(i) $\text{SeC}$

Atomic mass of Carbon = 12.011
Atomic mass of Se = 78.08

$a = 4.36 \times 10^{-8}\text{cm} \quad 1 \text{ a.m.u} = 1.66 \times 10^{-24}\text{gm}$

Mass density $= \frac{(\text{No. of atoms per unit cell}) \times (\text{mass of atom})x}{(1 \text{ a.m.u})} \times \frac{1}{\text{Volume of unit cell}}$

$= \frac{\left(4 \times 12.011 + 4 \times 78.08\right) \times 1.66 \times 10^{-24}}{(4.36 \times 10^{-8})^3}$

Density $= 3.211 \text{ gm/cm}^3$

(ii) Atomic mass of $\text{Ga} = 69.7$
Atomic mass of $\text{N} = 14.01$

$a = 5.65 \times 10^{-8}\text{cm}$

Mass density $= \frac{\left(4 \times 69.7 + 4 \times 14.01\right) \times 1.66 \times 10^{-24}}{(5.65 \times 10^{-8})^3}$

$= 3.08 \text{ gm/cm}^3$
(iii) Atomic mass of \( \text{As} = 74.92 \)
Atomic mass of \( \text{Ga} = 69.7 \)
Atomic mass of \( \text{P} = 30.97 \)
\[
a = 5.65 \times 10^{-8} \text{cm}
\]

Mass density = \[
4 \left[ \frac{69.7 + (0.56 \times 74.92) + (0.44 \times 30.97)}{1.66 \times 10^{-24}} \right] \\
= \frac{1}{(5.65 \times 10^{-8})^3}
\]
\[
= 4.61 \text{ gm/cm}^3
\]

(2) BCC Crystal

BCC Crystal = SC Lattice + \{(0,0,0), \frac{a}{2} (1,1,1)\}

FCC Crystal

FCC crystal = SC lattice + \{(0,0,0), \frac{a}{2} (1,0,1), \frac{a}{2} (1,1,0), \frac{a}{2} (0,1,1)\}
The distance between nearest neighbour atoms is $\text{NND}$

**B.C.C**

Nearest neighbour atoms

The length of the body diagonal is $\sqrt{3} a$

The body centered atom is at the midpoint of the length of the body diagonal is $\frac{\sqrt{3}}{2} a$

Nearest neighbour atoms are the bottom corner atom on the left hand side and the body centered atom

$\therefore \text{NND} = \frac{\sqrt{3}}{2} a$
The distance between nearest neighbour atoms

\[ \text{nnl} = \frac{\sqrt{2}a}{2} = \frac{a}{\sqrt{2}} \]

Diamond Structure:

[Refer to the fig 1.4 (a) & 1.4 (c) in text]

The length of the body diagonal = \( \sqrt{3} a \)

Since the nearest neighbour atom is one-quarter of the way down the diagonal from the top left-hand corner of the cube, \( \text{N.N.D.} = (\sqrt{3} a) \frac{1}{4} \)

\[ \text{N.N.D.} = \frac{\sqrt{3}}{4} a \]
(b) Lattice constant $a = 5.43 \times 10^{-8}$ cm

Number of atoms per cm$^2$ at the surface of wafer

$$\frac{[(\frac{1}{4})4] + 1}{a^2} = \frac{2}{a^2} = 6.783 \times 10^{14} \text{ atoms/cm}^2$$

(d) Number of atoms/cm$^2$ = \frac{4(\frac{1}{4}) + 2(\frac{1}{6}) + 2}{(\sqrt{2}a \times a)}

$$= \frac{4}{\sqrt{2}a^2} = 9.592 \times 10^{14} \text{ atoms/cm}^2$$
(a) (i) Miller index

1, 3, 1 are intercepts

1, 1/3, 1 inverting

3, 1, 3 reducing to lowest whole number

Miller index notation for the plane (3 1 3)

(ii) Miller index notation for the direction normal to the plane is [3 1 3]

(b) (i) 1, 1, 1/2 intercepts

1, 1, 2 inverting

1, 1, 2 reducing to lowest whole number

Miller index notation for the plane (1 1 2)

(ii) Miller index notation for the vector pictured is [0 0 1]