Name	Class	Register Number

5073/01 (with SPA)

16/4P2/5073/1

CHEMISTRY
PAPER 1

Thursday **11 August 2016** **1 hour**

SECOND PRELIMINARY EXAMINATION
(SECONDARY FOUR)

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your name, class and index number on all the work you hand in.
Do not use staples, paper clips, glue or correction fluid.

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

Read the instructions on the Answer Sheet very carefully.

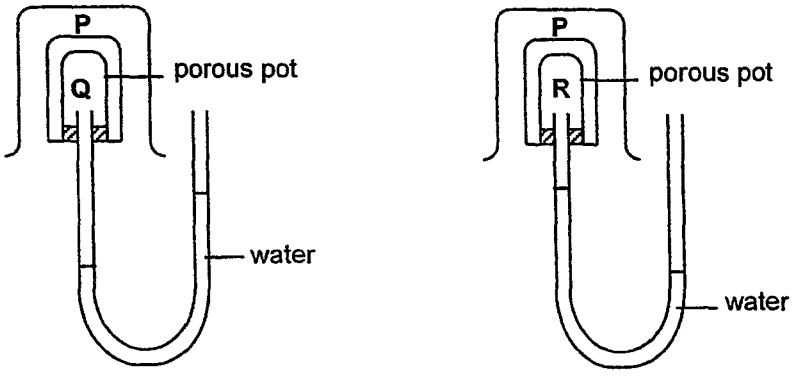
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

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

A copy of Periodic Table is printed on **page 16**.

This question paper consists of 16 printed pages (including this cover page)

1 Two beakers containing gas **P** were placed over two porous pots containing gases **Q** and **R** as shown below.



What are the relative molecular masses of gases **P**, **Q** and **R** in ascending order?

A **P , Q , R**
B **Q , P , R**
C **R , P , Q**
D **R , Q , P**

2 The table below shows the properties of lead(II) sulfate, sodium chloride and naphthalene.

substance	lead(II) sulfate	sodium chloride	napthalene
solubility in water	insoluble	soluble	insoluble
solublity in ethanol	insoluble	insoluble	soluble
reaction to heat	no effect	no effect	sublimes

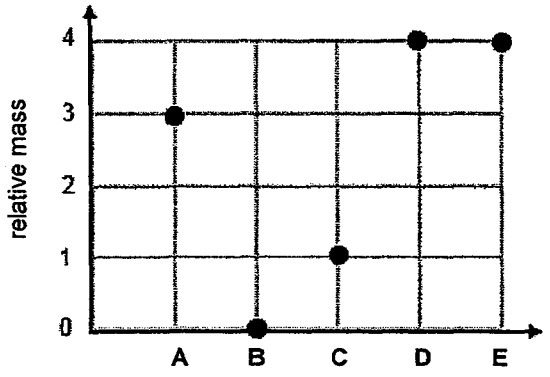
What is the sequence of steps involved in obtaining a pure sample of lead(II) sulfate from a solid mixture of lead(II) sulfate, sodium chloride and naphthalene?

1 dissolve the mixture in ethanol
2 dissolve the mixture with water
3 filter the mixture
4 carry out sublimation
5 evaporate the filtrate
6 rinse and dry the residue

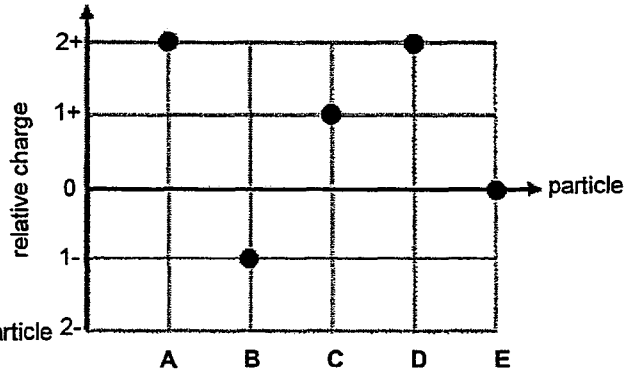
A 1 , 3 , 6 , 2
B 1 , 4 , 3 , 5
C 4 , 1 , 3 , 6
D 4 , 2 , 3 , 6

3 Graphs 1 and 2 show the relative masses and relative charges of five particles, **A – E**.

Graph 1



Graph 2



Which of the following statements are correct?

1 Particle **B** could represent an electron.
2 Particle **C** could represent a hydrogen ion.
3 Particle **E** could represent the nucleus of a helium atom.
4 Particles **A** and **D** could represent the nuclei of isotopes.

A 1 and 2 only
B 3 and 4 only
C 1, 2 and 4 only
D 2, 3 and 4 only

4 **X**, **Y** and **Z** are compounds of elements in Period 3. Their electrical conductivities are shown in the table below.

	X	Y	Z
electrical conductivity of the compound in the molten state	good	good	does not conduct
electrical conductivity of the mixture obtained upon addition of water to the compound	good	does not conduct	does not conduct

What are the possible identities of **X**, **Y** and **Z**?

	X	Y	Z
A	Al_2O_3	$SiCl_4$	NaF
B	NaF	Al_2O_3	SiO_2
C	NaF	$SiCl_4$	SiO_2
D	$SiCl_4$	SiO_2	Al_2O_3

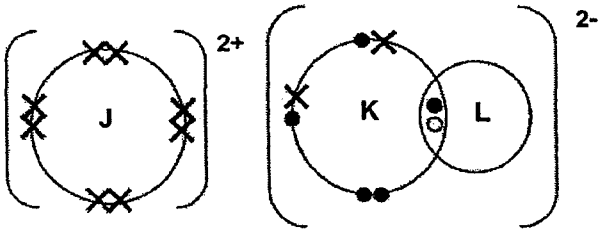
5 How many molecules shown below contain single covalent bonds?

Cl_2 H_2 HCl N_2 O_2

A 2 **B** 3 **C** 4 **D** 5

6 **J**, **K** and **L** are elements in the Periodic Table.

The 'dot-and-cross' diagram below shows the outermost electrons of a compound formed between **J**, **K** and **L**.



Which of the following statements are correct?

1 **J** and **K** will form a covalent compound with formula of J_3K_2.

2 **J** and **L** will form an ionic compound with formula JL_2.

3 **K** and **L** will form a covalent compound formula KL_3.

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

7 The reaction between iron(II) chloride and acidified potassium manganate(VII) is represented by the following ionic equation.

$$\mathbf{p}Fe^{2+}(aq) + \mathbf{q}H^{+}(aq) + MnO_4^{-}(aq) \rightarrow Mn^{2+}(aq) + \mathbf{v}Fe^{3+}(aq) + \mathbf{w}H_2O(l)$$

What are the coefficients representing **p**, **q**, **v** and **w**?

	p	**q**	**v**	**w**
A	2	4	2	2
B	3	6	3	3
C	4	8	4	4
D	5	8	5	4

8 A student examines two semi-precious stones known as quartz, SiO_2 and calcite, $CaCO_3$.

Which method can be used to distinguish between the two stones?

A add a fixed volume of distilled water followed by a few drops of Universal Indicator

B add a fixed volume of aqueous barium nitrate and observe for the formation of any precipitate

C add a fixed volume of dilute hydrochloric acid and test for the identity of any gas evolved

D add a fixed volume of aqueous sodium hydroxide to each of the sample and measure the temperature change

9 A farmer spreads lime, $Ca(OH)_2$ on acidic soil which has been treated with ammonium nitrate fertiliser.

Which of the following reactions will take place in the soil?

1 $Ca(OH)_2 + 2NH_4^+ \rightarrow Ca^{2+} + 2NH_3 + 2H_2O$

2 $Ca(OH)_2 + 2H^+ \rightarrow Ca^{2+} + 2H_2O$

3 $Ca(OH)_2 + SO_2 \rightarrow CaSO_3 + H_2O$

A 1 only

B 1 and 2 only

C 2 and 3 only

D 1, 2 and 3

10 Solid potassium halides react with concentrated sulfuric acid as shown in the equations below.

Equation 1 $2KCl + H_2SO_4 \rightarrow K_2SO_4 + 2HCl$

Equation 2 $2KBr + 2H_2SO_4 \rightarrow K_2SO_4 + SO_2 + Br_2 + 2H_2O$

Equation 3 $8KI + 5H_2SO_4 \rightarrow 4K_2SO_4 + H_2S + 4I_2 + 4H_2O$

What is the largest change in oxidation number of sulfur in each of the above equations?

