$q = -Q$

or $Q = -q$

52. Ans: $Qa\sqrt{\left(b^2+c^2\right)}$

Sol: $\overline{v} = a\hat{i}$

$\overline{B} = b\hat{j}+c\hat{k}$

$\overline{F} = Q\overline{v}\times\overline{B}$

$= Q\left(a\hat{i}\right)\times\left(b\hat{j}+c\hat{k}\right)$

$= Q\left(ab\hat{k}-ac\hat{j}\right)$

$\left|\overline{F}\right| = Q\sqrt{(ab)^2+(-ac)^2}$

$= Qa\sqrt{b^2+c^2}$

53. Ans: $-\frac{Qq}{2}\left(\frac{1}{R_2}-\frac{1}{R_1}\right)$

Note: K missing in the options

Sol: $T.E_1 = -\frac{kQq}{2R_1}$

$T.E_2 = -\frac{kQq}{2R_2}$

$W = T.E_2 - T.E_1$

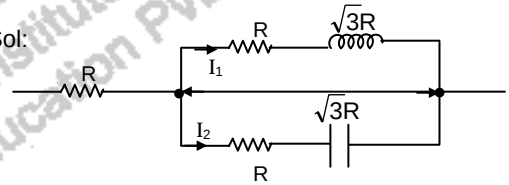
$= -\frac{kQq}{2R_2}+\frac{kQq}{2R_1}$

$= \frac{kQq}{2}\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$

$= -\frac{kQq}{2}\left(\frac{1}{R_2}-\frac{1}{R_1}\right)$

54. Ans: 3R

Sol:



$X_L = \omega.\frac{R\sqrt{3}}{\omega} = \sqrt{3}R$

$X_C = \frac{1}{\omega C} = R\sqrt{3}$

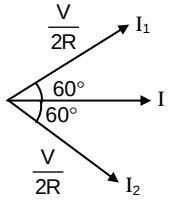
For upper part: $Z_1 = \sqrt{R^2+3R^2} = 2R$

$\tan\theta = \frac{\sqrt{3}R}{R} = \sqrt{3}$; $\theta = 60^\circ \Rightarrow I_1 = \frac{V}{2R}$

For lower part; $Z_2 = \sqrt{R^2+3R^2} = 2R$

$\tan\theta = \sqrt{3}$, $\theta = 60$; $I_2 = \frac{V}{2R}$

Phasor diagram



$I = 2\times\frac{V}{2R}\cos 60$

$= \frac{V}{2R} \Rightarrow \therefore$ equivalent to 2R resistance

since resultant I is in phase with V

Total R + 2R = 3R

55. Ans: $\sqrt{2}:1$

Sol: $\frac{E_A}{E_B} = \frac{U_A}{U_B} = \frac{1}{2}$

$\frac{E_A}{U_A} = \frac{E_B}{U_B} = \frac{E_A - U_A}{U_A} = \frac{E_B - U_B}{U_B}$

$\frac{K_A}{K_B} = \frac{U_A}{U_B}$ (K → Kinetic energy)

$K \propto p^2 \propto \frac{1}{\lambda^2}$

$\Rightarrow \therefore \frac{K_A}{K_B} = \frac{{\lambda_B}^2}{{\lambda_A}^2} = \frac{U_A}{U_B} = \frac{1}{2} \Rightarrow \frac{\lambda_A}{\lambda_B} = \sqrt{2}:1$

56. Ans: Directly proportional to the mean free path.

Sol: $\sigma = \frac{ne^2\tau}{m}$

Mean free path $\propto \tau$

$\sigma \propto \tau \propto$ mean free path

57. Ans: 26

Sol: After each collision

$E_1 = \frac{E}{2}$; $E_2 = \frac{E}{4}$ etc

$E_F = \frac{E}{2^n} \Rightarrow 0.04 = \frac{2\times10^6}{2^n}$

$2^n = \frac{2\times10^6}{2^2\times10^{-2}} = 2^{-1}\times10^8$

$n\log 2 = -\log 2 + 8$

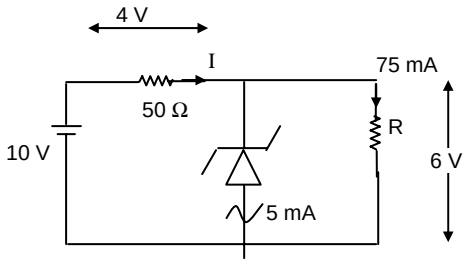
$\log 2(n+1) = 8$

$(n+1) = \frac{8}{\log 2} \cong 27$

$n = 26$

58. Ans: 80

Sol:



