

JUNIOR LYCEUM ANNUAL EXAMINATIONS 2004

Educational Assessment Unit – Education Division

FORM 5

CHEMISTRY

TIME: 1hr 45 mins

Name: _____

Class: _____

Useful Data: A copy of the Periodic Table is provided with this paper.

Relative atomic masses may be taken as:

C = 12, H = 1, N = 14, Cl = 35.5

**Section A: Answer All questions in this section, using the spaces provided.
This section carries 60 marks.**

1. This question concerns the following elements:

Aluminium, Calcium, Copper, Iodine, Sulphur

These elements may be used more than once to answer the questions below.

Choose from this list the element which -

a) on heating, forms a violet vapour which changes back to a dark solid on cooling

b) forms ions which are responsible for hardness in water _____

c) is manufactured from its oxide by electrolysis _____

d) can be displaced from an aqueous solution of one of its salts by adding zinc metal

e) exists in more than one allotropic form _____

f) forms an oxide that reacts with water to produce a solution with a pH greater than 7

g) forms a simple ion that reacts with acidified silver nitrate to form an insoluble yellow precipitate _____

h) has atoms that can lose one or two electrons in compound formation _____

(8 marks)

2. This question concerns the properties of gases.

Give the chemical **name or formula** for a **gas**:

a) that is brown and is formed when car exhaust fumes come into contact with air

b) that is commonly used as a domestic fuel _____

c) that will turn acidified potassium dichromate (VI) solution from orange to green

d) which bleaches damp litmus paper _____

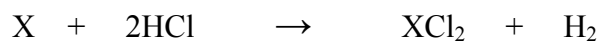
e) which does not tend to react _____

(5 marks)

3. a) 0.004 moles of a finely divided metal (X) were allowed to react with 10 cm³ (an excess) of 2 Molar hydrochloric acid at 20°C and atmospheric pressure. The volume of hydrogen collected was noted at suitable time intervals and the results obtained were:

Time (min)	1.0	2.0	3.0	4.0	5.0	6.0	7.0
Volume of hydrogen (cm ³)	45	66	81	91	95	96	96

