789.

Problem 53.3 (RHK)

Gold is a monovalent metal with a molar mass of 197 g mol^{-1} and a density of 19.3 g cm^{-3}. We have to calculate the density of charge carriers.

Solution:

As gold is a monovalent metal each atom will contribute one conduction electron. Therefore, the density of charge carriers will be equal to the number density of gold atoms. As the number density of gold atoms

$$n_{Au} = \frac{N_A \rho}{M},$$

where $N_A = 6.02 \times 10^{23}$ mol^{-1} is the Avogadro constant,

$M = 197\ \text{g mol}^{-1}$ is the molar mass of gold, and

$\rho = 19.3 \times 10^3$ kg m^{-3} is the density of gold, we find

$$n_{Au} = \frac{N_A \rho}{M} = \frac{6.02 \times 10^{23} \times 19.3 \times 10^3}{197 \times 10^{-3}}\ \text{m}^{-3}$$
$$= 5.89 \times 10^{28}\ \text{m}^{-3}.$$

Therefore, the density of conduction electrons in gold metal will be $5.89 \times 10^{28} \, \text{m}^{-3}$.