JUNIOR LYCEUM ANNUAL EXAMINATIONS 2006

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: C = 12, Cu = 63.5, O = 16, K = 39, Cl = 35.5

One mole of any gas occupies $22.4\,dm^3$ at standard temperature and pressure.

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

Marks Grid [For Examiners use only]

Question Nº.	Section A							Section B			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	
Max Mark	8	8	8	6	10	10	10	20	20	20	
Actual Mark											**Total Mark**

| 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.   A mixture of equal volumes of hexane (b.p. 69°C) and heptane (b.p. 100°C) was heated in the apparatus shown below. After a short time a liquid was seen in apparatus C.
The thermometer reading was recorded.
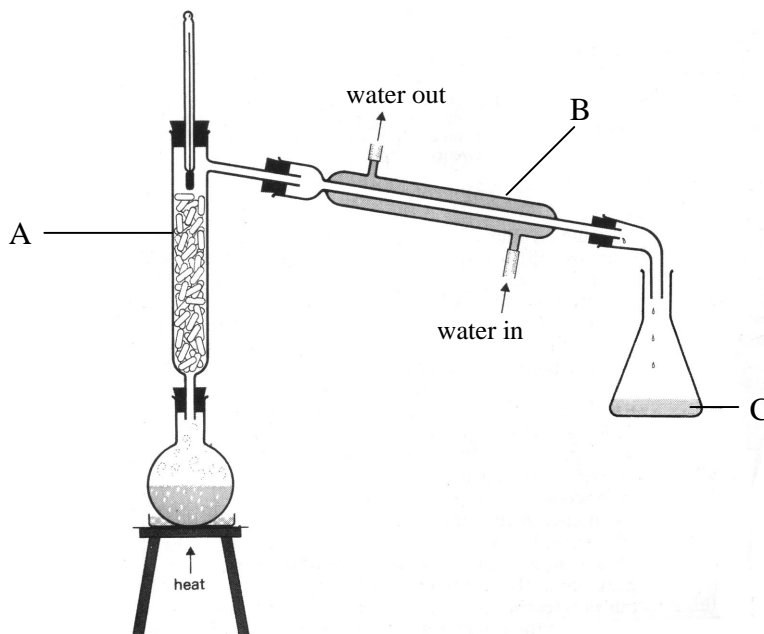
(a) What term is used to describe-

    (i)   this type of liquid/liquid mixture, _____

    (ii)   this method of separation, _____

    (iii) the apparatus labelled A, _____

    (iv) the apparatus labelled B? _____   (4 marks)

(b) Which liquid would collect at C? _____.   (1 mark)

(c) If hexane or heptane is reacted with bromine water:

    (i)   What type of reaction takes place? _____.

    (ii)   Will the bromine water be decolourised? _____.

                                                                  (2 marks)

(d) Name a **_raw material_** which is separated into a number of fractions by using this method

    of separation. _____.   (1 mark)

2. The diagrams below show the electron configurations for two **IONS**.
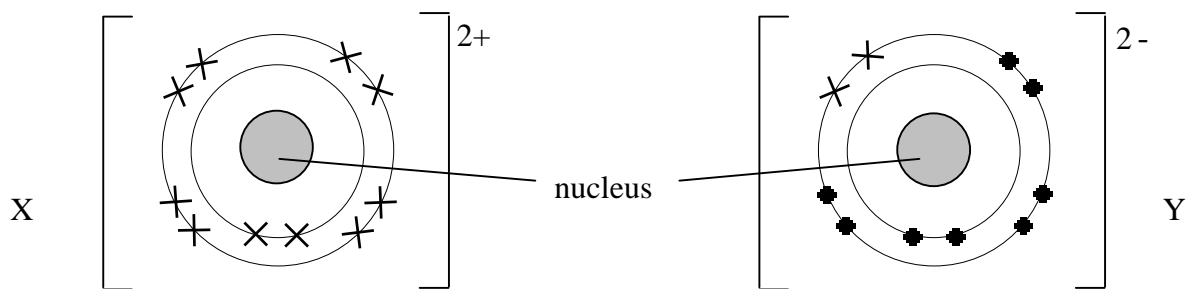
X   nucleus   Y

(a) What <u>term</u> do we use to describe-

   (i)   positive ions _____   (ii) negative ions _____

                                                (2 marks)

(b) What would be the number of <u>protons</u> in the nucleus of X and Y?

