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MINISTRY OF EDUCATION, BOTSWANA
in collaboration with
UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE
Botswana General Certificate of Secondary Education

CANDIDATE
NAME

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CENTRE
NUMBER

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CHEMISTRY

0570/03

Paper 3

October/November 2007

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces provided at the top of this page.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.

Write your answers in the spaces provided on the question paper.

Show your working for any calculations.

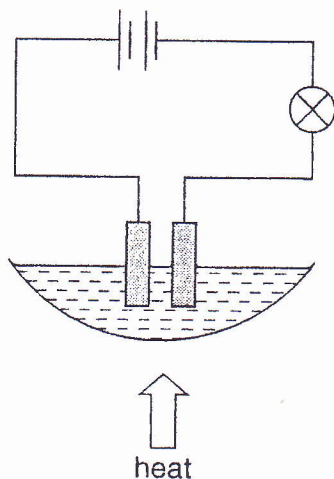
The number of marks is given in brackets [] at the end of each question or part question.

A copy of the Periodic Table is printed on page 12.

Page 6 of 8

| For Examiner's Use | |
|--------------------|--|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| Total | |

- 1 Lead(II) bromide, PbBr_2 , is electrolysed using inert electrodes as shown.



- (a) What happens to the brightness of the bulb when heating is stopped?

.....

Give a reason for your answer.

.....

.....[3]

- (b) Suggest another substance that can be used instead of lead(II) bromide to cause the flow of current.

.....[1]

- (c) 0.414 g of lead was deposited at the cathode when a current of 2.5 A was passed.

- (i) Calculate the number of moles in 0.414 g of lead.

[1]

- (ii) Calculate the total charge in Faradays required to liberate 0.414 g of lead at the cathode.

[2]

- (iii) Use your answer to (c)(ii) to calculate the amount of charge in coulombs.
[1 Faraday = 96500 coulombs]

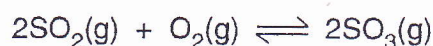
[1]

- (iv) Calculate the time taken, in seconds, to liberate the 0.414 g of lead if the current is 2.5 A.

[2]

[Total: 10]

- 2 Sulphur trioxide, SO_3 , is produced from sulphur dioxide, SO_2 , as shown by the reaction equation.



- (a) (i) The reaction is reversible.

What is meant by a *reversible* reaction?

.....[1]

- (ii) If the pressure at equilibrium is increased, will the yield of sulphur trioxide, SO_3 , increase, decrease or stay the same?

.....

Give a reason for your answer.

.....

.....[3]

- (b) State **two** conditions necessary for the production of sulphur trioxide, SO_3 , from sulphur dioxide, SO_2 , and oxygen, O_2 , in the Contact process.

1

2[2]

- (c) Describe how sulphur trioxide, SO_3 , is converted into sulphuric acid, H_2SO_4 , in the Contact process.

.....

.....[2]

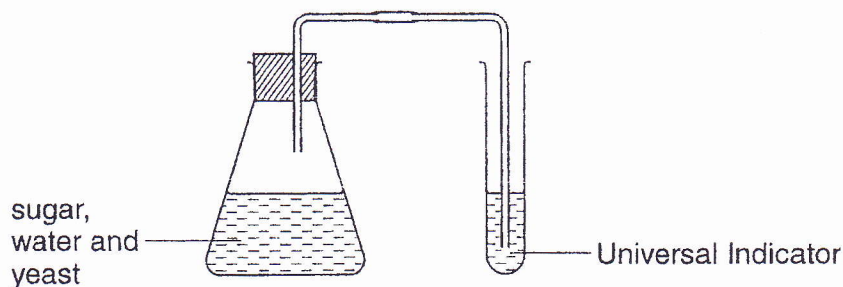
- (d) Give **two** uses of sulphur dioxide, SO_2 , other than for the production of sulphuric acid by the Contact process.

1

2[2]

[Total: 10]

- 3 The diagram shows how ethanol was prepared from water and sugar solution.



- (a) Name the process by which ethanol is produced from water and sugar solution.
[1]
- (b) The gas produced is bubbled through water containing Universal Indicator.
- (i) Name the gas produced.
[1]
- (ii) What colour change is observed as the gas is bubbled through the Universal Indicator solution?
 to[2]
- (c) A student suggested boiling the sugar water and yeast solution so that the reaction can be faster. Explain why the solution should not be boiled.
[1]
- (d) (i) Describe how the ethanol can be separated from the mixture after the reaction is complete.
[1]
- (ii) When using the method named in (d)(i), describe how you would know that all the ethanol has been separated.
[1]
- (e) The ethanol is heated with potassium dichromate(VI) to form an organic compound.
- (i) Name the organic compound formed.
[1]
- (ii) Give the structural formula of the organic compound named in (e)(i).

- 4 The equation shows the reaction of one mole of methane with two moles of oxygen.



The bond energies are given in the table.

| bond | bond energy (kJ/mol) |
|------|-------------------------|
| C-H | 412 |
| C=O | 743 |
| H-O | 464 |
| O=O | 497 |

- (a) (i) Calculate the total energy needed to break all the bonds in the reactants.

total energy = + kJ/mol [2]

- (ii) Calculate the total energy needed to form all the bonds in the products.

total energy = - kJ/mol [2]

- (iii) Calculate the total energy change for the reaction.

total energy change = kJ/mol [2]

- (iv) State whether the reaction is exothermic or endothermic.

