20. Solid state

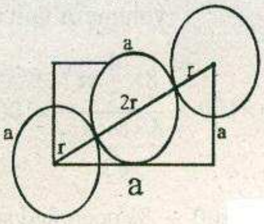
Q1.

Sol:

In FCC

$4r = \sqrt{2}a$

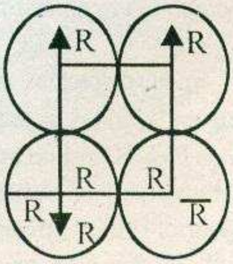
$r = \frac{\sqrt{2}a}{4} = \frac{1.414 \times 0.574\,nm}{4} = 0.203\,nm$



Smallest distance bet-^{n} two atoms = 2r = 0.406 nm **Ans**

Q2.

Sol: Consider one face



To enclose all these spheres we have to increase the side length by 2R

$\therefore$ new side length = 2R + 2R = 4R

$\therefore$ Volume of such cube = $(4R)^3 = 64R^3$ **Ans**

Volume of sphere = $8 \times \frac{4}{3}\pi R^3$

% volume occupied by atom = $\frac{8 \times (4/3) \times \pi R^3}{64R^3} \times 100 = \frac{\pi}{6} \times 100 = 52.33\%$ **Ans**

Q3.

Sol: $AC = \sqrt{2}AB$

$4r = \sqrt{2} \times 3.61\,A^0$

$r = 1.276\,A^0$

If r' is the size of small atom that perfectly fit then 2r + 2r' = BC

2.5523 + 2r' = 3.61

2r' = 1.05773

$r' = 0.528\,A^0 \approx 0.53\,A^0$ **Ans**

Q4.

Sol: $P.F = \frac{2 \times \frac{4}{3}\pi r^3}{\left(\frac{4}{\sqrt{3}}r\right)^3} = 0.68$ **Ans** (In BCC no. of effective atoms also $\sqrt{3}a = 4r \Rightarrow a = \frac{4r}{\sqrt{3}}$)

Q5.

Sol: $\%\text{ occupied space} = \dfrac{\text{Rank} \times \text{volume of each si atom}}{\text{volume of unit cell}} \times 100$

$$= \frac{8 \times \frac{4}{3}\pi r^3}{\left(\frac{8r}{\sqrt{3}}\right)^3} \times 100 = \frac{8 \times \frac{4}{3}\pi r^3}{\frac{8 \times 8 \times 8}{3\sqrt{3}} r^3} \times 100 = \frac{4\pi}{8 \times 8\sqrt{3}} \times 100 = \frac{3.14 \times 100}{16/\sqrt{3}} = 33.99\%$$

$\therefore$ % vacant space = 100 − % occupied space

= (100 − 34) % = 66% **Ans**

Q6.

Sol: $P.F = \dfrac{\text{Rank} \times \text{volume of each atom}}{\text{volume of unit cell}}$

$$P.F_{BCC} = \frac{2 \times \frac{4}{3}\pi r^3}{\left(\frac{4r}{\sqrt{3}}\right)^3} = 0.68 \quad \left(\text{In BCC } 4r = \sqrt{3}a\right)$$

Ans

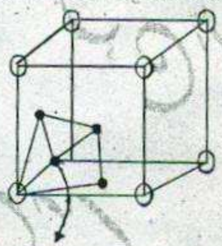
$$P.F_{SCC} = \frac{1 \times \frac{4}{3}\pi r^3}{(2r)^3} = 0.524 \quad (\because \text{in SCC } 2r = l)$$

Ans

Q7.

Sol: Diamond has FCC structure with a tetrahedron of atoms. This implies that carbon atom must be present at alternate tetrahedral voids of the FCC structure.

$\therefore$ No. of effective atom in one unit cell



$$= 8 \times \frac{1}{8} + 6 \times \frac{1}{2} + \frac{1}{2} \times 8 = 8$$ **Ans**

↓ Corners atoms ↓ face atoms ↓ tetrahedral void atoms

Q8.

Sol: Body centered like structure

In LiAg, the bigger atom will form the simple cubic unit cell & smaller atom will be at the centre of body. This type of structure is called body centred cubic like structure.

Q9.

Sol: No. of effective atoms of A in cubic C unit cell $= 8 \times \frac{1}{8} = 1$

No. of effective atoms of B in cubic unit cell $= 6 \times \frac{1}{2} = 3$

$\therefore$ Molecular formula of the compound $= AB_3$ **Ans**

Q10.

