JUNIOR LYCEUM ANNUAL EXAMINATIONS 2007

Educational Assessment Unit - Education Division

FORM 3 **CHEMISTRY** **TIME: 1h 30min**

Name: _____ Class: _____

Useful Data: A copy of the Periodic Table is printed below.
Relative atomic masses may be taken as: C =12, H = 1, Pb = 208, O =16.

PERIODIC TABLE

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

Key

a	relative atomic mass
X	symbol
b	atomic number

Marks Grid [For Examiners use only]

Question N°.	Section A						Section B			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	
Max Mark	10	10	10	10	10	10	20	20	20	
Actual Mark										Theory Total

85% of Theory Paper	15% Practical	**100% Final Score**

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

1. The differences between a mixture and a compound can be determined by carrying out the **same tests** on a **mixture** of iron and sulfur, and on the **compound** of iron (II) sulfide.

a) Complete the table below to give the missing results of the tests.

Test	**Iron/sulfur mixture**	**Iron (II) sulfide compound**
Effect of adding water	Iron sinks while sulfur floats	_____ _____ _____ _____
Action of dilute hydrochloric acid	_____ _____ _____ _____	A gas that has a smell of bad eggs (hydrogen sulfide) is liberated. The whole compound reacts with the acid.

(3 marks)

b) Give **two** general differences between mixtures and compounds that are **shown by the results of the tests described above.**

_____

_____

_____ (2 marks)

c) The symbols for iron and sulfur are $^{56}_{26}Fe$ and $^{32}_{16}S$ respectively. Use this information to state:

(i) the number of protons in an atom of iron _____

(ii) the number of neutrons in an atom of iron _____

(iii) the electron configuration of an atom of sulfur _____ (3 marks)

d) Iron is composed of different atoms called 'isotopes'. What does this mean?

_____

_____ (2 marks)

2. The diagrams below show the apparatus used to separate some mixtures.

Diagram A

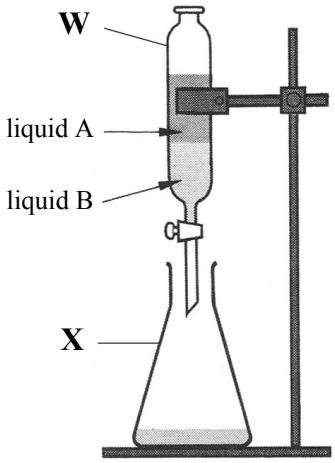
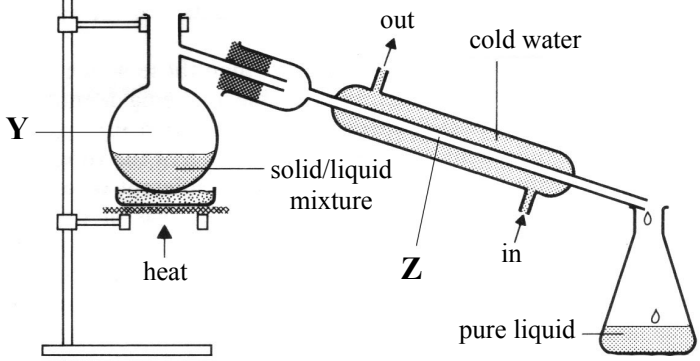


Diagram B



The apparatus in diagram A is used to separate a liquid / liquid mixture, while the apparatus in diagram B is used to separate a solid / liquid mixture.

a) (i) Name the apparatus labelled W and X.

W _____ X _____ (1, 1 mark)

(ii) Give an example of a mixture that can be separated as shown in diagram A.

_____ (1 mark)

(iii) What term is used to describe this type of liquid / liquid mixture?

_____ (1 mark)

b) (i) What name is given to the method of separation shown in diagram B?

_____ (1 mark)

(ii) Given an example of a solid / liquid mixture that can be separated by this method.

_____ (1 mark)

(iii) This method of separation involves two 'changes of state'. What is the change of state that takes place: –

at Y _____ at Z _____? (1, 1 mark)

(iv) Identify the mistake in set up B and state how it should be corrected.

_____

_____ (2 marks)

3. a) (i) Lithium chloride, LiCl, is an electrovalent (ionic) compound. Draw dot / cross diagrams, showing **ALL** electron shells, to show the **electron structure** and **charge** of the lithium ion and the chloride ion.

