CAMBRIDGE
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GCSE

Chemistry

Session: 1994 June
Type: Question paper
Code: 1375

MIDLAND EXAMINING GROUP 1375/1

General Certificate of Secondary Education

CHEMISTRY

PAPER 1

Tuesday **14 JUNE 1994** Afternoon 1 hour

Additional materials:
Personalised answer sheet (Form MS4)
Soft Pencil

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

Do not open this booklet until you are told to do so.

Write your name, Centre number and candidate number on the answer sheet in the spaces provided unless this has already been done for you.

There are **fifty** questions on this paper. Attempt **all** questions. For each question there are five possible answers labelled **A, B, C, D** and **E.** Choose the **one** you consider correct and record your choice in **soft pencil** on the separate answer sheet.

Read very carefully the instructions on the answer sheet.

INFORMATION FOR CANDIDATES

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

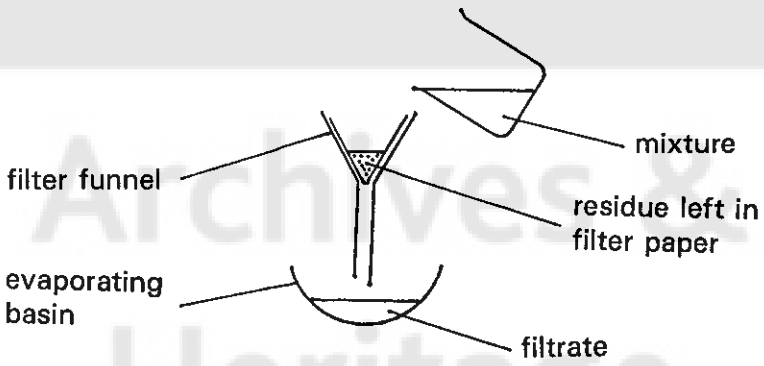
Relative atomic masses are given in the Periodic Table of the Elements provided overleaf which should be removed before starting work.

This question paper consists of 17 printed pages, one blank page and a Periodic Table.

1 Which one of the following is a single compound?

A air
B alumina
C coal
D crude oil
E sea water

2 The apparatus below can be used to separate some mixtures.



It could be used to separate

A ethanol from a mixture of ethanol and water.
B sand from a mixture of charcoal and sand.
C sand from a mixture of water and sand.
D common salt from sea water.
E pure water from sea water.

PERIODIC TABLE OF ELEMENTS

TEAR OUT THIS PAGE

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 Sulphur 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 †															

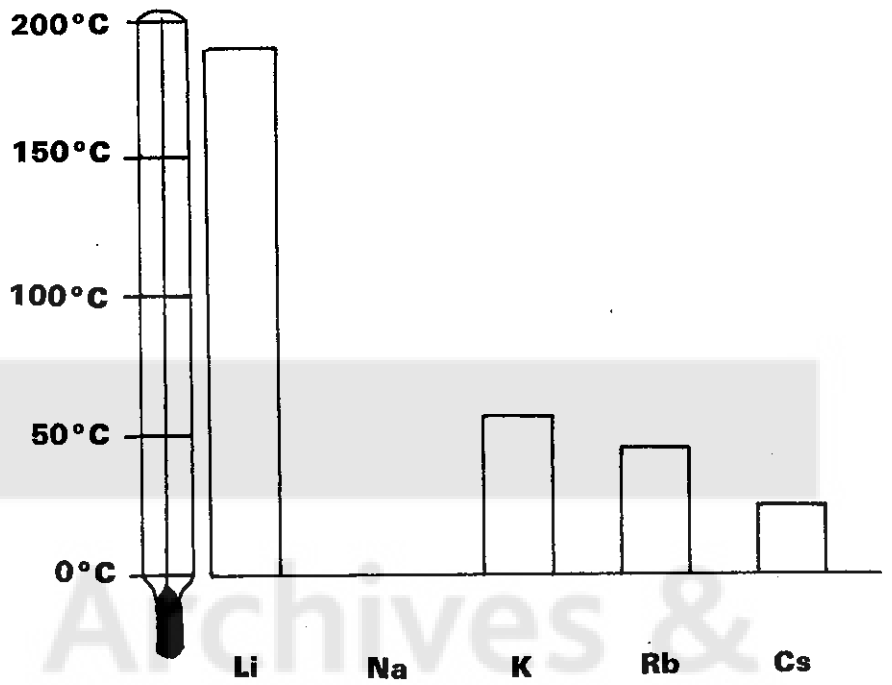
140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	Pa Protactinium 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 Lanthanum series

† 90-103 Actinium series

Key: a / X / b — a = relative atomic mass; X = atomic symbol; b = atomic number

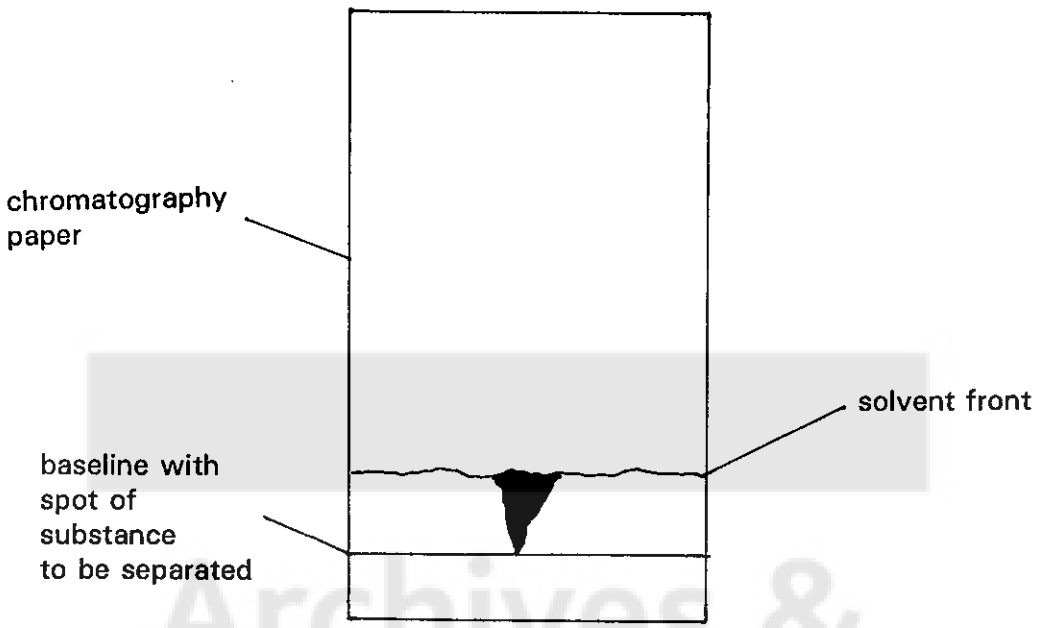
3 The chart shows the melting points of the elements in Group I of the Periodic Table. The melting point of sodium is missing.



Which of the following is the most likely melting point of sodium?

A 0 °C
B 23 °C
C 63 °C
D 98 °C
E 183 °C

4 A student tried to separate a mixture of food dyes by chromatography. Separation was poor, as shown in the chromatogram below.



Which change to the process would improve the result?

A using enough solvent to cover the baseline

B using a smaller piece of chromatography paper

C putting a larger spot of the dye mixture onto the paper

D allowing the solvent to rise further up the paper

E using a larger piece of chromatography paper

5 The element with atomic number 17 will form an ionic compound with the element whose electronic structure is

A 2, 4

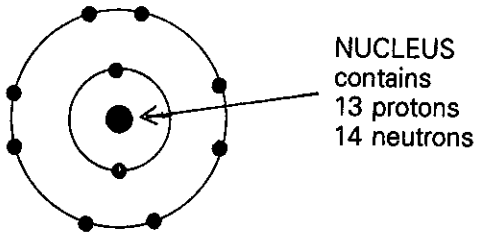
B 2,8,6

C 2,8,7

D 2,8,8

E 2,8,8,1

6 An **ion** of an element is represented below.



What is the element?

