Write your name here

Surname	Other names

Edexcel
International GCSE

Centre Number | Candidate Number

Chemistry

Paper: 1C

1006D

Sample Assessment Material
Time: 2 hours

Paper Reference
4CH0/1C

You must have:
Ruler
Candidates may use a calculator.

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Show all the steps in any calculations and state the units.

Information

- The total mark for this paper is **120**.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

S41646A

S 4 1 6 4 6 A 0 1 2 8

PEARSON

The Periodic Table of the Elements

1	2										3	4	5	6	7	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	63.5 **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	[98] **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	[209] **Po** polonium 84	[210] **At** astatine 85	[222] **Rn** radon 86
[223] **Fr** francium 87	[226] **Ra** radium 88	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated					

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The Lanthanides (atomic numbers 58-71) and the Actinides(atomic numbers 90-103) have been omitted.***

Cu and Cl have not been rounded to the nearest whole number.

1006D

Answer ALL questions.

1 The table shows the properties of four substances.

Use the information in the table to answer the following questions.

Substance	Melting point in °C	Boiling point in °C	Conducts electricity when	
			solid	liquid
A	1650	2230	no	no
B	1538	2862	yes	yes
C	– 7	59	no	no
D	801	1413	no	yes

Place a cross (☒) in the appropriate box to indicate your answer.

Choose from **A** to **D** a substance that could be:

(5)

(a) a metal

A ☐ **B** ☑ **C** ☐ **D** ☐

(b) a giant covalent structure

A ☑ **B** ☐ **C** ☐ **D** ☐

(c) an ionic compound

A ☐ **B** ☐ **C** ☐ **D** ☑

(d) a liquid at 25 °C

A ☐ **B** ☐ **C** ☑ **D** ☐

(e) a solid at 1600 °C

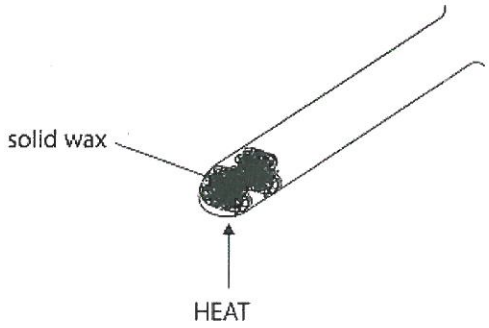
A ☑ **B** ☐ **C** ☐ **D** ☐

(Total for Question 1 = 5 marks)

1006D

2 A student investigated what happened when a sample of wax was heated using a Bunsen burner.

He set up the apparatus as shown in the diagram.



The student heated the solid wax strongly with a Bunsen burner until it turned into a liquid.

(a) Give the name of the process that occurs when a solid turns into a liquid.

(1)

melting

(b) Explain **one** change needed to make the experiment safer.

(2)

- Heat in water bath or - Use test tube holder
- Wax may catch fire - prevent burning by hot test tube

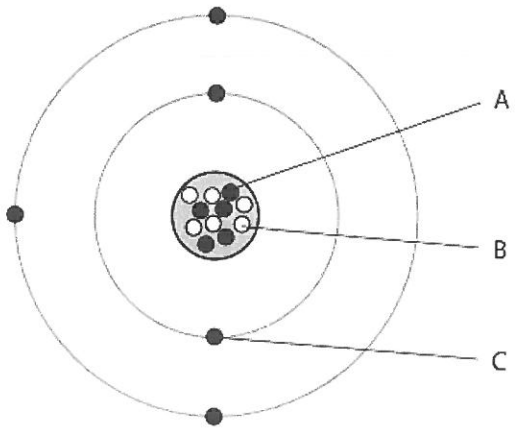
(c) Describe the changes in arrangement, movement and energy of the particles when the liquid wax cools to become a solid.

(3)

- Arrangement becomes more regular
- Particles vibrate in a fixed position
- Particles lose energy.

(Total for Question 2 = 6 marks)

3 The diagram represents an atom of an element.



(a) The diagram shows that there are equal numbers of particles **A** and **C**.

(i) State the name of each of the particles **A** and **B**.

(2)

A Protons

B Neutrons

(ii) State the atomic number and mass number of this atom.

(2)

Atomic number 5

Mass number 11

(b) (i) State the **name** of this element.

(1)

Boron

(ii) State the electronic configuration of this element.

