

Name : _____ ()

Class : 4E1



Greenridge Secondary School

Preliminary Examination 2007

Subject : Chemistry (5068)

Secondary Four Express

Paper 2

Date : 18 Sep 2007

Duration : 1 h 45 min

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INSTRUCTIONS TO CANDIDATES

Write your name and index number in the spaces at the top of this page and on all separate answer paper used.

Section A

Answer all questions in the spaces provided.

Section B

Answer all three questions, the last question is in the form either/or.

Write your answers on any lined pages provided and/or a separate answer paper.

All essential working must be shown.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [] at the end of each question or part question.

A copy of the Periodic Table is printed on page 11.

FOR EXAMINER'S USE	
Section A	/50
Section B	/30
Total	/80

This paper consists of 11 printed pages, including this page.

Section A

Answer **all** the questions in this section in the spaces provided.
The total mark for this section is **50**.

- A1** Chlorine is a reactive halogen. It forms compounds with both fluorine and sodium. Chlorine (I) fluoride (ClF) melts at -156°C and sodium chloride (NaCl) melts at 808°C .
(a) Name the types of bonds present in each substance. **[2]**

Chlorine (I) fluoride : _____

Sodium chloride : _____

- (b) Explain the difference in melting points in terms of their bondings. **[4]**

- (c) Draw a 'dot' and 'cross' diagram to show the bonding in chlorine (I) fluoride. Show only the outer shell electrons. **[2]**

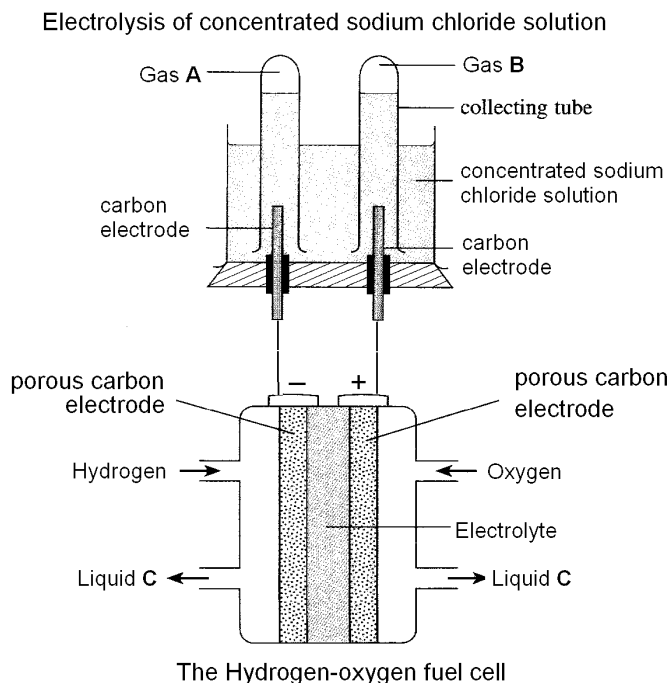
- A2** Precipitation may occur when two aqueous solutions are mixed.

- (a) Complete the following table. **[6]**

Solution mixed together	Formula of precipitate formed	Colour of precipitate formed
(i) silver nitrate and sodium chloride		
(ii) sodium iodide and lead (II) nitrate		
(iii) barium nitrate and copper (II) sulphate		

- (b) Name the physical process used to obtain the precipitate from a(i). **[1]**

- A3** In the following experimental set-up, the Hydrogen-oxygen fuel cell supplies electricity for the electrolysis of concentrated sodium chloride solution.



- (a) Name the gas **A** and **B**. [2]

Gas **A** : _____

Gas **B** : _____

- (b) Give the half equation of the reaction that produce
(i) gas **A**. [1]

- (i) gas **B**. [1]

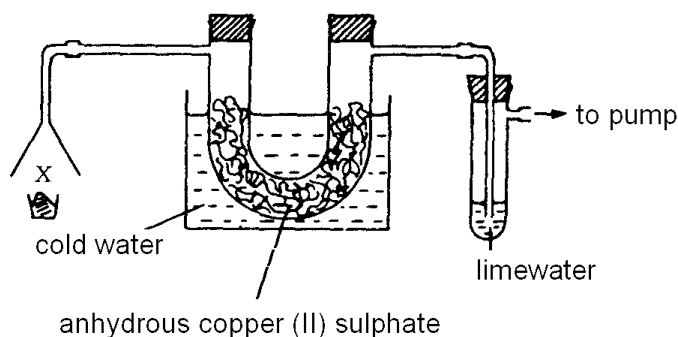
- (c) Name liquid **C**. _____ [1]

- (d) Redox reaction occurs in the Hydrogen-oxygen fuel cell. At the positive electrode (cathode), oxygen is reduced to form hydroxide ions. At the negative electrode (anode), hydrogen is oxidised to form water. Write the chemical reaction for reactions occurring at the cathode and anode. [2]

Cathode : _____

Anode : _____

- A4** The apparatus shown in the figure below can be used to investigate the gaseous products of combustion. The burning material is placed in the crucible at **X** and a slow stream of air is drawn through the apparatus by means of the pump.



