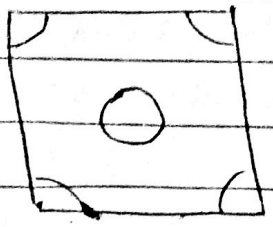
Date:

Question 1)

(a) silicon (Si) wafer (100)



(b) 4 corners atoms = $4 \times 1/4$

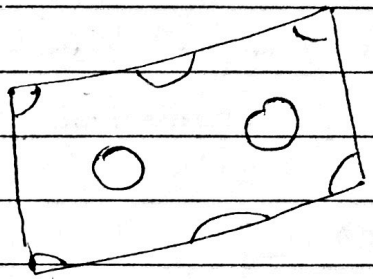
1 centre atom = 1×1

$4 \times 1/4 + 1 = 2$ atoms/cell

atoms/cm^2 = $2/(5.43\,A°)^2$

$= 6.783 \times 10^{14}$ atoms/cm^2

(c) silicon (Si) wafer (110)



4 corner atoms = $4 \times 1/4$

2 centre atoms = 1×1

2 atoms at the edges = $1/2 \times 2$

= 4 atoms/cells

atoms/cm^2 = $4/(5.43 \times \sqrt{2}(5.43))$

$= 9.59 \times 10^{14}$ atoms/cm^2

Question 2)

(a) The plan intercepts on the x, y, z axes are,

[1, 3, 1]

taking reciprocal,

[1/1, 1/3, 1/1]

multiplying by common denominator,

3. (3, 1, 3)

(b) Direction normal to plane has same miler indices as plane in cubic crystal

[3, 1, 3]

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c(i) x, y and z intercepts

[1, 1, 1/2]

reciprocal

(1, 1, 2)

(ii) x, y and z intercepts

[∞, ∞, 1]

reciprocal,

[1/∞, 1/∞, 1/1]

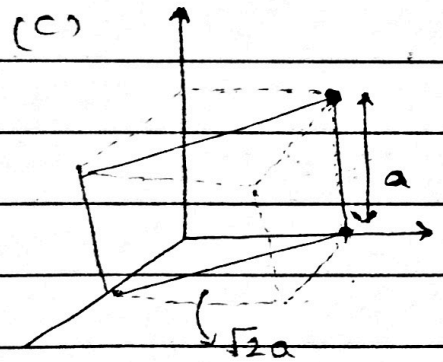
(0, 0, 1)

Question 3)

(a) simple cubic lattice

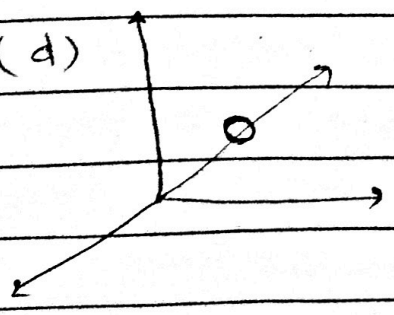
(b) atoms / volume (cm3) = $\frac{1 \text{ atom}}{a \times a \times a} = \frac{1}{a^3}$

(c)



atoms / cm2 = $\frac{1}{\sqrt{2}a^2}$

(d)



[1 1 1]

The specified vector has equal projection on the three cordinate axis.

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Q.4)

(a) $E_g = 0.66 \times 1.6 \times 10^{-19} J = 1.056 \times 10^{-19}$

At 300K :-

$$n_i = 1.66 \times 10^{15} (300)^{3/2} \exp^{-\left(\frac{1.056 \times 10^{-19}}{2 \times 1.38 \times 10^{-23} \times 300}\right)}$$

$$= 2.49 \times 10^{13} \text{ cm}^{-3}$$

At 600K -

$$n_i = 1.66 \times 10^{15} (600)^{3/2} \cdot e^{\left(-\frac{1.05 \times 10^{-19}}{2 \times 1.38 \times 10^{-23} \times 600}\right)}$$

$$n_i = 4.149 \times 10^{16} \text{ cm}^{-3}$$

Silicon has 1.078×10^{10} at 300K
and 1.526×10^{15} atoms at 600K
which are less than germanium.

(b) $N_D = 5 \times 10^{16}$

$$P = \frac{n_i^2}{N_D} = \frac{2.49 \times 10^{13}}{5 \times 10^{16}} = 1.25 \times 10^{10} \text{ cm}^{-3}$$