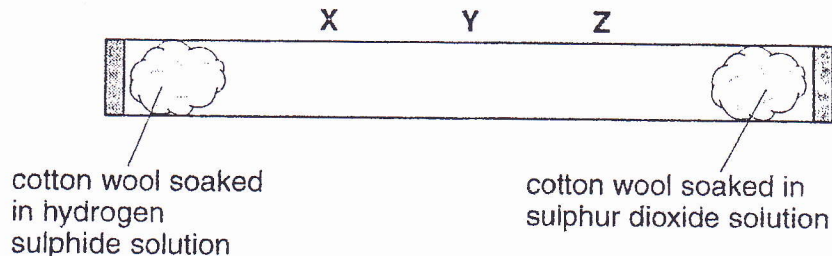
.....[1]

- (b) Draw a labelled energy level diagram, including activation energy, for the reaction of methane and oxygen.

[4]

[Total: 11]

- 5 The diagram shows how an experiment was set up.



The solutions release hydrogen sulphide gas, H_2S , and sulphur dioxide gas, SO_2 , respectively. The two gases react to form a yellow powder.

The equation for the reaction is



- (a) Balance the equation and write the state symbols for all the substances. [2]
- (b) (i) Calculate the relative molecular mass of hydrogen sulphide, H_2S .
[A_r : H, 1; S, 32]

[1]

- (ii) Calculate the relative molecular mass of sulphur dioxide, SO_2 .
[A_r : S, 32; O, 16]

[1]

- (iii) At which point, X, Y or Z, will the yellow powder be formed?

.....

Explain your answer.

.....

.....[2]

- (c) Name the process being demonstrated by this experiment.

.....[1]

- (d) Explain what would happen if the experiment was repeated at a slightly lower temperature.

.....

.....[2]

- 6 An experiment was done to determine the percentage of calcium carbonate, CaCO_3 , in a sample of limestone rock. The sample was crushed and added to hydrochloric acid to dissolve the limestone. 4.0g of the rock was added to 50cm^3 of 2.0mol/dm^3 hydrochloric acid which was in excess.

The equation for the reaction is shown.



The excess hydrochloric acid required 28.0cm^3 of 2.0mol/dm^3 sodium hydroxide, NaOH , for complete neutralisation. The equation is shown.



- (a) Calculate the number of moles of hydrochloric acid added to the rock.

[2]

- (b) Calculate the number of moles of sodium hydroxide that reacted with the excess hydrochloric acid.

[1]

- (c) How many moles of hydrochloric acid were in excess?

[1]

- (d) How many moles of hydrochloric acid reacted with the calcium carbonate in the rock?

[1]

- (e) Calculate the number of moles of calcium carbonate in the 4.0g sample of rock.

[2]

- (f) Calculate the mass of calcium carbonate in the 4.0g sample of rock.

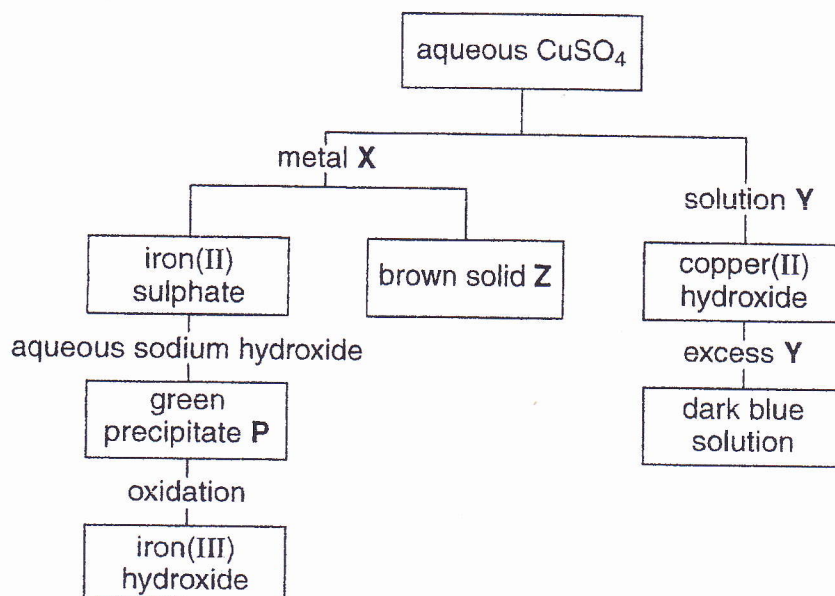
[2]

- (g) Calculate the percentage composition by mass of calcium carbonate in the rock.

[2]

[Total: 11]

- 7 Study the reaction scheme and answer the questions that follow.



- (a) Identify

(i) metal X,

.....[1]

(ii) solution Y,

.....[1]

(iii) green precipitate P,

.....[1]

(iv) brown solid Z.

.....[1]

- (b) Name the type of reaction which occurs between metal X and aqueous copper(II) sulphate.

.....[1]

- (c) (i) What is the colour of iron(III) hydroxide?

.....[1]

- (ii) Name the products formed when iron(III) hydroxide is heated.

1

2[2]

(d) Acidified potassium manganate(VII), KMnO_4 , was used to oxidise the green precipitate **P** to iron(III) hydroxide.

(i) State the colour change of the potassium manganate(VII).

..... to[1]

(ii) What happens to the oxidation state of iron during the oxidation?

.....[1]

[Total: 10]