A aluminium
B cobalt
C neon
D nitrogen
E silicon

7 The table below gives the melting points and boiling points of five elements. Which element is a liquid at 2500 °C?

Element	Melting Point /°C	Boiling Point /°C
A Aluminium	660	2470
B Bromine	−7	59
C Chlorine	−101	−35
D Iron	1540	2750
E Mercury	−39	357

8 What is the mass of calcium in 28 g of calcium oxide (CaO)? (Relative atomic masses: O = 16, Ca = 40)

A 8 g
B 16 g
C 20 g
D 40 g
E 56 g

9 Which one of the following chemical equations is correctly balanced?

A $Fe_3O_4 + 2H_2 \rightarrow 3Fe + 2H_2O$
B $H_2O \rightarrow H_2 + O_2$
C $H_2O_2 \rightarrow H_2O + O_2$
D $Mg(OH)_2 \rightarrow MgO + H_2O$
E $2Na + H_2O \rightarrow 2NaOH + H_2$

10 A sample of coal was found to contain 32 g of sulphur per tonne. What mass of sulphur dioxide would be formed on burning 1 tonne of coal?
(Relative atomic masses: O = 16, S = 32)

A 32 g
B 48 g
C 64 g
D 80 g
E 96 g

11 Magnesium reacts with oxygen as shown by the equation below.

$$2Mg + O_2 \rightarrow 2MgO$$

What volume of oxygen gas (O_2) measured at room temperature and pressure is needed to react completely with 12 g of magnesium?
(Molar gas volume is 24 dm^3 at room temperature and pressure.
Relative atomic masses: O = 16, Mg = 24)

A 2 dm^3
B 6 dm^3
C 16 dm^3
D 24 dm^3
E 48 dm^3

12 Aqueous sodium hydroxide is added to an unknown solution.
A white precipitate is formed which dissolves when more aqueous sodium hydroxide is added.
Which one of the following ions is present in the solution?

A Al^{3+}
B Cu^{2+}
C Fe^{2+}
D Fe^{3+}
E NH_4^+

13 Newly laid bricks sometimes become coated with a basic white deposit.

The best way to remove this deposit is to apply a mixture of detergent and a chemical which will react rapidly with the white deposit.

Which one of the following is the most suitable chemical to react with this deposit?

A aqueous ammonia
B ethanol
C hydrochloric acid
D limewater
E aqueous sodium hydroxide

14 Indigestion can be caused by excess acid in the stomach. Which one of the following substances could an indigestion tablet contain to neutralise the acid?

A glucose
B lemon juice
C magnesium hydroxide
D sodium chloride
E sugar

15 Sodium chloride is made from aqueous sodium hydroxide and hydrochloric acid. What is the correct sequence of steps in this preparation?

	Step 1	Step 2	Step 3
A	evaporation	neutralisation	cystallisation
B	evaporation	crystallisation	neutralisation
C	neutralisation	evaporation	crystallisation
D	crystallisation	evaporation	neutralisation
E	neutralisation	crystallisation	evaporation

16 Which one of the following does **NOT** conduct electricity?

A dilute sulphuric acid
B graphite
C magnesium ribbon
D aqueous sodium chloride
E solid lead(II) bromide

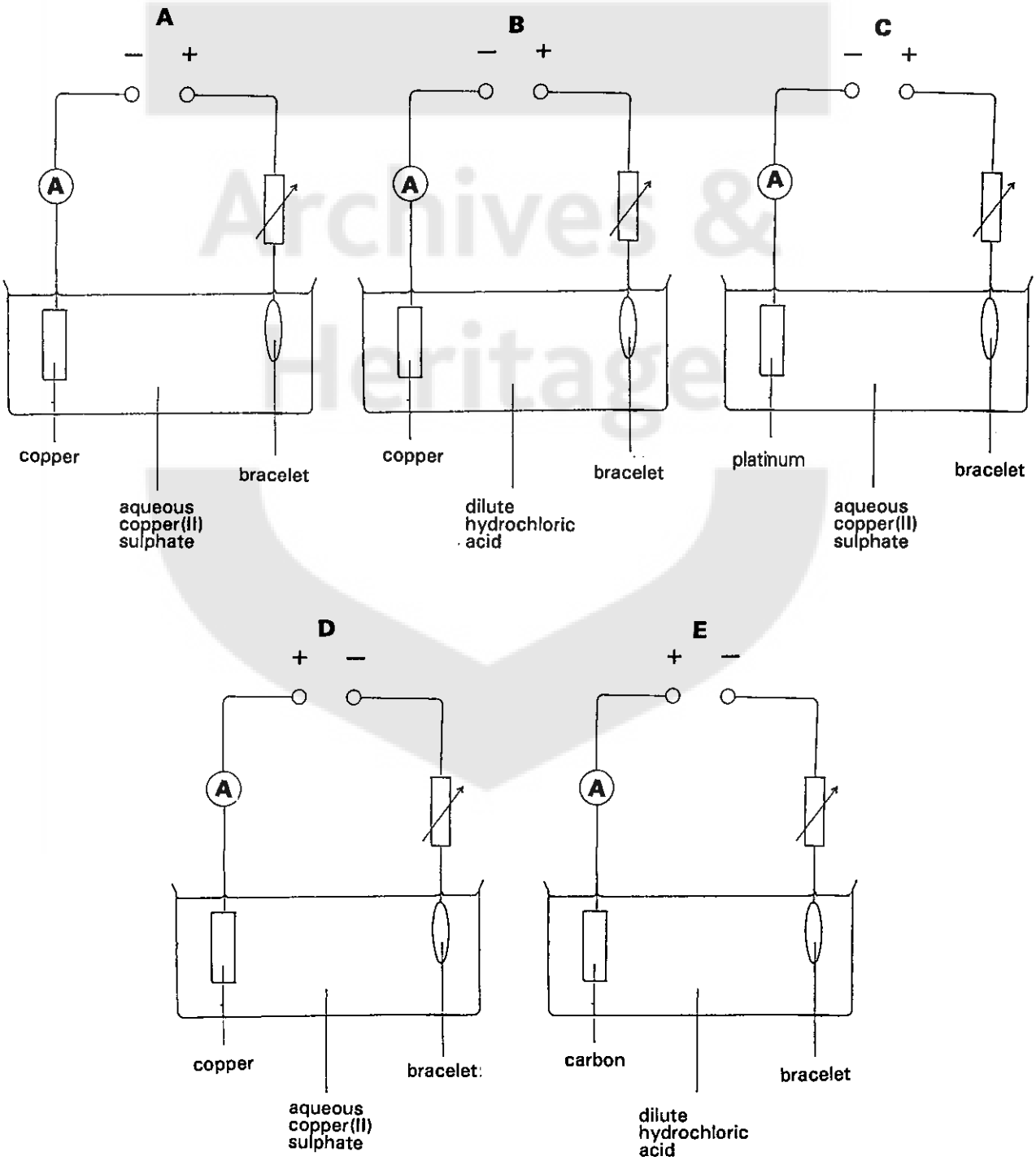
17 The particles which travel through the external wires connecting a cell to the electrodes during electrolysis are called

A anions.
B cations.
C electrons.
D neutrons.
E protons.

18 When aluminium electrodes are used in the electrolysis of dilute sulphuric acid, which process takes place at the positive electrode?

A analysing
B anodising
C decolourising
D displacing
E electroplating

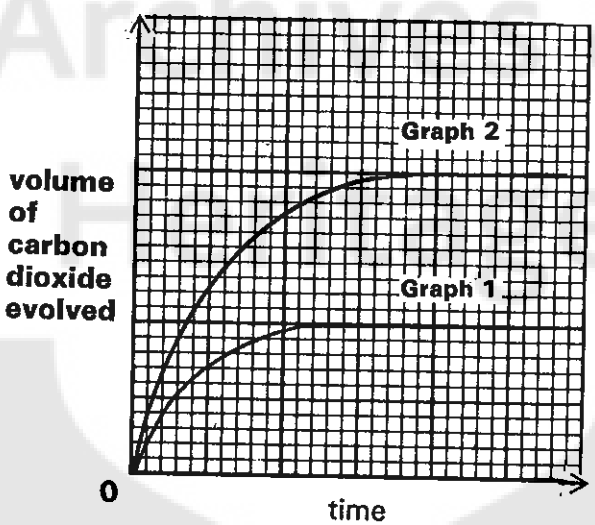
19 A metal bracelet is to be electroplated with copper. Which circuit should be used?



20 0.1 g of magnesium ribbon was reacted completely with hydrochloric acid. How would the result differ if 0.1 g of magnesium powder had been used under the same conditions?

	Using 0.1 g magnesium powder	
	Volume of hydrogen	Rate obtained
A	more	faster
B	more	slower
C	less	faster
D	same	slower
E	same	faster

21 The graphs below were obtained when limestone lumps reacted completely in an excess of dilute hydrochloric acid. Graph 1 was obtained using 10 g of limestone lumps.



Which change of experimental conditions could give rise to Graph 2?

A using twice the volume of acid
B using acid which is twice as concentrated
C using twice the mass of powdered limestone
D using powdered limestone
E measuring the volume at a higher pressure

22 The addition of hydrogen to a substance is

A hydration.
B hydrolysis.
C neutralisation.
D oxidation.
E reduction.