	1	2	3
A	0	2	8
B	0	4	8
C	1	2	4
D	2	0	4

11 Which pair of reactants can be used to prepare a pure, dry sample of silver nitrate?

A silver carbonate and dilute nitric acid

B silver chloride and aqueous sodium nitrate

C silver hydroxide and aqueous potassium nitrate

D silver sulfate and dilute nitric acid

12 Which of the following oxides is insoluble in aqueous sodium hydroxide?

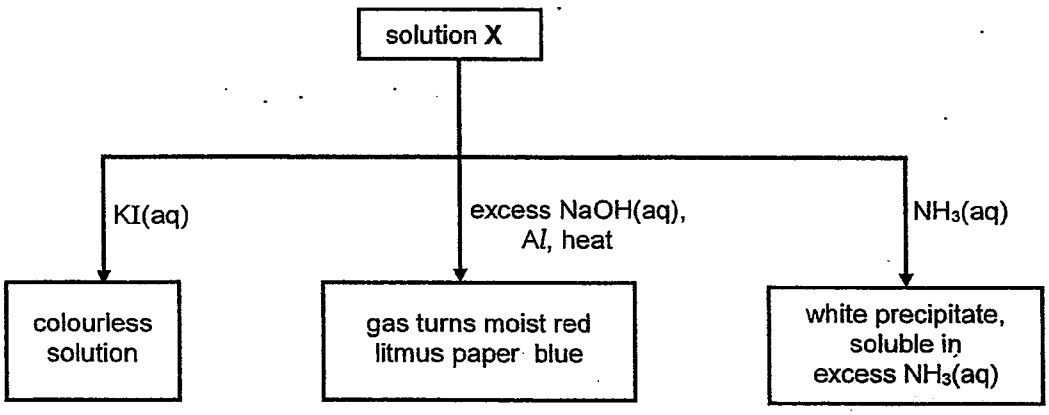
A Al_2O_3 **B** MgO **C** P_4O_{10} **D** SO_2

13 Separate samples of hydrogen peroxide are added to aqueous potassium iodide and to acidified potassium manganate(VII). The iodide ions are oxidised and the manganate(VII) ions are reduced.

Which of the following observations is correct?

	aqueous potassium iodide	acidified potassium manganate(VII)
A	brown to colourless	orange to green
B	brown to colourless	purple to colourless
C	colourless to brown	orange to green
D	colourless to brown	purple to colourless

14 The flow chart below shows some reactions of solution **X**.



What could be solution **X**?

A aluminium nitrate

B calcium chloride

C lead(II) nitrate

D zinc nitrate

15 60.0 cm^3 of oxygen gas reacted with 10.0 cm^3 of hydrocarbon in a closed vessel. 50.0 cm^3 of gases remained when it is cooled. The gases were then passed through aqueous sodium hydroxide and 30.0 cm^3 of oxygen gas was left.

What is the molecular formula of the hydrocarbon?

A CH_4 **B** C_2H_4 **C** C_2H_6 **D** C_3H_6

16 The reaction between aluminium powder and anhydrous barium nitrate is shown in the equation below.

$$10Al + 3Ba(NO_3)_2 \rightarrow 5Al_2O_3 + 3BaO + 3N_2$$

What is the mass of barium oxide produced when 5.40 g of aluminium powder reacts with 5.22 g of anhydrous barium nitrate?

A 1.62 g **B** 3.06 g **C** 9.18 g **D** 10.2 g

17 A sample of 4.00 dm^3 of air containing sulfur dioxide was passed through a suspension of calcium carbonate as shown in the equation below.

$$SO_2 + CaCO_3 \rightarrow CaSO_3 + CO_2$$

The mass of calcium sulfite formed at the end of the reaction is 12.0 g.

What is the percentage by volume of sulfur dioxide present in the sample of air at room temperature and pressure?

A 45.0 % **B** 60.0 % **C** 70.0 % **D** 85.0 %

18 Which statements describe one mole of nitrogen gas correctly?

1 It has a mass of 14.0 g.

2 It contains 6×10^{23} nitrogen atoms.

3 It occupies the same volume as 32.0 g of oxygen gas at room temperature and pressure.

A 2 only
B 3 only
C 1 and 2 only
D 1, 2 and 3

19 A sample of potassium oxide, K_2O is dissolved in 250 cm^3 of distilled water. 25.0 cm^3 of the solution is neutralised by 15.0 cm^3 of 2.00 mol dm^{-3} of dilute sulfuric acid.

What is the mass of potassium oxide dissolved in 250 cm^3 of distilled water?

A 2.82 g **B** 5.64 g **C** 28.2 g **D** 56.4 g

20 The element astatine is below iodine in Group VII of the Periodic Table.

Which of the following statements describes astatine correctly?

A It forms a covalent compound with sodium.

B It has a high melting point due to strong covalent bonds.

C It is a dark coloured gas at room temperature.

D It is a weaker oxidising agent than iodine.

21 The physical properties of elements **X**, **Y** and **Z** are shown in the table below.

element	melting point / °C	boiling point / °C	density / g cm^{-3}
X	-7.00	59.0	3.12
Y	98.0	882	0.97
Z	649	1107	1.74

What are the possible identities of **X**, **Y** and **Z**?

	X	**Y**	**Z**
A	Br_2	Na	Mg
B	Br_2	Al	Si
C	I_2	Mg	Na
D	I_2	Si	K

22 What are the effects of chlorofluorocarbons, methane and nitrogen dioxide on the atmosphere and environment?

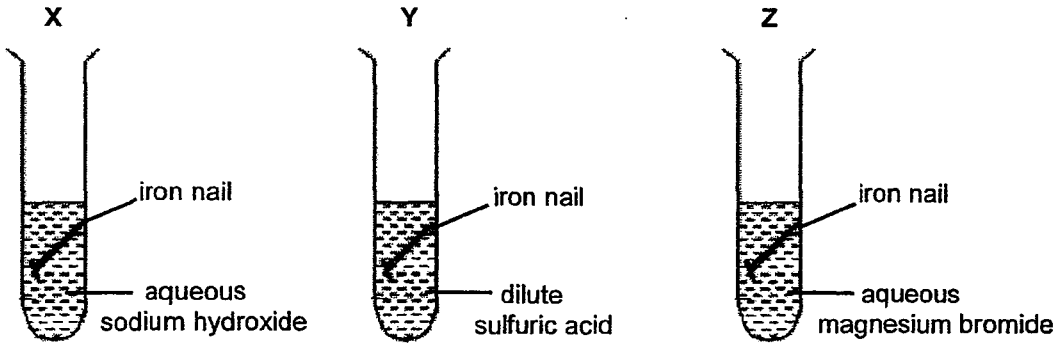
	chlorofluorocarbon	methane	nitrogen dioxide
A	acid rain	depletion of ozone layer	greenhouse gas
B	depletion of ozone layer	acid rain	global warming
C	depletion of ozone layer	greenhouse gas	acid rain
D	global warming	depletion of ozone layer	acid rain

23 First ionisation energy is defined as the minimum amount of energy required to remove an outermost electron from an atom to form a positively charged ion.

What are the trends in the following properties of elements down Group I?

	decomposition temperature of metal carbonate / °C	first ionisation energy
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

24 Three identical iron nails were placed into separate test tubes containing aqueous sodium hydroxide, dilute sulfuric acid and aqueous magnesium bromide.



Which of the following best describes the observations in each test tube after 10.0 minutes?

	X	Y	Z
A	no change	green solution	no change
B	green precipitate	green solution	no change
C	no change	no change	grey solid
D	reddish brown precipitate	green solution	no change

25 What are the main gases that escape from the top of the blast furnace during the extraction of iron from its ore?

A carbon dioxide, carbon monoxide, hydrogen

B carbon dioxide, carbon monoxide, nitrogen

C carbon dioxide, oxygen, sulfur dioxide

D nitrogen, oxygen, steam

26 Gaseous phosphorus pentachloride is thermally decomposed into gaseous phosphorus trichloride and chlorine.

The table below shows some bond energies.

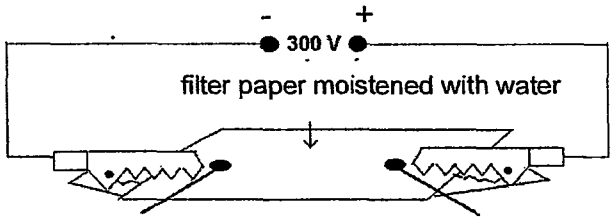
bond	bond energy / kJ mol^{-1}
P – Cl	330
Cl - Cl	240

Calculate the enthalpy change for the reaction.

A -90.0 kJ **B** +90.0 kJ **C** -420 kJ **D** +420 kJ

27 A drop of potassium iodide solution and a drop of lead(II) nitrate solution were added to a piece of filter paper moistened with water.

The filter paper was then connected to an electric circuit as shown below.



Which of the following observations is correct?

A A yellow precipitate is formed nearer to the anode.

B Bubbles of colourless gas at the cathode and a brown stain at the anode.

C Bubbles of colourless gas at the anode and a grey solid at the cathode.

D Grey solid at the cathode and a brown stain at the anode.

