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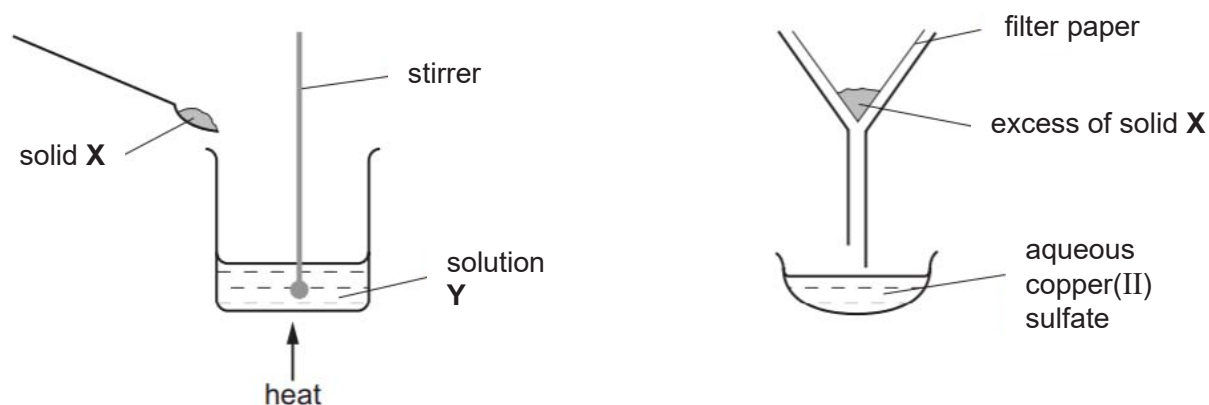


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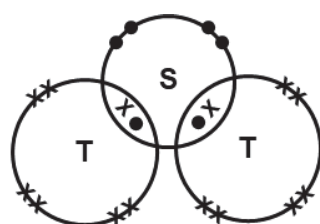
- 27 The apparatus shown is used to prepare aqueous copper(II) sulfate. Solid **X** is added into solution **Y** before the mixture is filtered to remove solid **X** as the residue.



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

| | X | Y |
|----------|----------------------|-----------------------------|
| A | copper | sulfuric acid |
| B | copper(II) carbonate | sulfuric acid |
| C | copper | aqueous iron(II) sulfate |
| D | sulfur | aqueous copper(II) chloride |

- 28 The diagram shows the arrangement of electrons in a molecule of compound **ST₂**.



legend

- : valence electron of a **S** atom
- x : valence electron of a **T** atom

Which of the following pairs could be **S** and **T**?

| | S | T |
|----------|----------|----------|
| A | calcium | chlorine |
| B | carbon | oxygen |
| C | oxygen | hydrogen |
| D | sulfur | chlorine |

- 33 Small portions of aqueous potassium iodide and of acidified, aqueous potassium manganate(VII) were separately added to a colourless solution **W**. The colour changes are shown in the table.

| | |
|--------------------------|--|
| aqueous potassium iodide | acidified aqueous potassium manganate(VII) |
| colourless to brown | purple to colourless |

Which statement about **W** is correct?

- A **W** is both an oxidising and a reducing agent.
 B **W** is neither an oxidising nor a reducing agent.
 C **W** is an oxidising agent but not a reducing agent.
 D **W** is a reducing agent but not an oxidising agent.
- 34 Which material is **not** involved in the large-scale extraction of iron from iron ore?

- A coke
 B haematite
 C limestone
 D slag

- 35 Instant cooling packs are used to treat sports injuries. When the pack is squeezed, a chemical reaction takes place and the pack becomes very cold.

Which row shows the temperature change and the type of reaction taking place?

