SINGAPORE CHINESE GIRLS' SCHOOL
Preliminary Examination
Secondary Four

CANDIDATE NAME

CLASS 4

REGISTER NUMBER

CENTRE NUMBER

INDEX NUMBER

Chemistry 5073/01

Paper 1 Multiple Choice

Tuesday **11 August 2015** **1 hour**

Additional Materials Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and index number on the Question Paper and Answer Sheet in the spaces provided

There are **forty** questions in this paper Answer **all** questions For each question, there are four possible answers, **A, B, C, D.**
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 14
The use of an approved scientific calculator is expected, where appropriate

This question paper consists of 14 printed pages

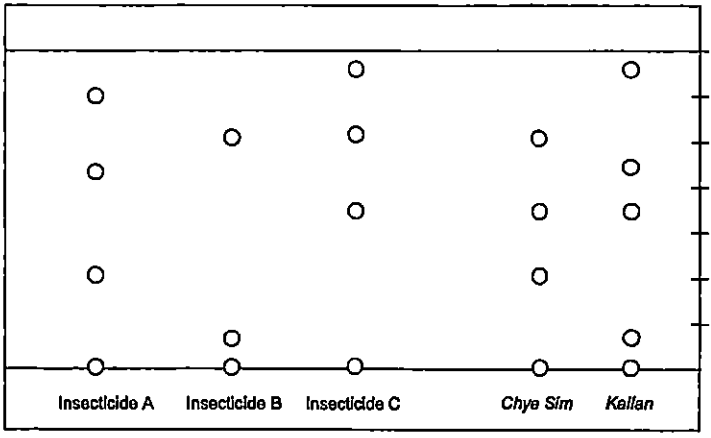
1 A student weighs out a fixed mass of copper and sulfur separately She heats the copper and sulfur together in a closed container to produce copper(II) sulfide After the reaction is complete, the unreacted sulfur is removed (all the copper has reacted) and the copper(II) sulfide formed is weighed The table shows the results of the investigation

Mass of copper before reaction	x g
Mass of sulfur before reaction	y g
Mass of copper(II) sulfide formed	z g
Mass of unreacted sulfur	p g

What is the value of p in terms of x, y and z?

A z-y
B y+z-x
C y-z
D x+y-z

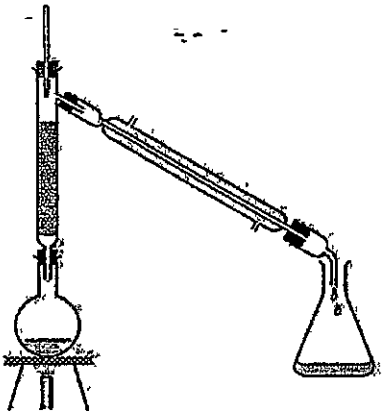
2 Samples of *Chye Sim* and *Kailan* vegetables were tested to determine if the poisonous insecticides A, B and C were present in them. The diagram below shows the results of the tests



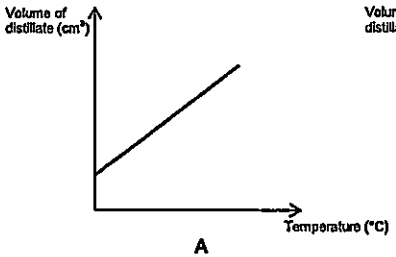
Which of the following statements is true based on the chromatogram above?

A Only *Chye Sim* contains at least one of the insecticides, A, B and C
B Only *Kailan* contains at least one of the insecticides, A, B and C.
C Both *Chye Sim* and *Kailan* contain at least one of the insecticides A, B and C
D Both *Chye Sim* and *Kailan* do not contain any of the insecticides A, B and C

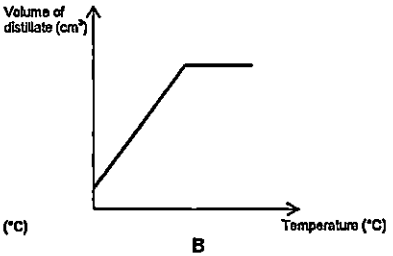
3 The following apparatus was used to separate 2 miscible liquids S (boiling point 60°C) and T (boiling point 90°C)



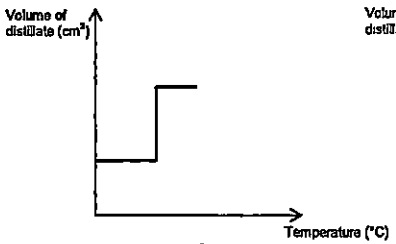
What is the graph obtained when the volume of distillate is plotted against temperature?



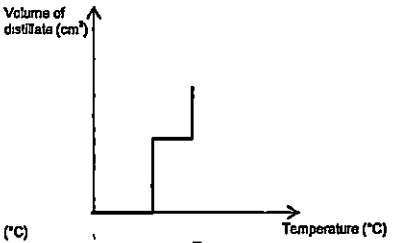
A



B



C



D

4 Study the following statements in a student's notebook

I In a solid, the particles are stationary and held in fixed positions due to strong forces of attraction
II When a solid is heated, the particles expand and become larger.
III At the melting point, the particles are able to slide and roll over one another
IV When the boiling point is reached, evaporation and boiling start to take place and the gas is formed

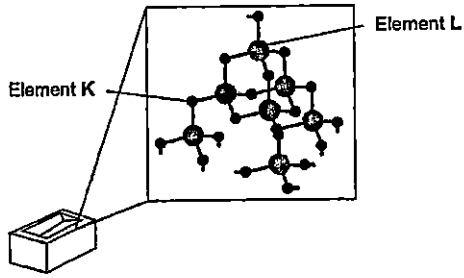
Which of the above statement(s) is(are) true?

A III only
B I and II only
C I, II and III only
D I, II, III and IV

5 In gold jewellery, the metal gold is usually mixed with copper and silver Which of the following changes in physical properties does not happen when the alloy is formed?

A Density decreases
B Hardness increases
C Colour changes
D Malleability increases

6 A major component of bricks is a compound consisting of elements K and L chemically combined together



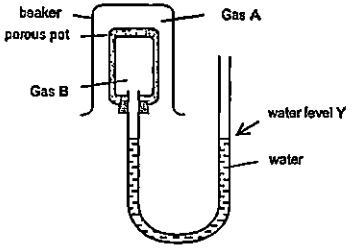
What are elements K and L?

	Element K	Element L
A	Carbon	Silicon
B	Silicon	Carbon
C	Oxygen	Silicon
D	Silicon	Oxygen

7 The atomic number of beryllium is 4
What is the electronic configuration of the beryllium ion?

A 2
B 2 2
C 2 7
D 2 8

8 A student uses the following apparatus to carry out a series of experiments to compare the rate of diffusion between different gases K, L, M and N



The table below summarises the observations made

Experiment	Gas A	Gas B	Observations after 5 mins
1	K	L	Water level Y rises
2	M	N	Water level Y falls
3	L	N	Water level Y rises

Which of the following correctly lists the gases in order of increasing relative molecular mass?

A K, L, M, N
B K, L, N, M
C M, N, L, K
D M, L, N, K

9 4 g of hydrogen is mixed with 16 g of oxygen and the mixture is ignited. Which of the following correctly describes the mixture at the end of the reaction?

	Mass of Hydrogen Left	Mass of Oxygen Left	Mass of Water Formed
A	0 g	0 g	20 g
B	0 g	8 g	12 g
C	2 g	8 g	20 g
D	2 g	0 g	18 g

10 The percentage composition by mass of a compound containing carbon, fluorine and chlorine is as follows

Carbon 18 05% Fluorine 28 50% Chlorine 53 45%

Which of the following could be the molecular formula of this compound?

A CF_3Cl
B CF_2Cl_2
C $C_2F_2Cl_2$
D C_2F_2Cl

11 Which one of the samples contains the most atoms?

A 1 5 mol of CO_2
B 0 5 mol of C_2H_6
C 3 0 mol of He
D 1 0 mole of SO_3

12 A sample of 2.50 g fertilizer was analysed for its sulfate content. After a series of procedures, 2 33 grams of barium sulfate were precipitated from the fertiliser What is the percentage composition by mass of sulfate in the fertiliser?

A 38 4%
B 41 2%
C 61 6%
D 93 2%

13 Three electrochemical cells are set up using copper metal and three unknown metals, U, V and W as electrodes, immersed in dilute sulfuric acid of the same concentration
The voltage produced in each cell is given in the table below

Cell	Metals used	Voltage
1	Copper and U	0 45
2	Copper and V	1 11
3	Copper and W	2 71

Which of the following correctly list the metals U, V and W in the order of increasing ease of oxidation?

A U, V, Copper, W
B W, V, Copper, U
C Copper, U, V, W
D Copper, W, V, U

14 What happens to the positive ions at the cathode during electrolysis?

A Nothing happens to the ions
B The ions lose electrons to form positive ions
C The ions lose electrons to form neutral atoms
D The ions gain electrons to form neutral atoms

15 Concentrated aqueous potassium chloride is electrolysed using carbon electrodes
What happens to the electrolyte?

A It becomes more acidic.
B It becomes more alkaline
C It becomes more dilute
D It becomes more concentrated

16 Which of the following correctly describes what takes place in a hydrogen-oxygen fuel cell?

A Hydrogen ions are reduced at the positive electrode to form hydrogen
B Hydrogen ions are oxidized at the positive electrode to form hydrogen
C Hydrogen gas is reduced at the negative electrode to form water
D Hydrogen gas is oxidized at the negative electrode to form water

17 Which of the following statements is true for an endothermic reaction?

A Energy is absorbed from the surroundings and temperature increases
B Energy is released to the surroundings and the temperature increases
C Energy is absorbed from the surroundings and temperature decreases
D Energy is released to the surroundings and temperature decreases

18 The equation for the reaction between magnesium and hydrochloric acid is given below

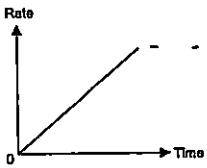
$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g) \qquad \Delta H = \text{negative}$$

Which statement about this reaction is incorrect?

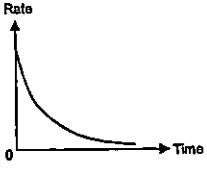
A The products possess less energy than the reactants
B The bonds of the reactants are stronger than the bonds of the products
C The total energy change in bond formation is more than that in bond breaking
D The magnesium has been oxidised.

19 Which of the following graphs represents how the rate of reaction varies with time when an excess of zinc reacts with dilute hydrochloric acid?

