DIRECTORATE FOR QUALITY AND STANDARDS IN EDUCATION
Department for Curriculum Management and eLearning
Educational Assessment Unit
Annual Examinations for Secondary Schools 2012

Track 3

FORM 4 **CHEMISTRY** **TIME: 1h 30min**

Name: ________________________ **Class: ______________**

Useful Data: Atomic numbers and relative atomic masses are shown in the periodic table printed below.
One mole of any gas occupies 22.4 dm^3 at standard temperature and pressure
Faraday constant = 96500 C mol^{-1} Q =It

State symbols are expected to be included in all chemical equations.

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

Theory Paper: 85%	Practical: 15%	Final Score: 100%

SECTION A – Answer ALL questions. This section carries 60 marks.

1a. For each of the following, decide if a reaction occurs.

If a reaction occurs, **complete the word equation**.

If a reaction does not occur, write: **no reaction**.

bromine + sodium chloride $\longrightarrow$ ____________________

bromine + sodium iodide $\longrightarrow$ ____________________

chlorine + potassium bromide $\longrightarrow$ ____________________

bromine + potassium chloride $\longrightarrow$ ____________________

[4]

b. A stream of chlorine gas is passed over hot iron wool.

(i) State what you would **observe** after some time.

____

(ii) Give the name of the new solid formed if the apparatus is kept dry throughout.

____

(iii) What happens if damp air is allowed to come into contact with the new solid?

____

[3]

c. Aqueous sodium hydroxide is added to aqueous iron (II) chloride.

(i) State what you would **observe** as the reaction proceeds.

____

(ii) Write a full equation to represent this reaction. **Include state symbols**.

____

[3]

2 Fill in the empty spaces in the table below:

	Reaction	Substance oxidized	Reason to show that named substance has been oxidized
1.	$Mg + 2HCl \longrightarrow MgCl_2 + H_2$		
2.	$CuO + H_2 \longrightarrow Cu + H_2O$		
3.	$2Na + Cl_2 \longrightarrow 2NaCl$		
4.	$2Fe^{2+} + Cl_2 \longrightarrow 2Fe^{3+} + 2Cl^-$		
5.	$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$		

[10]

3a. Fill in the empty spaces in the table below:

	Compound electrolysed	State of compound	**Observation** at cathode	**Observation** at anode
1.	lead bromide	molten electrolyte; graphite electrodes.		
2.	concentrated NaCl solution	aqueous electrolyte; platinum electrodes.		
3.	dilute H_2SO_4	aqueous electrolyte; platinum electrodes.		

[6]

b. Identify the substance formed or gas evolved in question a. at:

(i) the cathode in Electrolysis 1: ______________________

(ii) the anode in Electrolysis 1: ______________________

(iii) the anode in Electrolysis 2: ______________________

(iv) the anode in Electrolysis 3: ______________________

[4]

4 Tables A and B include lists of cations and anions together with simple tests that may be used for ion identification.

Table A	
Cations	Flame test colour
lithium	red
sodium	yellow
strontium	red

Table B	
Anions	Observations when dilute nitric acid is added
carbonate	effervescence
hydrogencarbonate	effervescence
hydroxide	no effervescence

a. Use the periodic table on the front page of this question paper to write the symbol of:

- a lithium ion: ______________________________
- a sodium ion: ______________________________
- a strontium ion: ______________________________

[3]

b. Give the **molecular** and **ionic** formulae of:

- lithium hydroxide: ____________ ____________
- sodium hydrogencarbonate: ____________ ____________
- strontium carbonate: ____________ ____________

[3]

c. Two ionic compounds P and Q are known to contain anions and cations from Table A and Table B only.

(i) Compound P gave a yellow flame test and produced effervescence with dilute nitric acid. Compound P may be:

either ________________ or ________________

(ii) Compound Q gave a red flame test and did not produce effervescence with dilute nitric acid. Compound Q may be:

either ________________ or ________________

[4]

5 You are required to find the concentration of an ascorbic acid solution by titrating it ag[...] standard iodine solution of concentration 0.5 mol dm^{-3}.

$$\underset{\textbf{ascorbic acid}}{C_6H_8O_6} + I_2 \longrightarrow \underset{\textbf{dehydroascorbic acid}}{C_6H_6O_6} + 2HI$$

Once all the ascorbic acid is neutralized, the excess iodine reacts with a starch solution indicator forming immediately a blue-black coloration. This indicates the endpoint of the titration.

a. Name **three** items of laboratory equipment necessary to conduct the titration.