(1)

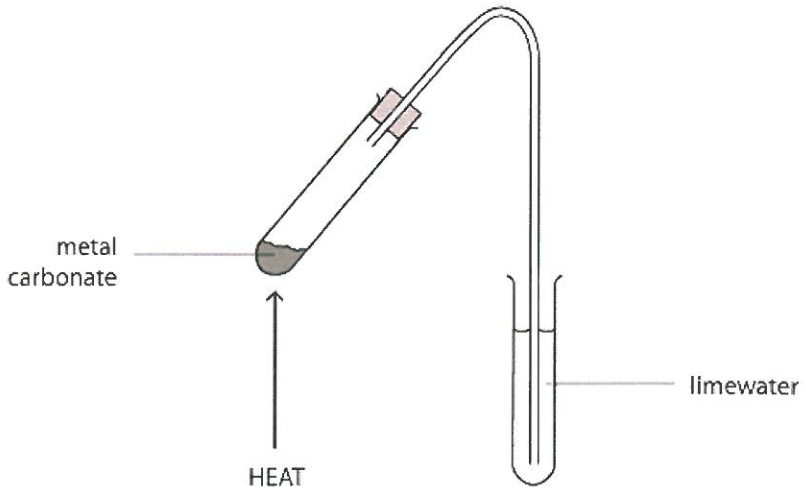
2, 3

(Total for Question 3 = 6 marks)

1006 D

4 A student wanted to find out how easily different metal carbonates decomposed on heating.

She placed a sample of a metal carbonate into a test tube and heated it, passing the gas given off through limewater using the apparatus shown in the diagram.



She heated three other metal carbonates in turn and measured the time taken for the limewater to turn milky.

Her results are given in the table.

Metal carbonate	Time taken in seconds
copper(II) carbonate	5
magnesium carbonate	25
lead(II) carbonate	15
sodium carbonate	does not turn milky

4 (a) State the name of the gas that causes the limewater to turn milky.

(1)

Carbon dioxide

(b) Use the results to identify, with a reason, which metal carbonate decomposed most easily.

(2)

- Copper(II) carbonate
- limewater turned milky in the least time

(c) What do the results suggest about the effect of heat on sodium carbonate?

(1)

Does not decompose

(d) State **two** things that the student must do to make sure the experiment is valid (a fair test).

(2)

1 - same vol/conc/amount of limewater
- same flame/temp

2 - same amount/mass of solid
- same distance of flame to tube
- same form of solid!

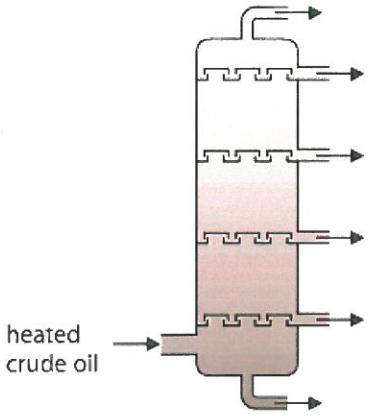
(Total for Question 4 = 6 marks)

(0061)

5 Fractional distillation is an important process in the oil industry.

In this process, the crude oil is separated into a number of fractions. Each fraction is a mixture of hydrocarbons.

The diagram shows the column used for fractional distillation.



(a) What is meant by the term **hydrocarbon**?

(2)

Compound containing only hydrogen + Carbon

(b) Bitumen, diesel, gasoline and refinery gases are three of the fractions obtained from crude oil.

(i) Which one of these three fractions has the lowest boiling point?

(1)

refinery gases

(ii) Which one of these three fractions is the most viscous?

(1)

bitumen

5 (c) Explain how the separation of crude oil into fractions takes place in the fractionating column.

(4)

- Crude oil vapours rises through the column
- There is temp gradient in the column / its hotter at the bottom than the top
- Different fractions have different boiling point
- Condense when they reach the part of the column that has a lower temp than their bp.
- Bubble caps prevent liquid fractions trickling down.

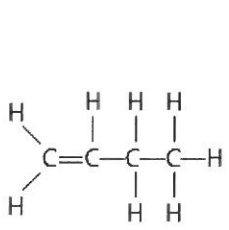
(Total for Question 5 = 8 marks)

10066

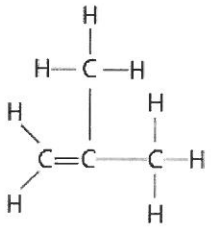
6 (a) Isomers are compounds that have the same molecular formula but different displayed formulae.