When petrol is burnt at **X** the white anhydrous copper (II) sulphate turns blue and the lime water turns milky.

- (a) Name the combustion products responsible for these observations. [2]

- (b) What can be deduced concerning the elements present in petrol? [2]

- (c) Name an element which when burnt would cause the lime water to turn milky but would **not** affect the anhydrous copper(II) sulphate. [1]

- (d) Name an element which when burnt would cause the anhydrous copper(II) sulphate to turn blue but would **not** turn the lime water milky. [1]

- A5** Stearic acid, a fatty acid, is a white solid which is insoluble in water, melts at 69.6°C and boils at 383°C. It can be represented by the formula $C_{18}H_{36}O_2$ and 1 mole of the acid will neutralise 1 mole of sodium hydroxide to form 1 mole of sodium stearate.

- (a) Give one piece of evidence which suggests that stearic acid is a covalent compound. [1]

- (b) Give one piece of evidence which suggests that stearic acid can be ionised. [1]

(c) Suggest a formula for sodium stearate. [1]

(d) An aqueous solution of sodium stearate will react with aqueous magnesium nitrate to form a white insoluble solid.

(i) Give the name of the solid formed. [1]

(ii) Suggest a formula for the solid. [1]

A6 Some metals displace others from their salt solutions. The results of a set of experiments are given in the following table.

	silver	zinc	copper	chromium	nickel
Silver nitrate		Silver displaced	Silver displaced	Silver displaced	Silver displaced
Zinc nitrate	No visible reaction		No visible reaction	No visible reaction	No visible reaction
Copper (II) nitrate	No visible reaction	Copper displaced		Copper displaced	Copper displaced
Chromium (III) nitrate	No visible reaction	Chromium displaced	No visible reaction		No visible reaction
Nickel (II) sulphate	No visible reaction	Nickel displaced	No visible reaction	Nickel displaced	

(a) Arrange the five metals in order of decreasing reactivity by completing the blanks below. [1]

_____, chromium, _____, _____, silver

(b) Explain how the most reactive metal is identified from the results above. [1]

(c) From your answer, choose the metal which is most suitable to be used to provide sacrificial protection for iron. [1]

(d) Explain your choice for (c) above. [1]

A7 Ammonia is manufactured in the Haber process by the reaction between hydrogen and nitrogen. The reaction is exothermic.

- (a) In terms of bonds broken and bonds formed, explain what is meant by an exothermic reaction. [1]

- (b) Name the essential conditions needed in the Haber process [2]

- (c) When one mole of ammonia is formed, the energy change, ΔH is -92kJ . Calculate the energy change which occurs when 48 dm^3 of hydrogen gas reacts with 48 dm^3 of nitrogen gas. [2]

A8 Sulphur dioxide is an industrial pollutant.

- (a) State **two** effects of sulphur dioxide on the environment. [2]

- (b) The combustion of coal in power stations produces waste gases containing sulphur dioxide. The sulphur dioxide can be removed by reaction with powdered limestone. State the type of reaction which occurs between sulphur dioxide and the limestone. [1]

A9 Strontium, Sr, is in Group II of the Periodic Table.

(a) How many electrons are there in the outer shell of an atom of strontium? [1]

(b) Is strontium a metal or a non-metal? [1]

(c) Will the oxide(s) of strontium be acidic, basic or amphoteric? [1]

(d) Write the formula for an ion you would predict strontium to form. [1]

(e) Give the formula of strontium oxide. [1]

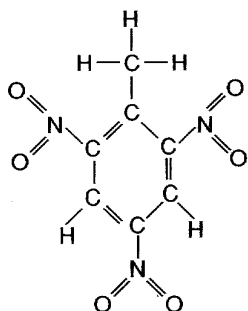
***** **End of Section A** *****

Section B

Answer **all three** questions from this section.

