Marks

- A doctor recommends to a pregnant woman that she takes an iron supplement of 50 mg (as Fe^{2+}) daily. To achieve this, what mass (to the nearest mg) of iron(II) gluconate-2-water, $FeC_{12}H_{22}O_{14}\cdot 2H_2O$, would be required? **3**

The atomic mass of Fe is 55.85 g mol^{-1}. a mass of 50 mg therefore corresponds to

$$\text{number of moles} = \frac{\text{mass}}{\text{atomic mass}} = \frac{50\times10^{-3}\ \text{g}}{55.85\ \text{g mol}^{-1}} = 8.95\times10^{4}\ \text{mol}$$

The molar mass of $FeC_{12}H_{22}O_{14}\cdot 2H_2O$ is:

molar mass = (55.85 (Fe) + 12×12.01 (C) + 26×1.008 (H) + 16×16.00 (O)) g mol^{-1}
= 482.178 g mol^{-1}

As 1 mole of this contains 1 mole of Fe, the mass of the supplement required is:

$$\text{mass} = \text{number of moles} \times \text{molar mass}$$
$$= (8.95\times10^{4}\ \text{mol}) \times (482.178\ \text{g mol}^{-1}) = 0.432\ \text{g}$$

- What is the mass of each of the following at 298 K and 101 kPa pressure? **4**

(i) argon (24.5 litre)

Argon is a gas under these conditions. 24.5 L corresponds to the volume of 1.00 mol at 298 K and 101 kPa. Therefore, the mass of argon is:

mass = number of moles × atomic mass = (1.00 mol) × (39.95 g mol^{-1}) = 40.0 g

(ii) water (24.5 litre)

Water is a liquid under these conditions. Its density is 0.997 g cm^{-3}. The mass is therefore:

mass = density × volume = (0.997 g cm^{-3}) × (24.5 × 10^3 cm^3) = 24400 g = 24.4 kg

(iii) chlorine (12.25 litre)

Cl_2 is a gas under these conditions. As 24.5 L corresponds to the volume of 1.00 mol, 12.25 L corresponds to $\dfrac{12.25\ \text{L}}{24.5\ \text{L mol}^{-1}} = 0.50\ \text{mol}$.

The molar mass of Cl_2 is (2 × 35.45 g mol^{-1}) = 70.9 g mol^{-1}. The mass is therefore:

mass = number of moles × atomic mass = (0.50 mol) × (70.9 g mol^{-1}) = 35.5 g

(iv) zinc (1.00 mole)

The atomic mass of Zn is 65.39 g mol^{-1}. The mass is therefore:

mass = number of moles × atomic mass = (1.00 mol) × (65.39 g mol^{-1}) = 65.4 g