23 Which equation represents a metal being oxidised?

A $CuO + H_2 \rightarrow Cu + H_2O$

B $2PbO + C \rightarrow 2Pb + CO_2$

C $Fe^{3+} + e^- \rightarrow Fe^{2+}$

D $Zn \rightarrow Zn^{2+} + 2e^-$

E $3Ag_2O + 2NH_3 \rightarrow 6Ag + 3H_2O + N_2$

24 Which product is obtained by oxidation of the raw material?

	Raw material	Formula	Product	Formula
A	nitrogen	N_2	ammonia	NH_3
B	limestone	$CaCO_3$	lime	CaO
C	sulphur	S	sulphuric acid	H_2SO_4
D	alumina	Al_2O_3	aluminium	Al
E	ethene	C_2H_4	poly(ethene)	$\{CH_2 - CH_2\}_n$

25 The element caesium (symbol Cs) is in the same group of the Periodic Table as sodium and potassium. Which one of the following is the formula for caesium chloride?

A Cs_2Cl

B $CsCl$

C $CsCl_2$

D $CsCl_3$

E Cs_2Cl_3

26 Which set shows the elements in order of increasing reactivity?

	least reactive	⟶	most reactive
A	lithium	potassium	sodium
B	chlorine	bromine	iodine
C	sodium	potassium	lithium
D	iodine	bromine	chlorine
E	argon	neon	helium

27 Use the Periodic Table to find the element which is in Period 4 and Group III. How many neutrons are in one atom of this element?

A 3
B 27
C 31
D 39
E 101

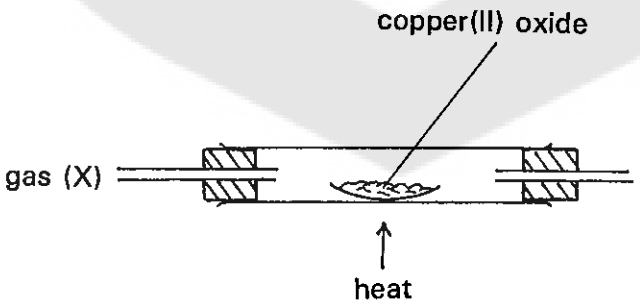
28 In which pair are both elements in the same period of the Periodic Table?

A calcium and carbon
B gold and silver
C helium and neon
D potassium and sodium
E silicon and sulphur

29 Which carbonate turns from green to black when heated to constant mass?

A calcium carbonate
B copper(II) carbonate
C lead(II) carbonate
D sodium carbonate
E zinc carbonate

30 Which gas (X) could be used to reduce copper(II) oxide to copper?



A carbon dioxide
B chlorine
C hydrogen
D nitrogen
E oxygen

31 A typical property of metallic elements is that they

A form an anion by losing electrons.

B form a cation by gaining electrons.

C react with an acid to form a salt and water.

D react with an alkali to form a salt and water.

E react with oxygen to form a basic oxide.

32 Element X exists as molecules X_2.
X forms a cation X^+.
X is a reducing agent.
Which element best fits this description?

A chlorine

B hydrogen

C neon

D oxygen

E sodium

33 Which metal does **not** react with cold water, steam or dilute sulphuric acid?

A calcium

B copper

C iron

D magnesium

E zinc

34 Which substance is most likely to be the cause of permanent hardness in water?

A calcium carbonate

B calcium hydrogencarbonate

C calcium sulphate

D sodium carbonate

E sodium hydrogencarbonate

35 Some compounds were dissolved in distilled water. The solutions had the same molarity. Equal volumes of these solutions were then shaken with three drops of soap solution. The height of lather formed was measured, and the results shown in the table below.

compound dissolved	height of lather/mm
sodium sulphate	20
sodium nitrate	19
potassium sulphate	20
calcium nitrate	1
calcium sulphate	1
magnesium sulphate	1

Which ions cause the hardness in these samples?

A Ca^{2+} and NO_3^-.

B Ca^{2+} and SO_4^{2-}.

C Mg^{2+} and SO_4^{2-}.

D Ca^{2+} and Mg^{2+}.

E Na^+ and K^+.

36 A major use for limestone is in the production of

A aluminium.

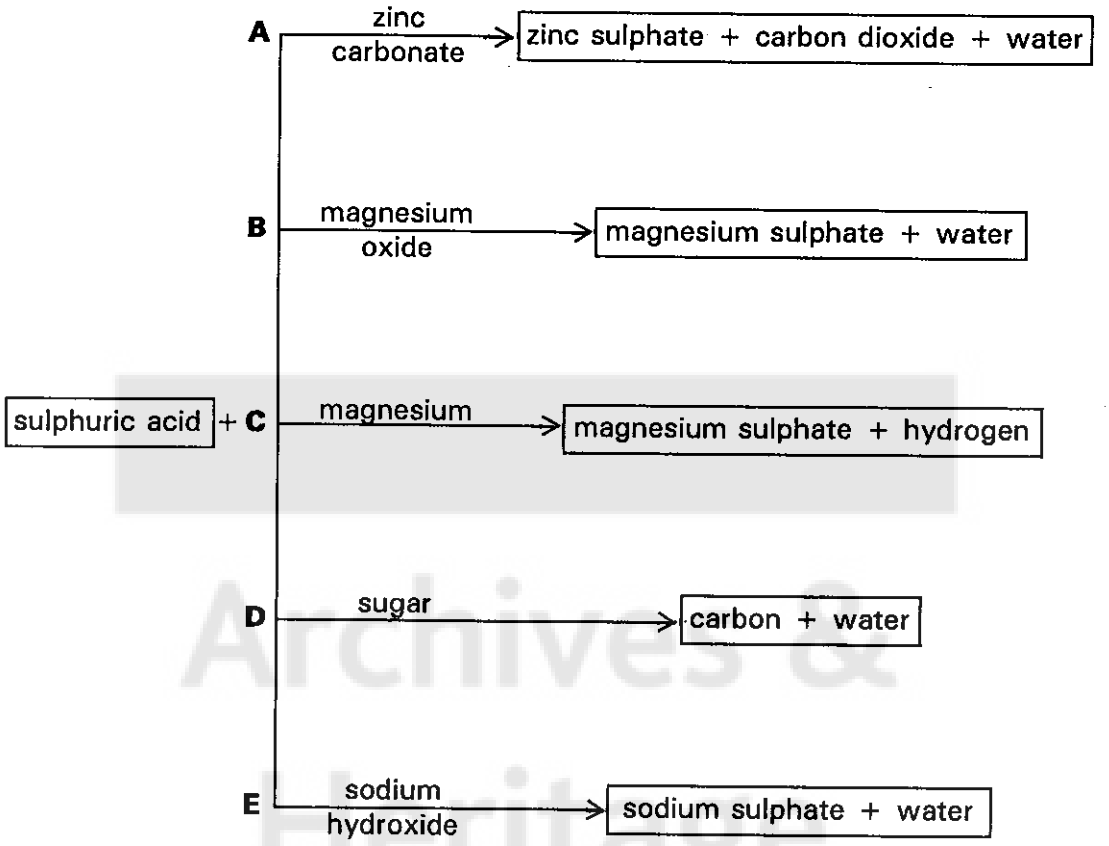
B chlorine.

C iron.

D petrol.

E sulphuric acid.

37 Five reactions of sulphuric acid are shown below.
For which of the reactions, letter **A** to **E**, must **concentrated** sulphuric acid be used?



38 Which one of the following tests and results shows that a carpet cleaner Q contains an ammonium compound?

	Test	Result
A	Add dilute hydrochloric acid to Q	A gas is given off which turns limewater cloudy.
B	Add dilute hydrochloric acid to Q.	A gas that burns is given off.
C	Warm Q with aqueous sodium hydroxide.	A gas is given off which turns moist indicator paper blue.
D	Add aqueous sodium hydroxide to aqueous Q.	A white precipitate is formed.
E	Add aqueous sodium hydroxide to aqueous Q.	A green precipitate is formed.

39 The gas given off when dilute hydrochloric acid is added to magnesium is

A ammonia.
B carbon dioxide.
C hydrogen.
D nitrogen.
E oxygen.

Questions 40 to 42

Questions 40 to 42 are concerned with the following table which shows the number of protons, neutrons and electrons in some particles.
Answers may be used once, more than once, or not at all.

	protons	neutrons	electrons
A	1	0	1
B	2	2	2
C	3	4	2
D	4	5	4
E	6	6	6

Which of these particles is

40 an atom with a mass number of 4?

41 an ion of an element with a charge of +1?

42 an atom with 4 electrons in its outer shell?

43 Which one of the following pairs of substances contains all the elements that a farmer needs in NPK fertilisers?

A sodium nitrate and potassium nitrate
B sodium nitrate and ammonium nitrate
C ammonium phosphate and sodium nitrate
D ammonium phosphate and potassium nitrate
E ammonium phosphate and ammonium nitrate

44 Why is it a hazard to discharge acid waste into rivers?

A It combines with water and on evaporation forms 'acid rain'.
B It causes the pH value of the river water to increase.
C It causes harm to fish and plants in the rivers.
D It always discolours the water in the rivers.
E It raises the concentration of hydroxide ions in the rivers.