28 Magnesium is extracted by electrolysis of molten magnesium chloride.

Which statements describe the extraction of magnesium correctly?

A Magnesium ions move to the anode and lose electrons to form magnesium.

B Magnesium ions move to the anode and gain electrons to form magnesium.

C Magnesium ions move to the cathode and lose electrons to form magnesium.

D Magnesium ions move to the cathode and gain electrons to form magnesium.

29 Heated reagent **X** is added dropwise to a test tube containing ethanol to form ethene. The ethene formed is purified by bubbling it through reagent **Y**.

What are reagents **X** and **Y**?

	reagent **X**	reagent **Y**
A	acidified potassium dichromate(VI)	aqueous sodium hydroxide
B	concentrated sulfuric acid	dilute sulfuric acid
C	concentrated sulfuric acid	dilute sodium hydroxide
D	aqueous sodium hydroxide	concentrated sulfuric acid

30 2.76 g of ethanol was added to an excess of aqueous acidified potassium manganate(VII). The reaction mixture was boiled under reflux and the product was collected by distillation.

The yield of the product was 75.0%

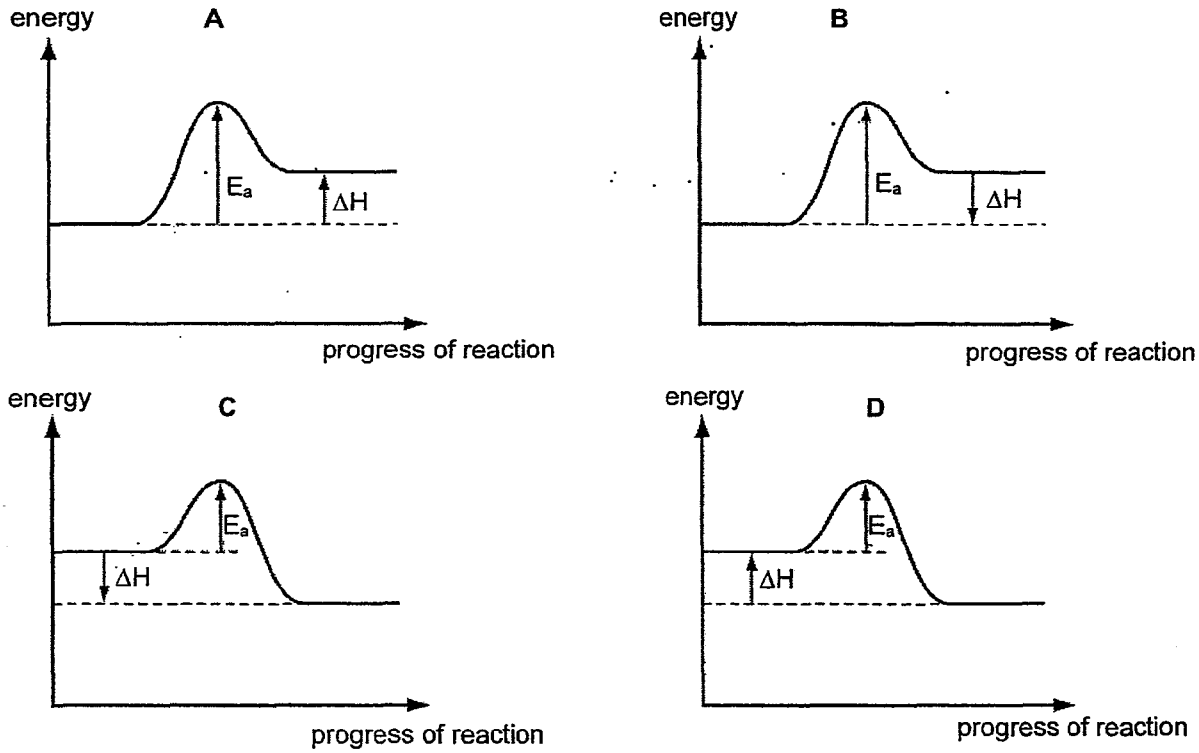
What is the mass of the collected product?

A 1.98 g **B** 2.70 g **C** 3.60 g **D** 4.44 g

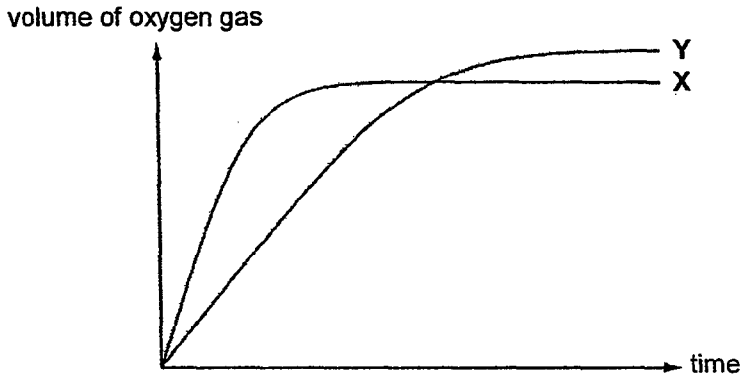
31 Nitrogen monoxide is an atmospheric pollutant that is formed inside car engines by the reaction between nitrogen and oxygen.

$$N_2(g) + O_2(g) \rightarrow 2NO(g) \qquad \Delta H = +66.0 \text{ kJ mol}^{-1}$$

Which of the following graphs represents the energy profile diagram for the reaction above?



32 The diagram below shows curve **X** which was obtained by the decomposition of 100 cm^3 of 1.00 mol dm^{-3} hydrogen peroxide using manganese(IV) oxide.



Which of the following changes made to the original experiment would produce curve **Y**?

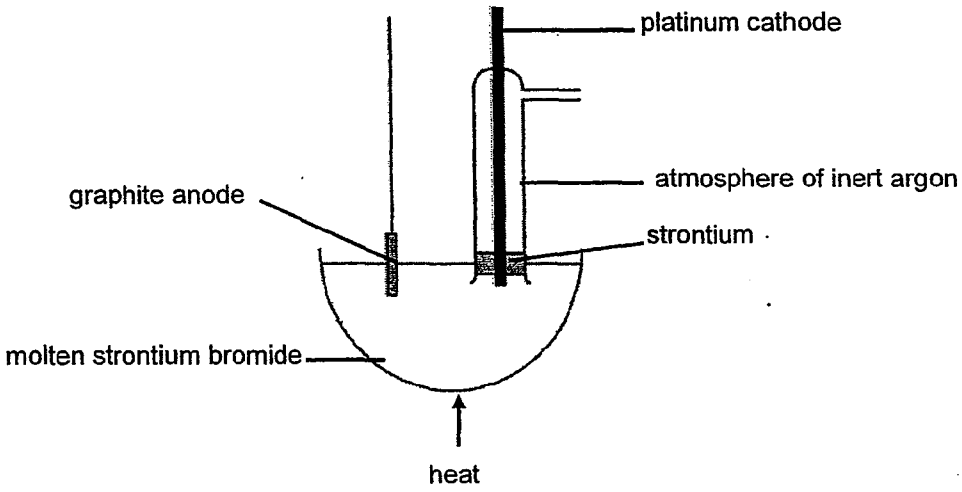
A adding 10.0 cm^3 of water to hydrogen peroxide

B adding 10.0 cm^3 of 0.100 mol dm^{-3} of hydrogen peroxide

C lowering the temperature of hydrogen peroxide by 10.0 °C

D reducing the mass of manganese(IV) oxide used

33 Strontium metal can be obtained by the electrolysis of molten strontium bromide, $SrBr_2$ as shown in the diagram below.



Why is an atmosphere of argon used around the cathode?

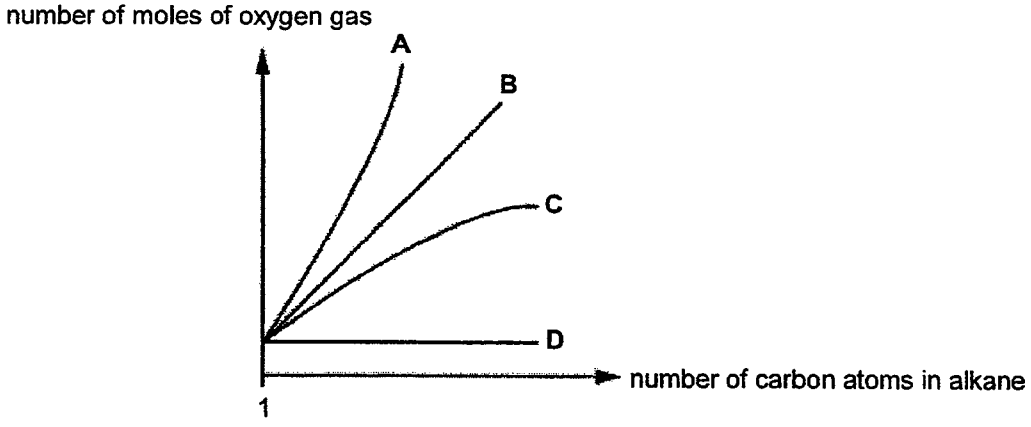
A A compound of strontium and argon formed on the surface protects the metal.