Sol: Rank of Atom A $= \frac{1}{8} \times 8 = 1$

Rank of Atom B = 1

$\therefore$ Molecular formula of the compound = AB

Q11.

Sol: In cubic closest packed structure

A is forming fcc structure, $\Rightarrow$ Rank = 4 & so B must be present in tetrahedral void so that it can have rank of 8, so that molecular formula of AB_2 is possible.

Now co-ordination no. of B (atom is tetrahedral void) = 4 **Ans**

Because tetrahedral void is formed by 4 atom

Co-ordination no. of A = 8 **Ans**

Because any atom at corner contributed by 8 unit cell & so have 8 tetrahedral voids around it.

Q12.

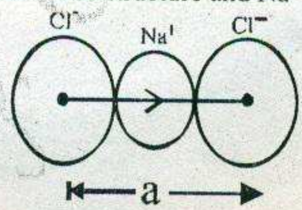
Sol: $\text{density} = \frac{\text{Rank} \times \text{Formula wt of NaCl}}{N_A \times \text{volume of unit cell}}$

Rank of NaCl structure = 4

Formula unit wt = 23 + 35.5 = 58.5 g

Distance bet-ⁿ Na^+ & Cl^- = 0.2819 nm.

In NaCl structure Cl^- form Fcc structure and Na^+ will be present in each octahedral void.



a = 2 (Dist-ⁿ bet-ⁿ Na^+ & Cl^-) $= 2 \times 0.2819$ nm.

$\therefore$ volume of cube $= a^3$

$$\text{Density} = \frac{4 \times 58.5\,g}{N_A \times (0.5638 \times 10^{-7}\,cm)^3}$$

$$2.165\,g/cc = \frac{4 \times 58.5}{N_A \times 0.179 \times 10^{-21}}$$

$$N_A = \frac{4 \times 58.5}{0.179 \times 2.165} \times 10^{21} = 6.023 \times 10^{23}$$ **Ans**

For side length of 1 mole of cube

$\therefore$ density $= \dfrac{\text{mass of 1 moles}}{\text{volume of 1 mole}}$

Volume of 1 mole $= \dfrac{58.5\,g}{2.165} = 27.02\,cm^3$

$\therefore$ If the side length of cube containing 1 mole of substance.

$a^3 = 27.02\ cm^3 \quad \Rightarrow a = 3\ cm$ **Ans**

No. of molecules in 1 mole of NaCl $= 6.023 \times 10^{23}$

No. of ions in whole volume $= 2 \times 6.023 \times 10^{23} = 1.2046 \times 10^{24}$

$\therefore$ No of ions along are side $= (1.2046 \times 10^{24})^{1/3} = 1.064 \times 10^{8}$ ions **Ans**

Q13.

Sol: Volume of unit cell $= (3.803 \times 10^{-8}\ cm)^3 = 55.0 \times 10^{-24}$ ions **Ans**

Also no. of atoms of Rh present in unit cell = 4

$\therefore$ Volume / atom of Rh $= \dfrac{55.0 \times 10^{-24}\,cm^3}{4} = 13.75 \times 10^{24}$

$\therefore$ Volume of Avogadro no. of Rh $= 13.75 \times 10^{-24} 6.023 \times 10^{23} = 8.282\ cm^3$ **Ans**

Q14.

Sol: At. Wt. of Pd = 106.4 g

$R_{Pd} = 1.375\ A^0$

In FCC structure, $\sqrt{2}a = 4r_{Pd}$

$a = 2\sqrt{2}\,r_{Pd} = 2 \times 1.414 \times 1.375\,A^0 = 3.88 \times 10^{-8}$ cm

$\therefore$ Volume $= (a)^3 = 58.795 \times 10^{-24}\ cm^3$

Density $= \dfrac{\text{Rank} \times \text{At. wt. pd}}{6.023 \times 10^{23} \times \text{volume}} = \dfrac{4 \times 106.4}{6.023 \times 10^{23} \times 58.795 \times 10^{-24}}$

$= 1.202 \times 10^{1} = 12.02\ gm/cm^3$ **Ans**

Q15.

Sol: Volume of FCC $= 31.699\ (A^0)^3$

$a^3 = 31.699\ (A^0)^3$

$a = 3.165\ A^0$

Also in FCC = $\sqrt{2}a = 4r$

$r = \dfrac{\sqrt{2}a}{4} = \dfrac{\sqrt{2} \times 3.165\,A^0}{4} = 1.1187\ A^0$ **Ans**

$\therefore$ Volume of 1 atom $= \dfrac{4}{3}\pi r^3 = \dfrac{4}{3} \times \pi \times (1.1187 A^0)^3 = 5.8675 (A^0)^3$ **Ans**

Q16.