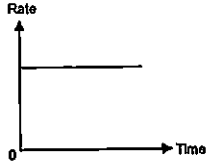
A



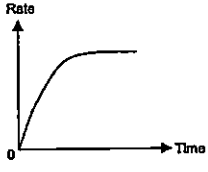
C



B



D



20 Which of the following is the strongest reducing agent?

A chlorine gas
B chloride ion
C bromine gas
D bromide ion

21 In which reaction is the underlined substance not reduced?

A $\underline{KBrO_3} + 5KBr + 6HNO_3 \rightarrow 6KNO_3 + 3Br_2 + 3H_2O$
B $3CH_3OH + 4\underline{MnO_4^-} \rightarrow 3HCOOH + 4MnO_2$
C $\underline{Ag_2CO_3} + 2NaOH \rightarrow Ag_2O + Na_2CO_3 + H_2O$
D $\underline{PbO_2} + 4HCl \rightarrow PbCl_2 + Cl_2 + 2H_2O$

22 A sample of air polluted with sulfur dioxide was passed through aqueous potassium iodide and acidified aqueous potassium permanganate. Which pair of colour changes are both correct?

	Aqueous potassium iodide	Acidified aqueous potassium permanganate
A	No change	Purple to colourless
B	Colourless to brown	Colourless to purple
C	No change	Colourless to purple
D	Brown to colourless	Purple to colourless

23 What is the ionic equation for the reaction that occurs when propanoic acid, C_2H_5COOH, and potassium hydroxide solutions are mixed?

A $H^+ + OH^- \rightarrow H_2O$
B $H^+ + KOH \rightarrow K^+ + H_2O$
C $C_2H_5COOH + KOH \rightarrow C_2H_5COOK + H_2O$
D $C_2H_5COO^- + K^+ \rightarrow C_2H_5COOK$

24 Which of the following are uses of sulfuric acid?

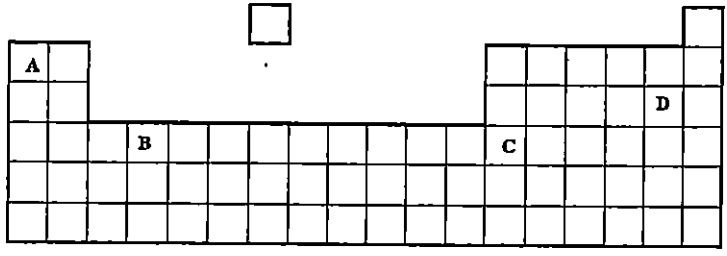
I Making fertilizers
II Sterilising water
III Making detergents
IV Used in car batteries

A I and II only
B II and III only
C I, III and IV only
D I, II, III and IV

25 The sulfate of element F is green Which other properties is element F likely to have?

	density	melting point
A	high	high
B	high	low
C	low	low
D	low	high

26 The positions of four elements in the Periodic Table are shown Which element is most likely to form an amphoteric oxide?



27 Which statements explain why aluminium is preferred to iron for making drink cans?

I Aluminium is lighter than iron
II Aluminium corrodes less easily than iron
III Aluminium is a better conductor of heat than iron

A I and II only
B I and III only
C II and III only
D I, II and III only

28 Which of the following explains why recycling ensures that metals will be available in the future?

A Dumping of metals in landfill sites is unsightly
B Recycling avoids the environmental damage caused by mining for metals
C Recycling costs less than obtaining metals from their ores
D There are only limited amounts of metals in the Earth's surface

29 Which reaction produces most of the carbon monoxide used to extract iron in the blast furnace?

A Burning coke in air
B Reacting coke with carbon dioxide
C Reacting iron(III) oxide with coke
D Decomposition of limestone

30 Metal U displaces metal V from an aqueous solution of the nitrate of V
Metal W reacts with cold water to give hydrogen, but metal U gives hydrogen only when reacted with steam
Metal U can be extracted from its oxide by reaction with carbon but not with hydrogen
What could elements U, V and W be?

	U	V	W
A	Magnesium	Lead	Sodium
B	Zinc	Copper	Calcium
C	Iron	Silver	Calcium
D	Copper	Iron	Magnesium

31 Which of the following gases cannot be removed from the exhaust gases of a petrol powered car by its catalytic convertor?

A Carbon dioxide
B Carbon monoxide
C Nitrogen dioxide
D Hydrocarbons

32 The table below gives the relative concentrations of polluting gases in the air in four different industrialised cities In which city, A, B, C or D, are limestone buildings most threatened by pollution?

	sulfur dioxide	nitrogen dioxide	ozone
A	17	46	23
B	32	33	30
C	38	40	11
D	45	14	21

33 Which of the following is NOT a problem associated with plastics?

A Burning plastics gives off toxic gases
B Disposal of plastics by burying can cause shortage of landfill sites
C Plastics made from plants are biodegradable.
D Manufacture of plastics leads to exhaustion of non-renewable energy resources

34 What process/reaction is occurring when ethene and octane are obtained from decane, $C_{10}H_{22}$?

A Cracking
B Polymerisation
C Fractional Distillation
D Combustion

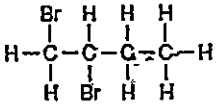
35 Nonane is an alkane present in petrol. What are the products formed when nonane is completely burnt in air?

A carbon dioxide and hydrogen
B carbon monoxide and water
C carbon dioxide and water
D carbon dioxide, carbon monoxide and water

36 Which of the following compounds can turn orange acidified potassium dichromate(VI) green?

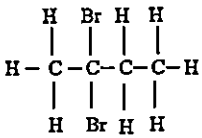
A CH_3CH_3
B CH_3CH_2OH
C CH_3COOH
D CH_3COOCH_3

37 One possible structure of $C_4H_8Br_2$ is

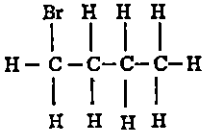


Which of the following are isomers of this organic compound?

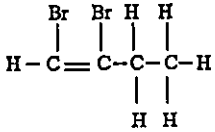
I



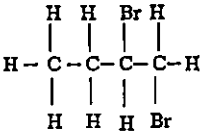
II



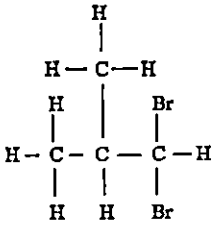
III



IV



V

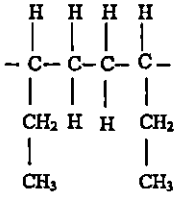


A I and V only
B II and III only
C III, IV and V only
D I, IV and V only

38 What is the molecular formula of the ester formed when propanol is reacted with butanoic acid?

A $C_2H_5CO_2C_4H_9$
B $C_3H_7CO_2C_3H_7$
C $C_3H_7CO_2C_4H_9$
D $C_4H_9CO_2C_3H_7$

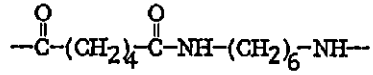
39 A polymer has the following structure



Its monomer is

A propene
B butene
C propane
D butane

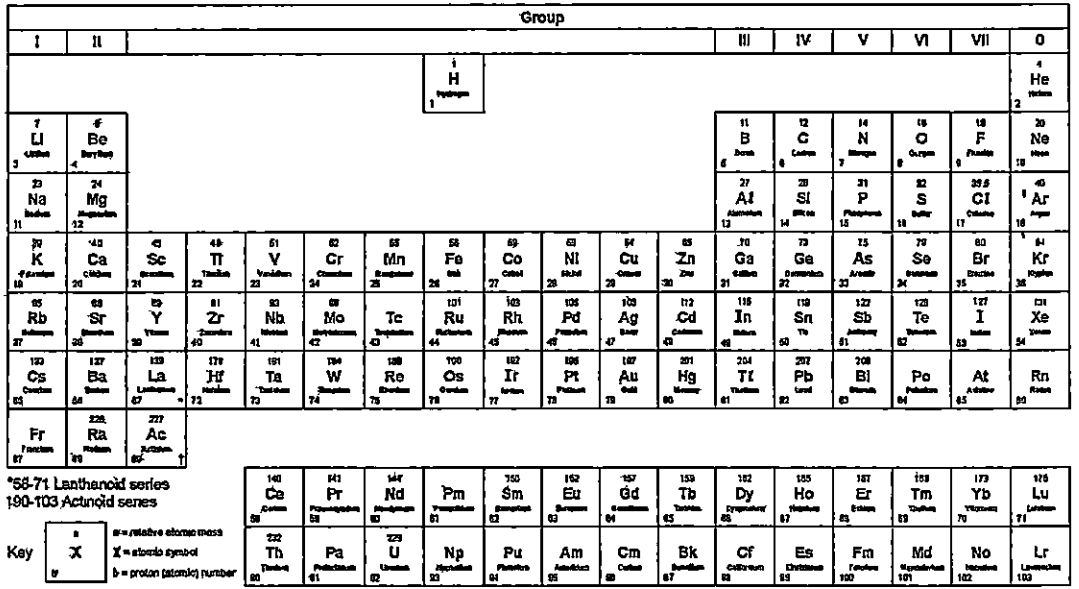
40 The diagram shows a repeat unit of a polymer
Which of the following statements about the polymer and the monomers it is made from is/are true?



I The polymer is made from the joining of many unsaturated monomers
II One of its monomers can react with sodium hydroxide
III The polymer is a polyester
IV If the total mass of the monomers reacted together to form the polymer is 1000kg, the maximum mass of polymer formed will also be 1000kg

A II only
B I and III only
C II and IV only
D II, III and IV only

DATA SHEET
The Periodic Table of the Elements



*58-71 Lanthanoid series
†90-103 Actinoid series

Key: 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.)

SINGAPORE CHINESE GIRLS' SCHOOL
Preliminary Examination
Secondary Four

CANDIDATE NAME

CLASS 4

CENTRE NUMBER

REGISTER NUMBER

INDEX NUMBER

Chemistry 5073/02

Paper 2 Theory

Tuesday **28 July 2015** **1 hour 45 minutes**

Candidates answer on the Question Paper.
No Additional materials are required.
READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A
Answer **all** questions in the spaces provided.

Section B
Answer **all** questions, the last question is in the form either/or.
Answer **all** questions in the spaces provided.

At the end of the examination, fasten all your work securely together.
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 22

The use of an approved scientific calculator is expected, where appropriate.

For Examiner's Use	
Section A	/50
B8	/12
B9	/8
B10	/10
Total	/80

This question paper consists of **22** printed pages.