B Presence of argon ensures strontium formed remains in molten form.

C Presence of argon prevents the formation of strontium oxide.

D Presence of argon stops the strontium formed from moving up the tube.

34 Which lines on the graph below shows the relationship between the number of carbon atoms in an alkane and the number of moles of oxygen gas required for complete combustion of the alkane?



35 Fuel cells are currently being researched as a possible alternative to fossil fuels. However, there are still many disadvantages of hydrogen fuel cells.

Which is not one of the disadvantages?

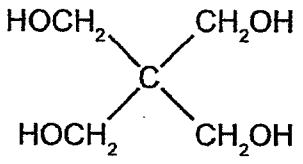
A Fuel cells produce greenhouse gases in the form of carbon dioxide.

B Hydrogen is flammable and explosive if the gas leaks.

C It is expensive and difficult to produce the hydrogen fuel.

D The reactants are gases that are difficult to store and transport.

36 The structure of pentaerythritol which is used in the manufacture of paint, is shown below.



Which of the following statements describes pentaerythritol correctly?

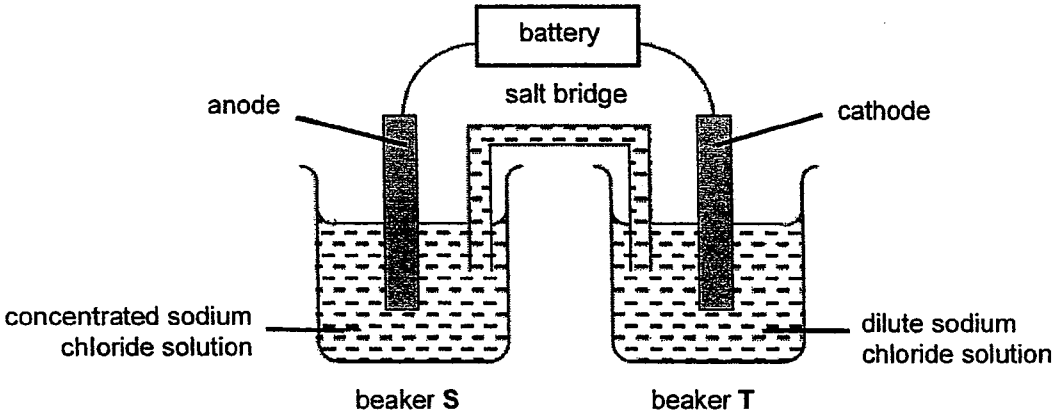
A It does not react with acidified potassium manganate(VII).

B Its empirical formula is different from its molecular formula.

C It reacts with methanoic acid to form a sweet smelling liquid.

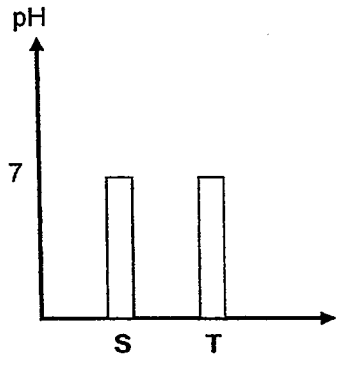
D One mole of pentaerythritol produces two moles of hydrogen gas upon reaction with excess sodium.

37 An apparatus is set up as shown below.

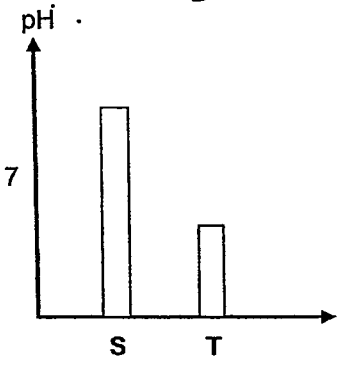


Which of the following diagrams shows the pH of the solution in each beaker when platinum electrodes were used?

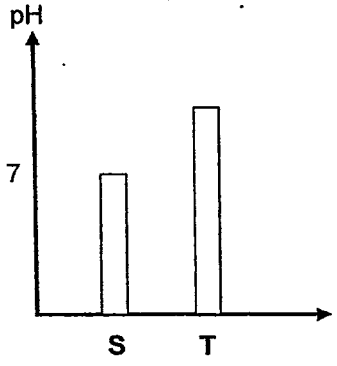
A



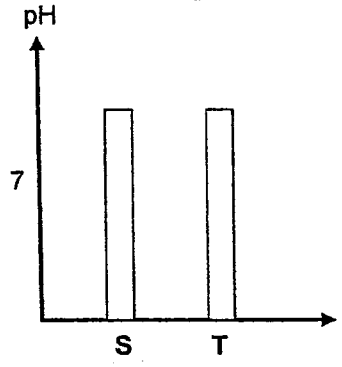
B



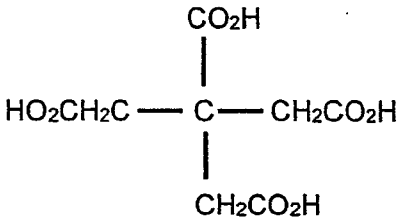
C



D

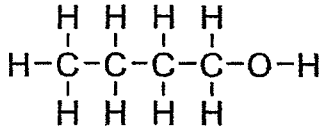


38 How many moles of hydrogen gas are evolved when an excess of sodium metal is added to one mole of the molecule with the structure as shown below?



A 1 **B** 2 **C** 3 **D** 4

39 Butanol, $C_4H_{10}O$, is an alcohol used as biofuel in car engines.



What is the number of structural isomers of butanol containing hydroxyl functional groups, including butanol?

A 2 **B** 3 **C** 4 **D** 5

40 The mass of 0.050 moles of vegetable oil increased by 24.0 g when reacted with excess aqueous bromine.

What is the number of carbon–carbon double bonds present in one molecule of the oil?

A 1 **B** 3 **C** 5 **D** 6

- End of Paper -

DATA SHEET
The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 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	- Ra Radium 88	- Ac Actinium 89 †															

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
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

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

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

(ii) Describe the arrangement and movement of the particles at the top of the fractionating column.

.....

.....

.....

.....[2]

(iii) Describe a method to determine the purity of the flavouring.

.....

.....[1]

(c) Describe how you would obtain a pure sample of silver chloride from a sample that is contaminated with some barium chloride.

.....

.....

.....

.....[2]

[Total: 7]

A2 Mobile phones are made from a large number of different substances.

The table below shows the composition of a typical mobile phone.

substance	percentage, by mass, of a typical mobile phone
plastics	56
ceramics	16
copper	15
iron	3
other materials	10

(a) One of the plastics used in a mobile phone is poly(propene).

(i) Name the reaction that occurs when poly(propene) is made.

.....[1]

(ii) Draw the structure of a repeating unit of poly(propene).

[1]

(b) The iron used in a mobile phone must not rust.

Suggest one method to stop the iron used from rusting. Explain your answer.

.....

.....

.....

.....[2]

(c) There is a growing awareness that mobile phones should be recycled.

(i) Suggest an advantage of recycling the substances used to make mobile phones.

.....

.....[1]

(ii) Suggest a disadvantage of recycling the substances used to make mobile phones.

.....

.....[1]

[Total: 6]

Name	Class	Register Number

5073/02 (with SPA)

16/4P2/5073/2

CHEMISTRY
PAPER 2

Thursday **4 August 2016** **1 hour 45 minutes**

SECOND PRELIMINARY EXAMINATION
(SECONDARY FOUR)

INSTRUCTIONS TO CANDIDATES

Write your name, class and index number 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, glue or correction fluid.

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

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

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

Section A	**/ 50**
Section B	**/ 30**
Total	**/ 80**

Deductions	
Presentation	
Significant Figures	
Units	

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

A copy of Periodic Table is printed on **page 22.**

Section A (50 marks)

Answer **all** the questions in this section in the spaces provided.

A1 **(a)** An important aspect of chemistry is purity and methods of purification.

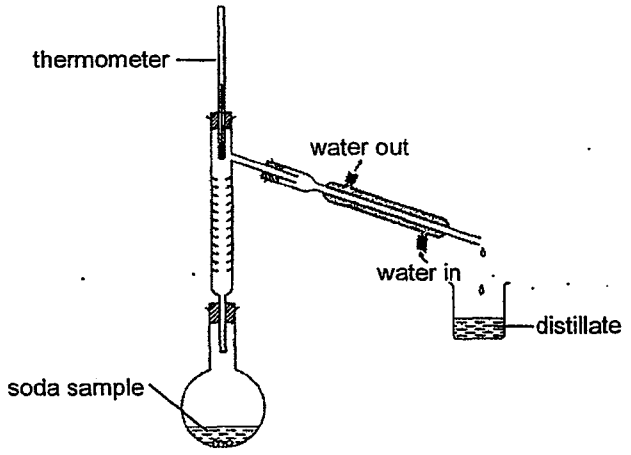
Give an example of substances used in everyday life which must be pure.