Sol: Density of Al should be given

Anyway density of Al is known from the periodic table with density mentioned in it

$d_{A_l} = 2.7$ g/ ml (must be given)

Rank Al = 4

At wt Al = 27

Volume of unit cell = $(4.094 \times 10^{-8} cm)^3$

$$d_{Al} = \frac{4\times27}{N_A(4.094\times10^{-8})^3} \Rightarrow N_A = \frac{4\times27}{2.7\times(4.094\times10^{-8})^3} = \frac{40\times10^{24}}{68.62}$$

$N_A = 5.83\times10^{23}$ **Ans**

Q17.

Sol: Specific gravity of metal = 10.2 at 25^0C

d metal = 10.2 g / cm^2

Body centred structure with a = 3.147 A^0

Rank of BCC = 2

$$d_{metal} = \frac{2\times At.wt}{N_A\times(a)^3} = \frac{2\times At.wt}{6.023\times10^{23}\times(3.147\times10^{-8}cm)^3}$$

$$\frac{10.2\times6.023\times(3.147)^3\times10^{-1}}{2} = At.wt$$

At wt of metal = 95.7 gm **Ans**

Q18.

Sol: No. of molecules per unit cell in FCC = 4

density = 5.267 g /cc

$N_A = 6.023\times10^{23}$

Mol. wt (ZnSe) = 144.4 gm

$$\therefore \text{ density} = \frac{Rank\times mol.wt}{6.023\times10^{23}\times a^3} \Rightarrow a^3 = \frac{4\times144.4\,gm}{6.023\times10^{23}\times5.267}$$

$\Rightarrow a = 5.661\times10^{-8}cm = 5.667\,A^0$ **Ans**

Q19.

Sol: $d_{fcc} = \frac{4\times60}{6.023\times10^{23}\times(4\times10^{-8})^3} = 6.23\,g/cc$ **Ans**

Q20.

Sol: $d_{PO} = \frac{Rank\times At\,mass}{N_A\times(a)^3}$

$$91.5\times10^{-3}\,g/cc = \frac{1\times209}{6.023\times10^{23}\times a^3}$$

$$a^3 = \frac{1\times209}{6.023\times10^{23}\times91.5\times10^{-3}} = 3.79\times10^{-21}$$

$a = 1.56\times10^{-7}$ cm **Ans**

Q21.

Sol: Let n is the no. of unit cell present in 50 gm of element

$$d_{metal} = \frac{Rank\times Atwt}{N_A\times a^3} \Rightarrow 8.5\,g/cc = \frac{1\times At\,wt}{6.023\times10^{23}\times(3\times10^{-8}cm)^3}$$

At wt = 138.23 g.

$\because$ no. of unit cell in 138.23 gm = N_A

$\therefore$ ——— 1 ——— $\frac{N_A}{138.23}$

$\therefore$ ——— 50 ——— $\frac{50}{138.23}\times 6.023\times 10^{23} = 2.178\times 10^{23}$ **Ans**

Q22.

Sol: $d_{hkl} = \frac{a}{\sqrt{h^2+K^2+l^2}}$

$d_{III} = \frac{a}{\sqrt{1^2+1^2+1^2}} = 0.3079\,\text{nm}$

$a = 0.3079\text{ nm}\times\sqrt{3} = 0.3079\times 1.732\text{ nm} = 0.5333\text{ nm}$ **Ans**

Q23.

Sol: For (a,b,c)

	x-axis	y-axis	z-axis
Intercepts	a	b	c
Wiess indics	$a/a = 1$	$b/b = 1$	$c/c = 1$
Miller indics	$\frac{1}{1} = 1$	$\frac{1}{1} = 1$	$\frac{1}{1} = 1$

$\therefore$ Miller indics = [1 1 1] **Ans**

For (2a, b, c)

	x-axis	y-axis	z-axis
Intercepts	2a	b	c
Wiess indics	$\frac{2a}{a} = 2$	$b/b = 1$	$\frac{c}{c} = 1$
Reverse	$\frac{1}{2}$	$\frac{1}{1}$	$\frac{1}{1}$
Miller indics	$\frac{1}{2}\times 2 = 1$	$1\times 2 = 2$	$1\times 2 = 2$

Miller indics = [1 2 2] **Ans**

For (2a, - 3b, - 3c)

	x-axis	y-axis	z-axis
Intercepts	2a	-3b	-3c
Wiess indics	$\frac{2a}{a} = 2$	$\frac{-3b}{b} = -3$	$\frac{-3c}{c} = -3$
Reverse	$\frac{1}{2}$	$\frac{-1}{3}$	$-1/3$
Miller indices	$\frac{1}{2}\times 6$ =3	$-1/3\times 6$ =-2	$-1/3\times 6$ = -2

$\therefore$ Miller indices = $[3\bar{2}\bar{2}]$ **Ans**

Q24.

