

# JUNIOR LYCEUM ANNUAL EXAMINATIONS 2005

Educational Assessment Unit - Education Division

FORM 5

CHEMISTRY

TIME: 1hr 45min

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Useful Data: A copy of the Periodic Table is printed below.

Relative atomic masses may be taken as: Ca = 40, C = 12, O = 16

One mole of any gas occupies 22.4 dm<sup>3</sup> at standard temperature and pressure.

### PERIODIC TABLE

1	2											3	4	5	6	7	0										
		<div style="display: flex; justify-content: center; align-items: center; width: 100%;"> <div style="border: 1px solid black; padding: 5px; margin-right: 20px;">                     1 <b>H</b> 1                 </div> <div style="border: 1px solid black; padding: 5px; margin-left: 20px;">                     4 <b>He</b> 2                 </div> </div>																									
7 <b>Li</b> 3	9 <b>Be</b> 4											11 <b>B</b> 5	12 <b>C</b> 6	14 <b>N</b> 7	16 <b>O</b> 8	19 <b>F</b> 9	20 <b>Ne</b> 10										
23 <b>Na</b> 11	24 <b>Mg</b> 12											27 <b>Al</b> 13	28 <b>Si</b> 14	31 <b>P</b> 15	32 <b>S</b> 16	35.5 <b>Cl</b> 17	40 <b>Ar</b> 18										
39 <b>K</b> 19	40 <b>Ca</b> 20	45 <b>Sc</b> 21	48 <b>Ti</b> 22	51 <b>V</b> 23	52 <b>Cr</b> 24	55 <b>Mn</b> 25	56 <b>Fe</b> 26	59 <b>Co</b> 27	59 <b>Ni</b> 28	63.5 <b>Cu</b> 29	65 <b>Zn</b> 30	70 <b>Ga</b> 31	73 <b>Ge</b> 32	75 <b>As</b> 33	79 <b>Se</b> 34	80 <b>Br</b> 35	84 <b>Kr</b> 36										
85 <b>Rb</b> 37	88 <b>Sr</b> 38	89 <b>Y</b> 39	91 <b>Zr</b> 40	93 <b>Nb</b> 41	96 <b>Mo</b> 42	99 <b>Tc</b> 43	101 <b>Ru</b> 44	103 <b>Rh</b> 45	106 <b>Pd</b> 46	108 <b>Ag</b> 47	112 <b>Cd</b> 48	115 <b>In</b> 49	119 <b>Sn</b> 50	122 <b>Sb</b> 51	128 <b>Te</b> 52	127 <b>I</b> 53	131 <b>Xe</b> 54										
133 <b>Cs</b> 55	137 <b>Ba</b> 56	139 <b>La</b> 57	178 <b>Hf</b> 72	181 <b>Ta</b> 73	184 <b>W</b> 74	186 <b>Re</b> 75	190 <b>Os</b> 76	192 <b>Ir</b> 77	195 <b>Pt</b> 78	197 <b>Au</b> 79	201 <b>Hg</b> 80	204 <b>Tl</b> 81	207 <b>Pb</b> 82	209 <b>Bi</b> 83	210 <b>Po</b> 84	210 <b>At</b> 85	222 <b>Rn</b> 86										

Key

<i>a</i>	relative atomic mass
<b>X</b>	symbol
<i>b</i>	atomic number

### Marks Grid [ For Examiners use only ]

Question N <sup>o</sup> .	Section A						Section B			
	1	2	3	4	5	6	7	8	9	
<b>Max Mark</b>	10	10	10	10	10	10	20	20	20	
<b>Actual Mark</b>										<b>Total Mark</b>

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

1. The questions below refer to the following substances:

aluminium metal,	barium sulphate,	ammonium chloride,
zinc carbonate,	copper metal,	lead (II) oxide,
magnesium metal,	potassium hydroxide,	sodium hydrogen sulphate.

Some of these substances may be used more than once.