   X: _____ protons   Y: _____ protons   (2 marks)

(c) Use the Periodic Table to **name** the elements that form the ions shown above.

   X: _____   Y: _____   (2 marks)

(d) (i)   Write the **ionic half equation** for an **atom** of X forming the positive ion.

              _____   (1 mark)

   (ii) Is this oxidation or reduction? _____.   (1 mark)

---

3. Study the following reactions in which a gas is liberated.

   (1)   calcium carbonate + dilute hydrochloric acid $\rightarrow$ gas P
   (2)   sodium chloride + concentrated sulfuric acid $\rightarrow$ gas Q
   (3)   copper + concentrated nitric acid $\rightarrow$ gas R

(a) Name the gases P, Q and R

   P = _____   Q = _____

   R = _____   (3 marks)

(b) (i)   Describe a test for

        Gas P _____

        Gas Q _____

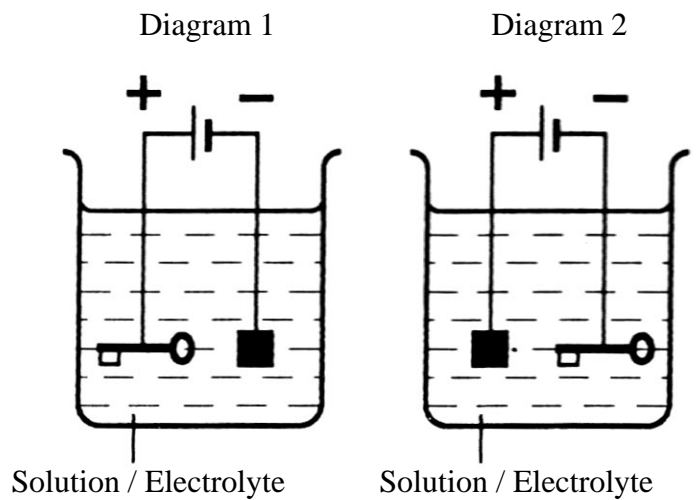   (ii) What would you <u>SEE</u> that shows gas R is being liberated?

        _____   (3 marks)

(c) Give a balanced equation for <u>ONE</u> of the reactions (1), (2), or (3) described above.

   _____   (2 marks)

4. Two students tried to coat an iron key with copper using electrolysis. They set up the apparatus as shown in diagrams 1 and 2 below.

Diagram 1   Diagram 2

Solution / Electrolyte   Solution / Electrolyte

(a) (i) In which apparatus would the metal key be electroplated with copper?

Diagram _____   (1 mark)

(ii) Give one reason why objects made of iron are electroplated.

_____   (1 mark)

(b) Suggest the name of a solution which would be suitable as an electrolyte in this

experiment. _____.   (1 mark)

(c) Put a ✓ next to the ionic half equation that represents the plating of copper on the iron

key.

$Cu - 2e \rightarrow Cu^{2+}$ ☐

$Cu^{2+} + 2e \rightarrow Cu$ ☐   (1 mark)

(d) Calculate the number of Faradays required to plate 0.127g of copper.

(2 marks)

5. (a) (i) Calculate the mass of anhydrous potassium carbonate (K_2CO_3) required to make up a solution of molar concentration 0.25M (0.25 mol dm^{-3})

(2 marks)

(ii) Calculate the mass of potassium chloride formed if 1.0dm^3 of this solution is reacted with excess hydrochloric acid.

$K_2CO_{3\ (aq)}$ + $2HCl_{(aq)}$ → $2KCl_{(aq)}$ + $H_2O_{(l)}$ + $CO_{2\ (g)}$
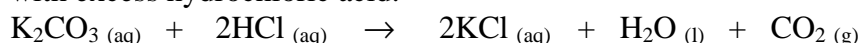
(2 marks)

(b) What is the name of the practical method by which-

(i) the exact volume of hydrochloric acid is added from a burette to the potassium carbonate solution in a conical flask?

_____. (1 mark)

(ii) solid potassium chloride can be obtained from potassium chloride solution?

_____. (1 mark)

(c) Some potassium chloride solution is reacted with silver nitrate solution and the resulting precipitate is exposed to light.