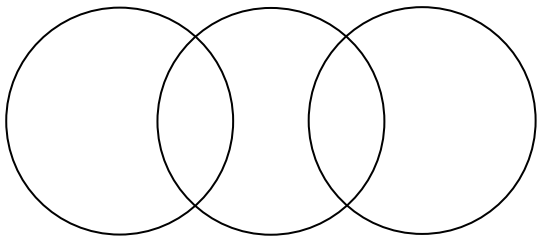
(3 marks)

(ii) Give **two general** properties of electrovalent (ionic) compounds.

_____

_____ (2 marks)

b) (i) Carbon dioxide is a covalent compound containing 'double pairs' of shared electrons (double bonds). Complete the diagram below that shows OUTER electron shells only, to show the bonding in a carbon dioxide molecule.
Use a dot (•) for electrons of carbon and a cross (**x**) for electrons of oxygen.
Write the symbols of the elements.



(3 marks)

(ii) Give **two general** properties of covalent substances.

_____

_____ (2 marks)

4. Atmospheric gases absorb radiation and keep the Earth warm but if these atmospheric gases increase excessively, too much heat is retained and global warming occurs.

a) Ozone is considered as one of the 'greenhouse' gases, however it plays an important role in the upper atmosphere as the 'ozone layer'.
What is this important role of the ozone layer?

_____ (1 mark)

b) The release of certain chemicals in the lower atmosphere is affecting the 'ozone layer' in the upper atmosphere.
(i) What is the general name for these chemicals?

_____ (1 mark)

(ii) Mention **one** way by which these chemicals escape into the atmosphere.

_____

_____ (1 mark)

c) The cylinder gas that we use at home is a hydrocarbon (a compound of carbon and hydrogen only). When we burn this hydrocarbon completely, a gas is released that is considered to be mainly responsible for the greenhouse effect.

Name this gas: _____ (1 mark)

d) The hydrocarbon has the following percentage composition by mass.
C = 87.26% H = 17.24%
(i) Calculate the **empirical** (simplest) formula of this compound.

(4 marks)

(ii) If the relative molecular mass of the compound is 58, find its **molecular** formula.

(2 marks)

5. Calcium sulfate is a compound that exists naturally in nature as gypsum and is the cause of hardness in water. Soap solution is used to test for hardness of water.

a) (i) State **two** observations that show water is hard when it is tested with soap solution.

_____

_____ (2 marks)

(ii) What advantage does a synthetic (soapless) detergent have over soap when used with a hard water?

_____ (1 mark)

b) (i) Write the formula for calcium sulfate.

_____ (1 mark)

(ii) What type of hardness does calcium sulfate cause?

_____ (1 mark)

(iii) One method of removing this type of hardness is by adding washing soda solution (aqueous sodium carbonate). Write a balanced equation for this reaction.

_____ (2 marks)

(iv) State **one** other method of removing this type of hardness.

_____ (1 mark)

c) Give **one** advantage of hard water.

_____ (1 mark)

d) Another form of calcium sulfate is 'Plaster of Paris', $CaSO_4.\frac{1}{2}H_2O$. When mixed with water it expands and sets to a hard mass of gypsum. Give one application / use of this property.

_____ (1 mark)

6. This question is about the reactions of acids and alkalis.

a) Give the **name** of:

(i) a strong acid _____

(ii) a strong alkali _____ (2 marks)

b) (i) Write an equation for the reaction between an acid and an alkali.

_____ (2 marks)

(ii) What name is given to this type of reaction?

_____ (1 mark)

c) If only part of the replaceable hydrogen ions of an acid is replaced by a metal, an acid salt is formed. Give the **name or formula** of an acid salt.

_____ (1 mark)

d) Some of the reactions of acids and alkalis with other substances follow a general pattern. Write balanced equations to show examples of these patterns of reactions.

(i) carbonate + acid $\rightarrow$ salt + water + carbon dioxide

_____

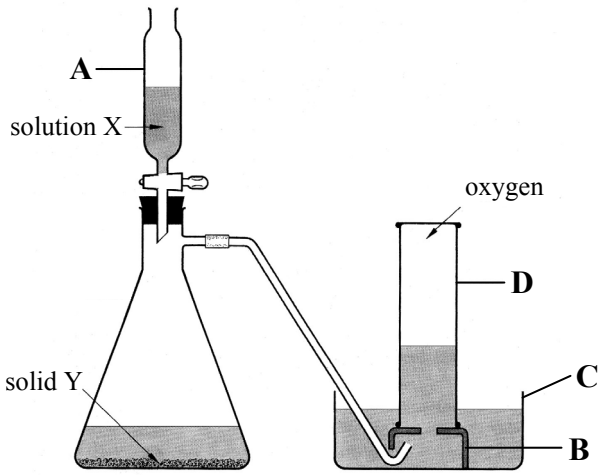
(ii) ammonium salt + alkali $\rightarrow$ salt + water + ammonia