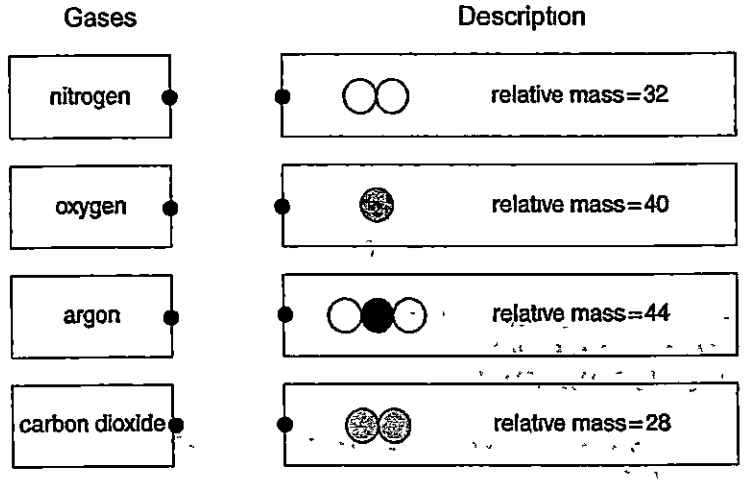
For Examiner's Use

Section A

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

A1 Four of the gases found in air are nitrogen, oxygen, argon and carbon dioxide

(a) Draw straight lines which correctly match the gases and the descriptions shown on the right.



[2]

(b) Study the 6 statements below. Put a tick (✓) in the box if the statement is true.

Air is a mixture. ☐

All gases in air are elements. ☐

The components in air are only made up of non-metals. ☐

There are weak attractions between the molecules in air. ☐

The gases in air have high melting and boiling points. ☐

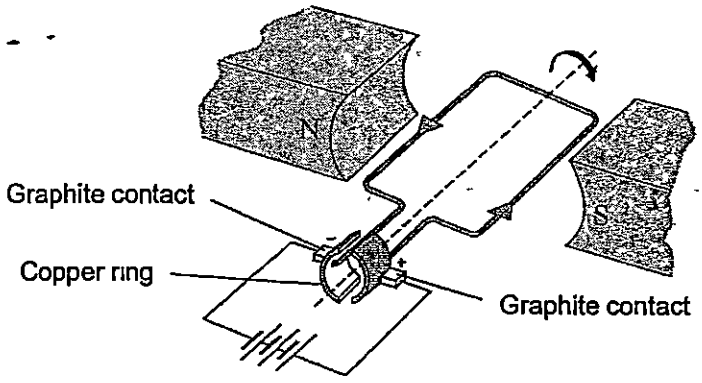
Liquid air does not have a fixed boiling point. ☐

[2]

[Total: 4]

For Examiner's Use

A2 The diagram below shows the main parts of an electric motor.



Graphite contacts are used to conduct electricity to the copper ring. When electricity passes through the wires, the copper ring rotates rapidly, turning the motor which is connected to the drill bit. The ring does not get stuck or become worn out.

(a) Explain, in terms of structure and bonding, why copper and graphite are able to conduct electricity.

(i) copper

. ...

.. . .

. . . . [2]

(ii) graphite

....

....

....

... . [2]

(b) Explain why the copper ring does not become worn out easily though it is in constant contact with the graphite during rotation.

....

....

... . [2]

[Total: 6]

For Examiner's Use

A3 A student carries out some tests on an unknown solution P which is known to contain 2 metallic cations and 1 anion She recorded her observations and deductions in the table shown below.

Expt No.	Procedure	Observations	Deductions
1a	To a solution of P, add sodium hydroxide solution.	*White ppt formed*	*Pb^{2+}, Zn^{2+}, Ca^{2+} or Fe^{2+} could be present*
1b	Add excess sodium hydroxide solution into the test tube	*Ppt decreased by approximately half Remaining ppt is insoluble in excess sodium hydroxide*	*Ca^{2+} is present*
2	Add Devarda's alloy to the mixture in expt 1b. Warm the mixture	*Gas evolved turns moist red litmus blue*	*Cl^- is present*
3a	To new sample of solution P, add aqueous ammonia.	*White ppt formed*	*Al^{3+}, Pb^{2+} or Zn^{2+} could be present*
3b	Add excess aqueous ammonia solution into the test tube.	*White ppt insoluble in excess aqueous ammonia*	*Al^{3+} or Pb^{2+} could be present*

(a) The student made **3** mistakes in her deductions. In the table below, state the experiment number in which the mistakes were made. **Briefly** explain your answer.

	Expt No.	Explanation
Mistake 1		
Mistake 2		
Mistake 3		

[3]

(b) Describe a simple test to differentiate between aluminium ions (Al^{3+}) and lead(II) ions (Pb^{2+}).

. ...

... .

.. . .

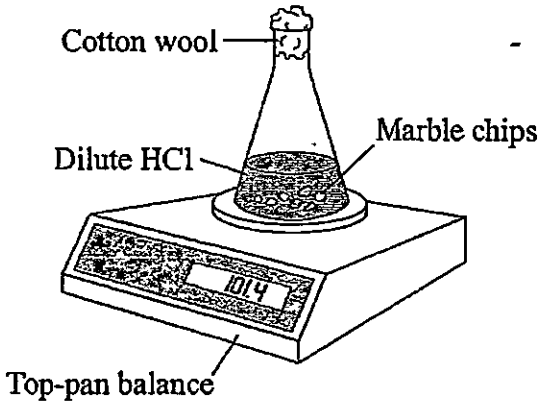
... .

.. .. [2]

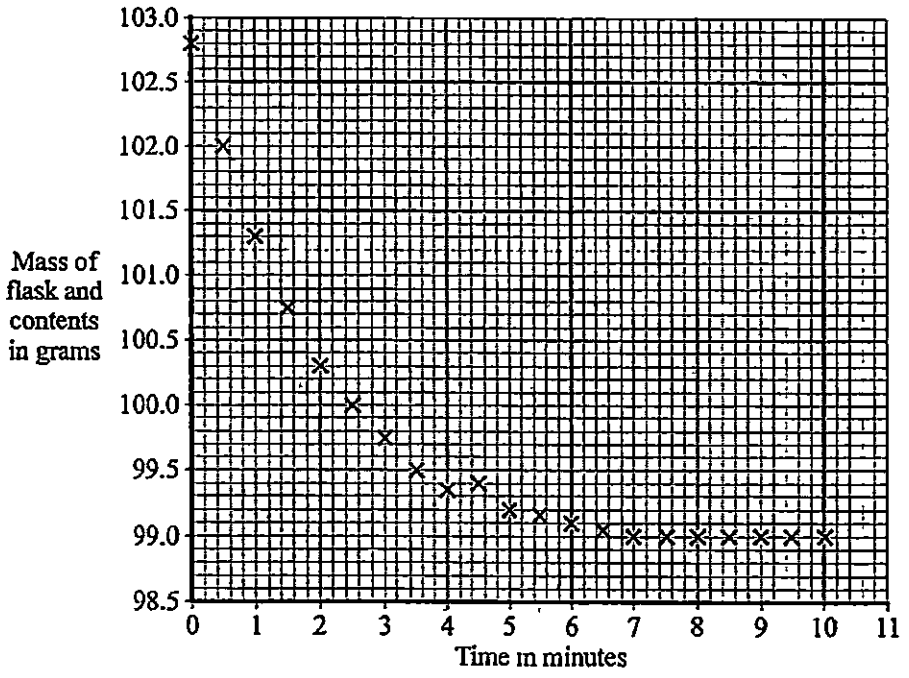
[Total: 5]

For Examiner's Use

A4 The rate of reaction between hydrochloric acid and excess marble chips (calcium carbonate) was investigated at a temperature of 40°C using the apparatus shown in the diagram below.



The mass of the flask and contents was measured every half minute for ten minutes. The data obtained was plotted on a graph shown in the grid below.



(a) Complete the graph by drawing a line of best fit. [1]

(b) Explain why the mass of the flask and contents decreased with time.

..... [1]

For Examiner's Use

(c) State the time taken for the reaction to complete.

. . . . . [1]

(d) A student repeated the experiment but forgot to place the cotton wool at the neck of the conical flask. State how his results would be different and explain your answer.

. . . . . [2]

(e) Given that 40 cm^3 of hydrochloric acid were used in the reaction, calculate the concentration of this acid in mol/dm^3.

[3]

Another student repeated the first experiment at a temperature of 50°C. All other variables were kept the same.

(f) On the same grid on page 5, draw the graph she can expect to obtain for this experiment. Label this graph **T**. [1]

(g) Explain, in terms of the collision theory, how an increase in temperature affects the rate of reaction.

. . . . . [3]

[Total: 12]

For Examiner's Use

A5 One method of manufacturing hydrogen is to pass methane and steam over heated nickel catalyst, a process called steam reforming.

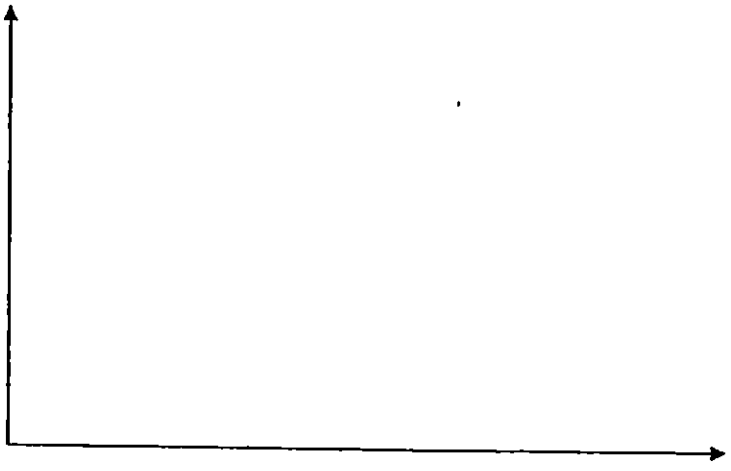
$$CH_4\,(g) + H_2O\,(g) \rightarrow CO\,(g) + 3H_2\,(g)$$

(a) Using the bond energies listed in the table below, calculate the enthalpy change (ΔH) of this reaction.

Bond	Bond energy (kJ/mol)
H – H	436
C – H	410
O – H	460
C – C	350
C ≡ O	1046

[3]

(b) Using your answer to part (a), draw the energy profile diagram using the axes given below, showing the activation energy and the enthalpy change clearly.



[3]

For Examiner's Use

(c) State whether this is an endothermic or exothermic reaction. Explain your answer in terms of bond breaking and bond forming.

.....

.....

.....

.....

..... [2]

[Total: 8]

For Examiner's Use

A6 The diagram below shows a food label describing the nutritional content of a packet of crackers.