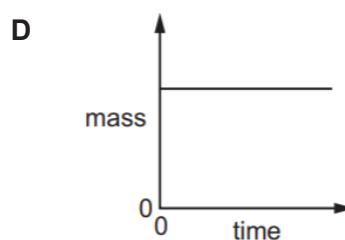
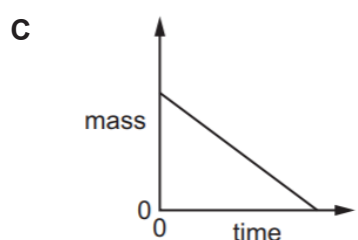
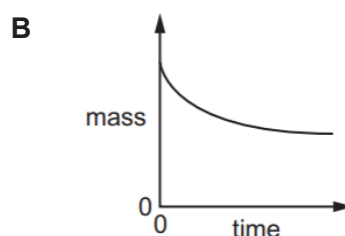
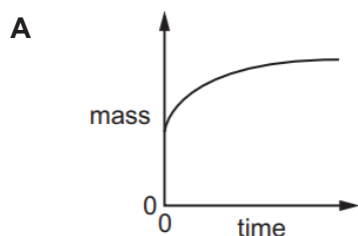
| | temperature change | type of reaction |
|---|--------------------|------------------|
| A | decrease | endothermic |
| B | decrease | exothermic |
| C | increase | endothermic |
| D | increase | exothermic |

- 36 Which reaction is endothermic?

- A $2\text{Ca} + \text{O}_2 \rightarrow 2\text{CaO}$
 B $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
 C $\text{Ca} + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2$
 D $\text{CaO} + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O}$

37 The mass of a beaker and its contents is plotted against time.

Which graph represents what happens when sodium carbonate reacts with an excess of dilute hydrochloric acid in an open beaker?



38 Ethanol is made by fermentation.

How is ethanol obtained from the fermentation mixture?

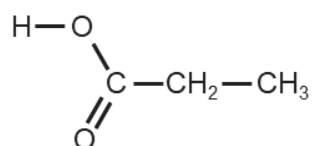
- A** chromatography
C filtration

- B** crystallisation
D fractional distillation

39 When crude oil is distilled, a number of fractions are collected. Which of these statements about the fractions is true?

- A** Each fraction is a single pure substance.
B Each fraction boils at the same temperature.
C The fraction with the highest range of boiling points burns least well.
D The fraction with the lowest range of boiling points burns with very sooty flame.

40 Which statement about the compound shown below is correct?



- A** It is ethanoic acid.
B It does not react with ammonia.
C It is formed by oxidation of propanol.
D It does not react with sodium carbonate.

Data Sheet**Colours of Some Common Metal Hydroxides**

| | |
|----------------------|------------|
| calcium hydroxide | white |
| copper(II) hydroxide | light blue |
| iron(II) hydroxide | green |
| iron(III) hydroxide | red-brown |
| lead(II) hydroxide | white |
| zinc hydroxide | white |

The Periodic Table of Elements

| | | Group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| I | II | III | IV | V | VI | VII | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 Li lithium 7 | 4 Be beryllium 9 | 11 Na sodium 23 | 12 Mg magnesium 24 | 13 Al aluminium 27 | 14 Si silicon 28 | 15 P phosphorus 31 | 16 S sulfur 32 | 17 Cl chlorine 35.5 | 18 Ar argon 40 | 19 K potassium 39 | 20 Ca calcium 40 | 21 Sc scandium 45 | 22 Ti titanium 48 | 23 V vanadium 51 | 24 Cr chromium 52 | 25 Mn manganese 55 | 26 Fe iron 56 | 27 Co cobalt 59 | 28 Ni nickel 59 | 29 Cu copper 64 | 30 Zn zinc 65 | 31 Ga gallium 70 | 32 Ge germanium 73 | 33 As arsenic 75 | 34 Se selenium 79 | 35 Br bromine 80 | 36 Kr krypton 84 | 37 Rb rubidium 85 | 38 Sr strontium 88 | 39 Y yttrium 89 | 40 Zr zirconium 91 | 41 Nb niobium 93 | 42 Mo molybdenum 96 | 43 Tc technetium - | 44 Ru ruthenium 101 | 45 Rh rhodium 103 | 46 Pd palladium 106 | 47 Ag silver 108 | 48 Cd cadmium 112 | 49 In indium 115 | 50 Sn tin 119 | 51 Sb antimony 122 | 52 Te tellurium 128 | 53 I iodine 127 | 54 Xe xenon 131 | 55 Cs caesium 133 | 56 Ba barium 137 | 57-71 lanthanoids | 72 Hf hafnium 178 | 73 Ta tantalum 181 | 74 W tungsten 184 | 75 Re rhenium 186 | 76 Os osmium 190 | 77 Ir iridium 192 | 78 Pt platinum 195 | 79 Au gold 197 | 80 Hg mercury 201 | 81 Tl thallium 204 | 82 Pb lead 207 | 83 Bi bismuth 209 | 84 Po polonium - | 85 At astatine - | 86 Rn radon - | 87 Fr francium - | 88 Ra radium - | 89-103 actinoids | 104 Rf Rutherfordium - | 105 Db dubnium - | 106 Sg seaborgium - | 107 Bh bohrium - | 108 Hs hassium - | 109 Mt meitnerium - | 110 Ds darmstadtium - | 111 Rg roentgenium - | 112 Cn copernicium - | 113 Nh nihonium - | 114 Fl flerovium - | 115 Lv livermorium - | 116 Uu unbinilium - | 117 Ts tennessine - | 118 Og oganeson - |

