ALEXANDER ROAD HIGH SCHOOL

AUGUST 2011 1 HOUR

PHYSICAL SCIENCE CONTROL TEST

MA, CO, IC TOTAL = 60

GRADE 12

Instructions

- The question paper consists of 6 questions.
- Answer all the questions.
- Answer section A on the answer sheet provided.
- Answer section B on folio and answer each question on a new side of a page.
- A non-programmable calculator may be used.
- Number the answers correctly according to the numbering system used.
- A data sheet will be provided for your use.

SECTION A

- Answer on the answer sheet -

QUESTION 1: One-word questions

1.1 The substance responsible for oxidation. (1)

1.2 A system in which all the substances are in the same phase. (1)

1.3 Fertiliser type found naturally. (1)

[3]

QUESTION 2: Multiple choice

Each question has only ONE correct answer. Choose the answer and make a cross (X) in the block (A–D) next to the question number (2.1 – 2.6) on the attached ANSWER SHEET.

2.1 Consider the following statements:

I The anode of a galvanic cell is positive.
II Oxidation takes place at the negative electrode of an electrolytic cell.
III Electroplating of metals occurs at the cathode.

Which statement(s) is/are correct?

A. I only B. II and III

C. I and II D. III only (2)

2.2 The correct statement regarding the molten sodium chloride electrolytic cell is:

A. The sodium forms from ionic sodium that is oxidised.

B. The chloride is reduced in order to form chlorine.

C. The ionic sodium is reduced to form sodium.

D. The chlorine gas forms from chloride that is oxidised. (2)

2.3 Consider the equilibrium reaction represented below…

$$\underset{\text{pink}}{Co(H_2O)_6^{2+}{}_{(aq)}} + 4Cl^-_{(aq)} \rightleftharpoons \underset{\text{blue}}{CoCl_4^{2-}{}_{(aq)}} + 6H_2O_{(l)} \quad \Delta H>0$$

Which ONE of the following changes to the reaction mixture will change the colour of the solution from blue to pink?

A. Add a few drops of silver nitrate to the reaction mixture.

B. Add a catalyst.

C. Add a few drops of concentrated hydrochloric acid to the mixture.

D. Place a bunsen burner under the reaction vessel. (2)

2.4 The rate of a chemical reaction is <u>NOT</u> directly proportional to…

A. The temperature of the system

B. The amount of product formed

C. The surface area of the reactants

D. The concentration of the reactants (2)

2.5 A bag of fertiliser marked 2:3:2 (28) tells us that nitrogen, phosphorus and potassium are present

A. in the ratio of 2% : 3% : 2% of the total mass of fertiliser in the bag.

B. In the ratio of 2% : 3% : 2% of the mass of 28 units of fertiliser in the bag

C. In the ratio of 8% : 12% : 8% of the total mass of fertiliser in the bag.

D. In the ratio of 28,5% : 43% : 28,5% of the total mass of fertiliser in the bag.

(2)

2.6 What is the capacity of a cell (in A.h) that maintains an emf of 12V and a current of 100 mA for 50 hours?

A. 1 A.h B. 5 A.h

C. 24 A.h D. 5000 A.h (2)

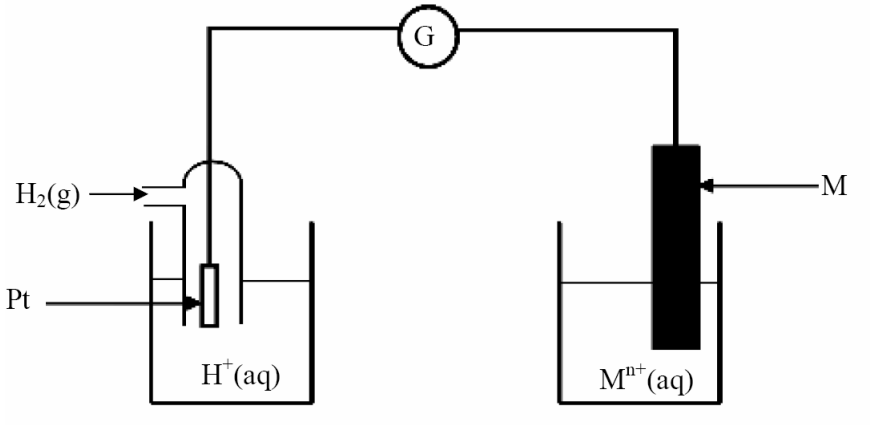
[6 x 2 = 12]
SUB – TOTAL: 15

SECTION B

- Answer all questions on folio paper -

QUESTION 3:

The diagram below represents part of an electrochemical cell consisting of a standard hydrogen cell and a metal electrode in contact with a standard solution of its own ions.



3.1 What is the advantage of using a "centre-zeroing" galvanometer instead of a voltmeter in the circuit? (1)

3.2 What addition must be made to the apparatus before the galvanometer will show a flow of charge? (1)

3.3 If the galvanometer needle deflects to the left when the metal/metal ion half cell is Fe/Fe^{2+}, in which direction will it deflect when the half cell is

3.3.1 Mg/Mg^{2+} (1)

3.3.2 Pb/Pb^{2+} (1)

3.4 If a new M/M^{n+} half cell is connected and the emf is 0,80 V, what metal is now being used? (1)

3.5 If the standard hydrogen electrode is now replaced by the Fe/Fe^{2+} electrode:

3.5.1 Describe what will occur at the anode. (2)

3.5.2 Write down the equation for the whole-cell reaction. (2)

3.5.3 Calculate the initial emf of this electrochemical cell at standard conditions. (Round off to two decimal places) (3)

3.6 If the cell is left connected, a voltmeter will show that the emf of the electrochemical cell decreases with time.
Explain this observation with reference to standard conditions.

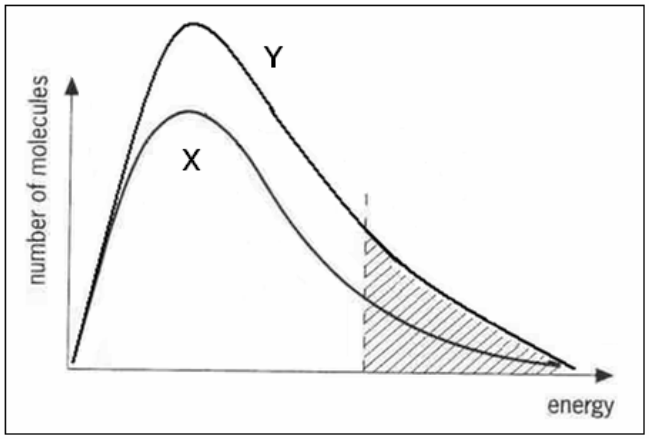
(3)
[15]

QUESTION 4

A learner investigates a way to increase the rate at which carbon dioxide gas develops in the reaction between methane and oxygen…

$$CH_4 + O_2 \rightarrow CO_2 + 2H_2O$$

By changing one reaction condition, she obtains the graph below, in which curve X denotes the initial condition and curve Y denotes the changed condition that produced the higher reaction rate.