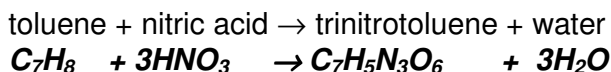
The last question is in the form of an either/or and only one of the alternatives should be attempted.
Write your answers on any lined pages provided and/or a separate answer paper.

- B10 (a)** T.N.T. is a high explosive. It stands for tri-nitro-toluene and it burns very quickly (**17 times faster** than gunpowder) and produces vast amounts of gases. These hot gases occupy large volumes which result in an explosion outwards. High explosives like T.N.T. are used for blasting in mining and road construction as well as in general demolition work.



Structural formula of
T.N.T. (tri-nitro-toluene)

T.N.T. can be made by reacting toluene with concentrated nitric acid.

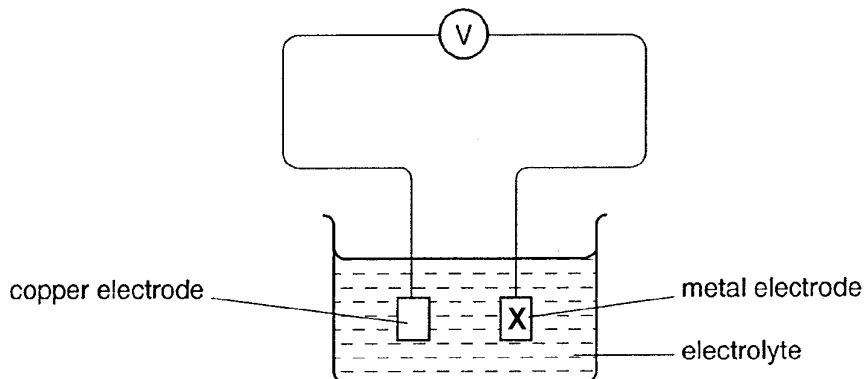


- (i) Is the empirical formula of T.N.T. different from its molecular formula? [1]
 - (ii) What is the relative molecular mass of T.N.T.? [1]
 - (iii) How many grams would there be in 1 mole of T.N.T.? [1]
 - (iv) If a factory produces 4.54 tonnes of T.N.T. per day, how many moles of T.N.T. is this? (*Assume 1 tonne = 1000 kg*). [1]
 - (v) How many tonnes of nitric acid would be needed to produce 4.54 tonnes of T.N.T. each day? [1]
- (b) When copper(I) oxide dissolves in dilute sulphuric acid, copper(II) sulphate and copper metal are produced.
- (i) Write the balanced chemical equation for the reaction. [1]
 - (ii) Discuss the changes in the oxidation states of copper in this reaction. [1]
 - (iii) Is copper(I) oxide oxidised or reduced this reaction? [1]
 - (iv) This reaction is called a disproportionation reaction. From your answer in (ii), deduce one characteristic feature of a disproportionation reaction. {Hint : $2\text{Sn}^{2+} \rightarrow \text{Sn} + \text{Sn}^{4+}$ is another example of a disproportionation reaction} [2]

B11 (a) Both butane and ethanol can be used as a fuel. The enthalpy change of combustion for 1 mole of ethanol is -1367 kJ while enthalpy change of combustion for 1 mole of butane is -2880 kJ.

- (i) Write an equation for the complete combustion of butane. [1]
 (ii) Write an equation for the complete combustion of ethanol. [1]
 (iii) Which fuel, butane or ethanol, provides more energy per unit mass? Explain your answer. [3]

(b) The diagram represents a simple cell for the production of electrical energy. One electrode is copper and the other is one of silver, iron, magnesium or zinc.



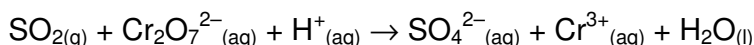
- (i) Suggest a suitable solution to use as the electrolyte. [1]
 (ii) Give an equation for the reaction taking place at electrode **X** when **X** is iron. [1]
 (iii) Copy and complete the table by inserting the names of the metals, silver, iron, magnesium and zinc. [3]

Meter reading /V	Metal
-1.25	
2.70	
1.15	
0.66	

B12. Either

A sample of air taken from the air around a power station that uses fossil fuels was found to contain many pollutants.