Sol: $a = 3\times 10^{10}$ m

(a) $d_{100} = \frac{a}{\sqrt{1^2+0^2+1^2}} = a = 3\times10^{-10}$

Bragg'c equation

$2d\sin\theta = n\lambda, n = 1,2,3-----$

For smallest diffraction angle, n = 1

$\sin\theta = \frac{\lambda}{2d} = \frac{1.5\times10^{-10}}{2\times3\times10^{-10}} = \frac{1}{4} \Rightarrow \theta = \text{Sin}^{-1}\left(\frac{1}{4}\right) = 15.48^0$ **Ans**

(b) $d_{III} = \frac{1}{\sqrt{1^2+1^2+1^2}} = \frac{a}{\sqrt{3}} = \sqrt{3}\times10^{-10}\text{m} = 1.732\times10^{-10}\text{m}$

Bragg's equation

$2d\sin\theta = n\lambda$, n =1, 2, 3------

For smallest diffraction angle, n = 1

$\sin\theta = \frac{\lambda}{2d} = \frac{1.5\times10^{-10}\text{m}}{2\times1.732\times10^{-10}\text{m}}$

$\text{Sin}\theta = 0.433 \Rightarrow \theta = \text{Sin}^{-1}(0.433) = 25.66^0$ **Ans**

Q25.

Sol: BCC structure

$d_K = 0.856\times10^3$ kg /m^3 = 0.856 g/cc

$d = \frac{2\times39}{6.023\times10^{23}\times a^3} \Rightarrow a^3 = \frac{2\times39}{6.023\times10^{23}\times0.856}$ CC

$a = 5.334\times10^{-8}$ cm = 5.334 A^0 = 533.4 Pm **Ans**

$d_{(2,0,0)} = \frac{a}{\sqrt{2^2+0^2+0^2}} = \frac{a}{2} = 266.7\,\text{pm}$

$d_{(1,1,0)} = \frac{a}{\sqrt{1^2+1^2+0^2}} = \frac{a}{\sqrt{2}} = \frac{533.4}{1.414}\text{pm} = 377.1\text{pm}$ **Ans**

$d_{(2,2,2)} = \frac{a}{\sqrt{2^2+2^2+2^2}} = \frac{a}{2\sqrt{3}} = \frac{533.4}{2\times1.732}\text{pm} = 154.0\text{ pm}$ **Ans**

Closest distance bet-^{n} atoms = 2r

In BCC, $\sqrt{3}a = 4r$

$2r = \frac{\sqrt{3}}{2}a = \frac{1.732}{2}\times533.4\,\text{pm} = 461.8\text{ pm} = 462\text{ Pm}$

Radius of K; $r = \frac{462}{2}\text{pm} = 231\,\text{pm}$ **Ans**

Q26.

Sol: $r_{Na^+} = 0.98\times10^{-10}$m

$r_{cl^-} = 1.81 \times 10^{-10} m$

radius ratio $= \dfrac{r_{Na^+}}{r_{Cl^-}} = \dfrac{0.98 \times 10^{-10} m}{1.81 \times 10^{-10} m}$

Radius ratio = 0.5414 belongs to (0.414, 0.732)

In case of octahedral voids

Radius ratio lies between 0.414 to 0.732

so Na^+ will be present in Octahedral void.

$\therefore$ Co-ordination no. of $Na^+ = 6$

Also co-ordination no. of $Cl^- = 6$ (6 Octahedral void around any Cl^- ion)

Q27.

Sol: CsCl has Body centered cubic structure in which Cl^- form simple cubic unit cell & Cs^+ ion will be present at body centered void.

In BCC void the radius ratio has range 0.732 to 0.999.

$\therefore$ Critical / limiting radius ratio = 0.732 **Ans**

It can b calculate in this way

In simple cubic unit cell of Cl^-

$2r^- = a$ (a : side length of cube)

Also $2(r^+ + r^-) = \sqrt{3}a$

$$\frac{2(r^+ + r)}{2(r^-)} = \frac{\sqrt{3}a}{a} = \sqrt{3} \Rightarrow \frac{r^+ + r^-}{r^-} = \sqrt{3}$$

$$1 + \frac{r^+}{r^-} = \sqrt{3} \Rightarrow \frac{r^+}{r^-} = \sqrt{3} - 1 = 0.732$$ **Ans**

Q28.