.....[1]

(b) Soda (a type of soft drink) is a homogeneous solution where all its components are evenly distributed in the solution. The table below shows some components in soda and their boiling points.

component	boiling point / °C
carbon dioxide	–78.5
flavouring (ester)	90.0
water	100

A student carried out fractional distillation to separate the components in a soda sample. The diagram below shows the apparatus that is used to carry out the process of fractional distillation. He first observed rapid bubbling of a colourless gas before 2 different distillate fractions were collected.

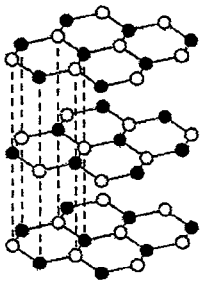


(i) Explain why only 2 distillate fractions can be collected.

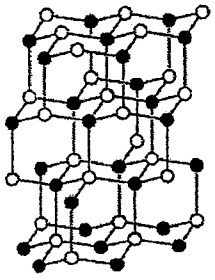
.....

.....[1]

A3 Boron nitride, BN, exists in two physical forms. The structures of these forms are shown below.



Structure **A**



Structure **B**

(a) Suggest why boron nitride with structure **A** can be used as a lubricant.

.....

.....

.....

.....[2]

(b) Suggest why boron nitride with structure **B** can be used in cutting tools and drill bits.

.....

.....

.....

.....[2]

(c) Boron nitride with structure **A** can be produced by reacting boron trioxide with ammonia at high temperatures in an inert atmosphere.

The equation for the reaction is shown below.

$$B_2O_3 + 2NH_3 \rightarrow 2BN + 3H_2O$$

(i) Draw a 'dot-and-cross' diagram to represent the bonding in boron trioxide. Show only the valence electrons.

[2]

(ii) Calculate the mass of boron nitride produced if 4.00 kg of boron trioxide is reacted with 4.00 kg of ammonia.

[2]

[Total: 8]

A4 Glucose reacts with excess oxygen to produce carbon dioxide and water.

$$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(g) \quad \Delta H = -2300 \text{ kJ mol}^{-1}$$

In a reaction, 100 cm^3 of carbon dioxide was produced.

(a) Is the reaction exothermic or endothermic?

Explain your answer in terms of bond breaking and bond forming.

.....

.....

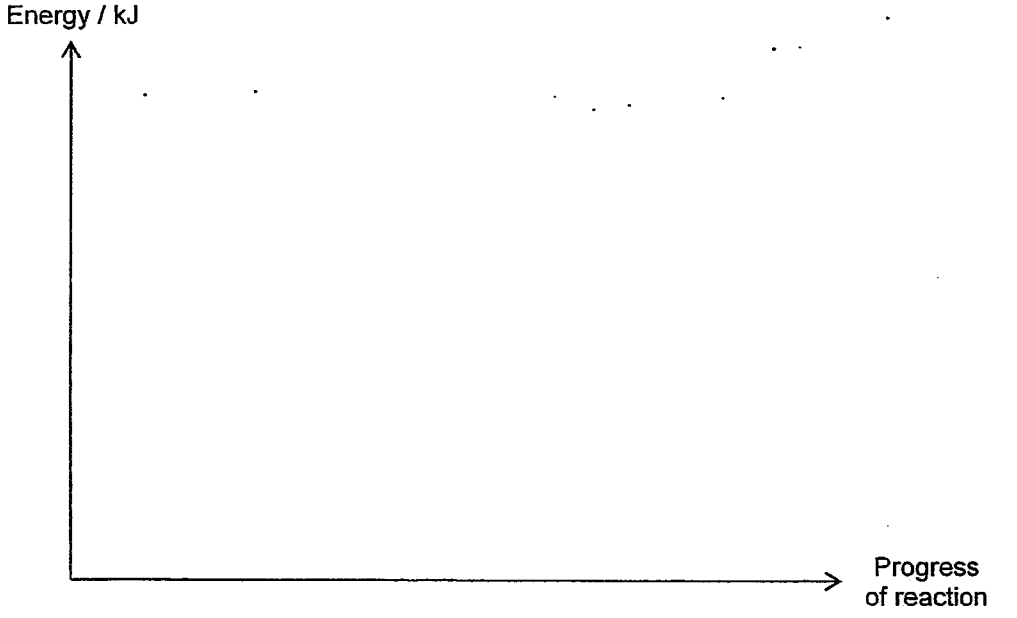
.....[2]

(b) Calculate the energy change for the reaction.

[2]

(c) Draw an energy profile diagram for the reaction of glucose with excess oxygen.

Indicate the enthalpy change, ΔH, and activation energy, E_a, on the diagram clearly.



[3]

(d) In another experiment, an aqueous solution of glucose was heated with alkaline copper(II) sulfate solution and a brick-red precipitate of an oxide of copper was formed. A 1.44 g sample of this oxide was found to contain 1.28 g of copper.

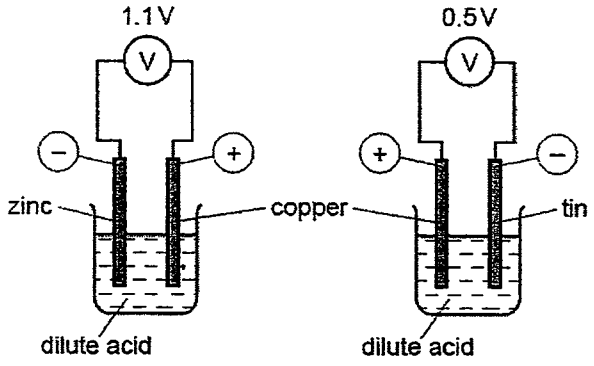
Calculate the empirical formula of this oxide of copper.

[2]

[Total: 9]

A5 This question is about simple cells.

(a) Two simple cells are shown in the diagram below.



(i) Explain why the more reactive metal is the negative electrode.

.....

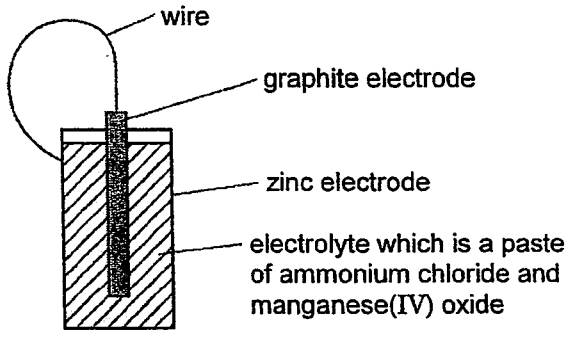
.....[1]

(ii) How can you deduce that zinc is more reactive than tin?

.....

.....[1]

(b) The diagram below shows a battery. The central rod is made of graphite. It is surrounded by an electrolyte which is a paste of ammonium chloride and manganese(IV) oxide. The central rod and electrolyte are enclosed by a zinc container.



(i) Indicate the direction of electron flow on the diagram. [1]

(ii) Explain why the electrolyte is a paste.

.....

.....[1]

(iii) Write the half-equation for the reaction at the zinc electrode.

[1]

[Total: 5]

A6 **(a)** Ethyl butanoate is an ester which occurs naturally in many fruits. It has an odour which resembles that of pineapple and is a common chemical used in flavours and fragrances.

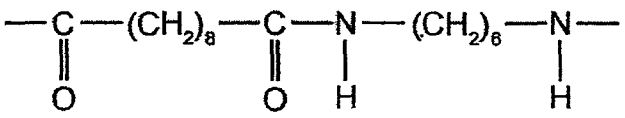
(i) Draw the full structural formula of the ester.

[1]

(ii) Name the two compounds that react to form ethyl butanoate.

.....[1]

(b) Nylon is a synthetic polymer. It has the structural formula shown below.



(i) Name the linkage in present in nylon.

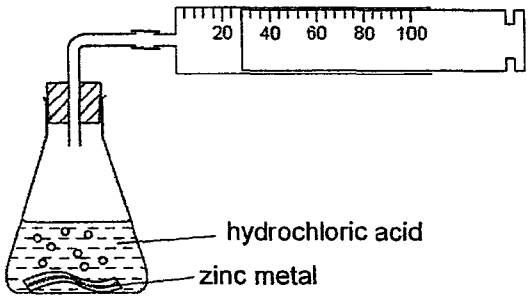
.....[1]

(ii) Draw the structural formulae of the monomers which reacted to form nylon.