Nutrition Facts

Serving Size 5 Crackers (16g)
Servings Per Container About 14

Amount Per Serving	
Calories 80 · Calories from Fat 35	
	% Daily Values
Total Fat 4g	**6%**
Saturated Fat 0.5g	**3%**
Trans Fat 0g	
Polyunsaturated Fat 2g	
Monounsaturated Fat 1g	
Cholesterol 0mg	**0%**
Sodium 150mg	**6%**
Total Carbohydrate 10g	**3%**

From the food label, it can be seen that the cracker contains both saturated and unsaturated fat.

(a) Describe a simple chemical test to differentiate between saturated fat and unsaturated fat.

.....

.....

.....

..... [2]

(b) Describe the main difference in structure between monounsaturated fat and polyunsaturated fat.

.....

.....

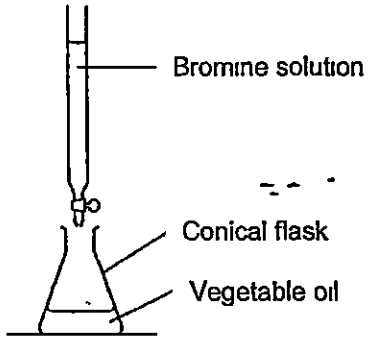
..... [1]

Saturated fats are linked to heart problems. In order to be able to claim that their crackers are healthy, the manufacturer decides to use a vegetable oil which has a higher unsaturated fat content. In a test to determine what kind of vegetable oil is healthier, a laboratory investigation was carried out.

20 cm^3 of different vegetable oils were titrated with bromine solution of concentration 0.50 mol/dm^3. The results are shown in the table on page 10.

10

For Examiner's Use



Vegetable oil	Initial burette reading (cm^3)	Final burette reading (cm^3)	Volume of bromine solution used (cm^3)
Palm	0.2	13.7	
Peanut	0.2	12 6	
Soya	0.1	14.4	
Sunflower	0.5	18.9	

(c) Complete the table above. [1]

(d) What colour change in the conical flask would be observed at the end point of the titration?

From . .. . to .... [1]

(e) Which is the healthiest vegetable oil to use to manufacture the crackers? Explain your answer.

Healthiest vegetable oil : ....

Reason . .. .

.. . .

... .,..... . ...

... . [2]

(f) Unsaturated vegetable oils can be hardened to make margarine. Describe how this process is carried out.

... ...

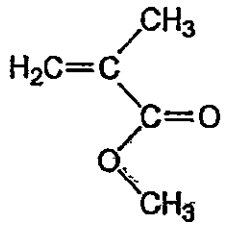
.. ..

... ... [2]

[Total: 9]

For Examiner's Use

A7 The diagram below shows the structure of an ester molecule **M**.



(a) Circle clearly on the above diagram the group of atoms which makes this molecule an ester. [1]

When **M** is reacted with water under reflux in the presence of a catalyst, an alcohol and a carboxylic acid are formed.

(b) Draw the structures of the 2 products formed.

Product 1 Product 2 [2]

When **M** undergoes polymerization, a polymer called Perspex is formed.

(c) What type of polymer is Perspex? Give a reason for your answer.

Type of polymer : ....

Reason : . .. .

.... [2]

(d) Draw the structure of Perspex, showing **two** repeat units.

[1]

[Total: 6]

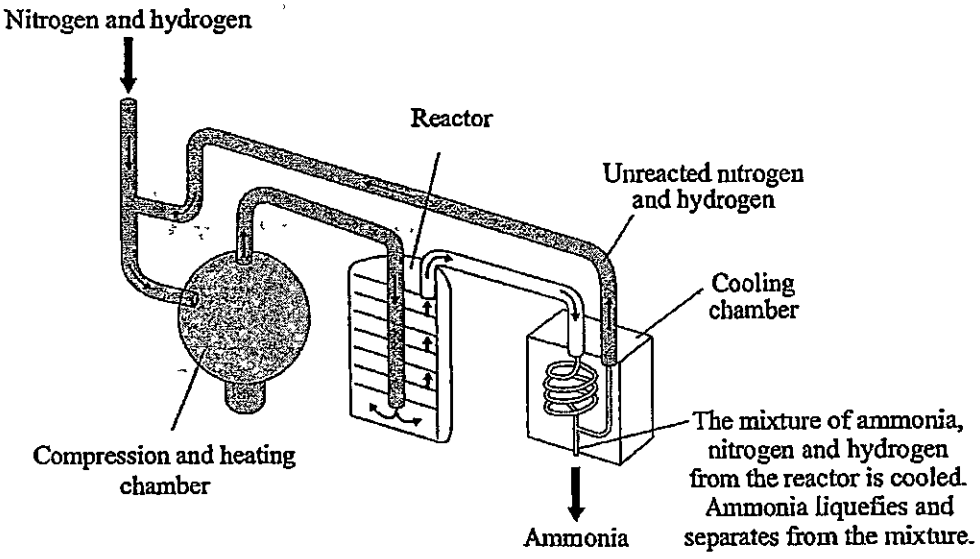
Section B

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

The last question is in the form of an either/or and only one of the alternatives should be attempted.

B8 The Haber process, also called the Haber–Bosch process, is an artificial nitrogen fixation process and is the main industrial procedure for the production of ammonia today. It converts atmospheric nitrogen to ammonia by reacting it with hydrogen. Named after its inventors, German chemists Fritz Haber and Carl Bosch, who developed it in the first half of the twentieth century, the Haber process provided Germany with a source of ammonia for the production of explosives during World War I. Today, the ammonia is mainly used to produce fertilisers.

The diagram below shows how a modern ammonia manufacturing plant looks like.



The yield of ammonia can vary, depending on the temperature and pressure. The table below shows the percentage yield under different conditions.

Pressure (atm)	Temperature (°C)					
	100	200	300	400	500	600
10	-	50.7	14.7	3 9	1.2	0.2
25	91.7	63.6	27.4	8.7	2 9	-
50	94.5	74.0	39 5	15.3	5 6	1.1
100	96.7	81.7	52.5	25 2	10.6	2.2
200	98.4	89.0	66.7	38.8	18.3	-
400	99.4	94.6	79.7	55 4	31.9	-
1000	-	98.3	92.6	79.8	57.5	12.9

(a) Write the equation (including state symbols) for the reaction between nitrogen and hydrogen in the Haber Process.

. . . . [1]

(b) State the main source of nitrogen and the process by which it is obtained.

.... [1]

(c) Suggest why air is not used in the Haber process although 78% of air is nitrogen.

. . . .

.... [1]

(d) The reactant gases are passed through a substance in the reactor. Name this substance and state its function.

Substance : ....[1]

Function : . . . . [1]

(e) From the information in the table, describe how temperature and pressure affects the yield of ammonia

.. . .

....

. .. .

....

... . [2]

(f) A particular ammonia plant uses a temperature of 400°C and pressure of 200 atm. Using the information in the table, calculate the mass of ammonia formed when 210 tonnes of nitrogen are reacted.

[2]

(g) The gases that leave the reactor still contain nitrogen One reason for this is that nitrogen is a relatively inert gas. Explain this property of nitrogen in terms of its bonding.

[2]

(h) The boiling points of nitrogen, hydrogen and ammonia are as follows :

Gas	Boiling point
nitrogen	-196°C
hydrogen	-253°C
ammonia	-33°C

Suggest a suitable temperature that the cooling chamber must have to be able to function effectively.

Temperature of cooling chamber : [1]

[Total: 12]

B9 The vertical columns in the Periodic Table are called Groups.

(a) Lithium is the first element in Group I.
Describe what you will observe when a piece of lithium is put into water.

.....

.....

.....

.....

..... [2]

(b) Fluorine is the first element in Group VII.
Describe and explain what you will observe when fluorine is bubbled in aqueous sodium iodide.

.....

.....

.....

.....

..... [2]

(c) Lithium reacts with fluorine to form lithium fluoride which melts at 845°C.

(i) Draw the 'dot and cross' diagram to show the bonding in lithium fluoride.

[2]

(ii) Explain why lithium fluoride has a high melting point

. .. .

. .. .

. ...

.. ..

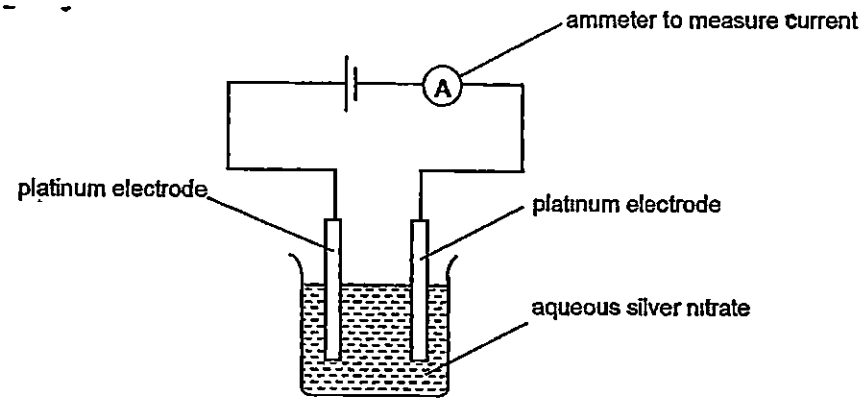
.. ..

.. .. [2]

[Total: 8]

EITHER

B10 A student carried out the electrolysis of two equal volumes of silver nitrate solutions of the same concentration using platinum electrodes as shown in the diagram below.



In Experiment 1, a current of 1 0 ampere was used and the mass of one of the electrodes was weighed every 5 minutes to determine the mass of the silver deposited. This was done for 60 minutes. The results in the following table are plotted on the grid on page 18.

Time (min)	0	5	10	15	20	25	30	35	40	45	50
Mass of silver deposited (g)	0	0.30	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.80	2.80

In Experiment 2, the student repeated the procedure using the same volume of aqueous silver nitrate solution but he increased the current to 1.5 amperes instead The results are shown in the following table.