4.1 Which reaction condition did the learner change? (1)

4.2 Apply the collision theory and explain why the changed condition results in a higher reaction rate. (3)

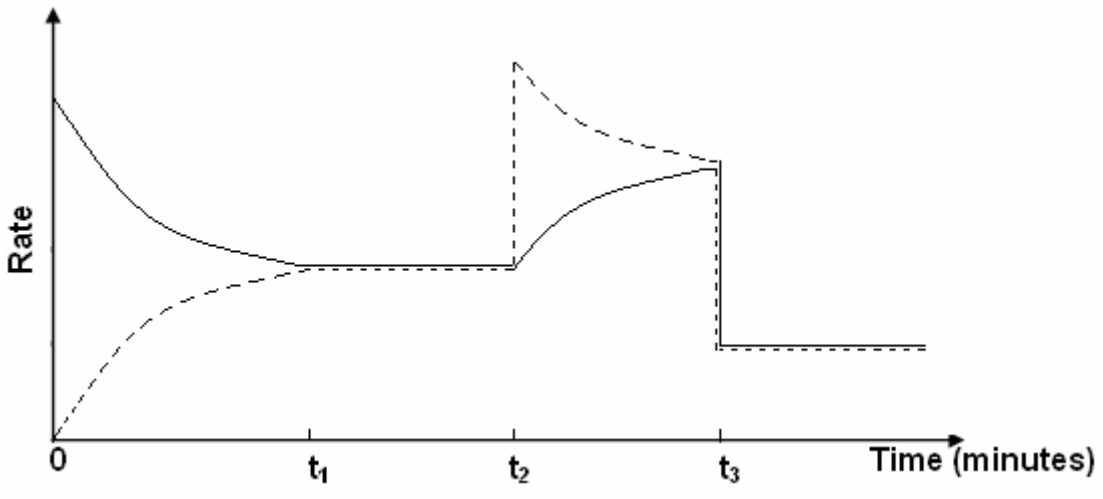
Many industries use ammonia as a coolant in their plants. Ammonia is also used in the fertilizer industry. The ammonia is manufactured by the Haber process in the presence of a catalyst at a temperature of 500^{O}C. The equilibrium process may be represented by the equation…

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

On one afternoon, an engineer in a fertilizer factory injects 10mol N_2 and 15mol H_2 into a 10dm^3 sealed Haber reaction vessel. Equilibrium is reached, and it is found that the number of mols of NH_3 in the vessel is 6mol.

4.3 Calculate the value of the equilibrium constant at the given temperature. (6)

4.4 Consider the following graph that shows that the temperature of the system was increased to 600^{O}C at time t_2 and the reaction conditions changed at time t_3, answer the questions that follow.



4.4.1 What is the meaning of the horizontal line between t_1 and t_2? (1)

4.4.2 Is the **forward** reaction *exothermic* or *endothermic*? (write only the word) (1)

4.4.3 How was the conditions of the reaction changed at time t_3? (1)

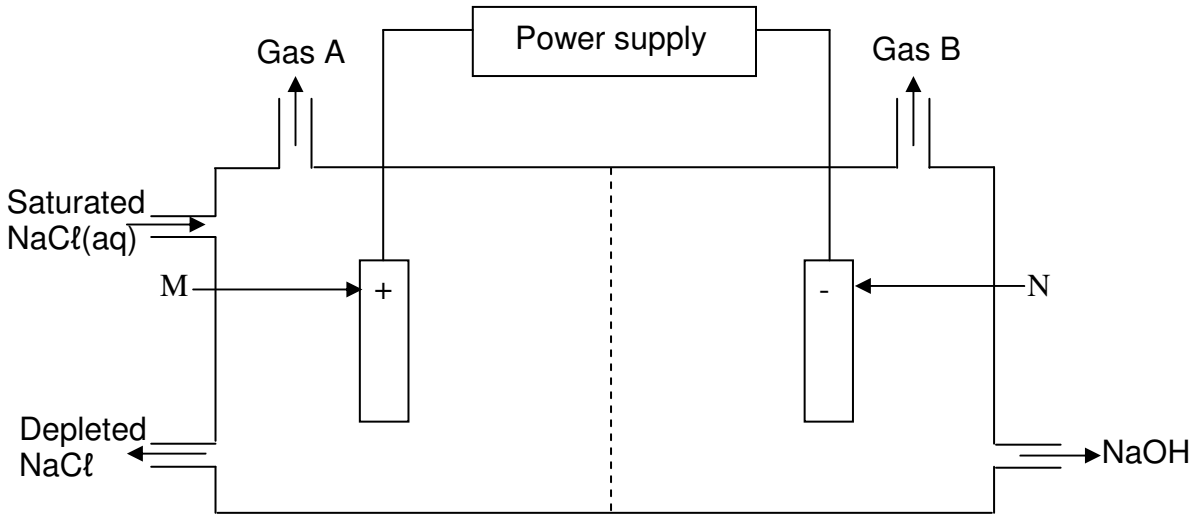
4.4.4 Draw what the graph would look like after time t_4 when the pressure of the system Is increased (no values are required, only the shape is important) (2)

[15]

QUESTION 5

Chloralkali manufacturing process

The chloralkali (also called 'chlorine-caustic') industry is one of the largest electrochemical technologies in the world. Chlorine is produced using three types of electrolytic cells. The simplified diagram below shows a cationic membrane cell.