Sol: In CCP

Packing fraction $= \dfrac{\text{total volume occupied by atoms}}{\text{Total volume of unitcell}} = \dfrac{4 \times \frac{4}{3}\pi r^3}{a^3}$

Also $\sqrt{2}a = 4r \Rightarrow a = 2\sqrt{2}r$

$$\therefore \text{P.f.} = \frac{4 \times \frac{4}{3}\pi r^3}{(2\sqrt{2}r)^3} = \frac{16\pi}{3 \times 16\sqrt{2}} = \frac{\pi}{3\sqrt{2}} = 0.7406$$

$\therefore$ Void fraction = 1 − packing fraction = 1 − 0.7406 = 0.2594 **Ans**

$$\text{P.F}_{hcp} = \frac{6 \times \frac{4}{3}\pi r^3}{24\sqrt{2}r^3} = \frac{\pi}{3\sqrt{2}} = 0.7406$$

$$\text{Volume of hcp} = 6 \times \frac{\sqrt{3}}{4}a^2 \times c = 6 \times \frac{\sqrt{3}}{4} \times (2r)^2 \times 4\sqrt{\frac{2}{3}}r = 24\sqrt{2}r^3$$

$\therefore$ Void fraction $= 1 - \text{P. F}_{\cdot hcp} = 1 - 0.7406 = 0.2594$ **Ans**

Q29.

Sol: $d = \dfrac{\text{Rank} \times \text{Mol.wt}}{6.023 \times 10^{23} \times \text{volume}}$

$\Rightarrow 0.92 = \dfrac{\text{Rank} \times 18}{6.023 \times 10^{23} \times (a^2 \sin 60^0 \times C)}$

(angle given should be 60^0)

$\text{rank} = \dfrac{0.92 \times 6.023 \times 10^{23} \times (4.53 \times 10^{-8})^2 \times \dfrac{\sqrt{3}}{2} \times 7.41 \times 10^{-8}}{18}$

⇨ Rank = 4 **Ans**

Q30.

Sol: r = 1.1 mm ; h = 3.56 cm ; P= 420 Pa & $d(CH_3COOH) = 1.0492\ g/cm^3$

From Laplace equation

$y = \dfrac{r}{2}(P - hdg) = \dfrac{1.1 \times 10^{-3}}{2}(420 - 3.56 \times 10^{-2} \times 1.0492 \times 10^3 \times 9.8)$

$= \dfrac{1.1 \times 10^{-3}}{2}(420 - 366.045) = \dfrac{1.1 \times 10^{-3}}{2} \times 53.95 = 29.675 \times 10^{-3} = 2.967 \times 10^{-2}$ N/m **Ans**

Q31.

Sol: $y = \dfrac{hdrg}{2\cos\theta}$

$\therefore h = \dfrac{2y\cos\theta}{drg}$

For $\theta = 0$. $y = 0.0284$ N / m, d = 0.866 g/cc, g = 9.8 m/s^2, h = 2 × 10^{-4} m.

$2 \times 10^{-4} = \dfrac{2 \times 2.84 \times 10^{-2}}{866 \times r \times 9.8} \Rightarrow r = 3.346 \times 10^{-2}$ m **Ans**

Q32.

Sol: diameter of tube = 1.0 mn

$\therefore r = 0.5\ mm = 0.5 \times 10^{-3}$ m

$\theta = 0$

$d_{Hg} = 13.6 \times 10^3\ Kg / m^3$

$\gamma = 4.6 \times 10^{-1}$ N /m.

$h = \dfrac{2\gamma}{\rho r g} = \dfrac{2 \times 4.6 \times 10^{-1}}{13.6 \times 10^3 \times 0.5 \times 10^{-3} \times 9.8} = 0.138 \times 10^{-1} = 1.38 \times 10^{-2}$ m **Ans**

Q33.

Sol: $\dfrac{n_1}{n_2} = \dfrac{t_1(d_1 - d_0)d_1}{t_2(d_2 - d_0)d_0}$ d_1 = density of metal ball

$\dfrac{n_A}{n_B} = \dfrac{t_1(-d_1 + d_0)}{t_B(-d_E + d_0)}$

$$\frac{n_A}{2.5cp} = \frac{5}{7.5}\frac{(7.7\times10^3 - 1.5\times10^3)}{(7.8\times10^3 - 4.6\times10^3)}$$

$$n_A = \frac{2}{3}\times\frac{6.3}{3.2}\times 2.5xp = 3.28\ Cp$$ **Ans**

Q34.