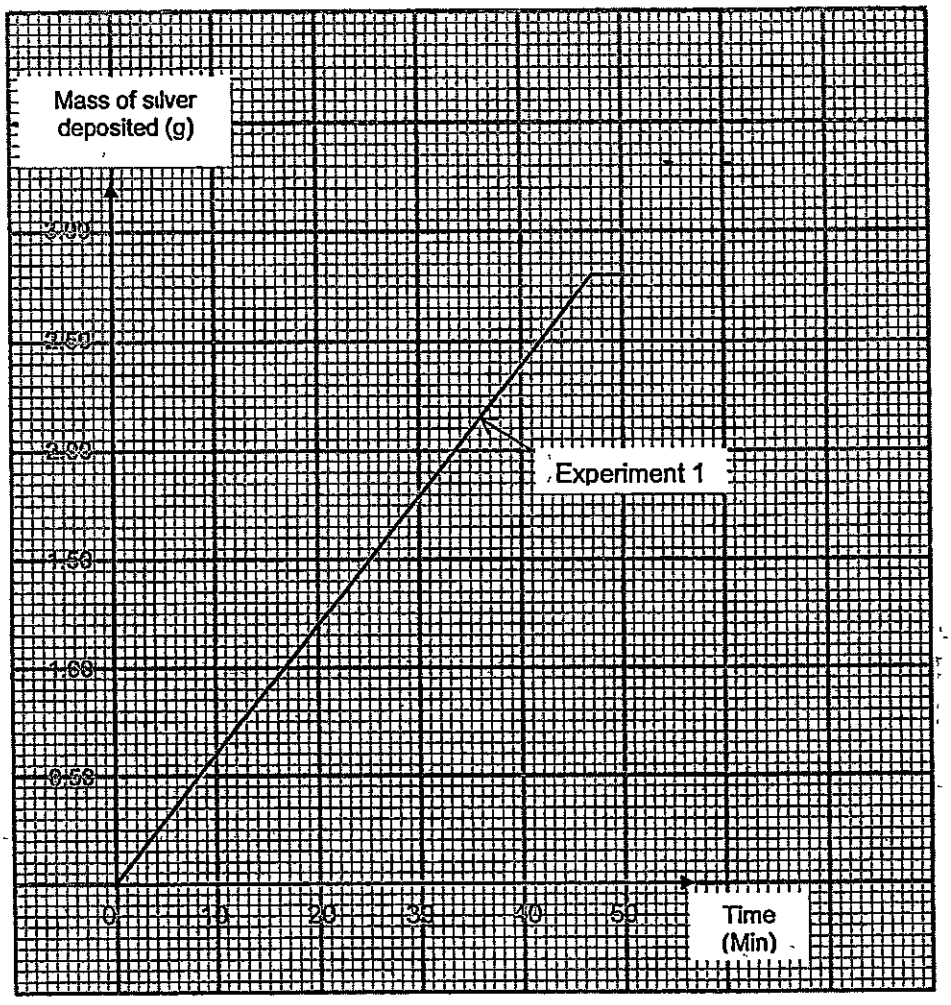
Time (min)	0	5	10	15	20	25	30	35	40	45	50
Mass of silver deposited (g)	0	0.45	0.90	1.35	1.80	2.25	2 70	?	2 80	2.80	2.80

(a) Name the electrode that was weighed in the experiment. Write the equation for the reaction which takes place at this electrode

Electrode : . ...

Equation . ... [2]

(b) Plot the graph of mass of silver deposited against time for Experiment 2 on the same grid on page 18. Label the graph "Experiment 2" clearly.



[1]

(c) Determine the mass of silver deposited after 35 minutes for the second experiment

. ... [1]

(d) State two conclusions from the results of the experiments.

. ...

. . ..

... .

....

.. .. [2]

(e) State a change in the electrolyte at the end of the electrolysis of the two silver nitrate solutions.

.. . . [1]

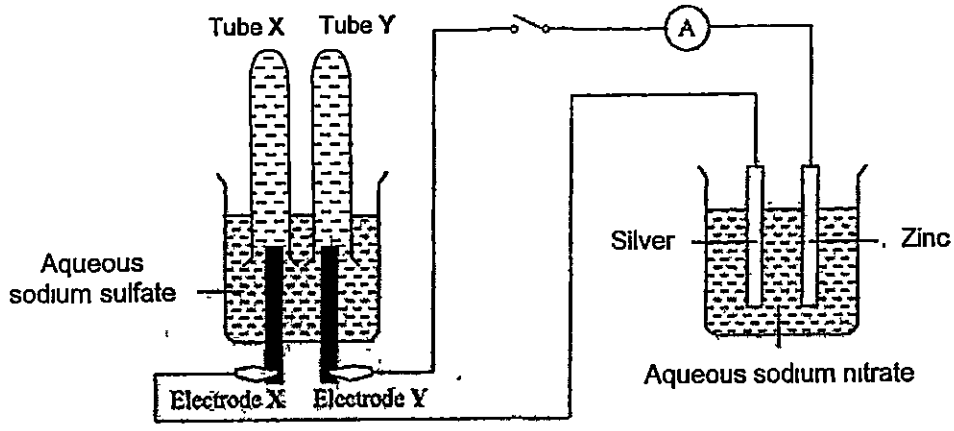
(f) If the electrolyte were replaced by copper(II) sulfate solution and the same current of 1 ampere was passed through, calculate the mass of copper deposited at the end of 40 minutes.

[3]

[Total: 10]

OR

B10 The diagram below shows an experimental set-up of a simple cell and an electrolytic cell Both electrodes **X** and **Y** are made of graphite. The switch is then closed and reactions take place in both cells



(a) Which is the simple cell? Explain your answer.

Simple Cell : Cell . ... [1]

Explanation : . ...

. . . .

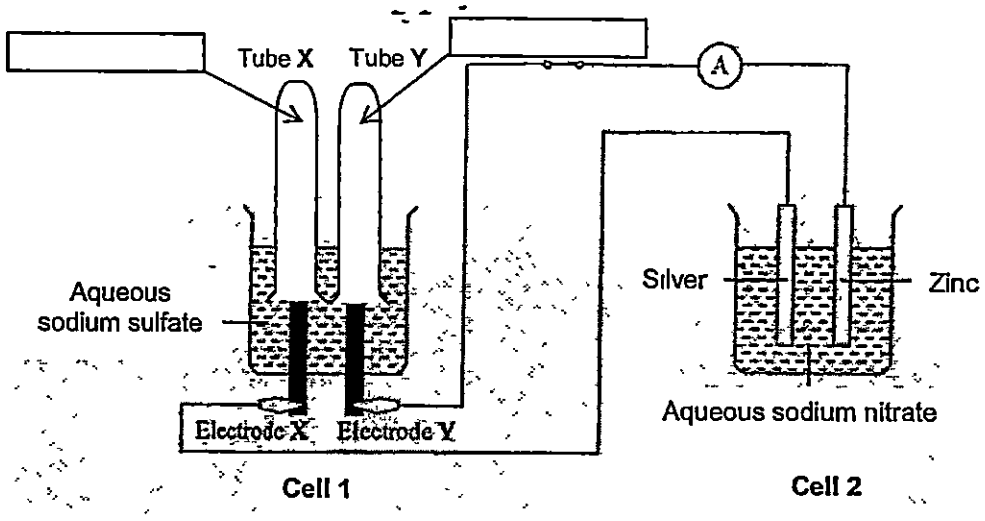
. . . . [1]

(b) Write the ionic equations for the reactions which take place at the electrodes of **Cell 1.**

Electrode **X** : .. .. [1]

Electrode **Y** : .... [1]

(c) Complete the diagram below to show the new levels of the aqueous sodium sulfate solution after the switch is closed for a while and hence the relative volumes of gases collected in tube **X** and tube **Y**. Label clearly the gases collected in each tube [2]



(d) Electrode **X** is then replaced by a copper rod. State an observation and explain your answer.

Observation : ..... [1]

Explanation : ..... [1]

(e) State and explain an observation that can be made in **Cell 2** during the experiment.

Observation : ..... [1]

Explanation : ..... [1]

[Total: 10]

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II										III	IV	V	VI	VII	0
							1 H Hydrogen 1									4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4										11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12										27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
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 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57 *	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	Rn Radon 86
Fr Francium 87	226 Ra Radium 88	227 Ac Actinium 89 †															

*58-71 Lanthanoid series	140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
†90-103 Actinoid series	232 Th Thorium 90	Pa Protactinium 91	238 U Uranium 92	Np Neptunium 93	Pu Plutonium 94	Am Americium 95	Cm Curium 96	Bk Berkelium 97	Cf Californium 98	Es Einsteinium 99	Fm Fermium 100	Md Mendelevium 101	No Nobelium 102	Lr Lawrencium 103

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

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)

Answers for SCGS Preliminary Examination Chemistry P1 2015

1-5	D	D	D	A	D
6-10	C	A	B	D	C
11-15	A	A	C	D	B
16-20	D	C	B	C	D
21-25	C	A	A	C	A
26-30	C	A	D	B	B
31-35	A	C	C	A	C
36-40	B	A	B	B	A

SINGAPORE CHINESE GIRLS' SCHOOL
Preliminary Examination
Secondary Four

CANDIDATE NAME			
CLASS	4	REGISTER NUMBER	
CENTRE NUMBER		INDEX NUMBER	

Chemistry

5073/02

Paper 2 Theory

Tuesday **28 July 2015** **1 hour 45 minutes**

Candidates answer on the Question Paper
No Additional materials are required
READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in
Write in dark blue or black pen
You may use a soft pencil for any diagrams or graphs
Do not use staples, paper clips, highlighters, glue or correction fluid/tape

Section A
Answer all questions in the spaces provided

Section B
Answer all questions, the last question is in the form either/or.
Answer all questions in the spaces provided

At the end of the examination, fasten all your work securely together
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 22

The use of an approved scientific calculator is expected, where appropriate

Answers

For Examiner's Use	
Section A	/50
B8	/12
B9	/8
B10	/10
Total	/80

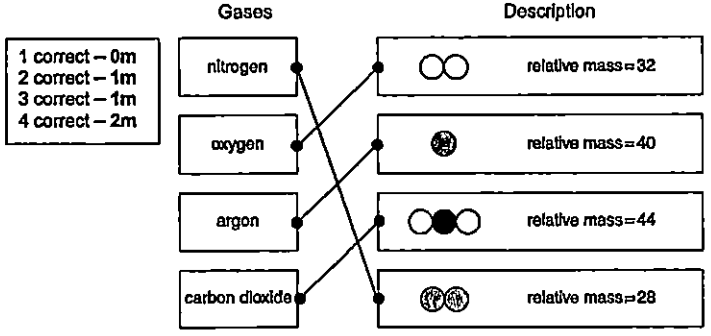
For Examiner's Use

Section A

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

A1 Four of the gases found in the air are nitrogen, oxygen, argon and carbon dioxide

(a) Draw straight lines which correctly match the gases and the descriptions shown on the right.



