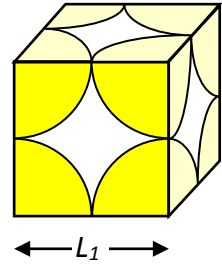


## 估數量（小學）評分準則

1. (a)  $d = 10\sqrt{2} = 14.1\text{cm}$  [1M + 1A]  
 (b)  $d = 10\sqrt{3} = 17.3\text{cm}$  [1M + 1A]



2. Consider a unit cell of structure 1 (Simple Cubic) [2M]

no. of sphere inside the unit cell =  $8 \times \frac{1}{8} = 1$  [1A]

Let  $L_1$  be the length of the unit cell.

Length  $L$  of the unit cell =  $d$ , where  $d$  is the diameter of the sphere [1M + 1A]

$\therefore$  no. of sphere per unit cell is  $\rho_1 = \frac{1}{d^3}$  [1M + 1A]

- Consider a unit cell of structure 2 (Body Centre Cubic) [2M]

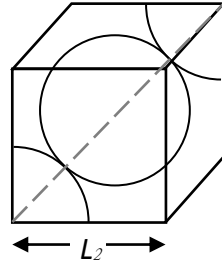
no. of sphere inside the unit cell =  $8 \times \frac{1}{8} + 1 = 2$  [1A]

Let  $L_2$  be the length of the unit cell.

$$\sqrt{3}L_2 = 2d$$

$\therefore$  The length  $L_2$  of the unit cell is  $\frac{2d}{\sqrt{3}} = 1.15d$  [1M + 1A]

$\therefore$  no. of sphere per unit cell is  $\rho_2 = \frac{2}{\left(\frac{2d}{\sqrt{3}}\right)^3} = \frac{1.30}{d^3}$  [1M + 1A]



- Consider a unit cell of structure 3 (Face Centre Cubic) [2M]

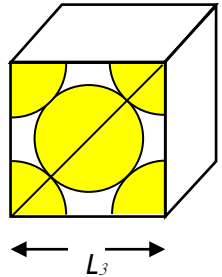
no. of sphere inside the unit cell =  $8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$  [1A]

Let  $L$  be the length of the unit cell.

$$\sqrt{2}L_3 = 2d$$

$\therefore$  The length  $L_3$  of the unit cell is  $\sqrt{2}d = 1.41d$  [1M + 1A]

$\therefore$  no. of sphere per unit cell is  $\rho_2 = \frac{4}{(\sqrt{2}d)^3} = \frac{1.41}{d^3}$  [1M + 1A]



$\therefore$  Structure 1 < Structure 2 < Structure 3 [2A]

3. (a) Structure 1: Size of unit cell = 0.015m

$\therefore$  The  $1\text{m}^3$  box can carry  $\frac{1}{0.015^3} = 296296$  unit cells.

$\therefore$  no. of of marbles =  $296296 \times 1 = 296296$  [2M + 2A]

Structure 3: Size of unit cell =  $\sqrt{2} \times 0.015 = 0.021\text{m}$

∴ The  $1\text{m}^3$  box can carry  $\frac{1}{0.021^3} = 104757$  unit cells.

∴ no. of of marbles =  $104757 \times 4 = 419026$  [2M + 2A]

∴ The estimated no. of marbles is  $\frac{419026+296296}{2} = 357661$  [1M+1A]

3. (b) % error  $\approx \frac{419026-357661}{357661} \times 100\% = 17.2\%$  [1M+1A]

4. (a) By playing around with the mushroom, it is observed that a pack of 4 mushroom can be treated roughly a sphere. [2M]

As an example, the diameter of that “sphere” is roughly 4cm. Similarly, using part (c)’s approach.

Structure 1: Size of unit cell = 0.04m

∴ The  $1\text{m}^3$  box can carry  $\frac{1}{0.04^3} = 15625$  unit cells.

∴ no. of of mushroom =  $15625 \times 1 \times 4 = 62500$  [1M+1A]

Structure 3: Size of unit cell =  $\sqrt{2} \times 0.04 = 0.021\text{m}$

∴ The  $1\text{m}^3$  box can carry  $\frac{1}{0.021^3} = 5524$  unit cells.

∴ no. of of marbles =  $5524 \times 4 \times 4 = 88384$  [1M+1A]

∴ The estimated no. of mushroom is  $\frac{62500+88384}{2} = 75442$  [1M+1A]

4. (b) % error  $\approx \frac{88384-75442}{75442} \times 100\% = 17.2\%$  [1M+1A]

5. % error [2A]