Select from the above list:

- a) a **metal** that reacts with dilute hydrochloric acid to give vigorous effervescence and liberate hydrogen. \_\_\_\_\_
- b) a **metal** that can react *both* with dilute sulphuric acid and with sodium hydroxide.  
\_\_\_\_\_
- c) a **metal** that does NOT react with dilute hydrochloric acid or dilute sulphuric acid. \_\_\_\_\_
- d) an *insoluble base* that reacts with dilute nitric acid. \_\_\_\_\_
- e) an **alkali** (a soluble base). \_\_\_\_\_
- f) a *soluble normal salt*. \_\_\_\_\_
- g) an **acid salt**. \_\_\_\_\_
- h) a substance that reacts with a dilute acid to liberate carbon dioxide gas.  
\_\_\_\_\_
- i) a substance that liberates ammonia gas when heated with sodium hydroxide solution  
\_\_\_\_\_
- j) an **insoluble salt** that can be prepared by precipitation \_\_\_\_\_

(10 marks)

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2. Sodium fluoride is similar to sodium chloride.

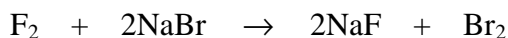
- a) Name the 'family' of elements to which sodium and fluorine belong.  
sodium: \_\_\_\_\_ fluorine: \_\_\_\_\_ (2 marks)
- b) Sodium fluoride is an ionic compound. Draw diagrams to show the electron configuration and charge of the sodium ion and the fluoride ion.

(3 marks)

- c) Sodium fluoride *solution* undergoes electrolysis. Give a reason why sodium is not obtained at the cathode.

\_\_\_\_\_ (1 mark)

- d) Fluorine will displace bromine from potassium bromide according to the equation:



- (i) Rewrite this as an **ionic** equation omitting spectator ions.

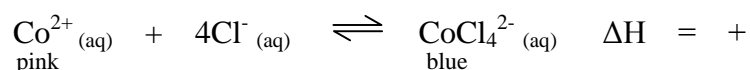
\_\_\_\_\_ (2 marks)

- (ii) Explain why this is a **redox** reaction.

\_\_\_\_\_  
\_\_\_\_\_ (2 marks)

- 
3. a) This question is about the effect of *concentration* and of *temperature* on an equilibrium mixture.

The equation for the system is:



- i) What colour would the mixture turn to if some concentrated hydrochloric acid is added? \_\_\_\_\_ (1 mark)

Give a reason for your answer using Le Chatelier's principle.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (2 marks)

- ii) The forward reaction is endothermic. If a warm sample of the mixture is cooled, it turns pink. Explain this observation in terms of Le Chatelier's principle.

\_\_\_\_\_  
\_\_\_\_\_ (2 marks)

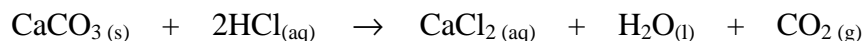
- b) Cobalt chloride can act as a catalyst. What effect (if any) does a catalyst have on the equilibrium position? \_\_\_\_\_

Explain your answer. \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ (3 marks)

- c) Cobalt is a transition metal. Give *two* properties (apart from acting as a catalyst) that cobalt would show.

\_\_\_\_\_ (2 marks)

4.  $200\text{cm}^3$  of hydrochloric acid of concentration  $2.0\text{M}$  ( $2\text{mol dm}^{-3}$ ) are added to  $5\text{g}$  of ***lump form*** marble (calcium carbonate) at a temperature of  $30^\circ\text{C}$ .  
The reaction represented by the following equation takes place.