$4 = I\times 50$

$I = \frac{4}{50}$

$= 0.08$ A

$= 80$ mA

$6 = 75\times R$

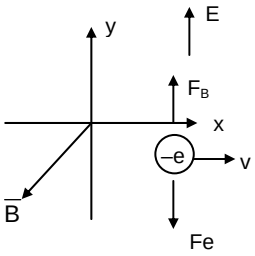
$6 = 75\times10^{-3}\times R$

$R = \frac{6}{75\times10^{-3}}$

$= \frac{6\times1000}{75} = 80\ \Omega$

59. Ans: 40 in +ve z-direction

Sol:



$eE = eVB$

$E = VB$

$8\times10^7 = 2\times10^6\times B$

$B = \frac{8\times10^7}{2\times10^6} = 40$

60. Ans: 120

Sol: For reflected light for maximum

$2\mu d = \frac{\lambda}{2}$

$2\times1.3\times d = \frac{620}{2} = 310$

$d = \frac{310}{2.6} \cong 120$ nm

61. Ans: Q + PR

Sol: $PQ + PQR + \bar{P}Q + P\bar{Q}R$

$= Q(P+\bar{P}) + R(PQ + P\bar{Q})$

$= Q + R(P(Q+\bar{Q}))$

$= Q + RP$

62. Ans: 90°

Sol: In case of minimum deviation

$n = \frac{\sin\frac{(\delta + A)}{2}}{\sin\frac{A}{2}}$

$\sqrt{2} = \frac{\sin\frac{(A+A)}{2}}{\sin\frac{A}{2}}$ [$\delta = A$]

$\sqrt{2} = \frac{\sin A}{\sin\frac{A}{2}}$

$$\sqrt{2} = \frac{2\sin\frac{A}{2}.\cos\frac{A}{2}}{\sin\frac{A}{2}}$$

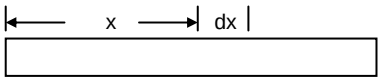
$$\cos\frac{A}{2} = \frac{1}{\sqrt{2}}$$

$$\frac{A}{2} = 45°$$

$$A = 90°$$

63. Ans: $\frac{2\sqrt{L}}{3A\sigma_0}$

Sol:



$$dR = \frac{1}{\sigma(x)} \times \frac{dx}{A}$$

$$= \frac{dx}{\frac{\sigma_0 L}{\sqrt{x}} A}$$

$$= \frac{1}{LA\sigma_0}\int_0^L \sqrt{x}\,dx$$

$$= \frac{1}{LA\sigma_0} \times \left[\frac{x^{3/2}}{\frac{3}{2}}\right]_0^L$$

$$= \frac{1}{LA\sigma_0} \times \frac{2}{3} \times L^{3/2}$$

$$= \frac{2\sqrt{L}}{3A\sigma_0}$$

64. Ans: 16R

Sol: $E \propto T^4$

$T_1 = 273$ K

$T_2 = 273 + 273 = 546$

$$\frac{E_1}{E_2} = \left(\frac{T_1}{T_2}\right)^4 = \left(\frac{273}{546}\right)^4$$

$$\frac{E_1}{E_2} = \frac{1}{16}$$

$E_2 = 16E_1$

65. Ans: R = 0, T = 0, A = 1

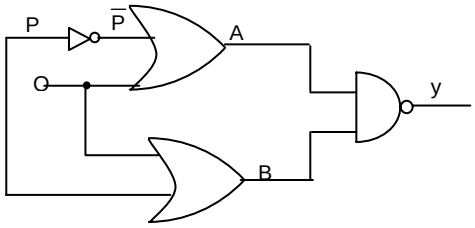
Sol: $R \to 0 \to$ no reflection

$T \to O \to$ not transparent

$A \to 1 \to$ Total absorption

66. Ans: $Y = \overline{Q}$

Sol:



$A = \overline{P} + Q$; $B = P + Q$

$Y = \overline{(\overline{P} + Q) \bullet (P + Q)}$

$= \overline{\overline{P} + Q} + \overline{P + Q}$

$= P.\overline{Q} + \overline{P}.\overline{Q}$

$= \overline{Q}(P + \overline{P})$

$= \overline{Q}$

67. Ans: 3.33×10^{-8}

Sol: Intensity $= \frac{60}{4\pi(12\times10^3)^2}$

$$= \frac{60}{4\times\pi\times144\times10^6}$$

$= 3.3 \times 10^{-8}$

68. Ans: 2 g

Sol: $v_{sound} = \sqrt{\frac{\gamma RT}{M}}$

For diatomic $\gamma = 1.4$

$$1260 = \sqrt{\frac{1.4\times8.314\times273}{M}}$$

$$(1260)^2 = \frac{1.4\times8.314\times273}{M}$$

$$M = \frac{1.4\times8.314\times273}{(1260)^2}$$

$= 2 \times 10^{-3}$ kg / mol

= 2 g

69. Ans: Kinetic energy varies as $\frac{1}{R}$

Sol: L = Angular momentum = mvr

$$= m\times\sqrt{\frac{GM}{R}}\times R$$

$= m\sqrt{GMR}$

$L \propto \sqrt{R}$

p = Linear momentum = mv

$= m\sqrt{\frac{GM}{R}}$

$p \propto \frac{1}{\sqrt{R}}$

$T \propto R^{3/2}$

$r = \frac{1}{T} \propto R^{-3/2}$

$v = \sqrt{\frac{GM}{R}}$

$K.E = \frac{1}{2}mv^2$

$= \frac{1}{2}m \times \frac{GM}{R}$

$K.E \propto \frac{1}{R}$

70. Ans: I to 2I and keeping N and R unchanged.

Sol: $B = N\frac{\mu_0 I}{2R}$

71. Ans: zero

Sol: $V = V_0 \sin\omega t$

$I = I_0 \sin\left(\omega t + \frac{\pi}{2}\right)$

$\phi = \frac{\pi}{2}$

$p = V_{rms}\, I_{rms} \cos\frac{\pi}{2}$

$= 0$

72. Ans: Pressure

Sol: $\frac{I}{c} = \frac{U}{A \times t} \times \frac{1}{c} \quad \left(\frac{U}{c} = \Delta p\right)$

$= \frac{\Delta p}{t} \times \frac{1}{A} = \frac{F}{A}$ = pressure

73. Ans: He

Sol:

Element	I^{st} I.E (kJ mol^{-1})
N	1400
Ne	2080
He	2370
H	1310
Li	520

74. Ans: For transition elements, the d-electrons are filled monotonically with increase in atomic number

Sol: The variation of ionisation energy along a period is not regular due to stability of half filled and completely filled electronic configurations

75. Ans: Si < P < C < N

Sol: In Pauling scale the electronegativity values are
N = 3.0, C = 2.5, P = 2.1, Si = 1.8

76. Ans: 8, 4

Sol: The electronic configuration is
$[Xe]\ 6s^2\ 5d^1\ 4f^7$

77. Ans: $NaHSO_3$

Sol: $2SO_2 + Na_2CO_3 + H_2O \longrightarrow 2NaHSO_3 + CO_2$

78. Ans: $Ca_3(PO_4)_2$

Sol: Portland cement contain silicates and aluminates of calcium

79. Ans: In plastics industry

Sol: Aluminium sulphate is used in purification of water, as a mordant in dyeing and in paper industry

80. Ans: None of the above

Sol: The maximum number of covalent bonds formed by nitrogen is four and that of phosphorus is six

