Worksheet 5.1: Solutions

Calculations involving gases and solutions

No.	Answer
1	**a** $n(C_6H_{12}O_6) = \frac{m}{M} = \frac{5.00}{180.156} = 0.027\,75$ $n(O) = 6 \times n(C_6H_{12}O_6) = 6 \times 0.027\,75 = 0.166$ mol **b** $n(H_2O_2) = \frac{m}{M} = \frac{8.36}{34.016} = 0.2458$ mol $n(\text{atoms}) = 4 \times n(H_2O_2) = 4 \times 0.2458 = 0.9832$ $N(\text{atoms}) = n \times N_A = 0.9832 \times 6.022 \times 10^{23} = 5.92 \times 10^{23}$
2	$c_1 \times V_1 = c_2 \times V_2$, $\therefore V_2 = \frac{c_1 \times V_1}{c_2} = \frac{0.300 \times 35.0}{0.0900} = 116.7$ mL $\therefore V(H_2O)$ added = 116.7 – 35.0 = 81.7 mL
3	$pV = nRT \therefore p = \frac{0.49 \times 8.314 \times 327.1}{3.0} = 4.4 \times 10^2$ kPa
4	Mass of 1 mole = $4 \times 10^{-22} \times 6.022 \times 10^{23} = 2 \times 10^2$ g
5	$pV = nRT$ and $n = \frac{m}{M} \therefore pV = \frac{m}{M}RT \therefore V = \frac{mRT}{pM} = \frac{62.0 \times 8.314 \times 397.1}{210 \times 44.01} = 22.1$ L
6	$c(NaCl) = \frac{n}{V} = \frac{m}{M \times V} = \frac{70.2}{58.44 \times 1.00} = 1.201\ \text{mol L}^{-1}$ $V_2 = \frac{c_1 \times V_1}{c_2} = \frac{1.201 \times 1.00}{0.670} = 1.79$ L $\therefore$ 1.79 – 1.00 = 0.79 L of water must be added.
7	$pV = nRT$ and $n = \frac{m}{M} \therefore pV = \frac{m}{M}RT \therefore M = \frac{mRT}{pV} = \frac{2.06 \times 8.314 \times 300.1}{20 \times 16} = 16\ \text{g mol}^{-1}$ The gas is methane.
8	Mass of ammonia = 1.50% of 150 mL = × 150 = 2.25 g
9	$pV = \frac{mRT}{M} \therefore M = \frac{mRT}{pV} = \frac{0.778 \times 8.314 \times 299.1}{99.8 \times 122 \times 10^{-3}} = 159\ \text{g mol}^{-1}$ The halogen must be bromine (Br_2).
10	600 ppm = 600 mg in 1.0 kg = 0.600 g in 1000 g = 0.0600 g of Hg in 100 g of water $n(Hg) = \ = 2.991 \times 10^{-4}$ mol $n(\text{Hg atoms}) = 2.991 \times 10^{-4} \times 6.022 \times 10^{23} = 1.80 \times 10^{20}$ atoms

Calculations involving gases and solutions

No.	Answer
11	$n(Pb(NO_3)_2) = \frac{m}{M} = \frac{3.5}{331.22} = 0.0106$ mol $c(Pb(NO_3)_2) = \frac{n}{V} = \frac{0.0106}{0.060} = 0.177$ mol L^{-1} $c_2 = \frac{c_1 \times V_1}{V_2} = \frac{0.177 \times 10}{30} = 0.059$ mol L^{-1}
12	$c_2 = \frac{c_1 \times V_1}{V_2} = \frac{16 \times 50}{100} = 8.0\%$ m/v 8.0% m/v = 8.0 g/100 mL = 80 g L^{-1} = 80 000 mg L^{-1} Assuming the density of the water is 1 g mL^{-1} = 1 kg L^{-1} Therefore, the concentration is 80 000 mg per 1 kg of solution = 8.0×10^4 ppm.
13	**a** 2.33 g in 398 mL of water. Assuming the density of the solution is 1 g mL^{-1}, the volume of the solution is also 398 mL. % m/v = x 100 = 0.585% **b** $n(AgNO_3) = \frac{m}{M} = \frac{2.33}{169.91} = 0.01371$ mol $c(AgNO_3) = \frac{n}{V} = \frac{0.01371}{0.398} = 3.44 \times 10^{-2}$ mol L^{-1}