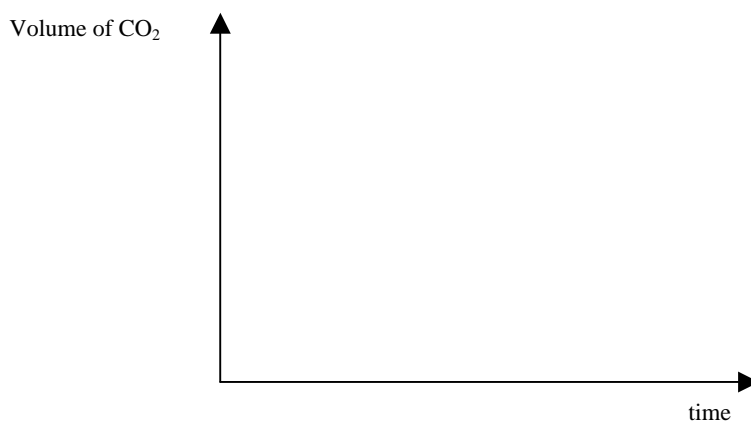


- a) What would be the effect on the *rate* of reaction (increases / decreases) when each of the following changes are made in turn. In each case, assume that all other conditions remain identical. Give a reason for your answers using the idea of **particle collisions**.

	New Condition	Rate	Reason
(i)	$5\text{g}$ of powdered marble		
(ii)	$200\text{cm}^3$ of $1.0\text{M}$ ( $1.0\text{ mol dm}^{-3}$ ) HCl		
(iii)	The reaction is carried out at $20^\circ\text{C}$		

(6 marks)

- (b) Sketch the curve you would obtain for a graph that shows the volume of carbon dioxide liberated at fixed time intervals.



(2 marks)

- c) Calculate the volume of carbon dioxide liberated at stp when  $5\text{g}$  of calcium carbonate react completely with the acid.

(2 marks)

5. This question is about *analysis* of compounds.

a) On heating a white crystalline solid A, it produces brown fumes and a gas which relights a glowing splint. The residue is yellow when hot and white when cold.

Give the:

i) Name or formula of the cation in A: \_\_\_\_\_

ii) Name or formula of the anion in A: \_\_\_\_\_ (2 marks)

b) A solid sample of an unknown substance B produces a yellow colour in a Bunsen flame when a flame test is carried out.

When dilute hydrochloric acid is added to solid B and warmed, a colourless pungent smelling gas is liberated.

Give the:

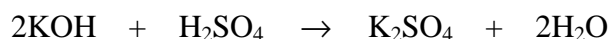
i) Name or formula of the cation in B: \_\_\_\_\_

ii) Name or formula of the anion in B: \_\_\_\_\_ (2 marks)

c) A student needed to determine the concentration of a solution of sulphuric acid by titration against potassium hydroxide solution of concentration  $0.2 \text{ mol dm}^{-3}$  (0.2 M).

For each titre carried out, a volume of  $25 \text{ cm}^3$  potassium hydroxide was used.

The equation for the reaction is:



The results obtained are shown in the following table:

Readings	Rough	Titre 1	Titre 2
2 <sup>nd</sup> burette reading	17.5	34.1	16.7
1 <sup>st</sup> burette reading	0.0	17.5	0.0
Volume $\text{H}_2\text{SO}_4$ used ( $\text{cm}^3$ )	17.5	16.6	16.7

i) Calculate the number of moles of KOH in  $25 \text{ cm}^3$  solution.

(2 marks)

ii) Use your answer to part (i) and the mole ratio of alkali:acid (from the balanced equation) to find the number of moles of sulphuric acid that must have reacted.

(1 marks)

iii) Calculate the average titre value of sulphuric acid used in the titration.

(1 mark)

iv) Use your answers to parts (ii) and (iii) to calculate the concentration of the sulphuric acid solution.

(2 marks)

6. This question compares the properties of ethane,  $C_2H_6$  and ethene  $C_2H_4$  which are members of different homologous series.

a) Give the *structural* formula for ethane and ethene

Name	Structural formula
Ethane:	
Ethene:	

(2 marks)

b) Ethane and ethene differ in the way they burn.

(i) Describe briefly, the difference in the *appearance* of the *flame*, when each gas is burned.

ethane: the flame is \_\_\_\_\_

ethene: the flame is \_\_\_\_\_ (2 marks)

(ii) Write a balanced equation for the complete combustion of ONE of these gases.

