

## Higher Chemistry

### Chemistry In Society Unit 3 Ink Exercise 1



The Chemical Industry, Mole Calculations, Percentage Yield and Atom Economy

### Multiple Choice 10 Marks

- 1.) Which of the following is the best description of a feedstock
- A A consumer product such as a textile, plastic or detergent
  - B A Complex chemical that has been synthesised from small molecules
  - C A mixture of chemicals formed by the cracking of the naphtha fraction from oil
  - D a chemical from which other chemicals can be extracted or synthesised
- 2.) Which of the following is a raw material in the chemical industry
- A Ammonia
  - B Calcium Carbonate
  - C Hexane
  - D Nitric Acid
- 3)  $2\text{NO}_{(g)} + \text{O}_{2(g)} \rightarrow 2\text{NO}_{2(g)}$

How many litres of nitrogen dioxide gas would be produced in a reaction, starting with a mixture of 5 litres of nitrogen monoxide gas and 2 litres of oxygen gas? (All volumes are measured under the same conditions of temperature and pressure.)

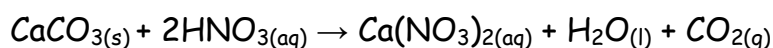
- A 2
- B 3
- C 4
- D 5

- 4.) What volume of oxygen (in litres) would be required for the complete combustion of a gaseous mixture containing 1 litre of carbon monoxide and 3 litres of hydrogen?

(All volumes are measured at the same temperature and pressure.)

- A 1
- B 2
- C 3
- D 4

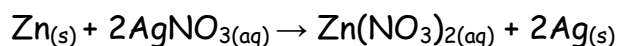
- 5.) Calcium carbonate reacts with nitric acid as follows.



0.05 mol of calcium carbonate was added to a solution containing 0.08 mol of nitric acid. Which of the following statements is true?

- A 0.05 mol of carbon dioxide is produced.
  - B 0.08 mol of calcium nitrate is produced.
  - C Calcium carbonate is in excess by 0.01 mol.
  - D Nitric acid is in excess by 0.03 mol.
- 6.) A mixture of magnesium bromide and magnesium sulfate is known to contain 3 mol of magnesium and 4 mol of bromide ions. How many moles of sulfate ions are present?
- A 4
  - B 3
  - C 2
  - D 1

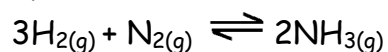
- 7.) A pupil added 0.1 mol of zinc to a solution containing 0.05 mol of silver(I) nitrate.



Which of the following statements about the experiment is correct?

- A 0.05 mol of zinc reacts.
  - B 0.05 mol of silver is displaced.
  - C Silver nitrate is in excess.
  - D All of the zinc reacts.
- 8.) 10 g of magnesium is added to 1 litre of 1 mol l<sup>-1</sup> copper(II) sulphate solution and the mixture stirred until the reaction is complete. Which of these is a result of this reaction?
- A All the magnesium reacts.
  - B 63.5 g of copper is displaced.
  - C 2 mol of copper is displaced.
  - D The resulting solution is colourless.

- 9.) Ammonia is manufactured from hydrogen and nitrogen by the Haber Process.



If 80 kg of ammonia is produced from 60 kg of hydrogen, what is the percentage yield?