81. Ans: 2, 3 and 4 are correct

Sol: Enthalpy of formation of N_2H_4 is +50.4 kJ mol^{-1}

82. Ans: 1 alone

Sol: O_2^{2-} has only one sigma bond

83. Ans: 1, 3, 4 and correct

Sol: OCl^- is not used as a detergent

84. Ans: A blue-violet solution is obtained

Sol: $K_2Cr_2O_7 + H_2SO_4 + 4H_2O \longrightarrow 2CrO_5 + K_2SO_4 + 5H_2O$
CrO_5 is blue-violet in colour

85. Ans: 1 and 2

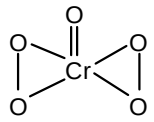
Sol: $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2O_3 + 4H_2O$

$NH_4NO_2 \xrightarrow{\Delta} N_2 + 2H_2O$

$NH_4VO_3 \xrightarrow{\Delta} V_2O_5 + 2NH_3 + H_2O$

$NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$

86. Ans: 2

Sol: 

87. Ans: 3

Sol: Si, Ge and Sn can form more than four bonds

88. Ans: 5

Sol: Electronic configuration − $1s^2$, $2s^2$, $2p^1$ − 3 valence electrons
Effective nuclear charge = 2.6

89. Ans: anthracene → p-cresol → Chlorobenzene

Sol: Chlorobenzene is adsorbed more strongly by alumina while anthracene is adsorbed weakly

90. Ans: 5

Sol: Five structural isomers of alkane are possible for C_6H_{14}

91. Ans: acetophenone

Sol: $C_6H_5-C\equiv CH + H-OH \xrightarrow[HgSO_4]{dil.H_2SO_4}$

$C_6H_5-\underset{OH}{\overset{|}{C}}=CH_2 \rightleftharpoons C_6H_5-\overset{O}{\overset{\|}{C}}-CH_3$

92. Ans: A, B

Sol: Pyrrole (A) and cyclopentadienyl anion (B) are aromatic

93. Ans: sulphonation

Sol: Sulphonation of aromatic compounds using fuming H_2SO_4 is reversible

94. Ans: A molecule containing a plane of symmetry can be optically active

Sol: A molecule containing a plane of symmetry is achiral

95. Ans: Rearrangement of carbocation by E1 mechanism

Sol: Neopentyl bromide undergoes elimination by rearrangement of initially formed carbocation by E1 mechanism

96. Ans: chlorobenzene

Sol: Chlorobenzene does not easily undergo nucleophilic substitution

97. Ans: pent-2-yn-1-ol

Sol: $CH_3-CH_2-C\equiv C-CH_2OH \xrightarrow{[O]}$

$CH_3-CH_2-C\equiv C-\overset{O}{\overset{\|}{C}}-H$

Product formed is resonance stabilised

98. Ans: propiophenone

Sol: $C_6H_5-\overset{O}{\overset{\|}{C}}-CH_2-CH_3$
propiophenone

Since it does not contain $CH_3-\overset{O}{\overset{\|}{C}}-$ group, it does not undergo haloform reaction

99. Ans: vinyl chloride

Sol: Since halogen is joined to sp^2 hybridised carbon in vinyl chloride, it is not reactive

100. Ans: peroxyacetic acid

Sol: Peroxyacetic acid is much weaker than all other given acids

101. Ans: nitrosonium ion

Sol: The electrophile involved in the reaction is $NO^{\oplus}$

102. Ans: uracil

Sol: Uracil is present only in RNA

103. Ans: bio-waste

Sol: Green fuel (or biofuel) is the fuel obtained from bio-waste

104. Ans: hypnotics

Sol: Barbiturates are hypnotics (i.e., sleep producing drugs)