_____

(4 marks)

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

7. The diagram below shows the laboratory preparation and collection of oxygen gas over water.



a) Give the names of the items of apparatus labelled A to D. (4 marks)

b) (i) **Name** solution X and solid Y. (2 marks)

(ii) Give an equation for the decomposition of solution X and state the **function** of solid Y. (3 marks)

c) (i) Why is it possible to collect oxygen over water? (1 mark)

(ii) Draw a diagram to show the apparatus required to dry oxygen. Label the apparatus and name the drying agent. (6 marks)

d) Oxygen reacts with both metals and non-metals. Give one observation and the name **or** formula of the oxide formed when copper metal and sulfur are heated strongly in air. (4 marks)

8. Although water is a neutral liquid, some metals and non-metals can react with water to form alkaline and acidic solutions.

a) (i) Sodium reacts with water to give an alkaline solution. State the **apparatus** used, describe in detail what is **seen**, and name the products obtained when sodium is reacted with water containing pH indicator. (6 marks)

(ii) Write a balanced equation for this reaction, including state symbols. (3 marks)

(iii) State one safety precaution that needs to be taken during this reaction (other than wearing safety glasses and a lab coat). (1 mark)

b) Chlorine reacts with water to give a mixture of two acids.
One of the acids is hypochlorous acid [or chloric (I) acid], formula HOCl.

(i) State a colour change you would expect to **see** if chlorine gas is bubbled through water containing pH indicator. Give the **name** and **formula** of the other acid produced. (3 marks)

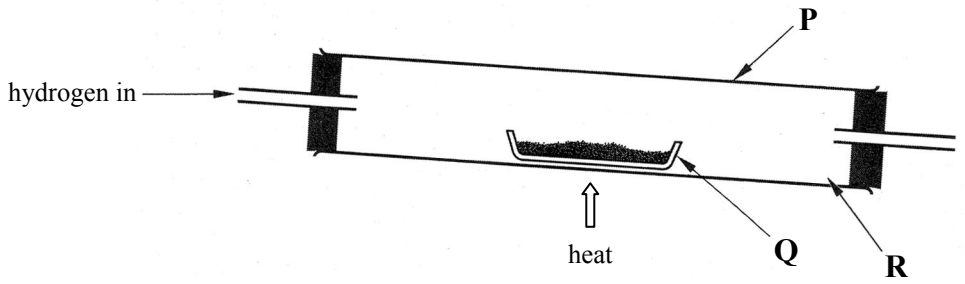
(ii) State a safety precaution that needs to be taken during this reaction. (1 mark)

c) Magnesium and carbon both react with steam to form an **oxide** and hydrogen.

(i) Write equations for **both** of these reactions. (4 marks)

(ii) Describe the state or appearance of **both** of the oxides formed in (i). (2 marks)

9. The diagram below shows the apparatus that can be used to determine the formula of an oxide of lead.



The following is a short description of the main experimental steps.

① Apparatus Q is weighed empty.

② A small amount of the metal oxide is put in apparatus Q and reweighed. Q containing the metal oxide is placed in apparatus P.

③ Hydrogen gas is generated and a stream of dry hydrogen gas is passed over the heated metal oxide. Drops of a liquid collect at R.

④ Heating is stopped and the apparatus and metal is allowed to cool, while a current of hydrogen still passes.

⑤ Apparatus Q and the metal are weighed when cool.

⑥ Steps ③ to ⑤ are repeated until two consecutive weighings are the same.

Results:		
	mass of apparatus Q empty	5.00g
	mass of apparatus Q + oxide of lead	6.20g
	mass of apparatus Q + lead metal	6.04g

a) **Name** the items of apparatus P and Q. (2 marks)

b) **Name** the reagents needed to produce hydrogen gas and <u>give an equation</u> for the reaction between them. (4 marks)

c) What is the liquid that collects at R? (1 mark)

d) (i) Why is hydrogen left to pass after heating is stopped in step ④? (2 marks)

(ii) What term is used to describe step ⑥ and why is this done? (2 marks)

e) Lead has three oxides, lead (II) oxide, lead (IV) oxide and tri-lead tetra-oxide.

(i) Write the formulae for these **three** oxides. (3 marks)

(ii) Use the results of the experiment to calculate and find which of these three oxides was present. (6 marks)