(i) Give an **ionic** equation (omitting spectator ions) for the reaction of silver nitrate solution with potassium chloride solution.
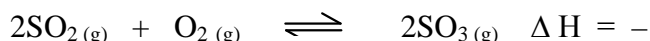
_____. (2 marks)

(ii) What colour will the precipitate be immediately after mixing the solutions?

_____.

(iii) What happens when the precipitate is exposed to light?

_____. (2 marks)

6. In the second stage of the Contact Process, sulfur dioxide is converted to sulfur trioxide.
The reaction is represented by

$$2SO_{2\,(g)} + O_{2\,(g)} \rightleftharpoons 2SO_{3\,(g)} \quad \Delta H = -$$

(a) Under certain conditions, a <u>dynamic equilibrium</u> is established.

   (i) How does the equation indicate a dynamic equilibrium?

   _____. (1 mark)

   (ii) What does the term *dynamic* mean?

   _____

   _____. (1 mark)

(b) (i) What effect will increasing the temperature have on the AMOUNT of sulfur trioxide

   in the equilibrium mixture? _____. (1 mark)

   (ii) Explain your answer to (i) in terms of Le Chatelier's Principle.

   _____

   _____

   _____. (2 marks)

(c) What would be the effect on the yield (amount) of sulfur trioxide if a small leak causes
the concentration of oxygen in the system reaction mixture to fall? Explain your answer.

   _____

   _____

   _____.(2 marks).

(d) A catalyst is used in this process.

   (i) What is the reason for using a catalyst?

   _____. (1 mark)

   (ii) What effect (if any) does it have on the proportion of sulfur trioxide in the

   equilibrium mixture? _____. (1 mark)

   (iii) Name the catalyst used in the industrial process.

   _____. (1 mark)

7. The alkanes are an <u>homologous series</u> of saturated <u>hydrocarbons</u> of general formula $C_n H_{2n+2}$

   (a) Explain the meaning of the terms:

   (i) homologous series _____

   _____

   (ii) saturated _____

   _____ (2 marks)

   (b) (i) Write down the molecular formula of the alkane for which n = 4

   _____.   (1 marks)

   (ii) This alkane exists in two different molecular structures. Draw <u>full</u> structural

   formulae for these two arrangements showing **all** bonds.

                                                                  (2 marks)

   (iii) What term is used to describe the property illustrated in (ii)?

   _____.   (1 mark)

   (c) Propane gas (C_3H_8) is a useful fuel. If it is burned in a good supply of air:

   (i) name the products of combustion,

   _____.   (1 mark)

   (ii) write an equation for the reaction,

   _____.   (2 marks)

   (iii) state the volume of oxygen required for the complete combustion of $4dm^3$ of propane.

   _____.   (1 marks)

PLEASE TURN OVER FOR **SECTION B**

8.   (a) Use the theory of *'particle collisions'* to describe the effect of the following **three** factors on the rate of reaction.
   - (i)   increasing the temperature
   - (ii) increasing the concentration of a solution
   - (iii) using smaller pieces of a solid reactant   (6 marks)

     (b) Select **ONE** of the above factors and describe, in detail, a *laboratory* experiment that can be carried out in order to show the effect of this factor on the rate of a suitable reaction. Your answer should include a diagram of the apparatus, the method and how you would interpret the results   (14 marks)

---

9.   (a) Briefly describe the bonding between the atoms in a molecule of water. Give a diagram to show the bonding   (5 marks)

     (b) Many elements and compounds are changed when water is added to them. For each substance given below, describe their reaction and indicate the conditions under which the reaction occurs.
   - (i)   sodium metal
   - (ii) a freshly prepared, solid lump of calcium oxide
   - (iii) ethene gas

      Give equations for the reactions.   (15 marks)

---

10.   Suggest explanations for the following statements, giving *observations* and *equations* where relevant.
   - (a) Aluminium is the third most abundant element in the Earth's crust, but it is difficult and expensive to extract.

   - (b) The change on heating hydrated copper (II) sulfate crystals can be readily reversed.

   - (c) Concentrated sulfuric acid is a dehydrating agent.

   - (d) There are two types of chlorine atoms that have mass numbers 35 and 37, but the relative atomic mass of chlorine is normally given as 35.5.

                                            (20 marks)