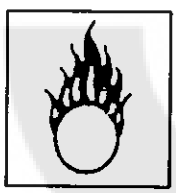
45 An element which burns to form a pollutant gas is

A calcium.
B hydrogen.
C magnesium.
D sodium.
E sulphur.

46 The 'HAZARD' label below is taken from a bottle of lead(II) nitrate.

LEAD(II) NITRATE

$Pb(NO_3)_2$ $M_r = 331$



Contact with combustible material may cause fire. Harmful by inhalation and if swallowed.
Danger of cumulative effects.

Keep away from food, drink and animal feeding stuffs.

When using, do not eat, drink or smoke.

The 'HAZARD' label means that lead(II) nitrate is

A an oxidant and harmful.
B an oxidant and radioactive.
C flammable and harmful.
D volatile and radioactive.
E volatile and flammable.

47 Vinegar is used for pickling certain foods. It is a solution which contains 0.5 mol/dm^3 ethanoic acid (CH_3COOH: M_r = 60).
What mass of ethanoic acid is actually present in 4 dm^3 of vinegar?

A 30 g
B 60 g
C 120 g
D 240 g
E 480 g

48 Ethene (C_2H_4) reacts with steam to form

A carbon dioxide.
B ethane.
C ethanoic acid.
D ethanol.
E methane.

49 Which change involves only a substitution reaction?

A ethanol → ethanoic acid
B ethanol → poly(ethene)
C ethene → ethane
D ethene → ethanol
E ethane → bromoethane

50 Which one of the following is **true** about both ethene and ethane?

A They are members of the same homologous series.
B They are isomers of each other.
C They both have the same relative molecular mass.
D They both contain covalent bonds.
E They are both saturated hydrocarbons.

Centre Number	Candidate Number

Candidate Name .....

MIDLAND EXAMINING GROUP 1375/2

General Certificate of Secondary Education

CHEMISTRY

PAPER 2

Tuesday **21 June 1994** **Morning** 1 hour

Candidates answer on the question paper.
No additional materials are required.

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TIME 1 hour

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **ALL** questions.

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

INFORMATION FOR CANDIDATES

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

Marks will be awarded for the accurate use of spelling, punctuation and grammar.

Relative atomic masses are given in the Periodic Table of Elements provided overleaf which should be removed before starting work

FOR EXAMINER'S USE	
Pages 2/3	
4/5	
6/7	
8/9	
10/11	
12/13	
14/15	
16/17	
Sub-Total	
SPG	
TOTAL	

This question paper consists of 17 printed pages, 1 blank page and a Periodic Table.

[Turn over

For Examiner's Use

1 Give either the name or the formula of

(a) a gas that relights a glowing splint. _____ [1]

(b) an acid which contains sulphur. _____ [1]

(c) a metal that does not react with water, steam or dilute sulphuric acid. _____ [1]

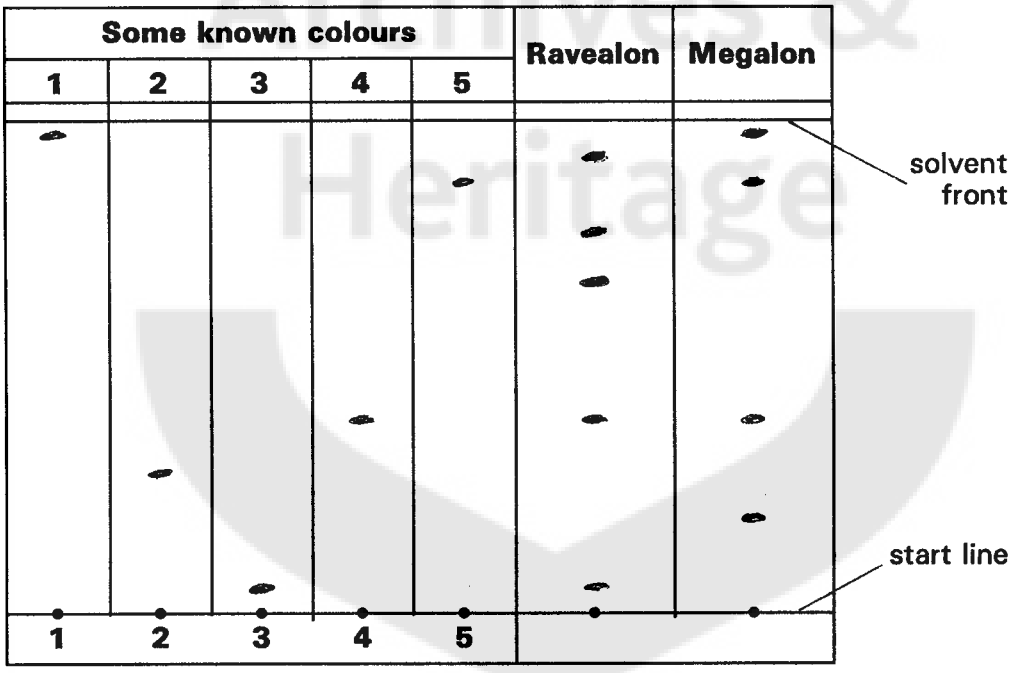
(d) the colour of a piece of pH paper after dipping it in aqueous sodium hydroxide. _____ [1]

(e) the element which has a relative atomic mass of 40. _____ [1]

(f) a metal which forms an ion with one positive charge eg X^+. _____ [1]

[6]

2 As part of a GCSE practical assessment a pupil compared the colourings in **Ravealon** and **Megalon** lipsticks. Samples of known colours were also used in the assessment. The chromatogram obtained by the pupil is given below.



(a) Use the chromatogram to help you answer the following questions.

(i) How many colours are there in **Megalon** lipstick? _____

(ii) How many of the colours in **Ravealon** lipstick could **not** be identified? _____

(iii) Suggest how the pupil could identify the unknown colours in **Ravealon** lipstick. _____

_____

_____ [3]

[Question 2 continued on next page

PERIODIC TABLE OF ELEMENTS

TEAR OUT THIS PAGE

The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
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23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 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 †															

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 Lanthanum series

† 90-103 Actinium series

Key: a / X / b — a = relative atomic mass; X = atomic symbol; b = atomic number

Question 2 - continued

(b) Another pupil had to find out whether the pink colour in rose petals was a single colour or a mixture of colours. The pupil crushed the petals, then warmed them with ethanol to extract the colouring matter.

(i) Why did the pupil crush the petals before adding the ethanol?

_____

(ii) Why is ethanol used when water is cheaper and readily available?

_____

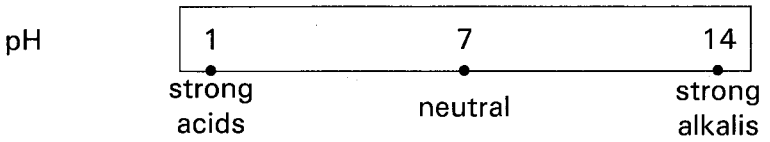
(iii) How could the colouring matter be separated from the insoluble crushed petals?

_____

_____ [3]

[6]

3 Part of the pH scale is shown below.



The table below shows the results of four experiments involving pH changes, but the experiments are not matched to the correct pH changes.

Complete the table by putting in the letter of the correct reaction in the box.

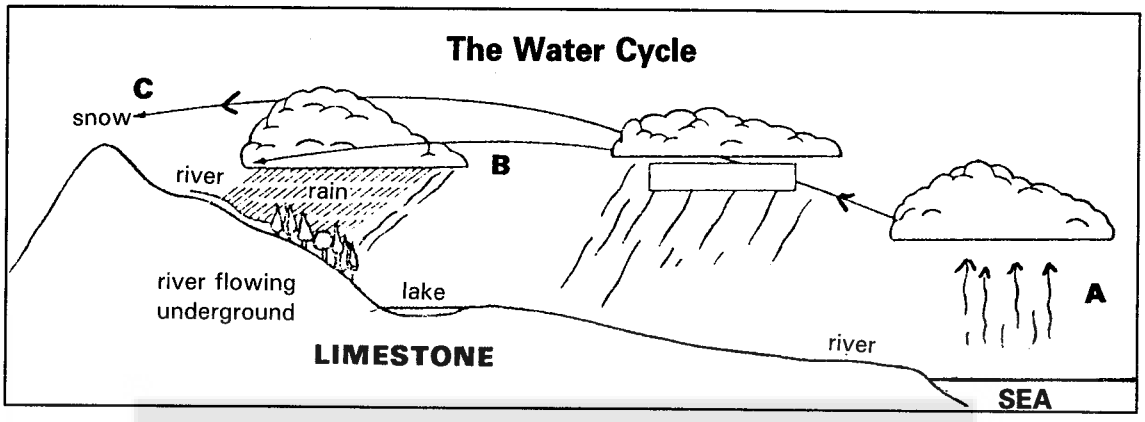
	Experiment	pH at start	pH at end	Incorrect reaction	Letter of correct reaction
(a)	one	1	7	**A** Sugar being dissolved in water	
(b)	two	7	7	**B** Hydrochloric acid neutralised by sodium hydroxide	
(c)	three	7	9	**C** Excess alkali being added to a weak acid	
(d)	four	5	13	**D** Ammonia gas bubbled into water	

[4]

[4]

For Examiner's Use

4 (a) The diagram represents the water cycle.