[2]

(b) Study the 6 statements below Put a tick (✓) in the box if the statement is true

Air is a mixture.	✓
All gases in air are elements.	
The components in air are only made up of non-metals	✓
There are weak attractions between the molecules in air	✓
The gases in air have high melting and boiling points	
Liquid air does not have a fixed boiling point.	✓

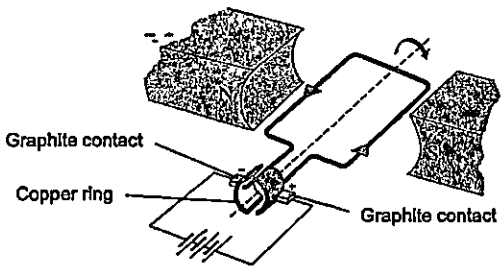
If 4 ticks or less, ignore wrong ticks
1 correct – 0m
2 correct – 1m
3 correct – 1m
4 correct – 2m
If 5 ticks or more, 1m

[2]

[Total 4]

For Examiner's Use

A2 The diagram below shows the main parts of an electric motor



Graphite contacts are used to conduct electricity to the copper ring When electricity passes through the wires, the copper ring rotates rapidly, turning the motor which is connected to the drill bit. The ring does not get stuck or become worn out

(a) Explain, in terms of structure and bonding, why copper and graphite are able to conduct electricity

(ai) NOT Accepted . Copper is surrounded by a sea of electrons; Copper has charged particles, Protons in a sea of electrons.

(i) copper

Outer/valence electrons of copper atoms are delocalized, **1m**

Electrons are mobile and able to move freely within metal lattice **1m**

[2]

(ii) graphite

1 valence electron from each carbon atom are not used for covalent

bonding with other atoms; **1m**

these delocalized electrons can move freely along the hexagonal layers **1m**

[2]

(b) Explain why the copper ring does not become worn out easily though it is in constant contact with the graphite during rotation.

Graphite is soft and slippery; **1m**

very little friction between the copper ring and graphite contacts, **1m**

[2]

(aii) NOT Accepted . Graphite has 3 valence out of 4 valence electrons involved in bonding (per atom not mentioned) ; Electrons bonded to each other ; One carbon bonded to 3 electrons , 3 out of 4 carbon atoms bonded, leaving one free to conduct electricity ; 3 out of 4 valence electrons bonded together , Van der waals forces between layers so there are free electrons between them ; Electrons move between layers

(b) NOT Accepted Graphite is soft (no mention of slippery) , Copper is hard ; Copper layers cannot slide

[Total: 6]

For Examiner's Use

A3 A student carries out some tests on an unknown solution P which is known to contain 2 metallic cations and 1 anion She recorded her observations and deductions in the table shown below.

Expt No	Procedure	Observations	Deductions
1a	To a solution of P, add sodium hydroxide solution	*White ppt formed*	*Pb^{2+}, Zn^{2+}, Ca^{2+} or Fe^{2+} could be present*
1b	Add excess sodium hydroxide solution into the test tube	*Ppt decreased by approximately half Remaining ppt is insoluble in excess sodium hydroxide*	*Ca^{2+} is present*
2	Add Devarda's alloy to the mixture in expt 1b Warm the mixture.	*Gas evolved turns moist red litmus blue*	*Cl is present*
3a	To new sample of solution P, add aqueous ammonia	*White ppt formed*	*Al^{3+}, Pb^{2+} or Zn^{2+} could be present*
3b	Add excess aqueous ammonia solution into the test tube	*White ppt insoluble in excess aqueous ammonia*	*Al^{3+} or Pb^{2+} could be present*

(a) The student made 3 mistakes in her deductions In the table below, state the experiment number in which the mistakes were made Briefly explain your answer

	Expt No.	Explanation
Mistake 1	1a	Fe^{2+} ions cannot be present as it forms green ppt, 1m
Mistake 2	1a	Aluminium ion (Al^{3+}) should also be a possible ion present as it forms white ppt with aqueous sodium hydroxide 1m
Mistake 3	2	Nitrate ion (NO_3^-) should be present, not chloride 1m

[3]

(b) Describe a simple test to differentiate between aluminium ions (Al^{3+}) and lead(II) ions (Pb^{2+})

Add aqueous potassium iodide, 1m, only lead(II) ions will give yellow ppt 1m

OR Add any solution containing chloride or sulfate ions (except of barium), 1m,

only lead(II) ions will give white ppt 1m

a) Mistake 3 - NOT Accepted :
Cl^- turns blue litmus red, then bleaches it;
Gas evolved is not chlorine (Chlorine gas is NOT mentioned ; only chloride ion)
Gas is NH_4^+ which turns red litmus blue , Ion should be NH_4^+, NH_3, NO_3^+

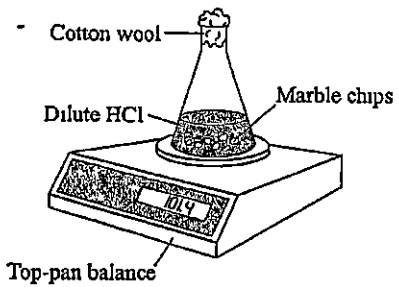
a) accept Expt 1 b
This means that Al^{3+} or Pb^{2+} may be present together with Ca^2
b) Displacement method, partial mark if explained correctly; Not accepted – use of barium chloride solution

[2]

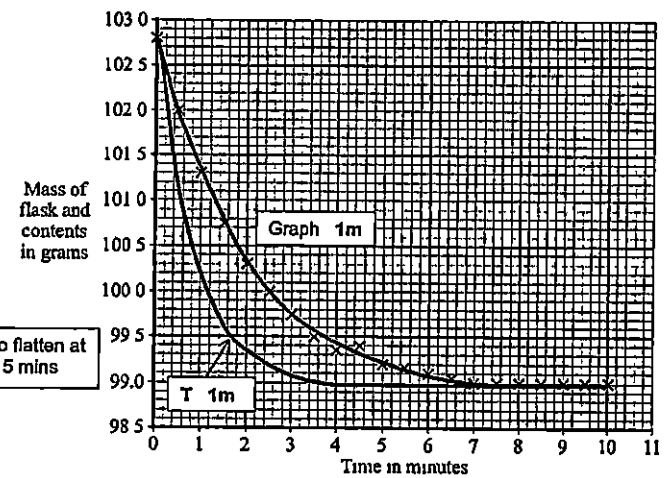
[Total: 5]

For Examiner's Use

A4 The rate of reaction between hydrochloric acid and excess marble chips (calcium carbonate) was investigated at a temperature of 40°C using the apparatus shown in the diagram below



The mass of the flask and contents was measured every half minute for ten minutes The data obtained was plotted on a graph shown in the grid below



Graph to flatten at about 3 5 mins

(a) Complete the graph by drawing a line of best fit. [1]

(b) Explain why the mass of the flask and contents decreased with time.

Carbon dioxide gas produced during the reaction escapes **1m**

b) Explanation must convey loss of carbon dioxide gas from flask to the surroundings

[1]

For Examiner's Use

(c) State the time taken for the reaction to complete

7 minutes **1m** | Reject all other answers [1]

(d) A student repeated the experiment but forgot to place the cotton wool at the neck of the conical flask State how his results would be different and explain your answer

Only answered 1st part correctly (no explanation) 1m , Correct answer but wrong/absurd reasoning 1m

Mass readings will be lower than the actual mass, **1m**

Without the cotton wool, some acid will be lost as acid spray **1m** [2]

(e) Given that 40 cm^3 of hydrochloric acid were used in the reaction, calculate the concentration of this acid in mol/dm^3

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$

ECF Max mark 1/3

Mass of carbon dioxide produced = 102 8 g – 99 0 g = 3 8 g

No of moles of carbon dioxide produced = $\frac{3.8}{44}$ moles = 0 086364 mole **1m**

2 moles of hydrochloric acid produces 1 mole of carbon dioxide

Hence, no of moles of hydrochloric acid present = 2 x 0 086364moles

= 0.17273 moles **1m**

Hence, concentration of hydrochloric acid = $\frac{0.17273}{0.04}$ = 4 32 mol/dm^3 **1m**

[3]

Another student repeated the first experiment at a temperature of 50°C All other variables were kept the same

(f) On the same grid on page 5, draw the graph she can expect to obtain for this experiment. Label this graph T [1]

(g) Explain, in terms of the collision theory, how an increase in temperature affects the rate of reaction

Particles gain kinetic energy and move faster or

More particles possess energy equal or greater than the activation energy, **1m**

Frequency of collisions increases, number of effective collisions increases

per unit time, **1m**

rate of reaction increases **1m**

[3]

[Total 12]

For Examiner's Use

A5 One method of manufacturing hydrogen is to pass methane and steam over heated nickel catalyst, a process called steam reforming

$$CH_4(g) + H_2O(g) \rightarrow CO(g) + 3H_2(g)$$

(a) Using the bond energies listed in the table below, calculate the enthalpy change (ΔH) of this reaction

No statements and wrong answer – 0m , minus 1m for no units or sign
If statements/concepts correct but calculation wrong, max 1m

Bond	Bond energy (kJ/mol)
H – H	436
C – H	410
O – H	460
C – C	350
C ≡ O	1046

Energy taken in to break bonds in reactants
4 C – H bonds in methane = 4 x +410 = +1640 kJ
2 O – H bonds in water = 2 x +460 = +920 kJ
Total energy taken in = + 1840 + 920 = +2560 kJ **1m**
Energy released when bonds are formed in products .
1 C≡O bond = 1 x -1046 = -1046 kJ
3 H – H = 3 x -436 = -1308 kJ
Total energy released = -1046 -1308 = -2354 kJ **1m**

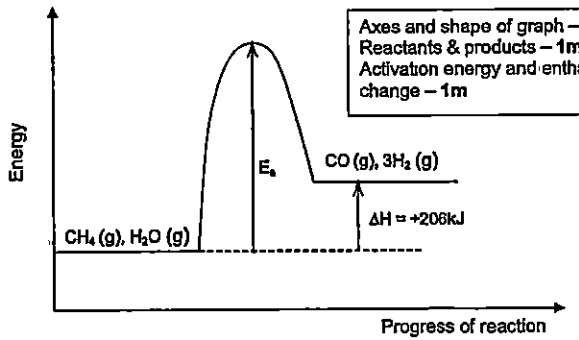
Hence, ΔH for reaction = +2560−2354 = +206 kJ **1m**

[3]

(b) Using your answer to part (a), draw the energy profile diagram using the axes given below, showing the activation energy and the enthalpy change clearly

ECF If Part a ΔH wrong but all parts correct in part b, max 3m
Reject terms such as energy needed, required for both bond-making/breaking processes

Axes and shape of graph – **1m**
Reactants & products – **1m**
Activation energy and enthalpy change – **1m**



[3]

For Examiner's Use

(c) State whether this is an endothermic or exothermic reaction Explain your answer in terms of bond breaking and bond forming

Energy taken in to break the bonds in methane and steam is greater than energy released when bonds are formed in carbon monoxide and hydrogen,

(or vice versa) hence it is an endothermic reaction

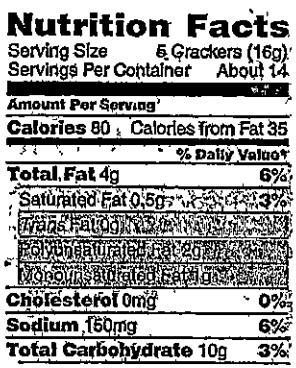
Energy taken in to break the bonds in reactants and energy released when bonds are formed in products – 1m Greater/lesser and endothermic reaction – 1m

[2]

[Total 8]

For Examiner's Use

A6 The diagram below shows a food label describing the nutritional content of a packet of crackers



Nutrition Facts

Serving Size 6 Crackers (16g)
Servings Per Container About 14

Amount Per Serving	
Calories 80	Calories from Fat 35
	% Daily Value†
Total Fat 4g	6%
Saturated Fat 0.5g	3%
Trans Fat 0g	
Polyunsaturated Fat 2g	
Monounsaturated Fat 1g	
Cholesterol 0mg	0%
Sodium 150mg	6%
Total Carbohydrate 10g	3%

From the food label, it can be seen that the cracker contains both saturated and unsaturated fat.