The molecular formula C_4H_8 represents several isomers.

The displayed formulae and names for two of these isomers are



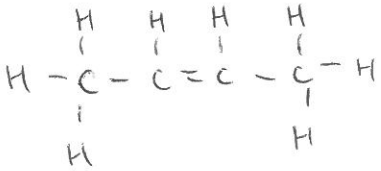
but-1-ene



methylpropene

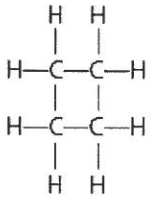
(i) Draw the displayed formula and give the name for another alkene with the molecular formula C_4H_8

(2)



Name but-2-ene

(ii) The displayed formula of another isomer of C_4H_8 is



cyclobutane

The general formula of cyclobutane is also C_nH_{2n}

State why cyclobutane is not an alkene.

(1)

No double bond / saturated.

6 (iii) Cyclobutane can be distinguished from but-1-ene by adding bromine water and shaking. Bromine water is orange.

State what you would see when bromine water is shaken separately with each compound.

(2)

Observation with cyclobutane

No colour change

Observation with but-1-ene

Turns colourless

(b) Cracking is used to break long alkane molecules into shorter alkanes and alkenes.

Explain why this process is of such importance in the petrochemical industry.

(2)

- crude oil contains too many long chain hydrocarbons
- Shorter chain hydrocarbons are more economically important
- e.g alkenes in polymer/plastic industry.

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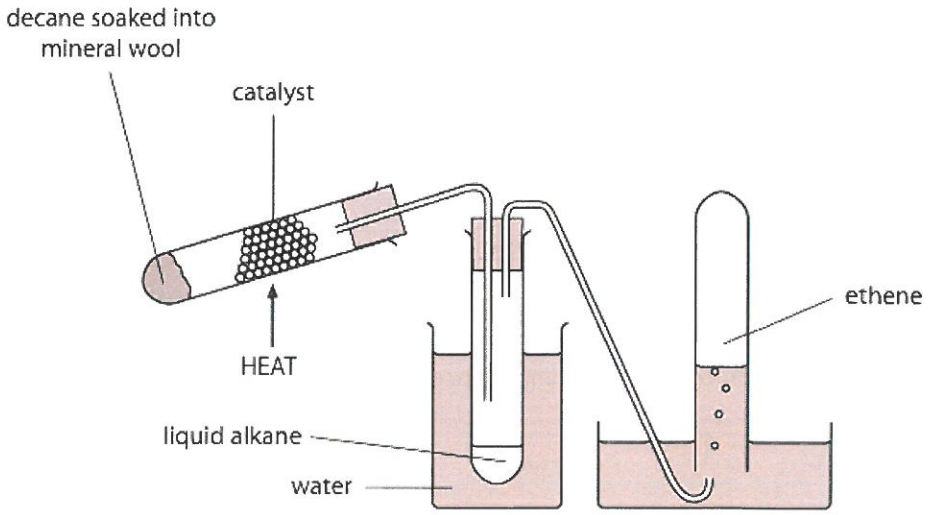
6 (c) Cracking can be carried out in the laboratory by passing the vapour of an alkane over a heated catalyst using the apparatus shown.



When decane ($C_{10}H_{22}$) is cracked, a shorter chain alkane and ethene (C_2H_4) can be produced.

(i) Write a chemical equation for the cracking of decane.

(2)

$C_{10}H_{22} \rightarrow C_2H_4 + C_8H_{18}$

(ii) The alkane produced can be used as a fuel for cars.

When this fuel is burned in a car engine, some incomplete combustion occurs. This produces carbon monoxide, which is dangerous to humans.

Explain why carbon monoxide is dangerous to humans.

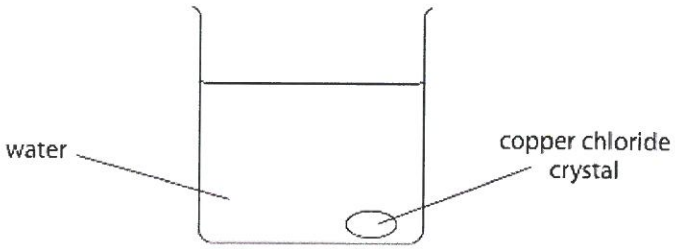
(2)

- Toxic / poisonous
- Restricts blood carrying oxygen.