________________ ________________ ________________ **[3]**

b. It was found that 50 cm^3 of the ascorbic acid available were exactly neutralized by 12.5 cm^3 of iodine solution of concentration 0.5 mol dm^{-3}.

(i) How many moles of iodine solution were used?

____

(ii) How many moles of ascorbic acid were used?

____

(iii) Find the concentration of the ascorbic acid used.

____ **[6]**

c. In this titration, the ascorbic acid solution is:

reduced ☐ oxidized ☐ neither reduced nor oxidized ☐ **[1]**

6a. Write down full chemical equations, **including state symbols** to represent each of the following reactions:

(i) Copper metal heated in a stream of oxygen.

____

(ii) The thermal decomposition of copper (II) carbonate.

____

(iii) The action of dilute hydrochloric acid on copper (II) oxide.

____ **[6]**

b. (i) Copper compounds, particularly copper (II) oxide are often used as **catalysts** in industry. Which general property of copper makes copper compounds suitable as catalysts in chemical reactions?

____

(ii) Copper compounds, particularly copper (II) chloride are used in fireworks as a colouring agent. Which colour in a fireworks display originates from copper compounds?

____ **[2]**

c. Give **one** reason for each of the following:

(i) When exposed to moist air, a reddish-brown copper sheet becomes green-coloured.

____

____

(ii) Copper compounds can be used as a wood preservative.

____

____ **[2]**

SECTION B – Answer TWO questions only on the foolscap provided.
This section carries 40 marks.

7a. Draw a labelled diagram of the apparatus you would use to show that a graphite rod conducts electricity but a polythene rod does not. **[4]**

b. Draw a labelled diagram of the apparatus you would use to show that aqueous copper (II) sulfate is an electrolyte but ethanol is not. **[4]**

c. Each of the compounds:

- aqueous copper (II) chloride
- aqueous sodium iodide
- aqueous magnesium sulfate

is tested for electrical conductivity using a modified version of the apparatus you used in question b.

For **each** of these electrolytes:

(i) outline your observations and identify the new products formed at each electrode.

(ii) explain what happens in terms of the preferential discharge of ions. **[12]**

8 Comment on each of the following statements:

Your comments should include:

- a detailed explanation of any reaction that occurs
- chemical equations where appropriate

a. An aqueous solution of hydrogen chloride is a good electrolyte but hydrogen chloride dissolved in methylbenzene is a non-electrolyte. **[5]**

b. Aluminium does not react with sulfuric acid unless it is rubbed with abrasive paper but zinc reacts readily. **[5]**

c. Zinc oxide reacts with both dilute hydrochloric acid and aqueous sodium hydroxide but copper (II) oxide reacts with dilute hydrochloric acid only. **[5]**

d. The reaction between aluminium powder and iron (III) oxide is highly exothermic. **[5]**

9a. The Environmental Protection Agency has established 10 mg/litre as the maximum contam[...] level for nitrate ions in underground water and 1 mg/litre for nitrate ions in drinkable tap water.

(i) Name **two** sources that are responsible for contaminating water with nitrate ions.

(ii) Which property of nitrates makes it possible for them to leach easily into underground water? **[3]**

b. (i) Give the name of a coloured gas that is evolved when most metallic nitrates are heated.

(ii) Give **two** properties of this gas.

(iii) Draw a labelled diagram of the apparatus that can be used for the laboratory preparation and collection of this gas.

(iv) Name **one** safety precaution you should take when preparing this gas in the laboratory.

(v) Write a full equation **complete with state symbols** for the reaction. **[12]**

c. Pure dry ammonia can be decomposed into its elements by passing it over heated iron wool.

(i) Write an equation **complete with state symbols** for this reaction.

(ii) What is the purpose of the iron wool?

(iii) 40 cm^3 of pure dry ammonia were completely decomposed into its elements. Calculate the **total** volume of gases produced if the original temperature and pressure were left unchanged throughout. **[5]**