(a) Describe a simple chemical test to differentiate between saturated fat and unsaturated fat.

Add aqueous bromine into the sample of fat and shake, **1m**

Unsaturated fat will decolourise the reddish brown bromine, no visible change with saturated fat (Bromine remains brown) **1m**

[2]

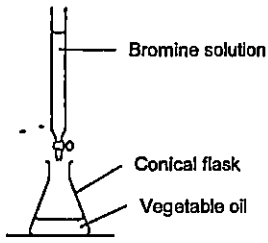
(b) Describe the main difference in structure between monounsaturated fat and polyunsaturated fat.

Monounsaturated fat has one carbon-carbon double bond per molecule compared to polyunsaturated which has many carbon-carbon double bonds in the molecules (or vice versa) **1m**

[1]

Saturated fats are linked to heart problems In order to be able to claim that their crackers are healthy, the manufacturer decides to use a vegetable oil which has a higher unsaturated fat content. In a test to determine what kind of vegetable oil is healthier, a laboratory investigation was carried out.

20 cm^3 of different vegetable oils were titrated with bromine solution of concentration 0 50 mol/dm^3. The results are shown in the table on page 10



Vegetable oil	Initial burette reading (cm^3)	Final burette reading (cm^3)	Volume of bromine solution used (cm^3)
Palm	0 2	13 7	13 5
Peanut	0 2	12 6	12 4
Soya	0 1	14 4	14 3
Sunflower	0 5	18 9	18 4

(c) Complete the table above

All values correct – 1m [1]

(d) What colour change in the conical flask would be observed at the end point of the titration?

From pale yellow/colourless to light brown (Both colours correct 1m) [1]

(e) Which is the healthiest vegetable oil to use to manufacture the crackers? Explain your answer

Healthiest vegetable oil . Sunflower oil 1m

Reason Sunflower oil needs the highest volume of bromine solution to react with it completely, suggesting that sunflower oil is most unsaturated (has the largest number of carbon-carbon double bonds 1m

[2]

(f) Unsaturated vegetable oils can be hardened to make margarine Describe how this process is carried out.

Carry out hydrogenation (or react vegetable oil with hydrogen), 1m

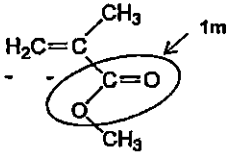
at temperature of 200°C and nickel catalyst 1m

[2]

[Total 9]

For Examiner's Use

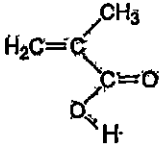
A7 The diagram below shows the structure of an ester molecule M



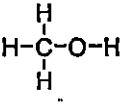
(a) Circle clearly on the above diagram the group of atoms which makes this molecule an ester. [1]

When M is reacted with water under reflux in the presence of a catalyst, an alcohol and a carboxylic acid are formed

(b) Draw the structures of the 2 products formed



1m



1m

Product 1 Product 2 [2]

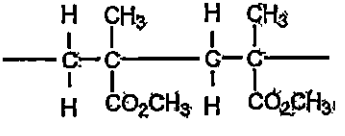
When M undergoes polymerization, a polymer called Perspex is formed

(c) What type of polymer is Perspex? Give a reason for your answer.

Type of polymer : Addition polymer 1m

Reason . M has a carbon-carbon double bond which allows addition polymerization to take place 1m [2]

(d) Draw the structure of Perspex, showing two repeat units



1m

[1]

[Total 6]

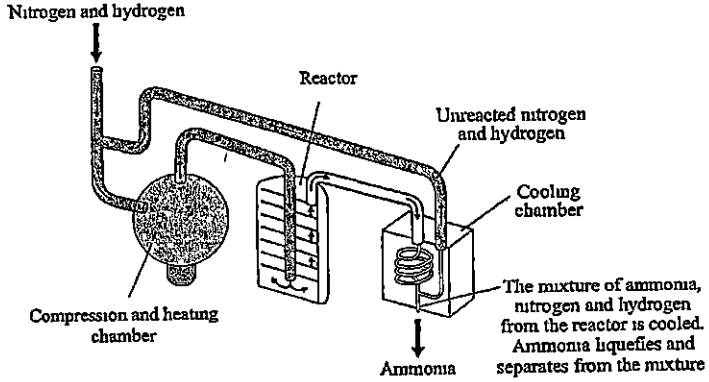
Section B

Answer all three questions in this section

The last question is in the form of an either/or and only one of the alternatives should be attempted

B8 The Haber process, also called the Haber–Bosch process, is an artificial nitrogen fixation process and is the main industrial procedure for the production of ammonia today. It converts atmospheric nitrogen to ammonia by reacting it with hydrogen Named after its inventors, German chemists Fritz Haber and Carl Bosch, who developed it in the first half of the twentieth century, the Haber process provided Germany with a source of ammonia for the production of explosives during World War I Today, the ammonia is mainly used to produce fertilisers

The diagram below shows how a modern ammonia manufacturing plant looks like



The yield of ammonia can vary, depending on the temperature and pressure The table below shows the percentage yield under different conditions

Pressure (atm)	Temperature (°C)					
	100	200	300	400	500	600
10	-	50 7	14 7	3 9	1 2	0 2
25	91 7	63 6	27.4	8 7	2 9	-
50	94 6	74 0	39 5	15 3	5 6	1 1
100	96 7	81 7	52 5	25 2	10 6	2 2
200	98 4	89 0	66 7	38 8	18 3	-
400	99 4	94 6	79 7	55 4	31 9	-
1000	-	98 3	92 6	79 8	57 5	12 9

(a) Write the equation (including state symbols) for the reaction between nitrogen and hydrogen in the Haber Process

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ **1m**

(b) State the main source of nitrogen and the process by which it is obtained

Fractional distillation of liquid air **1m** [1]

(c) Suggest why air is not used in the Haber process although 78% of air is nitrogen

Oxygen in the air will react with the hydrogen at high temperature and lower the yield of ammonia **1m** [1]

(d) The reactant gases are passed through a substance in the reactor Name this substance and state its function

Substance Finely divided iron **1m** [1]

Function Catalyst to speed up reaction **1m** [1]

(e) From the information in the table, describe how temperature and pressure affects the yield of ammonia

The higher the temperature, the lower the yield **1m**

The higher the pressure the higher the yield **1m**

[2]

(f) A particular ammonia plant uses a temperature of 400°C and pressure of 200 atm Using the information in the table, calculate the mass of ammonia formed when 210 tonnes of nitrogen are reacted

From mass ratio of equation, 28 units of nitrogen yields 34 units of ammonia

Hence, 210 tonnes of nitrogen yield = $\frac{34}{28} \times 210 = 255$ tonnes of ammonia **1m**

From table, the yield at 400°C and 200 atm is 38 8%

Hence, the mass of ammonia formed = $\frac{38.8}{100} \times 255 = 98\ 94$ tonnes of ammonia
= 98 9 tonnes (3 s f) **1m**

[2]

(g) The gases that leave the reactor still contain nitrogen One reason for this is that nitrogen is a relatively inert gas Explain this property of nitrogen in terms of its bonding

Nitrogen is a very inert/unreactive gas,

Each nitrogen molecule has 3 covalent bonds joining 2 nitrogen atoms, **1m**

a lot of energy is required to break these bonds **1m**

[2]

(h) The boiling points of nitrogen, hydrogen and ammonia are as follows

Gas	Boiling point
nitrogen	-196°C
hydrogen	-253°C
ammonia	-33°C

Suggest a suitable temperature that the cooling chamber must have to be able to function effectively

Temperature of cooling chamber Any temp between -34°C and -196°C **1m** [1]

[Total 12]

B9 The vertical columns in the Periodic Table are called Groups

(a) Lithium is the first element in Group I
Describe what you will observe when a piece of lithium is put into water

Lithium darts on the surface, **1m**

Reject skip or jump

sizzling sound, **1m**

sparks **1m** **(Any 2 points, 2m)**

[2]

(b) Fluorine is the first element in Group VII
Describe and explain what you will observe when fluorine is bubbled in aqueous sodium iodide

Iodine is not reddish brown!
Water present so iodine formed in aqueous state not as a purple gas!
NOT fluorine is more reactive than iodide ;
NOT iodide ion not iodine ion!

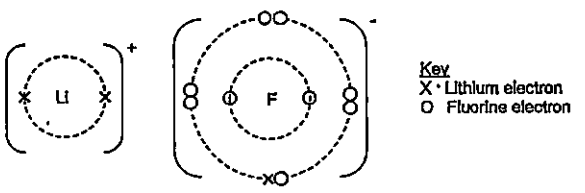
Colourless solution turns brown / black precipitate will be seen, **1m**

Fluorine is more reactive than iodine and displaces the iodide ions to form brown aqueous iodine **1m**

[2]

(c) Lithium reacts with fluorine to form lithium fluoride which melts at 845°C

(i) Draw the 'dot and cross' diagram to show the bonding in lithium fluoride



1m **1m**

[2]

(ii) Explain why lithium fluoride has a high melting point.