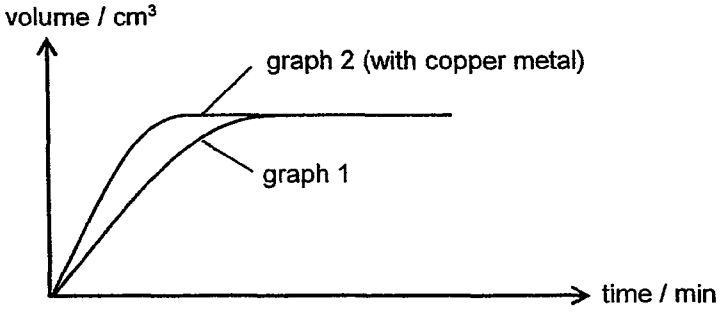
[2]

[Total: 5]

A7 The rate of reaction between a metal and an acid can be investigated using the apparatus shown below.



A piece of zinc metal was added to 50.0 cm^3 of 2.00 mol dm^{-3} hydrochloric acid. The acid was in excess. The hydrogen evolved was collected in the gas syringe and its volume measured every minute. The results were plotted and labelled as graph 1.



(a) The experiment was repeated to show that the reaction between zinc metal and hydrochloric acid is catalysed by copper. A small volume of aqueous copper(II) chloride was added to the acid before the zinc metal was added. The results of this experiment were plotted on the same grid and labelled as graph 2.

(i) Explain why the reaction mixture in the second experiment contains copper metal. Include an equation in your answer.

.....

.....

.....[2]

(ii) Explain how graph 2 shows that copper metal catalyses the reaction.

.....

.....

.....[2]

(b) The experiment was repeated a third time by adding a piece of zinc metal to 50.0 cm^3 of 2.00 mol dm^{-3} ethanoic acid, CH_3COOH.

(i) Sketch the curve obtained for the third experiment on the same diagram as graph 1 and label it **graph 3.** [1]

(ii) Explain the shape of your graph.

.....

.....

.....

.....[3]

(c) The experiment was repeated a final time by adding powdered zinc metal to 50.0 cm^3 of 2.00 mol dm^{-3} hydrochloric acid.

What will happen to the rate of reaction? Explain your answer using ideas about reacting particles.

.....

.....

.....

.....[2]

[Total: 10]

Section B (30 marks)

Answer all **three** questions in this section in the spaces provided.

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

B8 In organic chemistry, cycloalkanes are saturated hydrocarbons with the carbon atoms arranged in a single ring. Cycloalkanes are similar to alkanes in their general physical properties.

Cycloalkanes are commonly represented using their skeletal structures. Table 1 below shows the full structural formulae and skeletal structures of some cycloalkanes.

Table 1

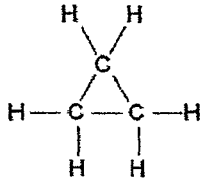
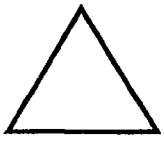
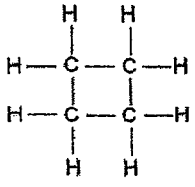
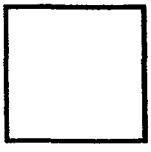
cycloalkane	full structural formula	skeletal structure
cyclopropane C_3H_6		
cyclobutane C_4H_8		

Table 2 below shows the melting points and boiling points of some cycloalkanes.

Table 2

name of cycloalkane	molecular formula	melting point / °C	boiling point / °C
cyclopropane	C_3H_6	-128	-33
cyclobutane	C_4H_8	-91	13
cyclopentane	C_5H_{10}	-94	49
cyclohexane	C_6H_{12}	6	81
cycloheptane	C_7H_{14}	-12	118
cyclooctane	C_8H_{16}	15	149

Table 3 below shows the melting points and boiling points of some alkanes corresponding to the cycloalkanes in Table 1.

Table 3

name of alkane	molecular formula	melting point / °C	boiling point / °C
propane	C_3H_8	-188	-42
butane	C_4H_{10}	-140	-1
pentane	C_5H_{12}	-130	36
hexane	C_6H_{14}	-95	69
heptane	C_7H_{16}	-91	98
octane	C_8H_{18}	-57	125

(a) Draw the skeletal structure of cyclohexane.

[1]

(b) Are cycloalkanes isomers of alkanes? Explain your answer.

.....

.....[1]

(c) What trends are shown by the data in Table 2?

.....

.....

.....[2]

(d) What do you notice about the melting and boiling points of the cycloalkanes and their corresponding alkanes?

Use the information provided to support your answer.

.....

.....

.....

.....[2]

(e) Describe and explain the trend in melting and boiling points of the alkanes in Table 3.

.....

.....

.....

.....[2]

(f) Cyclohexane can be synthesised from cyclohexene, C_6H_{10}.

(i) Cyclohexane and cyclohexene are both colourless liquids at room temperature and pressure.

Describe a test to distinguish between cyclohexane and cyclohexene.

.....

.....

.....[2]

(ii) Using an equation, show how cyclohexane is synthesised from cyclohexene. State the conditions required for the reaction.

.....

.....

.....[2]

[Total: 12]

B9 Methylamine, CH_3NH_2, is a weak base. Its properties are similar to those of ammonia.

(a) The equation below shows what happens when methylamine is dissolved in water.

$$\underset{\text{base}}{CH_3NH_2} + \underset{\text{acid}}{H_2O} \rightleftharpoons CH_3NH_3^+ + OH^-$$

Using the equation, explain why water behaves as an acid and methylamine as a base.

.....

.....[1]

(b) An aqueous solution of sodium hydroxide has pH 13. Predict the pH of an aqueous solution of methylamine which has the same concentration. Give a reason for your choice of pH.

.....

.....[2]

(c) Methylamine can neutralise acids.

$$CH_3NH_2 + HCl \rightarrow \underset{\text{methylammonium chloride}}{CH_3NH_3Cl}$$

(i) Write the equation for the reaction between methylamine and sulfuric acid.

[1]

(ii) Name the salt formed in **(c)(i)**.

.....[1]

(d) When aqueous methylamine is added to aqueous iron(II) sulfate, a dirty green precipitate is formed.

(i) What would be observed if aqueous methylamine is added to aqueous iron(III) nitrate?

.....[1]

(ii) Write an ionic equation with state symbols for the reaction in **(d)(i)**.

[2]

[Total: 8]

EITHER

B10 (a) There is much international concern that an increase in the atmospheric concentrations of methane and carbon dioxide can lead to global warming.

The table below shows the atmospheric concentration of methane and carbon dioxide from 1988 – 2008.

year	percentage, by volume, of methane in the atmosphere	percentage, by volume, of carbon dioxide in the atmosphere
1988	1.68×10^{-3}	3.49×10^{-2}
1993	1.71×10^{-3}	3.55×10^{-2}
1998	1.73×10^{-3}	3.65×10^{-2}
2003	1.78×10^{-3}	3.75×10^{-2}
2008	1.79×10^{-3}	3.85×10^{-2}

Methane is about 30 times more effective than carbon dioxide as a greenhouse gas.

(i) State one source of atmospheric methane.

.....[1]

(ii) Use the information above to explain why scientists are as concerned about methane in the atmosphere as carbon dioxide.

.....

.....

.....

.....[2]

(iii) Describe two possible consequences of an increase in global warming.

.....

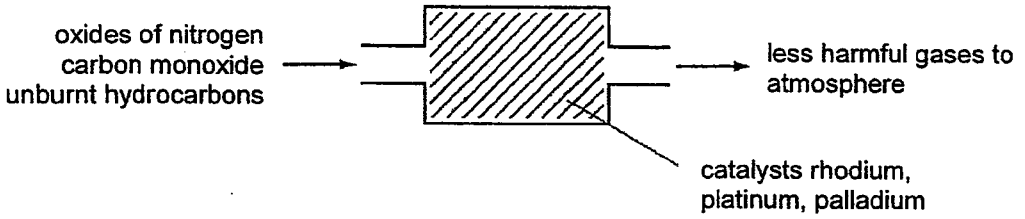
.....

.....

.....[2]

(b) One source of oxides of nitrogen in the atmosphere is from car internal combustion engines where nitrogen in the air combines with oxygen at high temperatures.

Oxides of nitrogen and other pollutants can be removed by catalytic converters, as shown in the diagram below.



(i) State another source of oxides of nitrogen in the atmosphere.

.....[1]

(ii) Describe one environmental problem caused by oxides of nitrogen.

.....

.....

.....

.....[2]

(iii) Rhodium catalyses the decomposition of the oxides of nitrogen.

$$2NO \rightarrow N_2 + O_2$$

The two other pollutants are carbon monoxide and unburnt hydrocarbons such as C_5H_{12} and C_8H_{18}. With the aid of equations, explain how they are converted into less harmful substances by the catalytic converter.

.....

.....

.....

.....[2]

[Total: 10]

OR

B10 (a) In the 1860s, John Newlands listed the elements in order of increasing atomic mass. Part of his Periodic Table is shown below.