Key

| |
|------------------------|
| proton (atomic) number |
| atomic symbol |
| name |
| relative atomic mass |

| Group | Element | Symbol | Atomic Number | Relative Atomic Mass |
|-------------|---------|-------------|---------------|----------------------|
| lanthanoids | 57 | La | lanthanum | 139 |
| | 58 | Ce | cerium | 140 |
| | 59 | Pr | praseodymium | 141 |
| | 60 | Nd | neodymium | 144 |
| | 61 | Pm | promethium | - |
| | 62 | Sm | samarium | 150 |
| | 63 | Eu | europium | 152 |
| | 64 | Gd | gadolinium | 157 |
| | 65 | Tb | terbium | 159 |
| | 66 | Dy | dysprosium | 163 |
| | 67 | Ho | holmium | 165 |
| | 68 | Er | erbium | 167 |
| | 69 | Tm | thulium | 169 |
| | 70 | Yb | ytterbium | 173 |
| 71 | Lu | lutetium | 175 | |
| actinoids | 89 | Ac | actinium | 227 |
| | 90 | Th | thorium | 232 |
| | 91 | Pa | protactinium | 231 |
| | 92 | U | uranium | 238 |
| | 93 | Np | neptunium | - |
| | 94 | Pu | plutonium | - |
| | 95 | Am | americium | - |
| | 96 | Cm | curium | - |
| | 97 | Bk | berkelium | - |
| | 98 | Cf | californium | - |
| 99 | Es | einsteinium | - | |
| 100 | Fm | fermium | - | |
| 101 | Md | mendelevium | - | |
| 102 | No | nobelium | - | |
| 103 | Lr | lawrencium | - | |

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).



| | | |
|------|-------|--------------|
| Name | Class | Register No. |
|------|-------|--------------|

SECONDARY 4 EXPRESS / 5 NORMAL ACADEMIC PRELIM EXAMINATION 2019

SCIENCE (CHEMISTRY)

Paper 3 Chemistry

Thursday 1040 – 1155

5076/03, 5078/03

29 August 2019

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on all the work you hand in.

You may use a soft pencil for any diagrams, graphs, tables or rough working.

Write in dark blue or black pen.

Do not use staples, paper clips, glue or correction fluid.

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

You may lose marks if you do not show your working or if you do not use appropriate units.

Section A

Answer **all** questions.

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

Section B

Answer any **two** questions.

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

| For Examiner's Use | |
|--------------------|--|
| Section A | |
| | |
| | |
| Total | |

A copy of the Data Sheet is printed on page 14.

A copy of the Periodic Table is printed on page 15.

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

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

Section A

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

- 1 Fig. 1.1 shows the formulae of some gases found in a sample of polluted air.