(Total for Question 6 = 11 marks)

7 Copper chloride is a soluble ionic compound. Solid copper chloride is green.

(a) A crystal of copper chloride was placed in a beaker containing water. It was left for several days.

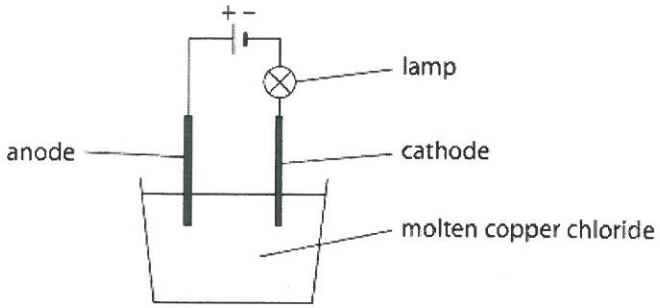


Explain how the appearance of the liquid in the beaker changes after several days.

(2)

• green colour spreads throughout the liquid
• by diffusion

(b) A chemist electrolyses a sample of molten copper chloride, $CuCl_2$.



Name the products formed at the electrodes.

(2)

Anode chlorine

Cathode copper

(c) Write an equation to show the formation of the product at the ~~negative~~ electrode.

(2)

chloride

$2Cl^- \rightarrow Cl_2 + 2e^-$

(Total for Question 7 = 6 marks)

1006D

8 Equal masses of iron, magnesium and zinc were placed in separate beakers, each containing 50 cm^3 of copper(II) sulfate solution.

The mass of copper displaced in each case was found and each experiment was performed three times. The results obtained are given in the table.

Metal	Mass of copper produced in grams		
	Experiment 1	Experiment 2	Experiment 3
iron	1.1	1.3	1.2
magnesium	2.3	3.2	2.2
zinc	0.9	0.8	1.10

(a) How can you tell that one of the results has been recorded to a greater precision than the others?

(1)

extra decimal place for zinc on expt 3

(b) Write a chemical equation for the reaction taking place between magnesium and copper(II) sulfate.

(2)

$Mg + CuSO_4 \rightarrow MgSO_4 + Cu$

(c) (i) State, in terms of electrons, what happens when a copper ion becomes a copper atom.

(1)

gains (two) electrons

(ii) What name is given to the type of change occurring in (c)(i)?

(1)

Reduction

(iii) State **two** observations you would expect to make when magnesium is added to copper(II) sulfate solution.

(2)

- Solutions turns colourless
- Brown solid forms
- gets warm

(Total for Question 8 = 7 marks)

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9 (a) An aqueous solution of hydrogen peroxide (H_2O_2) decomposes very slowly into water (H_2O) and oxygen (O_2) according to the following equation:

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

The reaction is faster when manganese(IV) oxide (MnO_2) is added. The manganese(IV) oxide remains chemically unchanged at the end of the reaction.

A student investigated the reaction in the presence of manganese(IV) oxide. He collected the oxygen gas produced and recorded its volume every five minutes. His results are shown in the table.

Time in minutes	0	5	10	15	20	25	30	35	40
Volume in cm^3	0	20	32	42	50	55	58	60	60

(i) The volume of gas given off between 5 and 10 minutes is 12 cm^3.

Calculate the volume of gas given off between 30 and 35 minutes.

(1)

Answer 2 cm^3

(ii) Explain, in terms of the changes in the rate of the reaction and collisions between particles, why your calculated volume is less than 12 cm^3.

(3)

- Reaction rate slows down
- because there are fewer hydrogen peroxide particles
- therefore less frequent collisions / fewer collisions per second

(iii) After how many minutes did the reaction finish?

(1)

35

(b) What type of substance is manganese(IV) oxide in this experiment?

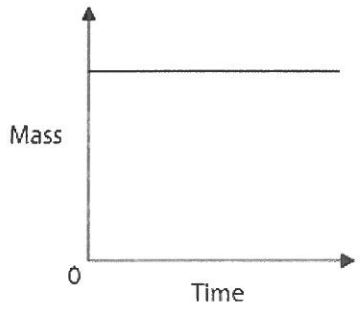
(1)

catalyst.