H 1	Li 2	Be 3	B 4	C 5	N 6	O 7
F 8	Na 9	Mg 10	Al 11	Si 12	P 13	S 14
Cl 15	K 16	Ca 17	Cr 18	Ti 19	Mn 20	Fe 21

(i) Describe two differences between Newlands' Periodic Table and the Periodic Table that we use today.

.....

.....

.....

.....[2]

(ii) Using information from Newland's Periodic Table, show how his Periodic Table is partially correct compared to the modern Periodic Table.

.....

.....[1]

(b) Chlorine gas can be used to distinguish between aqueous potassium bromide and aqueous potassium iodide, by bubbling chlorine gas through these two salt solutions.

(i) Describe a test to confirm the presence of chlorine gas.

.....

.....[1]

(ii) Describe how aqueous potassium bromide can be distinguished from aqueous potassium iodide when chlorine gas is bubbled through them.

.....

.....

.....

.....[2]

(iii) Write a chemical equation with state symbols for any of the reactions in **(b)(ii)**.

.....[2]

(iv) Explain, in terms of oxidation states, why the reaction in **(b)(iii)** is a redox reaction.

.....

.....

.....

.....[2]

[Total: 10]

- End of paper -

DATA SHEET
The Periodic Table of the Elements

Group I	Group II										Group III	Group IV	Group V	Group VI	Group VII	Group 0
																4 He Helium 2
							1 H Hydrogen 1									
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 *	176 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	- Ra Radium 88	- Ac Actinium 89 †															

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
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

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

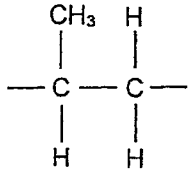
Key: a X b — a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

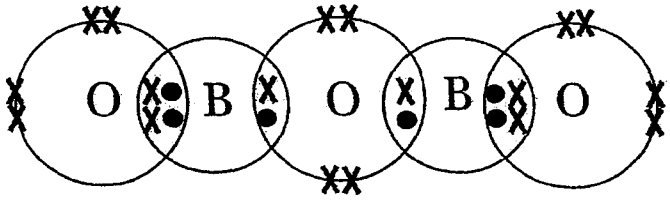
2016 Secondary 4 Chemistry Prelim 2 Answer Scheme + Markers' Report

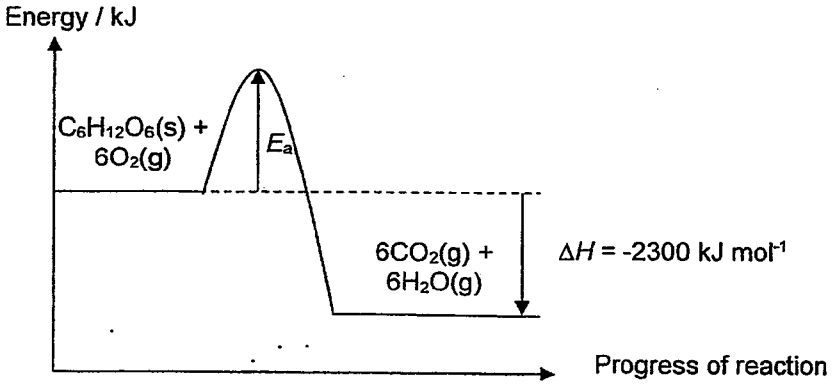
Paper 1

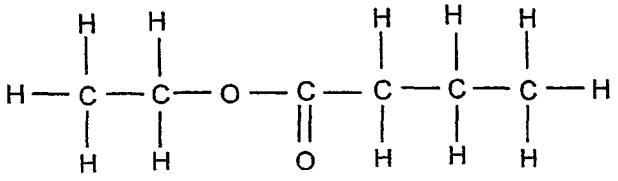
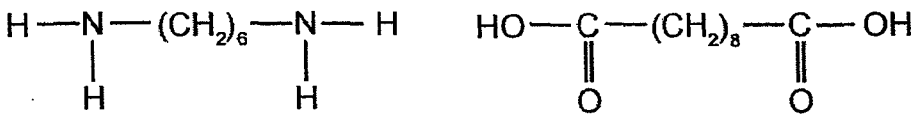
1	2	3	4	5	6	7	8	9	10
C	D	C	B	B	C	D	C	B	A
11	12	13	14	15	16	17	18	19	20
A	B	D	D	B	B	B	B	C	D
21	22	23	24	25	26	27	28	29	30
A	C	C	A	B	D	A	D	C	B
31	32	33	34	35	36	37	38	39	40
A	B	C	B	A	C	C	B	C	B

Paper 2 Section A

Qn	Suggested answers	Mark
A1a	Medicine / drugs, quartz, table salt / sodium chloride, sugar, food colouring, drinking water ... (or any logical examples)	1
A1b(i)	The boiling point of carbon dioxide (-78.5°C) is lower than room temperature (25°C) / carbon dioxide is a gas at room temperature and pressure, hence the water in the (Liebig) condenser cannot condense carbon dioxide and it escapes to the surroundings and is not collected as a distillate.	1
A1b(ii)	The particles are spread very far apart in a random / disorderly manner and move rapidly/at high speeds/racing at random / in all directions.	1 1
A1b(iii)	Carry out paper chromatography with a suitable solvent and locating agent. A single spot which matches literature value on the chromatogram shows that the distillate is a pure substance. OR Determine the boiling point of the distillate. A fixed boiling point which is equal to literature value shows that the distillate is a pure substance.	1
A1c	Add the distilled water into the mixture to dissolve the soluble barium chloride. Filter to obtain the barium chloride in the filtrate and insoluble silver chloride as the residue, wash the residue with a small amount of distilled water to remove impurities and dry between sheets of filter paper.	1 1
A2a(i)	Addition polymerisation	1
A2a(ii)		1

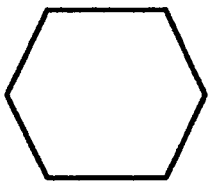
Qn	Suggested answers	Mark
A2b	Method (Any one of the following): use of a sacrificial metal / galvanise / electroplate / paint / coat with oil / alloy to make steel / Explain (Any one of the following): • Sacrificial protection – More reactive metal loses valence electrons more easily / is oxidised more easily than iron so it corrodes in place of iron. • Alloy – iron is surrounded by layer of chromium oxide which is impervious. • (BOD) Paint / coat with oil / electroplate tin / zinc – protective layer to stop oxygen and water from coming into contact with iron.	1 1
A2c(i)	Any one of the following: • reduces litter / reduces need for land fill sites • reduces need for incineration / produce less toxic gases when burnt • saves a finite/non-renewable resource / metal ores are a finite resource / crude oil is a finite resource • less energy used in recycling than extraction from raw materials or ores • less environmental damage due to mining activities or any logical answers	1
A2c(ii)	Any one of the following: • Can be costly to collect the mobile phones and sort out the materials • More manpower required to collect and sort out the materials • Can cause pollution such as release of toxic gases when plastics are melted during recycling or any logical answers	1
A3a	The hexagonal layers of boron and nitrogen atoms in boron nitride with Structure **A** are held together by weak intermolecular forces of attraction / Van der Waals forces of attraction. Hence, little energy required for the layers to slide over each other easily, resulting in boron nitride with structure **A** can be used as a lubricant.	1 1
A3b	The boron atoms and nitrogen atoms are alternately bonded by extensive strong covalent bonds throughout to form a rigid network structure / extensive network of strong covalent bonds. This rigid structure requires a lot of energy to break, making it difficult to break and hence boron nitride with structure **B** is hard and can be used in cutting tools and drill bits.	1 1
A3c(i)	 [1]: bonded electrons; [1]: unbonded electrons Legend: ● : electron of boron ✖ : electron of oxygen	2

Qn	Suggested answers	Mark
A3c(ii)	No. of moles of B_2O_3= 4000 / [2(11)+3(16)] = 57.14 mol No. of moles of NH_3 = 4000 / [14+3(1)] = 235.3 mol Mole ratio of B_2O_3 : NH_3 = 1:2 No. of moles of NH_3 required if all all B_2O_3 is used up = 114.3 mol Since 235.3 mol of NH_3, hence NH_3 is in excess and B_2O_3 is the limiting reactant. No. of moles of BN = 57.14 x 2 = 114.3 mol Mass of BN = 114.3 x (11+14) = 2860 g = 2.86 kg (3s.f.)	1 1
A4a	This reaction is exothermic. The total energy absorbed to break the bonds in 1 mole of glucose and 6 moles of oxygen is less than the total energy released to form bonds in 6 moles of carbon dioxide and 6 moles of water.	1 1
A4b	No. of moles of carbon dioxide = (100/1000) / 24 = 0.004167 mol No. of moles of glucose = 0.004167 / 6 = 0.0006945 mol Energy change = (-2300) x 0.0006945 = -1.60 kJ (3s.f.)	1 1
A4c	 [1]: shape of energy profile diagram + reactant/product labels [1]: labelling of activation energy, E_a (with single-head arrow) [1]: labelling of enthalpy change, ΔH (with single-head arrow)	3
A4d	<table><tr><th></th><th>Cu</th><th>O</th></tr><tr><td>Mass / g</td><td>1.28</td><td>1.44 – 1.28 = 0.160</td></tr><tr><td>Ar</td><td>64</td><td>16</td></tr><tr><td>No. of moles / mol</td><td>0.0200</td><td>0.0100</td></tr><tr><td>Ratio</td><td>2</td><td>1</td></tr></table> Formula : Cu_2O	1 1