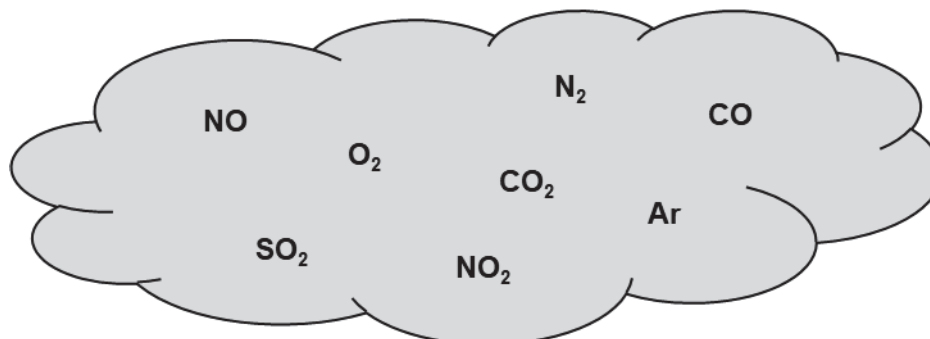


Fig. 1.1

- (a) Choose formulae from Fig. 1.1 to answer the following questions.
- (i) Give the formulae of a gas that is produced by incomplete combustion of fuels.
 [1]
- (ii) Give the formulae of a gas that contributes to global warming when present in excess.
 [1]
- (iii) Give the formulae of two gases that each contain an element with an oxidation state of +2.
 and [2]
- (b) It was found that two of the gases are acidic and may cause acid rain.
- (i) Name the two gases.
 and [2]
- (ii) Explain why acid rain is harmful to the environment.

 [1]
- (c) Which gas can be used to fill lightbulbs? Give a reason for your answer.

 [1]

2 ^{44}Ca is an isotope of calcium.

(a) Explain what is meant by the term *isotope*.

.....
 [1]

(b) Complete Table 2.1 to show the numbers of each type of particle in an **atom** of ^{44}Ca .

Table 2.1

| particle | number |
|----------|--------|
| proton | |
| neutron | |
| electron | |

[2]

(c) Table 2.2 shows an **ion** of ^{44}Ca containing the following particles.

Table 2.2

| particle | number |
|----------|--------|
| proton | 20 |
| neutron | 24 |
| electron | 18 |

Would you expect the number of electrons in an **atom** of calcium to be the same as that of its **ion**?

Give a reason to justify your answer.

.....

 [2]

- 3 Table 3.1 shows the soil pH ranges required by different crops for growth.

Table 3.1

| crop | pH range |
|-----------|-----------|
| peanut | 5.0 – 6.5 |
| millet | 6.0 – 6.5 |
| sunflower | 6.0 – 7.5 |
| paprika | 7.0 – 8.5 |
| mango | 5.5 – 6.0 |

- (a) A farmer plants peanuts and millet crops. Only the peanut crop grows well.
- (i) Predict the pH of the soil the farmer used.
 [1]
- (ii) Which other crop is most likely to grow well in the same soil?
 [1]
- (b) The farmer adds calcium hydroxide to the soil before adding fertiliser containing ammonium sulfate to the soil.
 Suggest one purpose of using calcium hydroxide.

 [1]
- (c) A reaction occurs between calcium hydroxide, $\text{Ca}(\text{OH})_2$ and ammonium sulfate, $(\text{NH}_4)_2\text{SO}_4$. Explain why the farmer should **not** have added these two substances to the soil.
 Include one chemical equation to support your answer.

 [3]

- 4 Fig. 4.1 describes a series of reaction for four substances **A**, **B**, **C** and **D**.