\_\_\_\_\_ (2 marks)

c) Ethane and ethene also differ in their reaction with bromine water.

(i) Describe briefly what is *SEEN* when each compound is tested with bromine water.

Ethane: \_\_\_\_\_

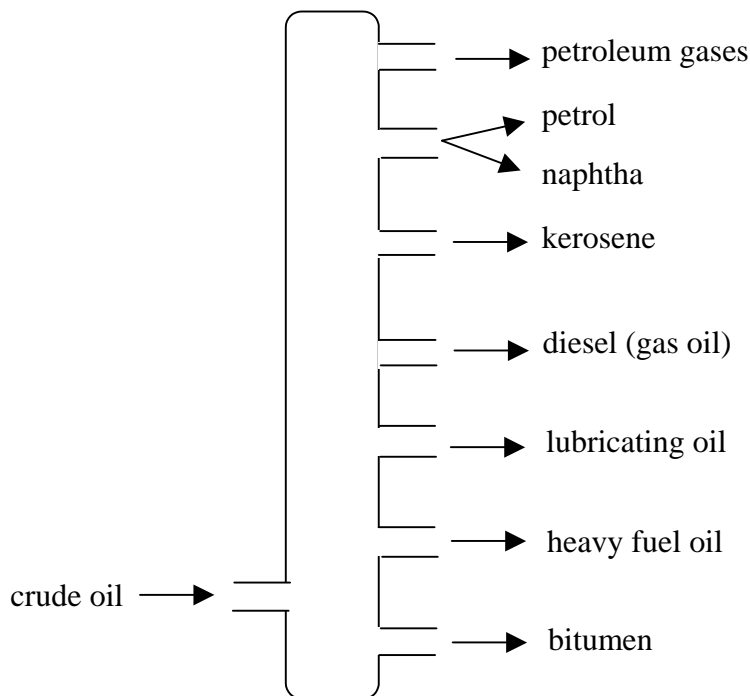
Ethene: \_\_\_\_\_ (2 marks)

(ii) Write a balanced equation to show how ONE of these compounds reacts with bromine water.

\_\_\_\_\_ (2 marks)

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

7. The diagram below represents a fractionating column used in the refining of crude oil.



- a) (i) Crude oil is a mixture of hydrocarbons which can be separated by fractional distillation. Describe the principle of this physical process emphasizing the difference between the fractions obtained. (6 marks)
- (ii) Give a use for any **four** of the fractions shown in the diagram. (4 marks)
- b) The process of cracking is used to break down heavy fractions into smaller, more useful hydrocarbons. Describe the principle of this chemical process, including conditions and an equation. (6 marks)
- c) Crude oil contains small amounts of sulphur compounds which are removed from some fuels such as petrol. Briefly explain the pollution problems which would arise if the sulphur compounds were not removed. (4 marks)

8. You have learnt how to prepare eight different gases in the laboratory. Three of these gases are: oxygen, hydrogen chloride, and sulphur dioxide.
- a) How would you test for **each** gas? (5 marks)
  - b) Give one *industrial* use for **each** gas. (3 marks)
  - c) Select **ONE** of the three gases given above and draw a clear, well-labelled diagram of the apparatus that you would use to prepare and collect a **dry** sample of the gas. Your answer should include the names of the reagent(s) and a balanced equation for the reaction. (12 marks)
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9. Explain the meaning of the underlined words in the following statements, which refer to the properties of carbon and its compounds. For each property give one observation. Write the balanced equations for parts (a), (b) and (c).
- a) Washing soda crystals ( $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ ) are efflorescent. (5 marks)
  - b) Carbon acts as a reducing agent when heated with copper (II) oxide. (5 marks)
  - c) (i) Carbon monoxide burns exothermically in air (oxygen) to form another gas. (4 marks)  
(ii) The gas formed in (c)(i) then reacts with lime water (calcium hydroxide solution) to form a precipitate. (4 marks)
  - d) Solid carbon dioxide (dry ice) sublimes. (2 marks)

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**END**

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