Sol: $n = 1\times10^4$ poise $= 10^3\ N\ m^{-2}s$

$d\ 3.2\ g/ml = 3.2\times10^3\ kg/m^3$

$r = 2.5\ mm = 2.5\times10^{-3}\ m$

$h = 1.0\ cm = 1\times10^{-2}\ m.$

$d_{PO} = 21.4\ g/ml = 21.4\times10^3\ kg/m^3$

$$\eta = \frac{2r^2(d-do)g}{9u} = \frac{2r^2(d-do)g}{9x/t}$$

$$\eta = \frac{2r^2(d-do)g}{2x}t$$

$$1\times10 = \frac{2\times(2.5\times10^{-3})^2(2.4\times10^3 - 3.2\times10^3)9.8\times t}{9\times1\times10^2}$$

$$9+10^{+1} = 2\times(625\times10^{-6}\times18.2\times10^3\times9.8)$$

$$t = \frac{9\times10^{+1}}{2\times6.25\times10^{-3}\times9.8\times18.2} \Rightarrow t = \frac{9.00\times10^4}{2\times6.25\times9.8\times18.2} = 40.5\sec$$ **Ans**

Q 35.

Sol: $h = \frac{2\gamma}{\rho rg} \quad \Rightarrow h_1 = \frac{2\gamma}{\rho r_1 g} \quad \& h_2 = \frac{2\gamma}{\rho r_2 g}$

$$h_1 - h_2 = \frac{2\gamma}{\rho g}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

$$5.50\times10^{-2} = \frac{2\gamma}{1.41\times10^3\times9.8}\left(\frac{-10^{+4}}{2} + \frac{10^{+4}}{1}\right)$$

$$5.5\times10^{-2} = \frac{2\gamma}{1.41\times9.81\times10^3}\times\frac{10^7}{2}$$

$$\gamma = 5.6\times10^{-2}\times1.41\times9.81\times10^7$$

$= 7.74\times10^{-2}\ N/m$ **Ans**

Q 36.

Sol: $\frac{\gamma_1}{\gamma 2} = \frac{m_1}{m_2}$ (Since no. of droplets are same)

$$\frac{\gamma_1}{72.75} = \frac{0.852}{3.64} \Rightarrow \gamma_1 = \frac{0.852}{3.64}\times72.75\ dyne/cm$$

$\gamma_1 = 17.03\ dyne/cm$ **Ans**

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Q33.

Sol: $\dfrac{n_1}{n_2} = \dfrac{t_1(d_1 - d_0)d_1}{t_2(d_2 - d_0)d_0}$ d_1 = density of metal ball

$\dfrac{n_A}{n_B} = \dfrac{t_1(-d_1 + d_0)}{t_B(-d_E + d_0)}$

$$\frac{n_A}{2.5\,cp} = \frac{5}{7.5}\frac{(7.7\times10^3 - 1.5\times10^3)}{(7.8\times10^3 - 4.6\times10^3)}$$

$$n_A = \frac{2}{3}\times\frac{6.3}{3.2}\times 2.5xp = 3.28\ Cp$$

Ans

Q34.

Sol: $n = 1\times10^4$ poise $= 10^3\ N\ m^{-2}s$

d 3.2 g / ml = $3.2\times10^3\ kg/m^3$

r = 2.5 mm = 2.5×10^{-3} m

h = 1.0 cm = 1×10^{-2} m.

d_{PO} = 21.4 g /ml = $21.4\times10^3\ kg/m^3$

$$\eta = \frac{2r^2(d-do)g}{9u} = \frac{2r^2(d-do)g}{9x/t}$$

$$\eta = \frac{2r^2(d-do)g}{2x}t$$

$$1\times10 = \frac{2\times(2.5\times10^{-3})^2(2.4\times10^3 - 3.2\times10^3)9.8\times t}{9\times1\times10^2}$$

$$9+10^{+1} = 2\times(625\times10^{-6}\times18.2\times10^3\times9.8)$$

$$t = \frac{9\times10^{+1}}{2\times6.25\times10^{-3}\times9.8\times18.2} \Rightarrow t = \frac{9.00\times10^4}{2\times6.25\times9.8\times18.2} = 40.5\sec$$

Ans

Q 35.