Lithium fluoride has giant crystal/ionic lattice structure, 1m

Strong electrostatic force of attraction between lithium and fluoide ions,

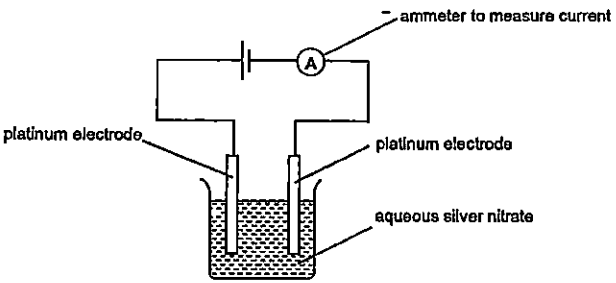
a lot of energy is required to break force of attraction, hence high m p 1m

[2]

[Total 8]

EITHER

B10 A student carried out the electrolysis of 2 equal volumes of silver nitrate solutions of the same concentration using platinum electrodes as shown in the diagram below



In Experiment 1, a current of 1 0 ampere was used and the mass of one of the electrodes was weighed every 5 minutes to determine the mass of the silver deposited. This was done for 60 minutes The results in the following table are plotted on the grid on page 18

Time (min)	0	5	10	15	20	25	30	35	40	45	50
Mass of silver deposited (g)	0	0 30	0 60	0 90	1 20	1 50	1 80	2 10	2.40	2 80	2 80

In Experiment 2, the student repeated the procedure using the same volume of aqueous silver nitrate solution but he increased the current to 1 5 amperes instead The results are shown in the following table

Time (min)	0	5	10	15	20	25	30	35	40	45	50
Mass of silver deposited (g)	0	0.45	0.90	1.35	1 80	2 25	2.70	?	2.80	2.80	2.80

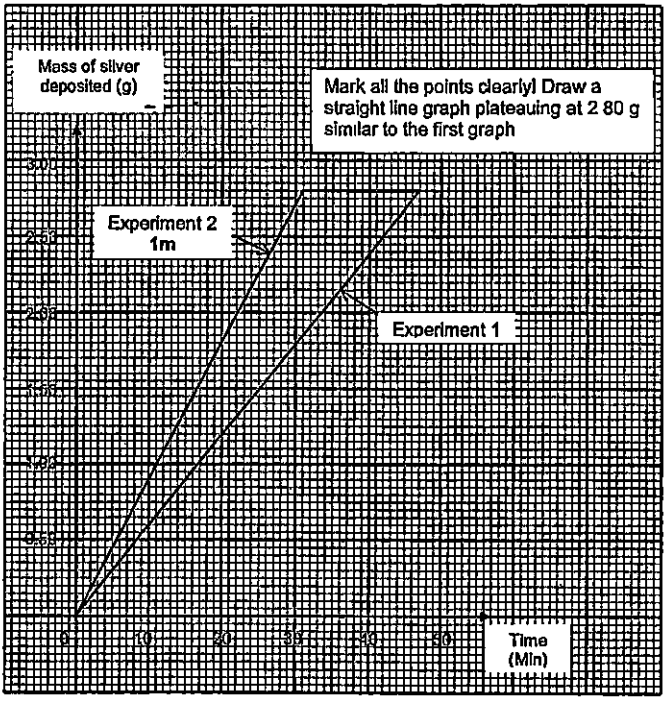
(a) Name the electrode that was weighed in the experiment. Write the equation for the reaction which takes place at this electrode

Electrode Cathode 1m

Equation . $Ag^+(aq) + e \rightarrow Ag(s)$ 1m [2]

(b) Plot the graph of mass of silver deposited against time for Experiment 2 on the same grid on page 18 Label the graph "Experiment 2" clearly

Remark , The tables show an increase in mass of the electrode so this must be the cathode Silver ions are preferentially discharged to form silver solid on the cathode



[1]

(c) Determine the mass of silver deposited after 35 minutes for the second experiment

2.80 g **1m** [1]

(d) State two conclusions from the results of the experiments

Mass of silver deposited is directly proportional to time, **1m**

The larger the current, the faster the rate of the silver deposited **1m** OR

An increase in current from 1 ampere to 1 5 amperes has no effect on the final mass of silver deposited [2]

The two experiments involve mass of silver deposited, time and current so conclusions should be specific to these factors and their relationships

Rejected
The final mass of silver for both experiments in 2 80 g (not a conclusion based on experiments but a fact)
An increase in current increases the rate of reaction/ rate of electrolysis (not specific enough)

When the same volume and concentration of solution is used, the mass of silver deposited will be the same (True but not based on experiments, we did not vary volume/concentration to investigate this)

(e) State a change in the electrolyte at the end of the electrolysis of the two silver nitrate solutions

The electrolyte becomes more acidic or pH decreases **1m OR** [1]

Concentration of silver ions decreases **1m**

(f) If the electrolyte were replaced by copper(II) sulfate solution and the same current of 1 ampere was passed through, calculate the mass of copper deposited at the end of 40 minutes

Number of moles of silver deposited = $\frac{2.4}{108}$ mole = 0 022222 mole **1m**

$$Ag^{+}(aq) + e \rightarrow Ag(s)$$

1 mole of silver ions takes in 1 mole of electrons to form 1 mole of silver

Hence, 0 022222 mole of silver has combined with 0 022222 mole of electrons

$$Cu^{2+}(aq) + 2e \rightarrow Cu(s)$$

Cu^{2+} ions takes in twice the number of electrons to form 1 mole of copper

Hence, number of moles of copper deposited by 0 022222 mole of electrons

= 0 5 x 0 022222 = 0 011111 mole **1m**

Mass of copper deposited = 0 011111 x 64 = 0.711 g (3 s f) **1m**

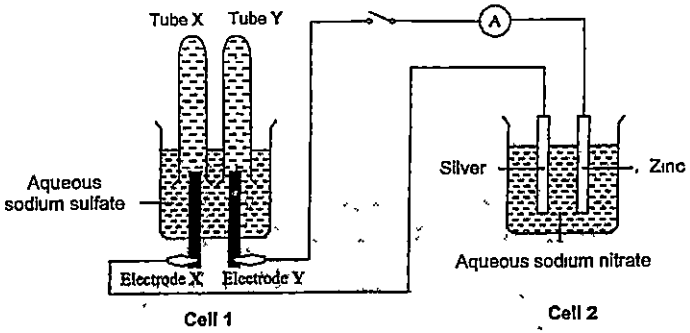
Rejected.
Mass of copper deposited = 2.40/ 2 = 1 20 g (Ratio of masses ≠ ratio of moles)

[3]

[Total 10]

OR

B10 The diagram below shows an experimental set-up of a simple cell and an electrolytic cell Both electrodes X and Y are made of graphite The switch is then closed and reactions take place in both cells



(a) Which is the simple cell? Explain your answer

Simple Cell Cell 2 **1m** [1]

Explanation : simple cell consists of 2 different metals dipped in electrolyte

and not connected to external power supply Both points **1m**

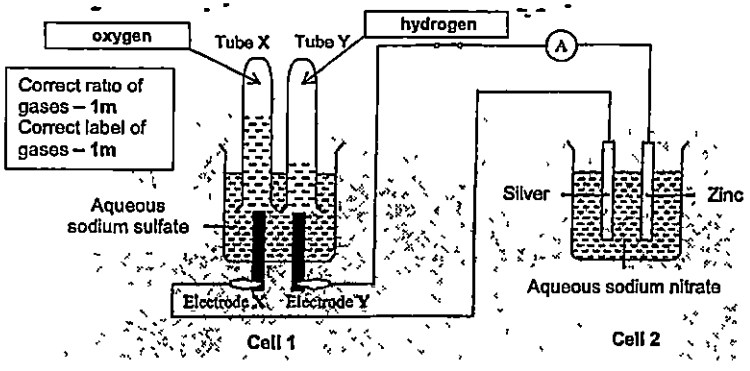
[1]

(b) Write the ionic equations for the reactions which take place at the electrodes of **Cell 1.**

Electrode X $4OH^-(aq) \rightarrow 2H_2O(l) + O_2(g) + 4e$ **1m** [1]

Electrode Y $2H^+(aq) + 2e \rightarrow H_2(g)$ **1m** [1]

(c) Complete the diagram below to show the new levels of the aqueous sodium sulfate solution after the switch is closed for a while and hence the relative volumes of gases collected in tube **X** and tube **Y** Label clearly the gases collected in each tube [2]



(d) Electrode **X** is then replaced by a copper rod State an observation and explain your answer.

Observation electrolyte will turn blue OR size of copper decreases **1m** [1]

Explanation : Copper electrode (the anode) ionizes to form copper(II) ions which is blue, hence electrolyte turns blue OR copper electrode becomes smaller as copper ionizes **1m** [1]

(e) State and explain an observation that can be made in **Cell 2** during the experiment.

Observation : Size of zinc decreases OR bubbles seen at silver electrode **1m** [1]

Explanation : zinc, the more reactive metal, ionizes to form zinc ions OR Hydrogen ions accept electrons to form hydrogen gas **1m**

[1]

[Total 10]

Rejected
Reddish brown solid deposited on electrode Y (this does not happen immediately, at the beginning effervescence is seen as hydrogen ions are preferentially discharged)

DATA SHEET
The Periodic Table of the Elements

Group																	
I	II										III	IV	V	VI	VII	0
							H 1									He 2
Li 3	Be 4										B 5	C 6	N 7	O 8	F 9	Ne 10
Na 11	Mg 12										Al 13	Si 14	P 15	S 16	Cl 17	Ar 18
K 19	Ca 20	Sc 21	Ti 22	V 23	Cr 24	Mn 25	Fe 26	Co 27	Ni 28	Cu 29	Zn 30	Ga 31	Ge 32	As 33	Se 34	Br 35	Kr 36
Rb 37	Sr 38	Y 39	Zr 40	Nb 41	Mo 42	Tc 43	Ru 44	Rh 45	Pd 46	Ag 47	Cd 48	In 49	Sn 50	Sb 51	Te 52	I 53	Xe 54
Cs 55	Ba 56	La 57 *	Hf 72	Ta 73	W 74	Re 75	Os 76	Ir 77	Pt 78	Au 79	Hg 80	Tl 81	Pb 82	Bi 83	Po 84	At 85	Rn 86
Fr 87	Ra 88	Ac 89 †															

Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	Ho 67	Er 68	Tm 69	Yb 70	Lu 71
Th 90	Pa 91	U 92	Np 93	Pu 94	Am 95	Cm 96	Bk 97	Cf 98	Es 99	Fm 100	Md 101	No 102	Lr 103

*58-71 Lanthanoid series
†90-103 Actinoid series

Key: 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.).