5.1 Why is it called a cationic membrane cell? (1)

5.2 Name the energy conversion in this process. (1)

5.3 What is the main property of the electrodes that are used in this process? (1)

5.4 Which is the anode? Write only **M** or **N**. (1)

5.5 Write down the equation for the half-reaction taking place at electrode **N**. (2)

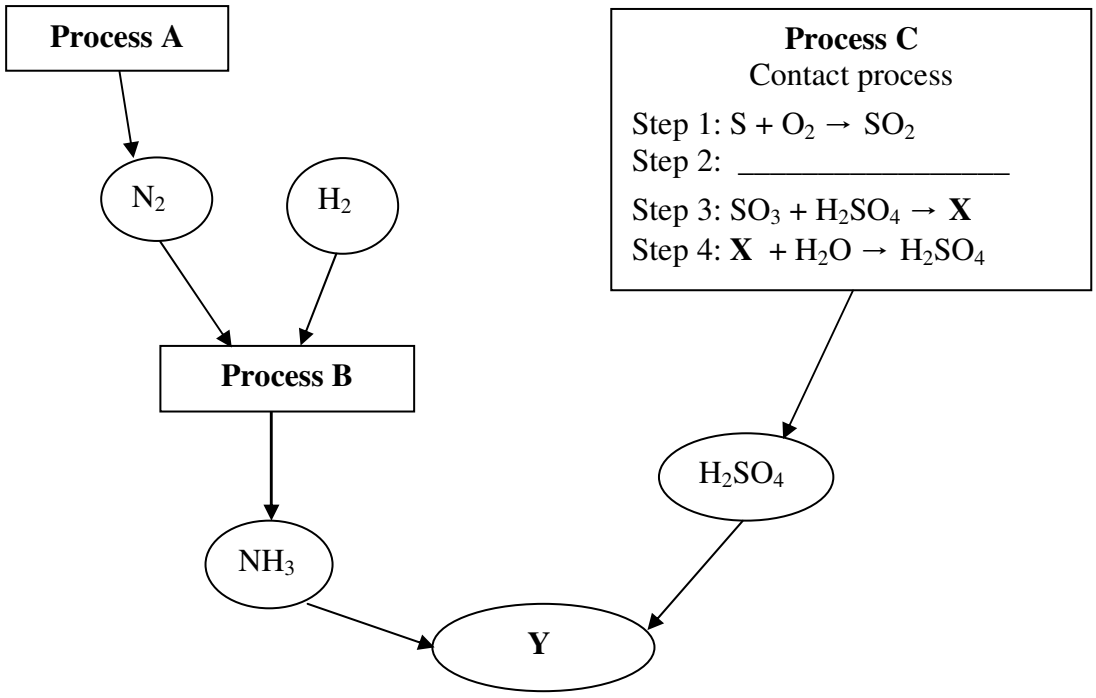
5.6 Which gas is chlorine gas? Write down only **Gas A** or **Gas B**. (1)

5.7 Give ONE reason why it is not advisable to build a chloralkali plant close to a residential area. (1)

[8]

QUESTION 6

6. About one third of the protein consumed by humans comes from fertilisers. The flow diagram below shows three industrial processes, A, B and C, that result in the production of fertilisers.



6.1 Write down the name of Process A. (1)

6.2 Write down the name of the process when the product of process B reacts with oxygen. (1)

6.3 Write down the balanced equation for step 2 of Process C**.** (2)

6.4 Write the FORMULA or the NAME of the fertiliser represented by **Y**. (1)

6.5 Fertiliser prices increased by more than 200 per cent since 2007. This rise is fuelled by new demand.

6.5.1 Give one reason why there is a continuous demand for fertilizers. (1)

6.5.2 Name the process of the consequence of the overuse of fertilizers. (1)

[7]

TOTAL 60 MARKS