Sol: $h = \frac{2\gamma}{\rho r g} \Rightarrow h_1 = \frac{2\gamma}{\rho r_1 g}$ & $h_2 = \frac{2\gamma}{\rho r_2 g}$

$$h_1 - h_2 = \frac{2\gamma}{\rho g}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$$

$$5.50\times10^{-2} = \frac{2\gamma}{1.41\times10^3\times9.8}\left(\frac{-10^{+4}}{2} + \frac{10^{+4}}{1}\right)$$

$$5.5\times10^{-2} = \frac{2\gamma}{1.41\times9.81\times10^3}\times\frac{10^7}{2}$$

$$\gamma = 5.6\times10^{-2}\times1.41\times9.81\times10^7$$

$= 7.74\times10^{-2}$ N/m **Ans**

Q 36.

Sol: $\frac{\gamma_1}{\gamma 2} = \frac{m_1}{m_2}$ (Since no. of droplets are same)

$$\frac{\gamma_1}{72.75} = \frac{0.852}{3.64} \Rightarrow \gamma_1 = \frac{0.852}{3.64}\times72.75\ \text{dyne/cm}$$

γ_1 = 17.03 dyne / cm **Ans**

Q 37.

Sol: $n_W = 100$

$n_0 = 280$

$\gamma_0 = ?$ If $Y_W = 0.07275$ N/m

$d_W = 0.998 \times 10^3$ kg/m^3

$d_0 = 0.755 \times 10^3$ kg/ m^3

$$\frac{\gamma_0}{\gamma_W} = \frac{d_O}{d_W}.\frac{n_W}{n_1}$$

$$\frac{\gamma_0}{0.07275} = \frac{0.755\times10^3}{0.998\times10^3}\times\frac{100}{280} \Rightarrow \gamma_0 = 0.019656 \text{ N/m}$$ **Ans**

Q38.

Sol: $n_0 = 0.084$ N /m^2

$d_o = 1.1 \times 10^3$ kg / m^3

$n_{H_2O} = 0.001101 \text{ N/m}^2$

$d_{H_2O} = 0.998\times10^3 \text{kg/m}^3$

$$\frac{n_1}{n_2} = \frac{t_1}{t_2}\times\frac{d_1}{d_2} \Rightarrow \frac{0.084}{0.00101} = \frac{to}{305}\times\frac{1.1\times10^3}{0.998\times10^3}$$

$$\frac{0.084}{0.00101}\times\frac{0.998}{1.1}\times30 = to \Rightarrow to = 37 \text{ min } 43.7 \text{ sec}$$ **Ans**

Q39

Sol: h = 1.0 cm

r = ?

If x- section is halfed then r will before $\frac{r}{\sqrt{2}}$

$$\therefore h = \frac{2\gamma}{\rho r g} \qquad \therefore h \propto \frac{1}{r}$$

$$\therefore \frac{h_1}{h_2} = \frac{r_2}{r_1} = \frac{r/\sqrt{2}}{r}$$

$$\Rightarrow \frac{1.0}{h_2} = \frac{1}{\sqrt{2}} \Rightarrow h_2 = 1.0\times\sqrt{2}\text{cm} = 1.414\text{cm}$$

Objective Problems

Q1. Ans - (c)

Q2. Ans-(a) Crystalline solid has diff-^{n} properties in different dir-^{n} , so it is an anisotropic material.

Q3. Ans - (c)

Q4. Ans - (a)

Q5. Ans - (b) Total element of symmetry = 9 + 13 + 1 = 23

Q6. Ans - (a) Primitive cubic unit cell
Body centred cubic unit cell
Face centred cubic unit cell

Q7. Ans - (a) Each Cl^- ion is surrounded by 6 octahedral voids in which Na^+ ions are present

Q8. Ans - (a)

Q9. Ans - (b)

Q10. Ans - (b)

Q11. Ans - (c) In FCC, Rank = $8\times\frac{1}{8}+\frac{1}{2}\times6=1+3=4$

Q12. Ans - (c)

Q13. Ans - (b)

Q14. Ans (a) Rank of A = 1, Rank of B = $\frac{1}{8}\times8=1$

Q15: Ans - (a)

Q16. Ans - (c) $\therefore 4r=\sqrt{3}a \quad \Rightarrow r\frac{\sqrt{3}a}{4}$ (in BCC)

Q17. Ans - (c) Volume of an atom = $\frac{4}{3}\pi r^3$

In simple cubic unit cell, no of atoms = 1

Also $a = 2r \Rightarrow r=\frac{a}{2}$

$\Rightarrow$ volume of atoms in simple cubic unit cell $=\frac{4}{3}\pi\left(\frac{a}{2}\right)^3 - \frac{4}{3}\pi\times\frac{a^3}{8} = \frac{\pi}{6}a^3$ Ans

Q18. Ans - (a) **Q19. Ans - (d)**

Q20. Ans - (c) **Q21. Ans - (b)**

Q22. Ans - (d) **Q23. Ans - (a)**

Q24. Ans - (d) **Q25. Ans - (b)**

If h, k, l is the miller indices of the plane then the plane is passing through points.