(i) What process occurs at **A**? _____

(ii) What happens at **B** to produce rain? _____

(iii) What change of state occurs at **C** and how is it brought about?

_____

_____ [4]

(b) (i) What problems could be created for households and factories in using the water from a limestone area?

_____

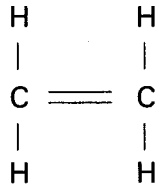
_____

(ii) How is water treated to ensure all bacteria in it are killed?

_____ [2]

[6]

5 (a) Ethene is an unsaturated hydrocarbon with the following structural formula.



(i) What is observed when ethene is bubbled through bromine water?

_____

(ii) Ethene is used to make poly(ethene).
Give one major use of poly(ethene).

_____ [2]

(b) The equation below shows the decomposition of the hydrocarbon decane.

$$\underset{\text{decane}}{C_{10}H_{22}} \rightarrow \underset{\text{octane}}{C_8H_{18}} + \underset{\text{ethene}}{C_2H_4}$$

(i) Which important industrial process is illustrated by the equation?

_____

(ii) A catalyst is used in the reaction.
What is the purpose of the catalyst?

_____

(iii) Ethene and steam react to form ethanol under suitable conditions.
Complete the equation below for this reaction.

$C_2H_4 + H_2O \rightarrow$ [3]

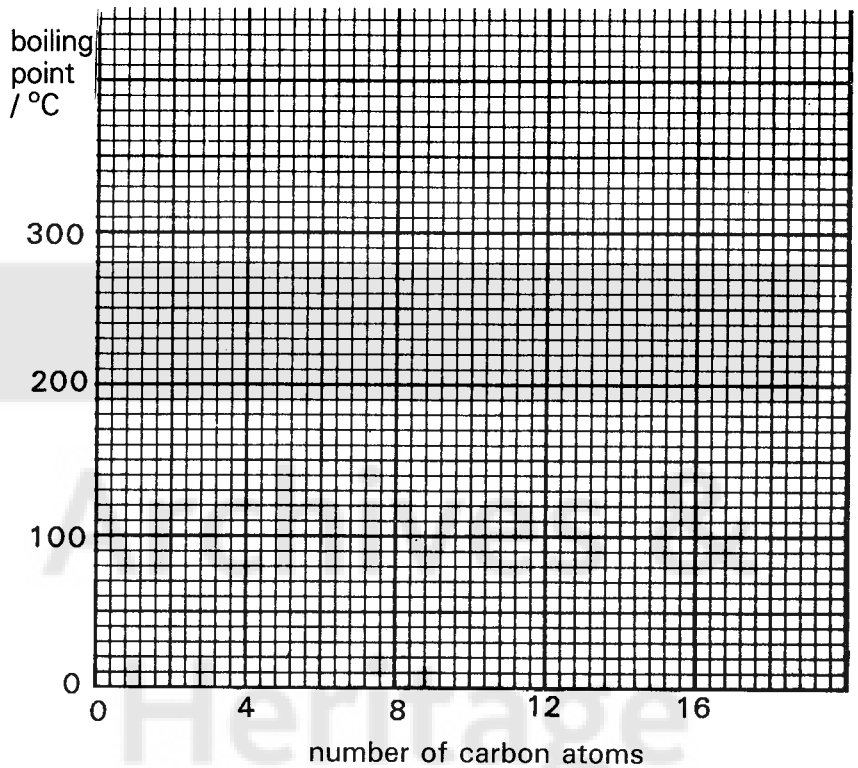
(c) Below is a table giving some information about fuels obtained from crude oil.

Name of fuel	Typical number of carbon atoms per molecule	Typical boiling point/°C
calor gas	4	0
petrol	8	50
paraffin	12	150
gas oil	16	300

[Question 5 continued on next page

Question 5 - continued

(i) On the grid below draw a line graph of the information in the table on page 6.



(ii) Use your graph to find the boiling point of a fuel with 14 carbon atoms per molecule.

_____

Show on the graph how you obtained your answer.

(iii) Suggest a relationship between the number of carbon atoms per molecule and the boiling point.

_____

_____

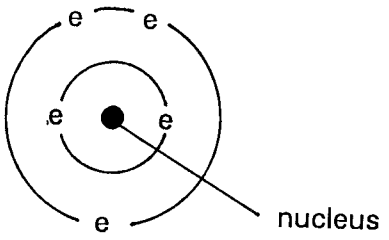
(iv) Suggest **ONE** reason why natural gas is used more as a fuel in North America and Britain than in Africa.

_____

_____ [7]

[12]

6 (a) The diagram below represents one atom of element X which has an atomic number of 5 and a relative atomic mass of 9.



(i) How many protons are present in the nucleus? _____

(ii) How many neutrons are present in the nucleus? _____

(iii) To which Group in the Periodic Table does X belong? ____

(iv) Write the symbol for the ion of X. _____ [4]

(b) The equation below shows the reaction that occurs when the oxide of X is heated with an excess of powdered magnesium.

$$Mg + X_2O_3 \rightarrow MgO + X$$

(i) Insert the figures in the spaces to balance the equation.

(ii) Explain the reaction in terms of oxidation and reduction.

_____

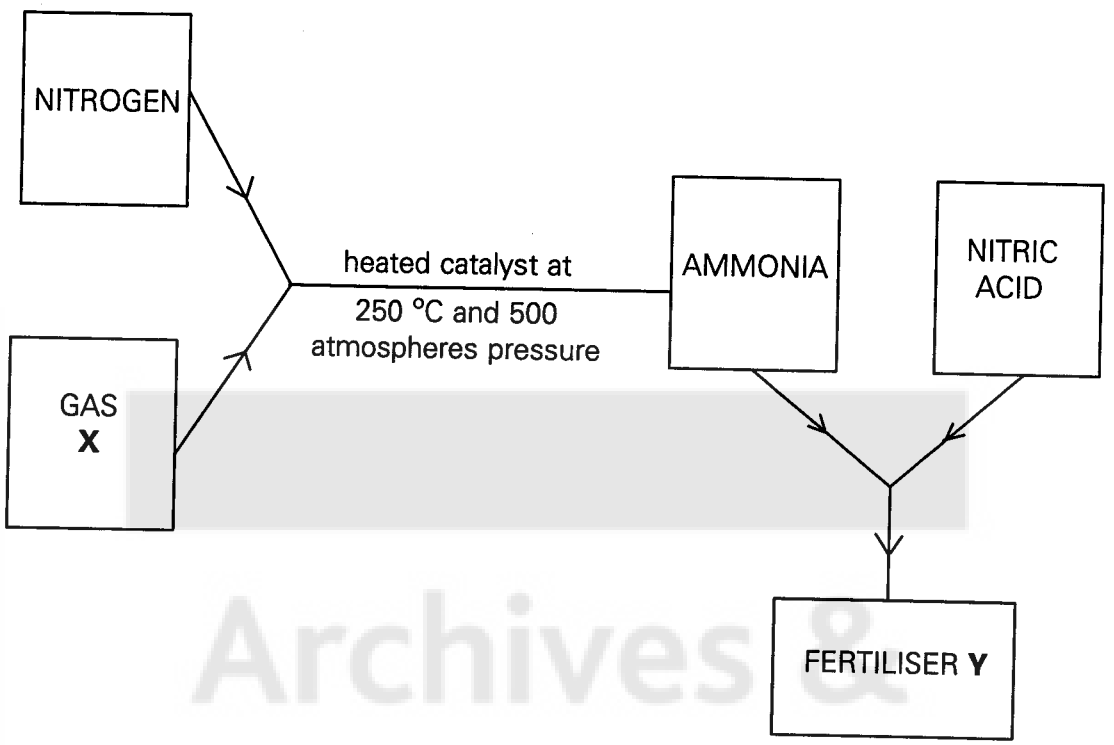
_____

(iii) The reaction is exothermic.
Explain what this means.

_____ [4]

[8]

7 The diagram below shows how a fertiliser is produced.



Study the diagram and then use it to answer the following questions.

(a) Name

(i) gas **X** _____

(ii) fertiliser **Y** _____ [2]

(b) What would be the effect on the speed of the reaction between nitrogen and gas **X** if,

(i) the temperature is increased to 450°C,

_____

(ii) a catalyst is not present?

_____ [2]

Question 7 - continued

(c) (i) Give **two** different reasons why fertilisers are used.

1 _____

2 _____

(ii) Give **one** possible disadvantage of using fertilisers.

_____

_____

(iii) Some fertilisers can be stored in plastic sacks.
Give **one** advantage of using plastic sacks instead of paper sacks for the storing of fertilisers.

