

## Section B Short answer (15 marks)

Section B consists of five questions. Write your answers in the spaces provided. You are advised to spend 20 minutes on this section.

1 Determine the percentage composition of iron(II) sulfate. (3 marks)

2 Respiration can be represented by the following equation:

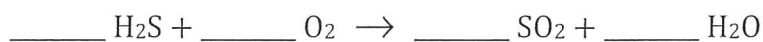


a Calculate the molecular mass of glucose. (1 mark)

b How many moles of carbon dioxide are produced per mole of glucose? (1 mark)

c How many particles of water are produced per mole of oxygen? (1 mark)

3 Hydrogen sulfide gas reacts with oxygen gas to form sulfur dioxide gas and water according to the equation:



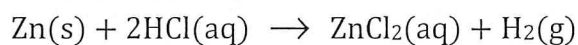
a Balance the equation by writing the correct coefficients in the spaces above. (1 mark)

b Calculate the mass of sulfur dioxide produced from 1.0 kg of hydrogen sulfide. (2 marks)

- 4 An unknown substance has the following percentage composition by mass:  
49.5% C, 5.2% H, 16.6% O, 28.8% N.
- a Determine the empirical formula of this compound. (2 marks)

- b If the molar mass of the compound is  $194.19 \text{ g mol}^{-1}$ , determine the molecular formula. (1 mark)

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- 5 A piece of zinc metal of mass 0.73 g is added to 1.3 g of hydrochloric acid. The following reaction takes place.



- a Calculate the moles of each reactant present before the reaction takes place. (1 mark)

- b One reactant is in excess (there is too much of it). Identify which reactant is in excess and by how many moles. (1 mark)

- c Calculate the mass of hydrogen gas produced in this reaction. (1 mark)

End of test (30 marks)

## Section B Short answer (15 marks)

Section B consists of five questions. Write your answers in the spaces provided. You are advised to spend 20 minutes on this section.

- 1 Determine the percentage composition of iron(II) sulfate. (3 marks)

*Answer:* FeSO<sub>4</sub>

Mass of Fe = 55.85

Mass of S = 32.07

Mass of O = 16.00 × 4

Formula mass = 55.85 + 32.07 + (16.00 × 4) = 151.92

$$\%Fe = \frac{55.85}{151.92} \times 100 = 36.8\%$$

$$\%S = \frac{32.07}{151.92} \times 100 = 21.1\%$$

$$\%O = \frac{64.00}{151.92} \times 100 = 42.1\%$$

- 2 Respiration can be represented by the following equation:



- a Calculate the molecular mass of glucose. (1 mark)

*Answer:* C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>

$$= (6 \times 12.01) + 12(1.008) + 6(16.00)$$

$$= 180.16$$

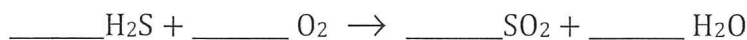
- b How many moles of carbon dioxide are produced per mole of glucose? (1 mark)

*Answer:* 6

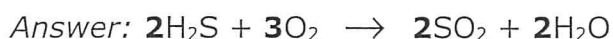
- c How many particles of water are produced per mole of oxygen? (1 mark)

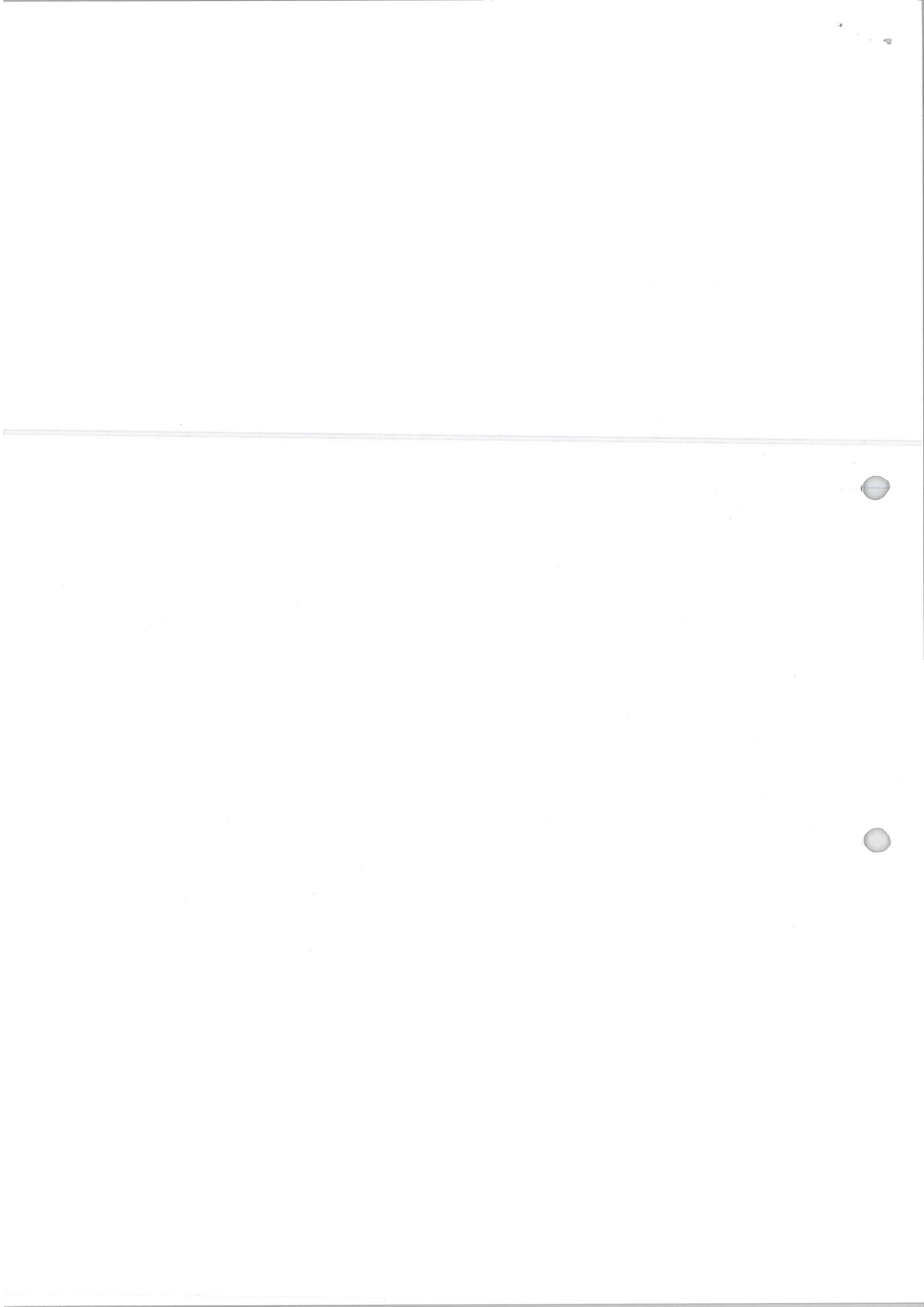
*Answer:* 1 mole of water per 1 mole of oxygen. This means there are  $6.02 \times 10^{23}$  molecules of water produced per mole of oxygen.