Qn	Suggested answers	Mark
A5a(i)	The more reactive metal loses electrons and the electrons flow from the negative to positive terminal.	1
A5a(ii)	The voltmeter reading of the zinc and copper cell is larger than the voltmeter reading for the tin and copper cell.	1
A5b(i)	Must label the direction of electron flow from zinc to graphite	1
A5b(ii)	To allow the ions to move from one electrode to the other electrode.	1
A5b(iii)	$Zn \rightarrow Zn^{2+} + 2e^-$	1
A6a(i)		1
A6a(ii)	Ethanol, butanoic acid	1
A6b(i)	Amide linkage	1
A6b(ii)	 [1m] for each monomer	2
A7a(i)	Zinc is more reactive than copper, so it will displace out copper metal from copper(II) chloride solution. $Zn(s) + CuCl_2(aq) \rightarrow ZnCl_2(aq) + Cu(s)$ OR $Zn(s) + Cu^{2+}(aq) \rightarrow Cu(s) + Zn^{2+}(aq)$ (state symbols not required)	1 1
A7a(ii)	Graph 2 is steeper / has a larger gradient than Graph 1 so it shows that copper speeds up the rate of reaction. The final volume of the hydrogen gas produced remains the same which shows that copper only speeds up the reaction without participating in the reaction.	1 1
A7b(i)	Graph 3 – less steep gradient, same final volume of hydrogen	1
A7b(ii)	Ethanoic acid is a weak acid so it dissolves and dissociates/ionises partially in water. The concentration of hydrogen ions in ethanoic acid is lower than the concentration of hydrogen ions in hydrochloric acid so the rate of reaction is slower, resulting in a less steep gradient. The final volume of hydrogen evolved / height of the graph is the same as graph 1 as the acid added in excess / zinc is the limiting reactant.	1 1 1

Qn	Suggested answers	Mark
A7c	The rate of reaction will increase. (must state but no marks) Powdered zinc metal has a larger surface area than the piece of zinc metal. Hence the zinc atoms and hydrogen ions collide more frequently, increasing the frequency of effective collisions. This results in an increase in the rate of reaction.	 1 1

Paper 2 Section B

Qn	Suggested answers	Mark
B8a		1
B8b	No (must state but no marks) They have different molecular formulae / general formulae.	 1
B8c	As the number of carbon atoms in the cycloalkane increases, the boiling point increases. As the number of carbon atoms in the cycloalkane increases, the melting point generally increases except for cyclopentane and cycloheptane.	1 1
B8d	The melting and boiling points of the cycloalkanes are higher than their corresponding alkanes. For example, the melting point and boiling point of cyclopropane is -128°C and -33°C respectively but the melting point and boiling point of hexane is -188°C and -42°C respectively. OR Also, the melting point and boiling point of cyclohexane is 6°C and 81°C respectively but the melting point and boiling point of hexane is -95°C and 69°C respectively.	1 1
B8e	The melting and boiling points of the alkanes increase down the homologous series (need to state but no mark) Down the homologous series, the relative molecular mass of the alkanes increases / molecule becomes bigger. There are more/stronger intermolecular forces of attraction between the molecules. Hence more energy is required to overcome the intermolecular forces of attraction.	 1 1
B8f(i)	Add aqueous bromine / bromine water to 2 test tubes containing cyclohexane and cyclohexene separately and shake the test tubes. The bromine water will turn from brown to colourless / decolourise **rapidly** in the test tube containing cyclohexene. No visible reaction for cyclohexane.	1 1

Qn	Suggested answers	Mark
B8f(ii)	$C_6H_{10} + H_2 \rightarrow C_6H_{12}$ Reaction conditions: 150 – 200 °C, nickel catalyst	1 1
B9a	Water contributes/loses a hydrogen ion AND methylamine gains/accepts the hydrogen ion.	1
B9b	Accept any pH value from 8 – 12 Sodium hydroxide is a strong base/alkali but methylamine is a weak base/alkali. Hence, the concentration of hydroxide ions is higher in sodium hydroxide than methylamine. (OR concentration of hydroxide ions is lower in methylamine than sodium hydroxide)	1 1
B9c(i)	$2CH_3NH_2 + H_2SO_4 \rightarrow (CH_3NH_3)_2SO_4$	1
B9c(ii)	methylammonium sulfate	1
B9d(i)	Reddish brown precipitate	1
B9d(ii)	$Fe^{3+}(aq) + 3OH^-(aq) \rightarrow Fe(OH)_3(s)$ [1m] – ionic equation; [1m] – state symbols	2
EITHER B10a(i)	bacterial decay of organic matter / methane hydrate / from cows / pig manure / marshes / swamps, etc	1
B10a(ii)	Methane percentage is increasing from 1.68 x 10^{-3} % in 1988 to 1.79 x 10^{-3} % in 2008. Explain the idea that 30 × (quote data) % of methane is more than (quote data) % of carbon dioxide / the overall greenhouse effect of methane is greater than that of carbon dioxide.	1 1
B10a(iii)	Sea-level rising / flooding of low lying area / water levels rising AND/OR Polar ice melting / ice caps melting / glaciers melting AND/OR Climate changes / (some) areas will have (severe) droughts. (any 2)	2
B10b(i)	Lightning activity	1
B10b(ii)	Oxides of nitrogen are oxidised by oxygen in air and dissolve in rainwater to form acid rain, destroying vegetation, damaging marine habitats, harming human health and corroding limestone buildings and metal infrastructures (any one).	1 1
B10b(iii)	$2CO + O_2 \rightarrow 2CO_2$ Carbon monoxide is oxidised to the relatively harmless / less harmful carbon dioxide. $C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$ OR $2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$ (or any logical examples of unburnt hydrocarbons) Unburnt hydrocarbons (C_xH_y) are oxidised to the relatively harmless / less harmful carbon dioxide and water.	1 1

Qn	Suggested answers	Mark
OR B10a(i)	Any 2 suitable differences e.g.: - no noble gases / no Group 0 / no Group 8 / only 7 groups - hydrogen / H in same Group as F, Cl; H on own / Period 1 - no transition elements (in the middle of table/block); transition element (block) present - halogens / F and Cl in first Group - not ordered according to atomic number - no proton / atomic numbers - Groups / Periods different / comments on different number of elements in groups / periods - metals and non-metals not grouped together - some transition elements placed in wrong Group / examples e.g. Mn placed with N	2
B10a(ii)	Any logical answer referring to (some) elements being in the same Group e.g. Li, Na, K (or Be, Mg, Ca) in same Group / vertical section / column OR any logical answer referring to the elements are arranged in increasing atomic/proton/nucleon/relative atomic mass number e.g. oxygen has a bigger atomic/proton/nucleon/relative atomic mass number than hydrogen (to quote value).	1
B10b(i)	Place a moist blue litmus paper at the mouth of the test tube. The presence of chlorine gas will turn the moist blue litmus paper red and then bleached.	1
B10b(ii)	If the mixture turns from colourless to lighter brown / orange-brown, the salt solution is aqueous potassium bromide. If the mixture turns from colourless to darker brown / some black precipitate formed, the salt solution is aqueous potassium iodide.	1 1
B10b(iii)	$Cl_2(g) + 2KBr(aq) \rightarrow 2KCl(aq) + Br_2(aq)$ OR $Cl_2(g) + 2KI(aq) \rightarrow 2KCl(aq) + I_2(aq)$ [1m]: balanced chemical equation; [1m]: state symbols	2
B10b(iv)	Oxidation state of bromine increases from -1 in KBr to 0 in Br_2. Oxidation occurs. Oxidation number of chlorine decreases from 0 in Cl_2 to -1 in KCl. Reduction occurs. Since oxidation and reduction occurs simultaneously, the above is a redox reaction. (must state but no mark; minus 1m if missing) **OR** Oxidation state of iodine increases from -1 in KI to 0 in I_2. Oxidation occurs. Oxidation number of chlorine decreases from 0 in Cl_2 to -1 in KCl. Reduction occurs. Since oxidation and reduction occurs simultaneously, the above is a redox reaction. (must state but no mark; minus 1m if missing)	1 1 **OR** 1 1