_____

_____

(iv) Other than cost, give **one** disadvantage of using plastic sacks to store fertilisers.

_____

_____ [5]

[9]

8 (a) Some time ago, a large quantity of powdered magnesium caught fire in a warehouse in the USA. All that remained after the magnesium had completely burned was a large quantity of white powder.

(i) Give the name and formula of the white powder.

_____ _____

(ii) A member of the fire service said that the fire was worse because the magnesium was in powder form. Suggest a reason for his statement.

_____

_____

(iii) Suggest **one** commercial use of magnesium.

_____ [4]

[Question 8 continued on next page

Question 8 - continued

(b) The table below compares the reactivity of four metals with cold water and steam.

Metal	Reaction with cold water	Reaction with steam
calcium	a steady reaction	violent reaction without heating
copper	no reaction	no reaction
iron	very little reaction	reacts when strongly heated in steam
magnesium	slightly more reactive than iron	burns brightly when heated in steam

(i) Use the reactions of the metals with cold water to place the metals in order of reactivity, the most reactive first.

most reactive _____

_____

_____

least reactive _____

(ii) When calcium reacts with cold water, hydrogen gas is formed. Give a chemical test to identify hydrogen.

Test _____

Result _____

(iii) Give the equations for the reaction between calcium and cold water.

Word equation _____

Symbol equation _____

(iv) Suggest why the reaction of calcium and steam takes place at a quicker rate than the reaction of calcium and cold water.

_____

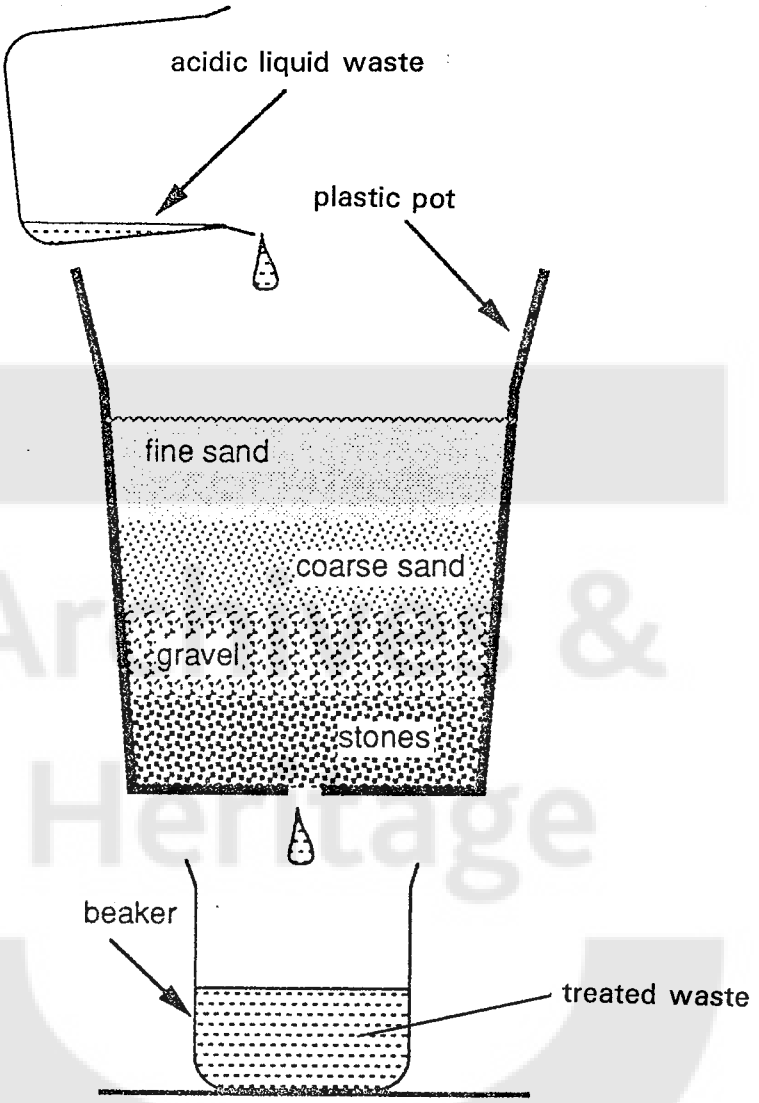
_____

(v) Give **one** commercial use of copper which depends on the fact that it does not react with water or steam.

_____ [8]

[12]

9 (a) The diagram represents a model of an apparatus used to treat the acidic liquid waste from a metal cleaning works.



[Source: British Steel plc]

(i) What process is illustrated? _____

(ii) What kind of material is being removed from the acidic liquid waste?

_____

(iii) Why is a plastic pot used in the apparatus rather than one made of steel?

_____ [3]

[Question 9 continued on next page

Question 9 - continued

(b) The treated waste is neutralised by adding crushed limestone (calcium carbonate).

(i) What is seen when the limestone is added to the treated waste? Give a reason for your answer.

_____

_____

_____

(ii) What simple test could be done to show that the treated waste had been neutralised by the calcium carbonate?

_____ [3]

(c) Another sample of acidic liquid waste from the metal cleaning plant was found to contain dissolved nickel compounds. The nickel was recovered, after neutralising the acid, by adding scrap iron. Explain how this process works.

_____

_____

_____ [2]

(d) Equal volumes (25 cm^3) of different treated wastes **A, B, C** and **D** were neutralised with aqueous sodium hydroxide.

Sample tested (25 cm^3)	Volume of aqueous sodium hydroxide/cm^3
A	13
B	9
C	24
D	6
Unused acid	25

(i) Which sample had the lowest concentration of acid?

_____

(ii) Which sample was about half the strength of the unused acid?

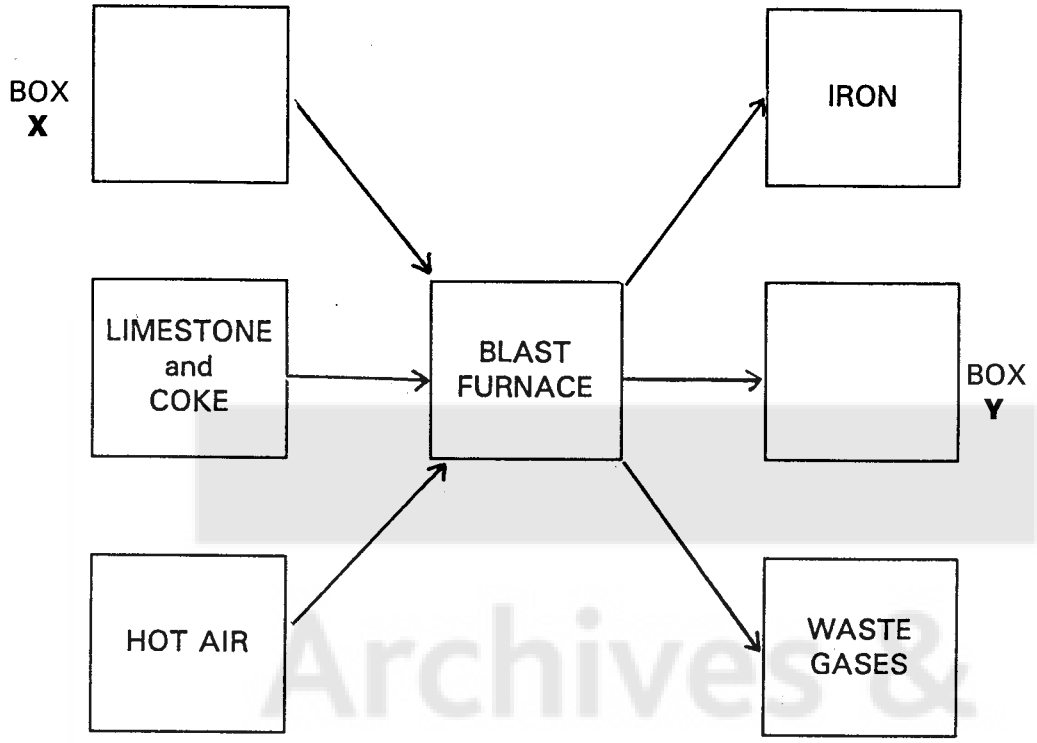
_____

(iii) Suggest why it was necessary to test unused acid.

_____ [3]

[11]

10 The flow diagram shows how iron is produced in the blast furnace.



The equations for the reactions taking place in the furnace are given below.