- (a) What is a pollutant? [1]
 (b) State a pollutant, other than nitrogen dioxide, in the sample which causes acid rain. [1]
 (c) Explain how the pollutant enters the air and how the amount can be reduced. [2]
 (d) Why do the levels of these pollutants in the atmosphere increase in during the months when the weather is the hottest? [1]
 (e) A sample of the polluted air can be treated for sulphur dioxide by bubbling it through acidified potassium dichromate (VI) solution. The ionic equation is given below



- (i) Balance the above ionic equation. [1]
 (ii) What is the property exhibited by sulphur dioxide in its reaction with acidified potassium dichromate(VI) solution? Explain your answer. [2]
 (iii) A solution contains 0.100 mol/dm^3 of dichromate (VI) ions. Given a 2.00 dm^3 sample of polluted air which contains 3.4% by volume of sulphur dioxide measured at room temperature and pressure, calculate the minimum volume of this solution required to remove sulphur dioxide. [2]

OR

Different volumes of dilute hydrochloric acid and aqueous sodium hydroxide, both at room temperature (28°C), were mixed and stirred with a thermometer. The highest temperature reached by each mixture was recorded. The results are shown in the table below.

Vol. of HCl /cm³	5	10	15	20	25	30	35	40	45
Vol. of NaOH /cm³	45	40	35	30	25	20	15	10	5
Maximum temperature changed /°C	1.5	2.9	4.4	5.8	7.3	7.3	5.3	3.1	1.1

- (a) Using a scale of 2 cm to represent 1°C on y-axis and 1 cm to represent 5 cm^3 of hydrochloric acid on x-axis, plot the graph of temperature change against volume of hydrochloric acid used. Using these points, **draw two straight lines**. The lines should cross. [3]
 (b) Write the equation for the reaction taking place. [1]
 (c) Name a suitable piece of apparatus you would use to measure the required volumes of the two solutions. [1]
 (d) What volumes of hydrochloric acid and sodium hydroxide should be mixed to give the largest possible rise in temperature? [1]
 (e) Reaction between hydrochloric acid and sodium hydroxide is an example of an exothermic reaction. What volumes of hydrochloric acid and sodium hydroxide should be mixed to give an exactly neutral solution? [1]
 (f) Given that the concentration of hydrochloric acid is 1.5 mol/dm^3 . Find the concentration of sodium hydroxide solution. [3]

~ The End ~

The Periodic Table of the Elements

I		II		Group																VII		0												
7 Li Lithium 3	9 Be Beryllium 4	23 Na Sodium 11	24 Mg Magnesium 12	39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36	85 Rn Radon 86												
13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulphur 16	17 Cl Chlorine 17	18 Ar Argon 18	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54	81 Tl Thallium 81	82 Pb Lead 82	83 Bi Bismuth 83	84 Po Polonium 84	85 At Astatine 85	86 Rn Radon 86							
37 Rb Rubidium 37	38 Sr Strontium 38	39 Y Yttrium 39	40 Zr Zirconium 40	41 Nb Niobium 41	42 Mo Molybdenum 42	43 Tc Technetium 43	44 Ru Ruthenium 44	45 Rh Rhodium 45	46 Pd Palladium 46	47 Ag Silver 47	48 Cd Cadmium 48	49 In Indium 49	50 Sn Tin 50	51 Sb Antimony 51	52 Te Tellurium 52	53 I Iodine 53	54 Xe Xenon 54	87 Fr Francium 87	88 Ra Radium 88	89 Ac Actinium 89	90 Th Thorium 90	91 Pa Protactinium 91	92 U Uranium 92	93 Np Neptunium 93	94 Pu Plutonium 94	95 Am Americium 95	96 Cm Curium 96	97 Bk Berkelium 97	98 Cf Californium 98	99 Es Einsteinium 99	100 Fm Fermium 100	101 Md Mendelevium 101	102 No Nobelium 102	103 Lr Lawrencium 103
103 La Lanthanum 103	104 Ce Cerium 104	105 Pr Praseodymium 105	106 Nd Neodymium 106	107 Pm Promethium 107	108 Sm Samarium 108	109 Eu Europium 109	110 Gd Gadolinium 110	111 Tb Terbium 111	112 Dy Dysprosium 112	113 Ho Holmium 113	114 Er Erbium 114	115 Tm Thulium 115	116 Yb Ytterbium 116	117 Lu Lutetium 117	118 Hf Hafnium 118	119 Ta Tantalum 119	120 W Tungsten 120	121 Re Rhenium 121	122 Os Osmium 122	123 Ir Iridium 123	124 Pt Platinum 124	125 Au Gold 125	126 Hg Mercury 126	127 Tl Thallium 127	128 Pb Lead 128	129 Bi Bismuth 129	130 Po Polonium 130	131 At Astatine 131	132 Rn Radon 132					

* 58 – 71 Lanthanoid series
+ 90 – 103 Actinoid series

Key

a	X
b	

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.)