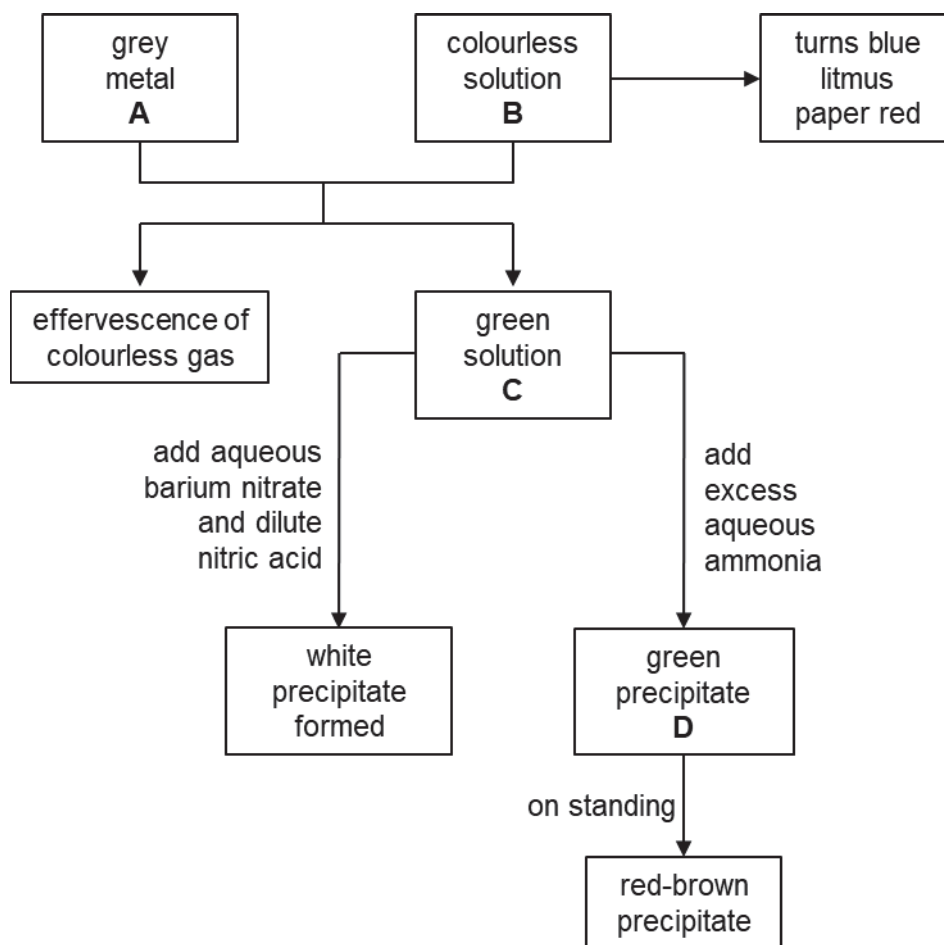


Fig. 4.1

Give the names of the following substances.

- (a) (i) **A**,
- (ii) **B**,
- (iii) **C**,
- (iv) **D**, [4]

- (b) Suggest the name of the metal ore from which grey metal **A** can be extracted from.

..... [1]

- (c) Write an ionic equation to show the reaction between colourless solution **B** and aqueous sodium hydroxide.

..... [1]

- 5 A student carried out some experiments to determine the relative reactivity of four metals, **P**, **Q**, **R** and **S**. Table 5.1 shows the results.

Table 5.1

| | metal P | metal Q | metal R | metal S |
|------------------------------|----------------|----------------|----------------|----------------|
| solution of P nitrate | – | X | X | X |
| solution of Q nitrate | ✓ | – | ✓ | ✓ |
| solution of R nitrate | ✓ | X | – | ✓ |
| solution of S nitrate | ✓ | X | X | – |

Key ✓ shows a reaction happened
 X show no reaction happened
 – show the experiment was not performed

- (a) Arrange the metals in order of reactivity, starting with the most reactive metal.

..... [1]

- (b) Metal **S** reacts with hydrochloric acid.
 What would you observe when metal **S** reacts with hydrochloric acid?
 Explain your reasoning.

.....

 [2]

- (c) Metal **P** melts at 650 °C and boils at 1091 °C.

Describe the arrangement and movement of the particles in metal **P** at 666 °C.
 Draw a diagram in Fig. 5.2 to illustrate your answer.



Fig. 5.2

.....

 [3]

- 6 Fig. 6.1 shows some characteristics and chemical reactions of two organic compounds, ethane and ethene.