A $C + O_2 \rightarrow CO_2$

B $C + CO_2 \rightarrow 2CO$

C $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

D $CaCO_3 \rightarrow CaO + CO_2$

E $CaO + SiO_2 \rightarrow CaSiO_3$

(a) Complete the flow diagram by filling in the name of the raw material in Box **X** and the name of the product in Box **Y** [2]

(b) Give **one** code letter of an equation which represents

(i) a thermal decomposition. _____

(ii) the formation of slag. _____

(iii) the main source of heat for the reaction. _____

(iv) a reaction which is **not** a redox reaction. _____ [4]

[Question 10 continued on next page

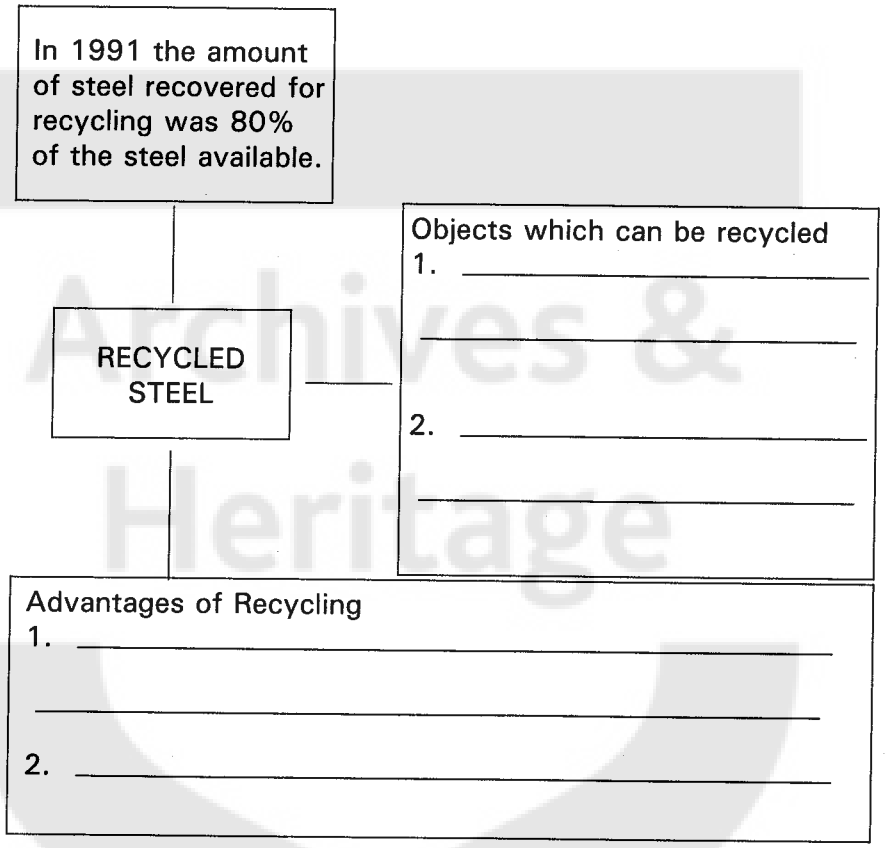
Question 10 - continued

(c) When steel products come to the end of their useful lives they can be recycled. About 80% of all steel available for recycling in the UK was actually recovered in 1991.

Complete the chart below by writing in

(i) two advantages of recycling.

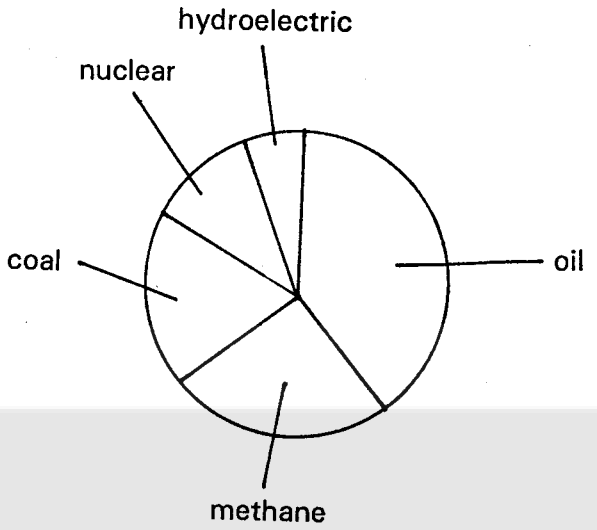
(ii) two steel objects which can be recycled.



[4]

[10]

11 The pie chart shows our main sources of energy.



(a) (i) Which one of these energy sources produces no pollution?

_____

(ii) Name a fuel which burns to produce carbon dioxide and water only.

_____

(iii) Suggest a reason why plants for the production of aluminium are often situated in areas where energy is produced by hydroelectric schemes.

_____ [3]

(b) Fuels such as coal contain sulphur compounds as impurities. These sulphur compounds produce sulphur dioxide when the fuel is burned.

(i) Write the symbol equation for the reaction which occurs when sulphur burns in air to form sulphur dioxide.

_____

(ii) How does sulphur dioxide produce "acid rain" in the atmosphere?

_____

_____

(iii) Give **two different** harmful effects of "acid rain".

1 _____

_____

2 _____ [4]

[Question 11 continued on next page

Question 11 - continued

(c) A recent fuel conservation study in schools showed that when 3 tonnes of solid fuel were burned 10 tonnes of carbon dioxide were produced.

(i) Calculate the relative molecular mass of carbon dioxide.

_____

(ii) A pupil using the relative molecular mass of carbon dioxide obtained in part (i) above calculated that 3 tonnes of carbon produced 11 tonnes of carbon dioxide when burned in air. Show how the pupil obtained this result.

_____

_____

_____ [3]

[10]

Centre Number	Candidate Number

Candidate Name _____

MIDLAND EXAMINING GROUP 1375/3

General Certificate of Secondary Education

CHEMISTRY

PAPER 3

Friday **24 June 1994** Afternoon 1 hour 30 minutes

Candidates answer on the question paper.
No additional materials required.

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces at the top of this page.

SECTION A

Answer **all** questions.

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

SECTION B

Answer **both** the questions.

Tear out and keep pages 9 and 10.

Write your answers to this section on the pages provided in this booklet.

INFORMATION FOR CANDIDATES

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

Marks will be awarded for the accurate use of spelling, punctuation and grammar.

Unless otherwise stated, equations must be given wherever possible and diagrams where they are helpful. 'Equation' means a balanced, symbol equation. Names, not symbols, should be used in descriptive work for all reacting substances and for the products formed.

You should spend no longer than 60 minutes on Section A.

Relative atomic masses are given in the Periodic Table of Elements provided overleaf which should be removed before starting work.

FOR EXAMINER'S USE	
Section A	
Section B	
Sub-Total	
SPG	
TOTAL	

This question paper consists of 18 printed pages and a Periodic Table.

[Turn over

SECTION A

Answer **ALL** the questions in this section.

A1 A student was trying to identify some salts. She carried out some tests and recorded her results. Here is the page from her notebook.

	Test	Observation
	Salt X	
1	Shake solid X with water	Does not dissolve
2	Heat solid X	Turns yellow when hot but returns to white when cold
3	Add hydrochloric acid to solid X	Gas given off
4	Test gas from 3 with limewater	White precipitate
	Salt Y	
5	Shake solid Y with water	Dissolves easily
6	Add aqueous sodium hydroxide to the solution from 5	No change
7	Warm the mixture from 6	A gas with a strong smell is produced. This gas turns red litmus blue
8	To an aqueous solution of Y add hydrochloric acid and barium chloride solution	White precipitate
	Salt Z	
9	Heat solid Z	Turns black. A brown gas is given off and a gas that relights a glowing splint
10	Shake solid Z with water	Blue solution formed
11	Add iron to a solution of Z	Pink solid produced in an almost colourless solution

(a) For **salt X**, give

(i) the name, _____

(ii) the formula. _____ [2]

(b) For **salt Y**, give

(i) the name _____

(ii) a large-scale use

_____

(iii) write the equation for the reaction in 7.

_____ [3]

[Question A1 continued on page 3

PERIODIC TABLE OF ELEMENTS
TEAR OUT THIS PAGE

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 Sulphur 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 †															

* Lanthanum 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
† Actinium 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 = atomic number

Question A1 - continued

(c) For **salt Z**, write

(i) the formula _____

(ii) the ionic equation for the reaction in 11.

_____ [2]

(d) Suggest a suitable pair of reagents and the necessary condition to prepare **salt X**.

Reagents _____ and _____

Condition _____ [3]

Total [10]

A2 Here is a list of substances.

calcium carbonate	iron
copper(II) oxide	lead(II) nitrate
ethanol	sodium chloride
hydrogen	

In answering the following questions each substance may be used once, more than once, or not at all.

Select from this list the substances that

(a) contain only covalent bonds.

_____ and _____ [1]

(b) occur naturally in large quantities in the Earth's crust.

_____ and _____ [1]

(c) have nine atoms in their formula.

_____ and _____ [1]

(d) react with aqueous silver nitrate.

_____ and _____ [2]

(e) have a relative molecular mass greater than 90.

_____ and _____ [2]

Total [7]

[Turn over

A3 The diagram shows a label from a bottle of household cleaner.