A  $\frac{80}{340} \times 100$

B  $\frac{80}{170} \times 100$

C  $\frac{30}{80} \times 100$

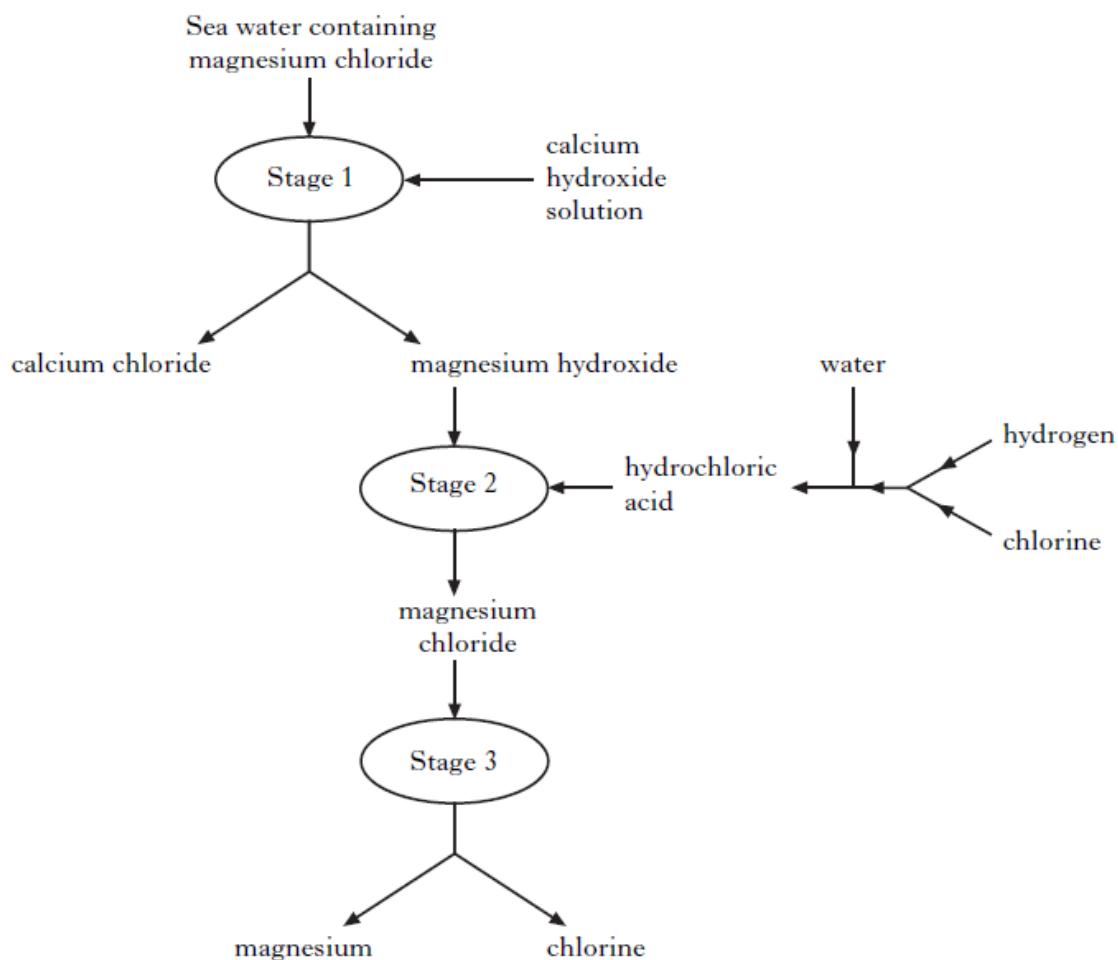
D  $\frac{60}{80} \times 100$

- 10.) Two identical samples of copper (II) carbonate were added to an excess of  $1 \text{ mol l}^{-1}$  hydrochloric acid and  $1 \text{ mol l}^{-1}$  sulphuric acid respectively. Which of the following would have been different for the two reactions?

- A The pH of the final solution
- B The volume of gas produced
- C The mass of water formed
- D The mass of copper(II) carbonate dissolved