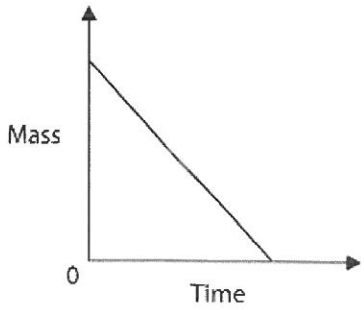
1006D

9 (c) Some of the graphs **A** to **F** below could represent changes occuring during the decomposition of hydrogen peroxide.

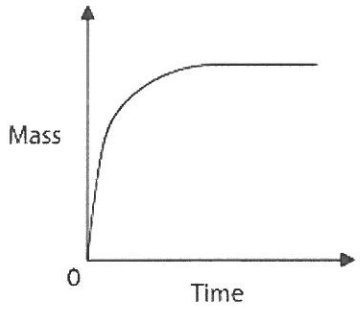
A



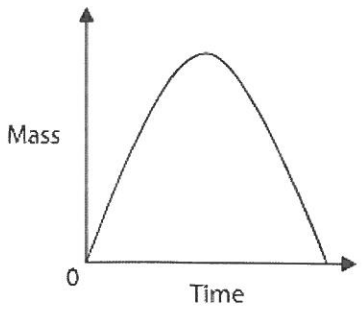
B



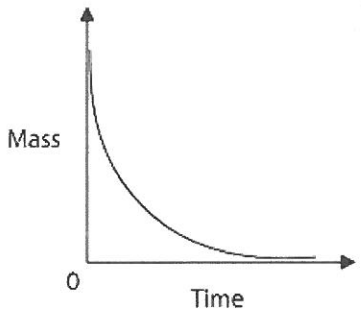
C



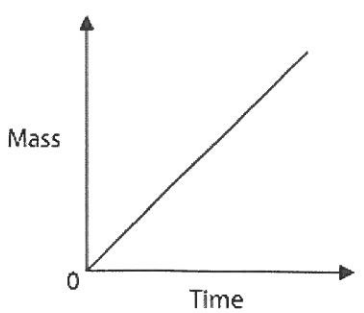
D



E



F



10 06 D

9 Answer the questions below by placing a cross (☒) in the appropriate box to indicate your answer.

Which graph could represent

(i) the total mass of oxygen given off as the experiment in (a) proceeds? (1)

☐ A ☐ B ☑ C ☐ D ☐ E ☐ F

(ii) the mass of hydrogen peroxide remaining as the experiment in (a) proceeds? (1)

☐ A ☐ B ☐ C ☐ D ☑ E ☐ F

(iii) the mass of the manganese(IV) oxide as the experiment in (a) proceeds? (1)

☑ A ☐ B ☐ C ☐ D ☐ E ☐ F

(Total for Question 9 = 9 marks)

1006 D

10 When potassium iodide solution is mixed with lead(II) nitrate solution, a reaction occurs to form the insoluble salt, lead(II) iodide.

The equation for this reaction is:

$$2KI(aq) + Pb(NO_3)_2(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$$

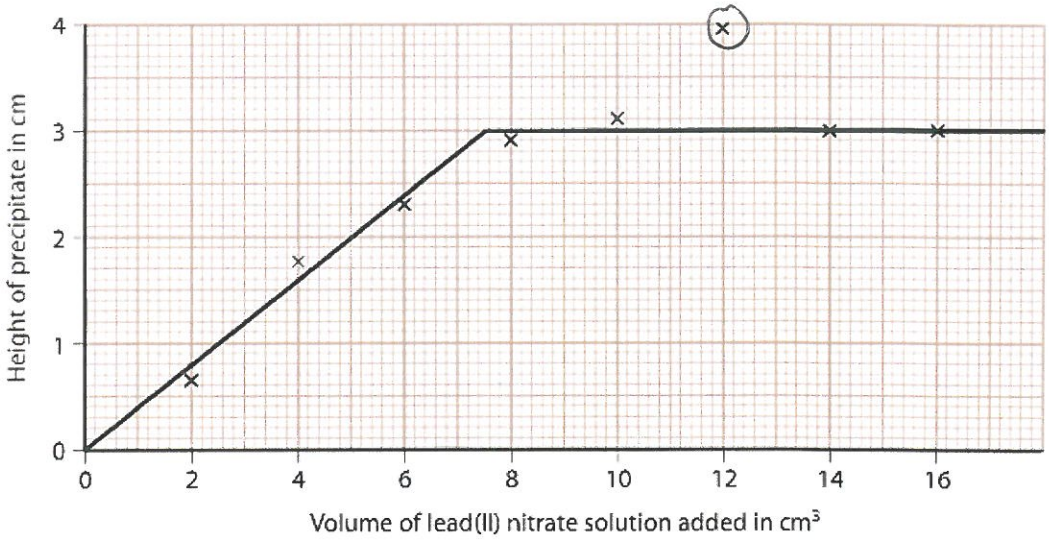
A student carried out an investigation to find how much precipitate was formed with different volumes of lead(II) nitrate solution.