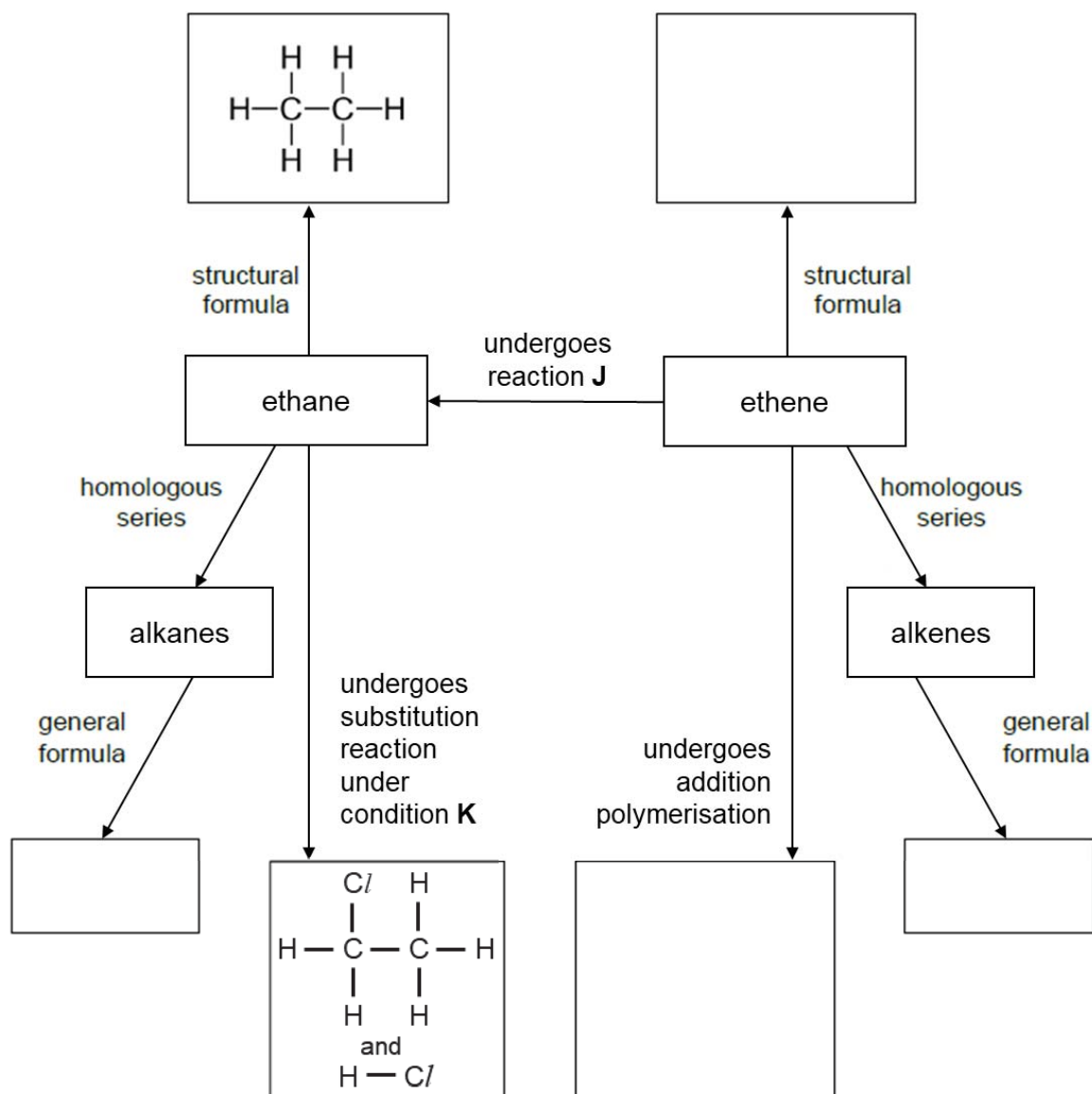


Fig. 6.1

- (a) Fill in the missing boxes in Fig. 6.1. [3]
- (b) Identify the following:
- (i) name of reaction J
- (ii) condition K [2]
- (c) Define what is meant by the term *homologous series*.

.....

..... [1]

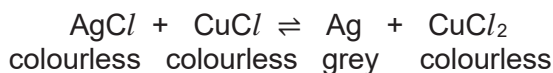
- (d) Both ethane and ethene exist as colourless gases at room temperature and pressure. Describe a test which can be used to distinguish between these two gases.

.....