The equation for the reaction is

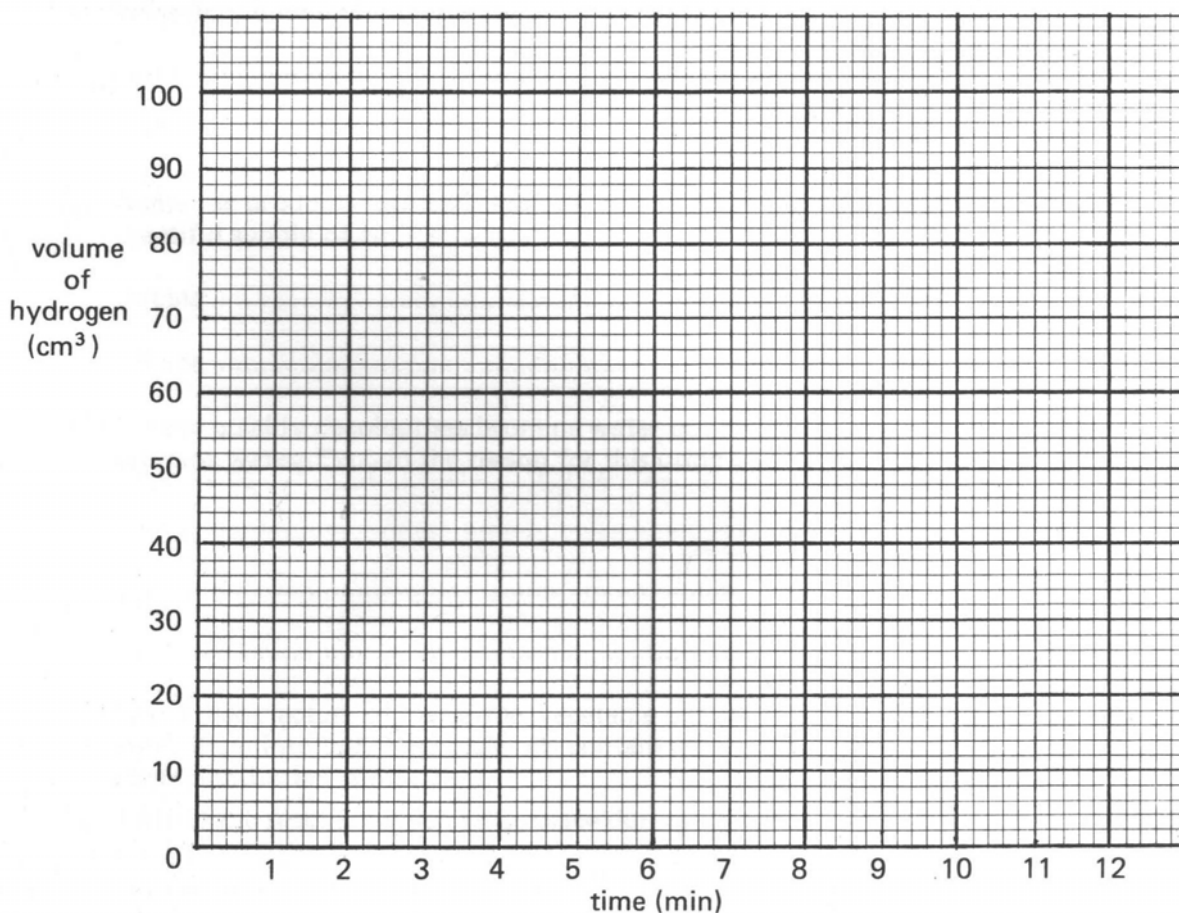


- i) Calculate the volume of 2M hydrochloric acid which is required to react with 0.004 moles of the metal (X).

(2 marks)

- ii) Plot the results using the axes provided. Label this **graph A**.

(2 marks)



- b) Draw a labelled diagram of an apparatus that would be suitable for carrying out the experiment.

(4 marks)

- c) (i) State the volume of hydrogen liberated when **half** the mass of metal (X) had reacted.

- (ii) After what time had half the mass of metal (X) reacted? _____
- (iii) Explain why the time for half the mass of metal (X) to react is less than half the total time for the complete reaction. _____ (4 marks)
- d) On the same axes as the original graph sketch the curve you would expect to obtain if 0.004 moles of metal (X) in **lump** form were used. Label this **graph B**. (1 mark)
- e) State two other factors that would affect the rate of the reaction. _____ (2 marks)

4. A metal M forms two sulphates, MSO_4 and $\text{M}_2(\text{SO}_4)_3$, which are blue and green respectively in aqueous solution.

- a) Write down the valency of M in the compound:
 (i) MSO_4 _____ (ii) $\text{M}_2(\text{SO}_4)_3$ _____ (2 marks)
- b) Where would you expect to find M in the Periodic Table?
 _____ (1 mark)
- c) M is unaffected by cold water but red hot M reacts with steam to form M_2O_3 and hydrogen.
 (i) Write an equation for this reaction.
 _____ (2 marks)
- (ii) Name a metal which would be near M in the reactivity series.
 _____ (1 mark)

5. Natural potassium consists mainly of two isotopes, which have mass numbers 39 and 41. Potassium has an atomic number of 19.

- a) Complete: The two isotopes have a different number of _____. (1 mark)
- b) **Name**, and give the **number** of each type of particles in the nucleus of an atom of ^{41}K .
 _____ (4 marks)
- c) The relative atomic mass of potassium is 39.1.
 Which isotope is more abundant? _____ (1 mark)
- d) Draw the electronic structure of a potassium **ion**.

- _____ (2 marks)
- e) (i) Write the **ionic half** equation to show how a potassium atom is converted to a potassium ion. _____
- (ii) Explain why a potassium ion has a positive charge.
 _____ (2 marks)

6. a) Hydrogen chloride is a gas that dissolves in water to give a strongly acidic solution but hydrogen chloride dissolved in methylbenzene does not show acidic properties. Explain this observation. _____
_____ (2 marks)

b) State and explain the results of testing the following mixtures for electrical conductivity.