(1) (0,0,0), (2) (0,0,1) (3) (1,1,0) & (4) (1,1,1)

$hx + ky + lz = e$

(1) $\Rightarrow ho + Ko + lo = 3 \quad \Rightarrow \quad e = 0$

$h\times0+k\times0+l\times1=0 \quad \Rightarrow l=0$

(2) $\Rightarrow h\times1+K\times1+l\times0=0 \quad \Rightarrow h+k=0$

(3) $\Rightarrow h+k+l=0 \quad h+k=0 \Rightarrow h=-K$

∴ Miller indics = (h, -h,0) = h(1, -1, 0).

Q 26. Ans – (b)

Q27. Ans - (d) Since twice the no. of atoms can be present as there are no. of atoms present in FCC unit cell.

Q28. Ans - (b)

Q29. Ans - (a) In BCC only one ion pair will be present in unit cell

$$d = \frac{2\times168.4}{6.023\times10^{23}\times a^3} = 3.988\,g/cc$$

$$a^3 = \frac{1\times168.4}{6.023\times3.988\times10^{23}} = 70.011\times10^{-23}\,cc$$

Q30. Ans - (d) For Cs^+ ion to be present in bcc void

radius ratio, $\frac{r^+}{r^-} = 0.732$ in limiting case when cation & anions just touches each other.

Q31. Ans -(a) $x = 8\times\frac{1}{8} = 1$

$$y = 6\times\frac{1}{2} = 3$$

$\therefore A_xB_y$ is AB_3

Q32. Ans - (c) A_3B_4, because at face centre it will remain so effective no. of A new = 3

Q33. Ans - (b) **Q34. Ans -(a), (c)**

Q35. Ans - (a) **Q36. Ans -(b)**

Q37. Ans - (d)

$$h = \frac{2\gamma\cos\theta}{\rho r g}$$

If x-section is doubled new radius becomes $\sqrt{2}$ times the initial radius.

$$\text{Height raised becomes} = \frac{1}{\sqrt{2}}\text{ times} = \frac{1}{\sqrt{2}}\times2.0\,cm = 1.414\,cm$$

Q38. Ans - (b)

$\because \eta = Ae^{E/RT}$ As $T\uparrow$, $r\downarrow$

Q39. Ans - (d) **Q40. Ans - (a)**

Q41. Ans - (b) **Q42. Ans - (b)**

Q43. Ans - (a)

Q44. Ans - (c)

$$\gamma(n-C_3H_7OH) = 23.78\,mJ\,m^{-2}$$

$$= 23.78\times10^{-3}\ N-/m$$

γ (CH_3OH) = 22.61 dyne – cm^{-1} = 22.61×10^{-3} N/m

γ (C_2H_5OH) = 2.275×10^{-2} N/m,

$\therefore \gamma(n-C_3H_7OH) > Y\,(CH_3OH) > Y\,(C_2H_5OH)$

Periodic Table

	1/IA	2/IIA	3/IIIB	4/IVB	5/VB	6/VIB	7/VIIB	8	9	10	11/IB	12/IIB	13/IIIA	14/IVA	15/VA	16/VIA	17/VIIA	18/VIIIA
1	1 H 1.008																	2 He 4.003
2	3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
3	11 Na 22.99	12 Mg 24.30											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
4	19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
5	37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc 98.91	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
6	55 Cs 123.9	56 Ba 137.3	La-Lu	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po 210.0	85 At 210.0	86 Rn 222.0
7	87 Fr 223.0	88 Ra 226.0	Ac-Lr	104 Db	105 Jl	106 Rf	107 Bh	108 Hn	109 Mt	110 Uun	111 Uuu							

VIII (groups 8, 9, 10)

s-block: groups 1–2; d-block: groups 3–12; p-block: groups 13–18

Lanthanides	57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm 146.9	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
Actinides	89 Ac 227.0	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.0	94 Pu 239.1	95 Am 241.1	96 Cm 244.1	97 Bk 249.1	98 Cf 252.1	99 Es 252.1	100 Fm 257.1	101 Md 258.1	102 No 259.1	103 Lr 262.1

f-block