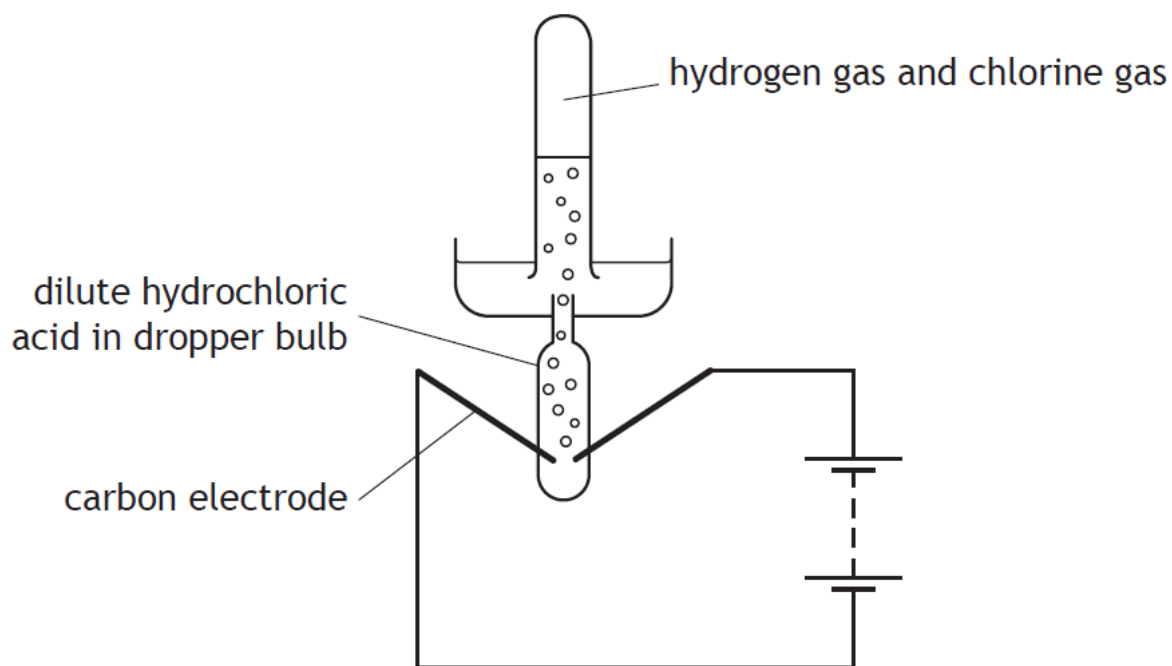
## Written 20 Marks

- 11.) Magnesium metal can be extracted from sea water.  
An outline of the reactions involved is shown in the flow diagram.



- (a) Why can the magnesium hydroxide be easily separated from the calcium chloride at Stage 1? (1)
- (b) Name the type of chemical reaction taking place at Stage 2. (1)
- (c) Give two different features of this process that make it economical. (2)

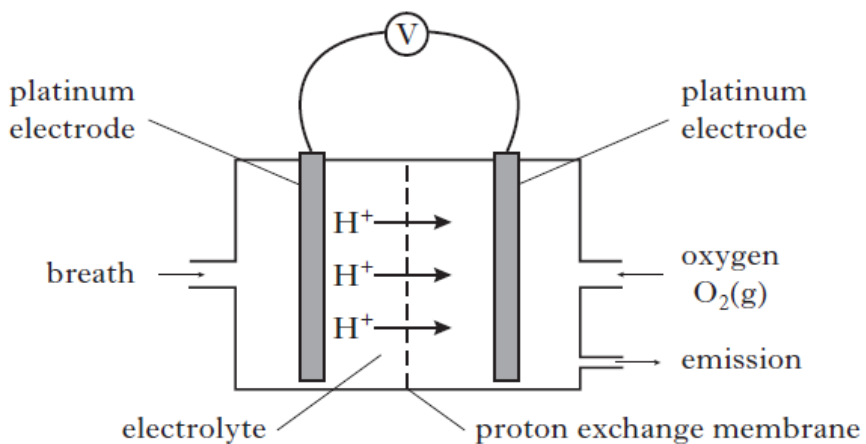
- 12.) The label on a tub of margarine states that 100 g of the margarine contains 0.70 g of sodium. The sodium is present as sodium chloride. Calculate the mass of sodium chloride, in grams, present in a 10 g portion of the margarine. The mass of one mole of sodium chloride, NaCl, is 58.5 g. (1)
- 13.) Hydrogen gas and chlorine gas react explosively in a photochemical reaction. In a demonstration experiment, the reaction was used to fire a table tennis ball across a room. A mixture of hydrogen gas and chlorine gas was generated by the electrolysis of hydrochloric acid.



