Q1 - 25 January - Shift 1

A cubic solid is made up of two elements X and Y. Atoms of X are present on every alternate corner and one at the center of cube. Y is at $\frac{1}{3}^{rd}$ of the total faces. The empirical formula of the compound is

(1) $X_2Y_{1.5}$ (2) $X_{2.5}Y$

(3) $XY_{2.5}$ (4) $X_{1.5}Y_2$

Space for your notes:

Q2 - 29 January - Shift 2

A metal M forms hexagonal close-packed structure. The total number of voids in 0.02 mol of it is _____ $\times 10^{21}$ (Nearest integer)

(Given $N_A = 6.02 \times 10^{23}$)

Space for your notes:

Q3 - 30 January - Shift 2

Iron oxide FeO, crystallises in a cubic lattice with a unit cell edge length of 5.0Å. If density of the FeO in the crystal is 4.0 g cm^{-3}, then the number of FeO units present per unit cell is _____ (Nearest integer)

Given : Molar mass of Fe and O is 56 and 16g mol^{-1} respectively.

$N_A = 6.0 \times 10^{23}$ mol^{-1}

Space for your notes:

Q4 - 31 January - Shift 2

A sample of a metal oxide has formula $M_{0.83}O_{1.00}$. The metal M can exist in two oxidation states +2 and +3. In the sample of $M_{0.83}O_{1.00}$, the percentage of metal ions existing in +2 oxidation state is _____ % (nearest integer)

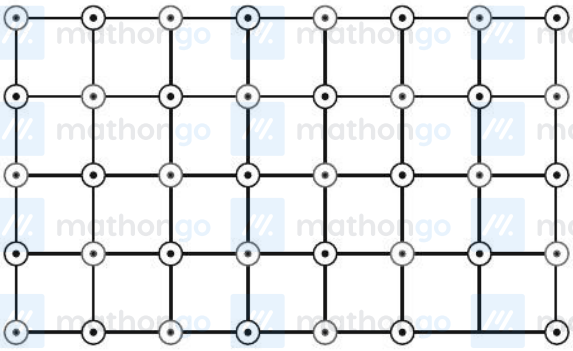
Space for your notes:

Q5 - 01 February - Shift 1

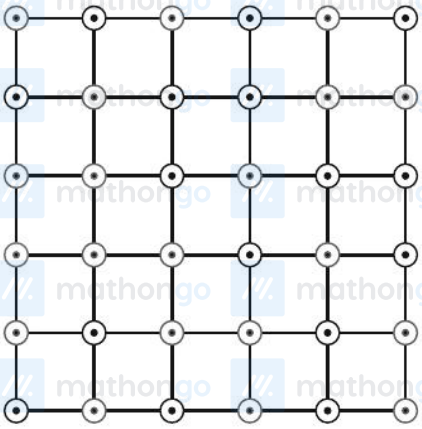
Which of the following represents the lattice structure of $A_{0.95}O$ containing A^{2+}, A^{3+} and O^{2-} ions?

⊙ A^{2+} ⊙ A^{3+} ⊙ O^{2-}

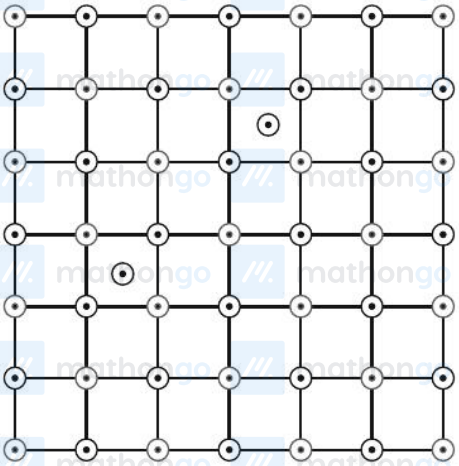
A.



B.



C.



(1) B and C only

(2) B only

(3) A and B only

(4) A only

Space for your notes:

Q6 - 01 February - Shift 2

A metal M crystallizes into two lattices :- face centred cubic (fcc) and body centred cubic (bcc) with unit cell edge length of 2.0 and 2.5 Å respectively. The ratio of densities of lattices fcc to bcc for the metal M is _____.

(Nearest integer)

Space for your notes:

Answer Key

(As per Official NTA Key released on 2 Feb)

Q1 (2) **Q2** (36) **Q3** (4) **Q4** (59)

Q5 (4) **Q6** (4)

Q1 (2)

$$X_{4\times\frac{1}{8}+1\times1}\quad Y_{6\times\frac{1}{3}\times\frac{1}{2}}$$

$$\Rightarrow\quad X_{\frac{1}{2}+1}\quad Y_1$$

$$\Rightarrow\quad X_{\frac{2}{3}}\quad Y_1$$

$$\Rightarrow\quad X_{1.5}\quad Y_1$$

$$\Rightarrow\ X_3\quad Y_2$$

Q2 (36)

One unit cell of hcp contains = 18 voids

No. of voids in 0.02 mol of hcp

$$=\frac{18}{6}\times6.02\times10^{23}\times0.02$$

$$\approx3.6\times10^{22}$$

$$\approx36\times10^{21}$$

Q3 (4)

$$d = \frac{Z \times M}{N_0 \times a^3}$$

$$4 = \frac{Z \times 72}{6 \times 10^{23} \times 125 \times 10^{-24}}$$

$$Z = 4.166 \simeq 4$$

Q4 (59)

$$M \begin{cases} \xrightarrow{+2} x \\ \xrightarrow{+3} (0.83 - x) \end{cases}$$

$$2x + 3(0.83 - x) = 2$$

$$x = 0.49$$

$$\% M^{2+} = \frac{0.49}{0.83} \times 100$$

$$= 59\%$$

Q5 (4)

Applying electrical neutrality principle in metal defficiency defect.

3 A^{2+} are replaced by $2A^{3+}$, thus one vacant site per pair of A^{3+} is created

Q6 (4)

$$d = \frac{Z \times M}{N_A a^3}$$

$$\frac{d_{FCC}}{d_{BCC}} = \frac{\frac{4 \times M_w}{N_A \times (2)^3}}{\frac{2 \times M_w}{N_A \times (2.5)^3}} = 3.90$$