"Formic acid", properly called methanoic acid, has the formula H CO_2 H. In reactions it is only the underlined H that causes acidity.

(a) (i) Calculate the relative molecular mass of methanoic acid.

_____

Question A3 continued on next page

Question A3 - continued

(ii) The solution of ATAKA is stated to be 40% W/W. This means that 40 g of methanoic acid is present in 100 g of solution.

Assuming that the density of ATAKA is 1.00 g/cm^3, calculate the mass of methanoic acid present in the bottle of ATAKA which contains 250 ml of solution. (1 ml = 1 cm^3)

(iii) Calculate the concentration, in mol/dm^3, of methanoic acid in ATAKA.

[5]

(b) (i) Give the chemical name for the scale that is formed in kettles.

(ii) Write the equation for the reaction between scale and the acid in ATAKA.

(iii) Suggest and explain a safety measure that must be taken **after** descaling the kettle.

[4]

Total [9]

A 4 The table below lists some metals and some of their properties.

Name	Symbol	Atomic Number	m.pt in °C	Density in g/cm^3	Order of Reactivity	Abundance relative to others	Cost in £/tonne
aluminium	Al	13	660	2.7	3	83 000	700
copper	Cu	29	1083	8.9	6	68	1 000
iron	Fe	26	1535	7.9	4	62 000	400
lead	Pb	82	327	11.4	5	13	300
magnesium	Mg	12	650	1.7	2	27 640	1 400
potassium	K	19	63	0.9	1	18 400	52 000
tungsten	W	74	3407	19.3	7	2	54 000

Use the information in the table and your own knowledge to answer the questions.

(a) Iron is used for water pipes. Give an advantage and a disadvantage of iron compared with copper for this use.

Advantage _____

Disadvantage _____ [2]

(b) Some North Sea divers have pieces of metal attached to their boots to stop them rising to the surface while working.

Suggest a suitable metal and give **TWO** reasons to support your choice.

Metal _____

Reason 1 _____

Reason 2 _____ [2]

[Question A4 continued on next page

Question A4 - continued

(c) The filament in electric light bulbs is made of tungsten. Give one reason for your choice and state one disadvantage of its use.

Suggest a reason why tungsten is preferred to copper for this use.

_____

_____ [1]

(d) The table shows the dates when four of the metals were discovered.

Metal	Year discovered
Iron	around 2500 BC
Lead	around 1000 BC
Tungsten	1783 AD
Potassium	1807 AD

Suggest reasons for the order of discovery of the metals as shown by these dates.

_____

_____

_____

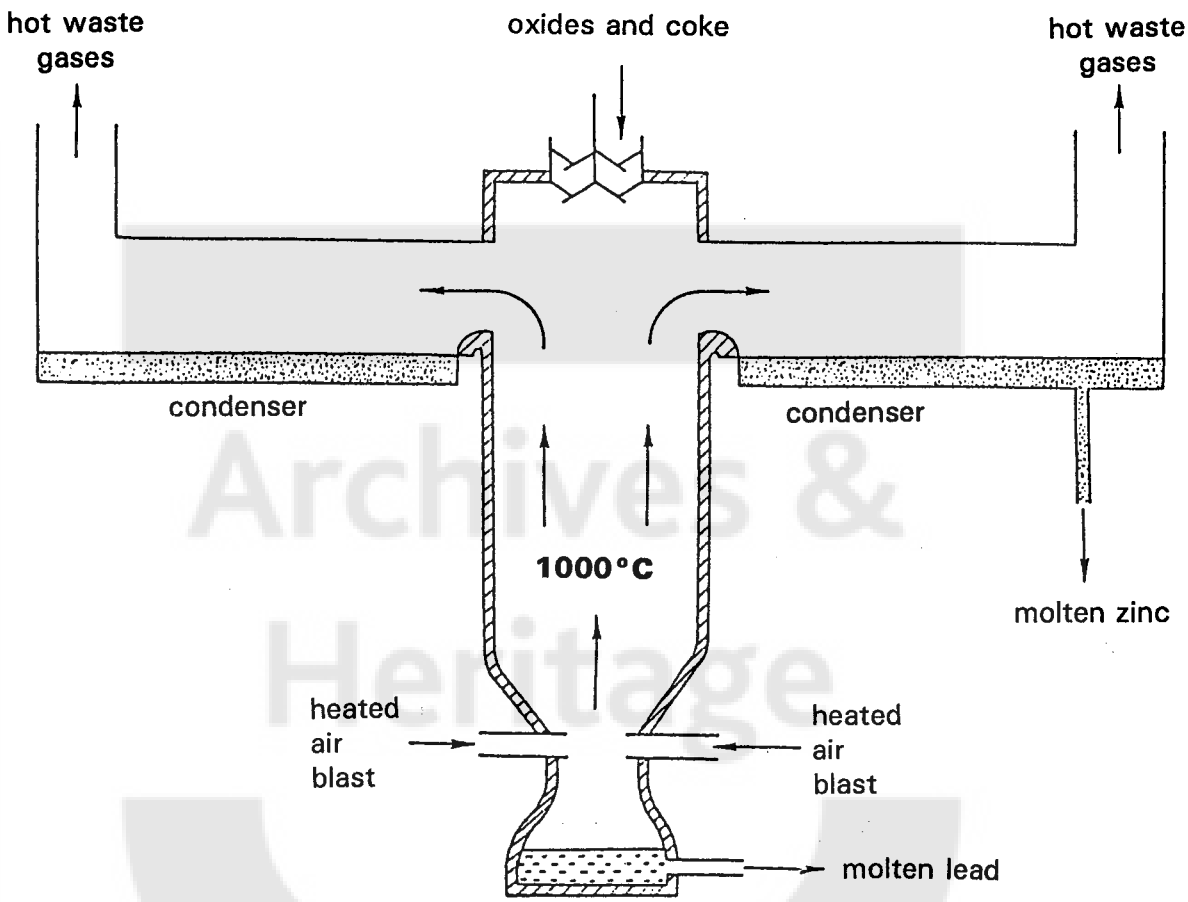
_____

_____ [4]

Total [9]

A5 Zinc and lead ores occur together in nature. The two metals are obtained, at the same time, in apparatus similar to the blast furnace.

A mixture of the metal oxides, obtained from their ores, is fed into the top of the furnace, together with coke. Hot air is blasted into the bottom of the furnace.



The melting and boiling points of the two metals are given in the table.

	melting point /°C	**boiling point /°C**
lead	328	1751
zinc	420	908

[Turn over for the rest of Question A5

Question A5 - continued

(a) Write an equation for the reaction between zinc oxide and coke.

_____ [1]

(b) The furnace must be maintained at a temperature of approximately 1000°C.

(i) Why is a lower temperature of 500°C not suitable?

_____

_____

(ii) Why is a higher temperature of 2000°C not suitable?

_____

_____

_____

(iii) It is important to conserve energy in the process. Suggest how the air blast to the bottom of the furnace should be heated.

_____

_____ [5]

[Question A5 continued on next page

Question A5 - continued

(c) Use the information below to help you place the four metals (chromium, strontium, rhodium and zinc) in order of reactivity.

A When zinc is heated with chromium(III) oxide, chromium is formed.

B Chromium reacts slowly with dilute hydrochloric acid to form chromium(III) choride.

C Strontium carbonate cannot be decomposed by heating with a bunsen burner.

D Hydrogen reduces rhodium oxide to the metal.

(i) Order of reactivity

most reactive _____

_____

_____

least reactive _____

(ii) Briefly explain your reasoning.

_____

_____

_____

_____ [4]

Total [10]

Section A [44]

SECTION B

Answer **both** the questions from this section.

Write your answers on the ruled pages that follow.

Tear out and keep this page.

B1 Read the passage below which may help you to answer the question.

Natural gas, which contains mostly methane, is a limited resource with **world** supplies (not just North Sea supplies) estimated to last sixty years. Crude oil will run out even sooner.

Imagine that in sixty years' time no more crude oil is available and natural gas is about to run out.

Describe the problems that would be encountered in the following areas:

(i) road transport,

(ii) power generation,

(iii) chemicals currently made from hydrocarbons

and discuss the steps that could be taken **now** to minimise these problems. [9]

B2 (a) Chlorine atoms can form both ionic bonds (for example, in sodium chloride) and covalent bonds (for example in chlorine molecules).

(i) Explain the difference between the formation of an ionic and the formation of a covalent bond.

(ii) Substances containing these bonds differ significantly in their melting point and in their ability to conduct electricity. State and explain these differences. [7]

(b) Chlorine, bromine and iodine are three members of the halogen group in the Periodic Table.

Consider the elements and/or their compounds and state, with detail,

(i) two ways in which they are similar.

(ii) two ways in which they differ. [4]

(c) Select two important substances which contain chlorine. For each one describe how it has been of benefit to society, and outline one disadvantage associated with its use. [4]

Total [15]

Section B [24]