- He used a measuring cylinder to transfer 15 cm^3 of potassium iodide solution into a clean boiling tube.
- Using a different measuring cylinder, he measured out 2 cm^3 of lead(II) nitrate solution and added this to the potassium iodide solution in the boiling tube.
- A yellow precipitate formed in the tube and was allowed to settle.
- The student then measured the height (in cm) of the precipitate using a ruler.

He repeated the experiment using different volumes of lead(II) nitrate solution.

In each experiment, the potassium iodide solution and lead(II) nitrate solution he used were of the same concentration.

The graph shows the results he obtained.



(a) Explain why the line on the graph rises to a maximum level, but then does not change.

(2)

- More precipitate as more lead nitrate present
- eventually all potassium iodide used up.

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10 (b) (i) On the graph, circle the point which seems to be anomalous.

(1)

(ii) Explain **two** things that the student may have done in the experiment to give this anomalous result.

(4)

1 • Not left long enough

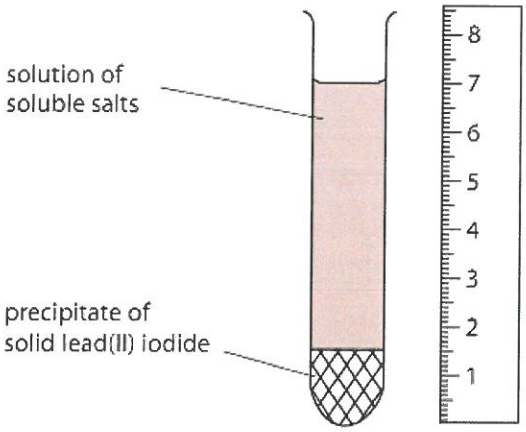
• therefore precipitate not fully settled

or • too much KI added

2 • So more precipitate made

or tube not vertical when precipitate was settling so precipitate not level.

(c) The diagram shows a result of an identical experiment.



(i) How much precipitate has been made in the tube?

(1)

1·5 cm

(ii) Use the graph to find the voume of lead(II) nitrate solution needed to make this amount of precipitate.

(1)

3·8 cm^3

(Total for Question 10 = 9 marks)

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11 Fluorine and chlorine are two elements in Group 7 of the Periodic Table.

Fluorine reacts with most elements in the Periodic Table, but it does not react with neon.

Neon is in Group 0 of the Periodic Table.

(a) Explain, in terms of the arrangement of electrons in its atoms, why neon is very unreactive.

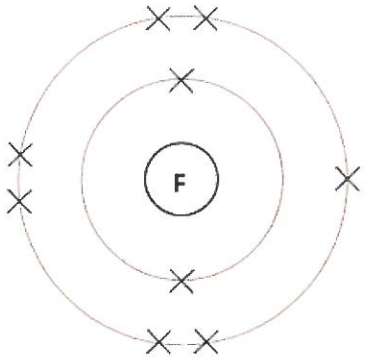
(2)

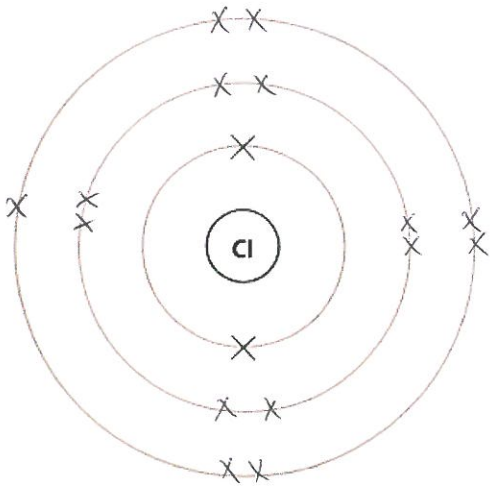
- 8 electrons in the outer shell
- does not easily gain or lose electrons.

(b) The diagram on the left shows the arrangement of the electrons in a fluorine atom.