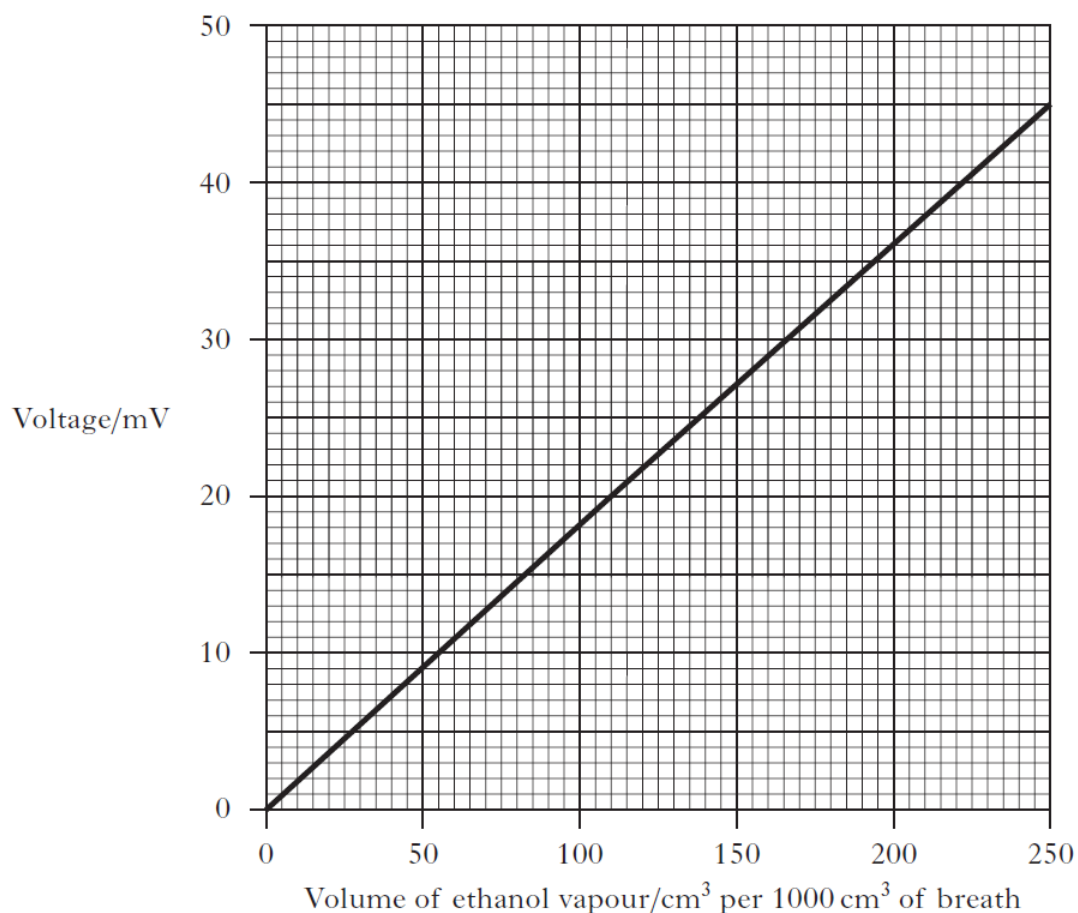
Calculate the number of moles of hydrochloric acid required to completely fill a 10 cm<sup>3</sup> test tube with the hydrogen gas and chlorine gas mixture.

(Take the molar volume of a gas to be 24 litres mol<sup>-1</sup>) (2)

- 14.) The concentration of ethanol in a person's breath can be determined by measuring the voltage produced in an electrochemical cell.



The graph on the next page shows how different ethanol vapour concentrations produce different voltages.



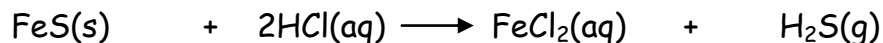
Calculate the mass of ethanol, in g, in 1000 cm<sup>3</sup> of breath when a voltage of 20 mV was recorded.

(Take the molar volume of ethanol, C<sub>2</sub>H<sub>5</sub>OH, vapour to be 24 litres mol<sup>-1</sup>.)  
**your working clearly.** (3)



15.) Hydrogen sulfide is a toxic gas with the smell of rotten eggs.

(a) Hydrogen sulfide gas can be prepared by the reaction of iron(II) sulfide with excess dilute hydrochloric acid:



(i) Hydrogen sulfide gas is very soluble in water. Draw a diagram to show an assembled apparatus that could be used to measure the volume of  $\text{H}_2\text{S}$  gas produced when a sample of iron(II) sulfide reacts with hydrochloric acid.

Your diagram should be labelled and should show the names of any chemicals used. (2)

ii) Calculate the mass, in g, of iron(II) sulfide required to produce  $79 \text{ cm}^3$  of hydrogen sulfide gas.

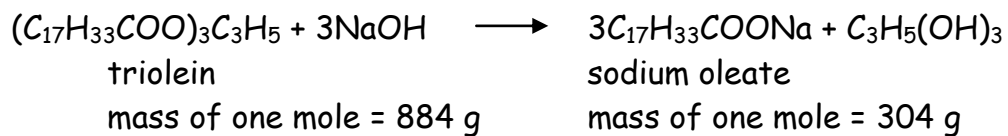
(Take the molar volume of hydrogen sulfide to be  $24 \text{ litres mol}^{-1}$ .)

**Show your working clearly** (2)

b) Hydrogen sulfide gas produced from iron(II) sulfide is often contaminated with hydrogen gas and gaseous arsenic compounds. To avoid these contaminants, hydrogen sulfide can be made by reacting aluminium sulfide with water. Hydrogen sulfide and aluminium hydroxide are produced.

Write a balanced equation for the production of hydrogen sulfide from aluminium sulfide and water. (2)

- 16.) In an experiment some oils were used to make soap. The oil, triolein, was reacted with sodium hydroxide.



5.0 g of triolein was dissolved in ethanol and placed in a test tube with excess sodium hydroxide. The mixture was heated to 80 °C. The experiment produced 1.28 g of sodium oleate.

- a) Calculate the percentage yield. (2)
- b) Calculate the atom economy of this reaction for the production of sodium oleate (2)