- 3 Hydrogen sulfide gas reacts with oxygen gas to form sulfur dioxide gas and water according to the equation:



- a Balance the equation by writing the correct coefficients in the spaces above. (1 mark)





- b Calculate the mass of sulfur dioxide produced from 1.0 kg of hydrogen sulfide. (2 marks)

Answer: 1 kg = 1000 g of H<sub>2</sub>S

$$n = \frac{m}{M}$$

$$n_{\text{H}_2\text{S}} = n_{\text{SO}_2} = \frac{1000}{[(2 \times 1.008) + 32.07]}$$

$$n = 29.337\dots$$

$$m_{\text{SO}_2} = n \times M$$

$$= 29.337\dots \times 64.07$$

$$= 1879.62\dots$$

$$= 1.88 \text{ kg SO}_2$$

- 4 An unknown substance has the following percentage composition by mass: 49.5% C, 5.2% H, 16.6% O, 28.8% N.

- a Determine the empirical formula of this compound. (2 marks)

Answer: Mass (in 100 g): C = 49.5 g, H = 5.2 g, O = 16.6 g, N = 28.8 g

$$n_{\text{C}} = \frac{49.5}{12.01} = 4.12$$

$$n_{\text{H}} = \frac{5.2}{1.008} = 5.1587$$

$$n_{\text{O}} = \frac{16.6}{16.00} = 1.0375$$

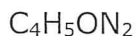
$$n_{\text{N}} = \frac{28.8}{14.01} = 2.0557$$

$$\text{C} = \frac{4.12}{1.0375} = 3.97 = 4$$

$$\text{H} = \frac{5.1587}{1.0375} = 4.97 = 5$$

$$\text{O} = \frac{1.0375}{1.0375} = 1$$

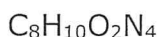
$$\text{N} = \frac{2.0557}{1.0375} = 1.98 = 2$$



- b If the molar mass of the compound is 194.19 gmol<sup>-1</sup>, determine the molecular formula. (1 mark)

Answer:  $(4 \times 12) + (5 \times 1) + (2 \times 14) + (1 \times 16.00) = 97$

$$\frac{194.19}{97} = 2$$



- 5 A piece of zinc metal of mass 0.73 g is added to 1.3 g of hydrochloric acid. The following reaction takes place.



- a Calculate the moles of each reactant present before the reaction takes place. (1 mark)

$$\text{Answer: } n_{\text{Zn}} = \frac{0.73}{65.39}$$

$$= 0.1116... \text{ mol}$$

$$n_{\text{HCl}} = \frac{1.3}{(1.008 + 35.45)}$$

$$= 0.03566... \text{ mol}$$

- b One reactant is in excess (there is too much of it). Identify which reactant is in excess and by how many moles. (1 mark)

Answer: Zn:HCl = 1:2 Only need  $\frac{0.03...}{2}$  mol of Zn. Zn is in excess by

$$0.1116 - \left(\frac{0.03...}{2}\right) = 0.094 \text{ mol}$$

- c Calculate the mass of hydrogen gas produced in this reaction. (1 mark)

Answer:

$$m_{\text{H}_2} = n \times M$$

$$= \left(\frac{0.03566}{2}\right) \times (2 \times 1.008)$$

$$= 0.0359...$$

$$= 0.036 \text{ g H}_2 \text{ gas}$$

End of test (30 marks)