Use the Periodic Table to help you to complete the diagram on the right to show the arrangement of electrons in a chlorine atom.

(2)





11 (c) When chlorine gas is bubbled into an aqueous solution of potassium iodide, the colourless solution turns brown.

(i) Complete the following ionic equation for the reaction that takes place.

(2)

$Cl_2(g)$ + 2 $I^-(aq)$ → $2Cl^-$ (aq) + I_2 (aq)

(ii) What is the name given to this type of reaction?

(1)

Displacement / redox

(iii) Why does the solution turn brown?

(1)

Iodine formed

(d) When chlorine reacts with concentrated sodium hydroxide solution, a compound is formed that contains 21.6% by mass of sodium and 33.3% by mass of chlorine. The rest is oxygen.

Calculate the empirical formula of this compound.

(4)

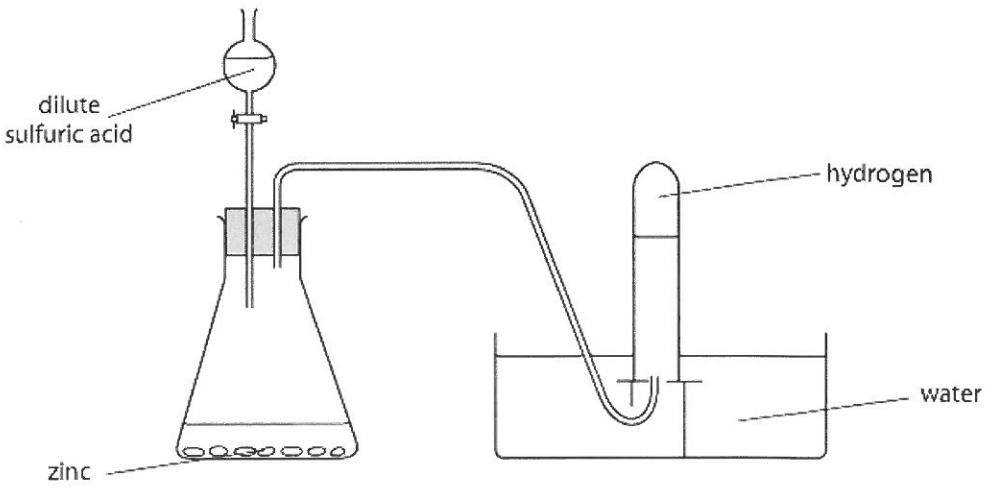
Na	Cl	O
21.6	33.3	45.1
23	35.5	16
0.939	0.938	2.819
0.938	0.938	0.938
1	1	3

$NaClO_3$

(Total for Question 11 = 12 marks)

1006D

12 Hydrogen can be prepared in the laboratory by reacting zinc with dilute sulfuric acid using the apparatus shown.



The equation for the reaction is:

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

The reaction is fairly slow but, when copper(II) sulfate solution is added, bubbles of hydrogen form much more quickly.

A student decided to investigate how copper(II) sulfate solution increased the rate of this reaction.

She set up the apparatus as shown, without copper(II) sulfate present, and counted the number of bubbles of hydrogen produced every 15 seconds.

She then repeated the experiment with copper(II) sulfate present.

(a) Explain why her method of counting the number of bubbles of hydrogen might not give accurate results in her second experiment, with copper(II) sulfate present.

(2)

- Bubbles may be different size
- so not valid

or

- Reaction rate is faster
- counting blubbles is more difficult.

12 (b) Describe how she should change the experiment to allow the collection of more precise results.

(2)

- Measure the volume of gas produced
- Using a gas syringe

The student then decided that she wanted to show that the gas collected was hydrogen. She burned a sample in oxygen and collected the colourless liquid that formed on cooling. If the gas were hydrogen then the colourless liquid should be pure water.

(c) Describe a **physical** test that she could perform to show that the colourless liquid is pure water.

(2)

Boils at 100°C

The student's teacher said that even if the colourless liquid were pure water then it does not necessarily mean that the gas was hydrogen.

(d) Suggest the name of another **gas** that produces water when it is burned in oxygen.

(1)

e.g. methane.

(Total for Question 12 = 7 marks)

10 66 D

13 Ammonia (NH_3) is manufactured in the exothermic reaction between nitrogen gas (N_2) and hydrogen gas (H_2) in the presence of an iron catalyst.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \quad \Delta H = -92 \text{ kJ/mol}$$

The nitrogen and hydrogen mixture is passed into a reaction chamber at a pressure of 200 atmospheres and a temperature of 450 °C.