105. Ans: 55.84

Sol: $Fe^{2+} \rightarrow Fe^{3+}$

Equivalent mass = $\frac{55.84}{1}$ = 55.84

106. Ans: 52

Sol: $\%\ C = \frac{24}{46} \times 100 = 52\%$

107. Ans: −555.4

Sol: $2C + 3H_2 + \frac{1}{2}O_2 \longrightarrow C_2H_5OH$

$\Delta_f H = -277.7\ kJ\ mol^{-1}$

$4C + 6H_2 + O_2 \rightarrow 2C_2H_5OH$

$\Delta H = 2 \times -277.7$

$= -555.4\ kJ\ mol^{-1}$

108. Ans: Both (B) and (C)

Sol: $CH_4 \rightarrow C + 4H$
The process is endothermic as well as non-spontaneous

109. Ans: 2

Sol: $X_2 + Y_2 \rightleftharpoons 2P$

$$K_1 = \frac{(2.52\times10^{-2})^2}{1.14\times10^{-2}\times0.12\times10^{-2}} = 46.42$$

$$K_2 = \frac{(3.08\times10^{-2})^2}{(0.92\times10^{-2})(0.22\times10^{-2})}$$

$= 46.86$

K value remain as a constant for the above stoichiometric coefficent

110. Ans: $\Delta_r H°$

Sol: $\ln K^* = -\frac{\Delta H^*}{RT} + \frac{\Delta S^*}{RT}$

$\Delta G^* = -RT \ln K^*$

ΔG^* − free energy of activation

111. Ans: NA

Sol: 1 mole water is produced by 2 Faraday

$$\text{No. of Faradays} = \frac{1\times595.1\times60\times60}{96500} = 22.2$$

No. of moles of water = 11.1
Wt. of water = 200 g

$$\text{Molality of the solution} = \frac{5\times5}{40} = 0.62$$

112. Ans: 374.19 K

Sol: $\Delta T_b = i.K_b.m$
$= 2 \times 0.52 \times 1$
$= 1.04$
Boiling point = 373.15 + 1.04
= 374.19 K

113. Ans: 173 s

Sol: $AgCl \rightleftharpoons Ag^+ + Cl^-$

$$[Ag^+] = \frac{1.8\times10^{-10}}{0.1} = 1.8\times10^{-9}M$$

1 L contain 1.8×10^{-9} moles of Ag^+
Quantity of electricity required
$= 1.8 \times 10^{-9} \times 96500$
$= 1.73 \times 10^{-4}$ C

$$\text{time required} = \frac{1.73\times10^{-4}}{1\times10^{-6}} = 173 \text{ s}$$

114. Ans: 5.88 V

Sol: Cell reaction is

$$Li_{(s)} + \frac{1}{2}F_{2(g)} \rightarrow Li^+_{(2M)} + F^-_{(2M)}$$

$$E = E° - \frac{RT}{nF}\ln [Li^+][F^-]$$

$$= 5.92 - \frac{8.314\times298}{1\times96500}\times\ln (2\times2)$$

$= 5.92 - 0.035 = 5.88$ V

115. Ans: 375.6 K

Sol: Degree of ionisation $\alpha = \frac{\lambda_m}{\lambda°_m}$

$$= \frac{240}{420} = 0.57$$

$i = 1 + (n - 1)\alpha = 1 + (2 - 1)\ 0.57$
$= 1.57$
$\Delta T_b = 1.57 \times 0.52 \times 3$
$= 2.45$
boiling point = 375.6

116. Ans: $k [D_2]^1 [A]^2$

Sol: When A changes to 3A, rate become 9 times and when D_2 changes to $3D_2$ rate become 3 times
$\therefore$ rate expression is
$r = k [D_2]^1 [A]^2$

117. Ans: $mol^{-1}\ L\ s^{-1}$

Sol: Unit of rate constant = $(mol\ L^{-1})^{1-n}\ s^{-1}$

Order of the reaction is $\frac{1}{2} + \frac{3}{2} = 2$

118. Ans: At high partial pressure of HI

Sol: When the partial pressure of reactant is very high, the surface of the catalyst will be saturated by the reactant molecules

119. Ans: $\Delta H < 0$ and $\Delta S < 0$

Sol: For adsorption
ΔH, ΔS and ΔG are negative

120. Ans: Increase and decreases

Sol: In Haber process
Mo acts as promoter while CO acts as poison