

THIRD EXAM

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Discussion Section #: \_\_\_\_\_

SHOW ALL WORK!!!!

REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!

Use the conversion constants and data given on the front page.

Given that bismuth, a semimetal, has a density of  $9.80 \text{ g/cm}^3$  and a carrier density of  $7.65 \times 10^{18} \text{ cm}^{-3}$ , calculate the number of charge carriers per atom. Bismuth has an atomic mass of 209.

$$\therefore \text{Mass density: } \rho = 9.80 \text{ g/cm}^3$$

$$\therefore \text{Mole density: } \mu = \frac{\rho (\text{g/cm}^3)}{\text{Atomic mass (g)}} = \frac{9.80 \text{ g/cm}^3}{209 \text{ g/mole}} = 0.0469 \text{ mole/cm}^3$$

$$\text{Number density: } n = N_0 \mu = 6.02 \times 10^{23} \text{ mole}^{-1} \times 0.0469 \text{ mole/cm}^3 = 2.82 \times 10^{22} \text{ cm}^{-3}$$

$$\therefore \text{Carrier number density} = 7.65 \times 10^{18} \text{ cm}^{-3}$$

$\therefore$  In the volume of  $1 \text{ cm}^3$ , we have  $2.82 \times 10^{22}$  atoms, and  $7.65 \times 10^{18}$  carriers.

$$\therefore \text{The number of charge carriers per atom} = \frac{7.65 \times 10^{18}}{2.82 \times 10^{22}} = \boxed{2.71 \times 10^{-4}}$$

Method 15

Answer 10