The reaction is reversible and, if left for long enough, can reach a position of dynamic equilibrium.

(a) Why is a catalyst needed in this reaction?

(1)

Speeds up reaction / lower activation energy / lower temp can be used.

(b) What is meant by the term **dynamic equilibrium**?

(2)

foward + reverse reactions are occurring at same rate

(c) A scientist working in the factory making ammonia suggested changing the reaction conditions to a pressure of 1000 atmospheres and a temperature of 250 °C.

Use your knowledge of equilibrium reactions and reaction rates to explain whether the scientist's suggestion was a good one.

(4)

- Increases pressure → increase yield ✓
  → increase rate ✓
- decrease temp → ~~increase~~ decrease rate ✓
  increase yield ✓

+ concluding comment

(0 06 1)

13 (d) The mixture of gases leaving the reaction chamber contains unreacted nitrogen and hydrogen as well as ammonia.

(i) Explain how the ammonia can be separated from the unreacted nitrogen and hydrogen after the mixture has left the reaction chamber.

(2)

- NH_3 has a low boiling point
- Mixture is cooled
- NH_3 condenses

(ii) What happens to the unreacted nitrogen and hydrogen after it has been separated from the ammonia?

(1)

(e) Ammonia is used to make the fertiliser ammonium nitrate (NH_4NO_3) by reacting ammonia with nitric acid.

Write a chemical equation for the reaction between ammonia and nitric acid.

(1)

$NH_3 + HNO_3 \longrightarrow NH_4NO_3$

(f) Describe a chemical test that you could perform to show that ammonium nitrate contains ammonium ions.

(3)

+ NaOH (aq.)

- NH_3 vapours given off
- turns red litmus blue.

(Total for Question 13 = 14 marks)

10 06 D

14 Zinc phosphide (Zn_3P_2) is found in some rat poisons. It is an ionic compound manufactured by heating zinc and phosphorus together.

(a) (i) The formula of the zinc ion is Zn^{2+}.

Deduce the formula of the phosphide ion.

(1)

P^{3-}

(ii) Explain why zinc phosphide does **not** conduct electricity when solid, but **does** when molten.

(2)

- Ions are not free to move when solid
- Ions are free to move when molten

(b) Calculate the relative formula mass (M_r) of zinc phosphide.

(2)

$(65 \times 3) + (31 \times 2)$

Relative formula mass = 257

1006 D

(c) A bag containing 51.4 kg (51 400 g) of zinc phosphide stored in a factory warehouse was accidentally contaminated with water.

Zinc phosphide reacts with water to form zinc hydroxide and phosphine gas, PH_3.

The equation for the reaction is:

$$Zn_3P_2(s) + 6H_2O(l) \rightarrow 3Zn(OH)_2(s) + 2PH_3(g)$$

(i) Calculate the minimum mass of water, in kg, needed to react with all of the zinc phosphide in the bag.

(3)

$\frac{51400}{257}$

$= 200 \times 6 = 1200 \times 18 = 21600\,g$

Mass of water needed = 21.6 kg

(ii) The factory was evacuated because phosphine can burst into flames immediately when it comes into contact with oxygen in the air.

What does this suggest about the activation energy for the reaction between phosphine and oxygen?

(1)

low

(iii) Is the reaction between phosphine and oxygen endothermic or exothermic? Use information from part (ii) to justify your answer.

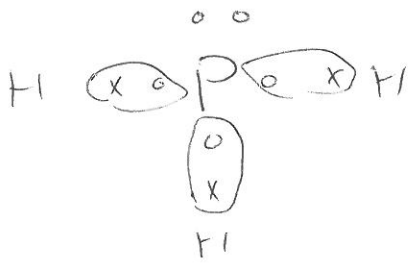
(1)

exothermic because it burst into flames.

(14d) (i) Phosphine is similar to ammonia (NH_3) in the way its atoms are bonded.

Draw a dot and cross diagram to show the arrangement of electrons in a molecule of phosphine. You should show only the outer electrons of each atom.

(2)



(ii) Explain why phosphine has a low boiling point.

(2)

- small/simple covalent molecule ✓
- weak intermolecule forces. ✓
- little energy required to break ✓

(Total for Question 14 = 14 marks)

TOTAL FOR PAPER = 120 MARKS