(i) water shaken with some finely powdered calcium carbonate

(ii) calcium carbonate and water which has some hydrogen chloride gas dissolved in it

_____ (5 marks)

7. a) An alkane has the following percentage composition by mass

C = 80% H = 20%

(i) Calculate the **empirical** formula for this compound. (2 marks)

(ii) Given that this hydrocarbon has a relative molecular mass of 30, deduce its molecular formula. (1 mark)

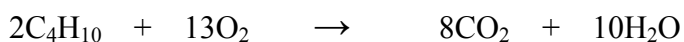
b) Another alkane has the molecular formula C₅H₁₂.

(i) Name this alkane. _____ (1 mark)

(ii) Draw two possible structural formulae for C₅H₁₂. (2 marks)

(iii) What term is used to describe the two different structures? _____
(1 mark)

c) The equation for the complete combustion of butane is:



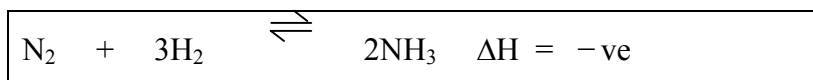
Calculate the volume of oxygen required for the combustion of 100cm³ butane.

(2 marks)

**Section B: Answer any TWO question from this section on the separate sheets provided.
Each question carries 20 marks.**

8. This question concerns the laboratory preparation of ethene and its properties.
- a) Ethene can be prepared in the laboratory by **dehydration of ethanol**.
Explain this statement, including essential conditions and an equation for the reaction. (A diagram is **not** required). (6 marks)
- b) Ethene undergoes a number of **addition** reactions such as halogenation, hydration and hydrogenation. For **each** of these addition reactions,
(i) **name** the substance that adds on the ethene,
(ii) give an **equation** for the reaction. (9 marks)
- c) Ethene burns with a smoky flame. Give a reason for this observation and write an equation for the reaction. (3 marks)
- d) Give **two** uses of ethene. (2 marks)
9. This question deals with the general properties of carbonates.
- a) Most carbonates are insoluble so they can be prepared by precipitation from a soluble carbonate.
(i) Name a **soluble** carbonate. (1 mark)
(ii) Describe how you would use the carbonate you named in (i) to prepare a sample of **insoluble** barium carbonate. (6 marks)
- b) Most carbonates decompose on heating according to the pattern
metal carbonate \rightarrow metal oxide + carbon oxide
(i) Describe the changes that you would **see** when copper(II) carbonate is heated.
(ii) Write an equation for the reaction. (3 marks)
- c) Briefly describe the following uses of carbonates with the help of equations.
(i) A solution of washing soda ($\text{Na}_2\text{CO}_{3(\text{aq})}$) can be used as a water softener.
(ii) Limestone (CaCO_3) is used to remove impurities in the Blast furnace. (6 marks)
- d) Describe how an unknown solid could be tested for the presence of the CO_3^{2-} ion.
Give an ionic equation for the reaction. (4 marks)

10. During the synthesis of ammonia from nitrogen and hydrogen the following percentages of ammonia at equilibrium were obtained at various temperatures and pressures.



pressure temperature	50atm	200atm	400atm
100°C	94.5%	98.4%	99.4%
450°C	5.6%	18.3%	31.9%

- a) (i) Explain why a **high** pressure and a **low** temperature produce the highest **yield** of ammonia at equilibrium. (4 marks)
- (ii) Suggest reasons why this reaction is carried out industrially at a pressure of 200 atm (instead of 400 atm) and at 450°C (rather than at 100°C). (3 marks)
- b) Name a suitable catalyst for this process and state the effect, if any, of the catalyst on the **rate** of formation and on the **yield** of ammonia. (3 marks)
- c) Explain the following observations, including equations where possible.
- Ammonia (i) turns damp red litmus paper blue,
(ii) forms a white smoke with hydrogen chloride,
(iii) turns heated copper(II) oxide from black to reddish brown. (7 marks)
- d) Calculate the relative molecular mass of ammonia and hydrogen chloride. Why does ammonia diffuse faster than hydrogen chloride? (3 marks)

END