 [2]

- 7 Photochromic glass is used in sunglasses. In bright light, the glass darkens reducing the amount of light reaching the eye. When the light is less bright, the glass becomes colourless increasing the amount of light reaching the eye.

Photochromic glass contains very small amounts of the halides silver chloride and copper(I) chloride. The reaction between these two chlorides is considered to be a redox reaction.



- (a) Explain why the reaction is redox.

.....

 [2]

- (b) A student attempted to make a sample of pure silver chloride by reacting silver oxide with dilute hydrochloric acid. He did not succeed.

- (i) Explain why the student was **not** successful in obtaining pure silver chloride.

.....
 [1]

- (ii) Suggest and name **two** reagents that can be used to make silver chloride.

Outline the steps the student should take in order to make a **pure** and **dry** sample of silver chloride.

.....

 [3]

Section B

Answer any **two** questions in this section.

Write your answers in the spaces provided.

- 8 Ammonia, NH_3 , has many uses. It is used predominantly in the manufacture of fertilisers to support agriculture. It is also used extensively in the chemical and textile industries. A very soluble gas, ammonia dissolves in water to form aqueous ammonia, an alkali.

Ammonia is made via a reaction between nitrogen and hydrogen known as the Haber process. This reaction can be represented by the following chemical equation:

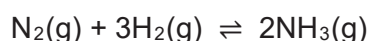


Fig. 8.1 shows the percentage yield of ammonia when different temperatures and pressures are used during the manufacture of ammonia.

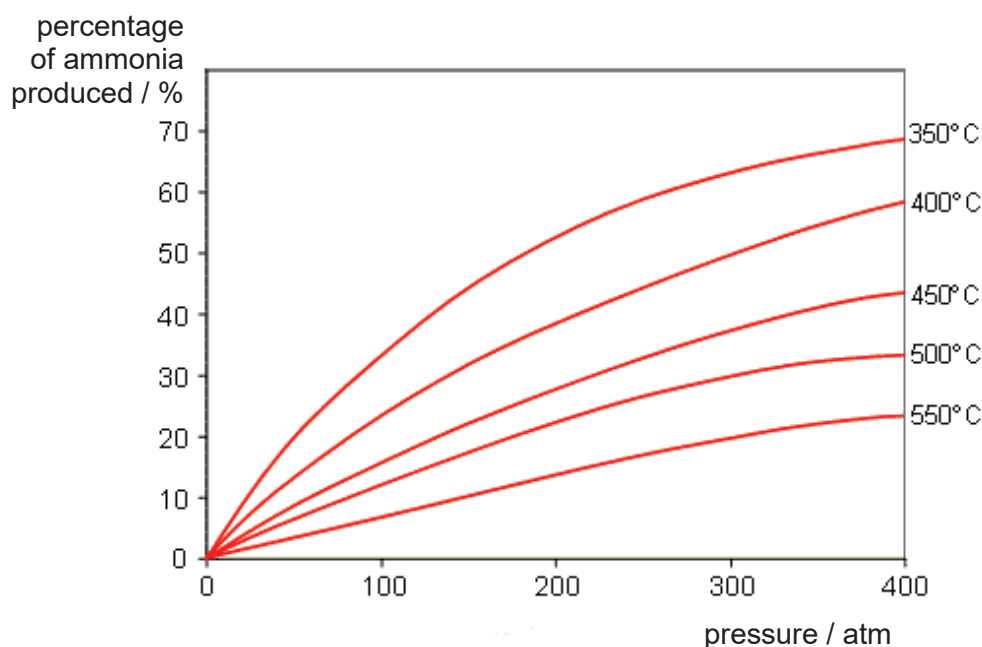


Fig. 8.1

- (a) State a source of hydrogen gas.

..... [1]

- (b) A student made the following claim:

“Ammonia does not conduct electricity in gaseous state but it can conduct electricity in aqueous state.”

Do you agree with the student’s claim? Explain your answer.

.....

 [2]

- (c) (i) With reference to Fig. 8.1, do you think that it is better to use a higher temperature to manufacture ammonia? Explain your answer.

.....
 [1]

- (ii) Use your knowledge of reacting particles to explain how the rate of reaction may be affected when the pressure used to manufacture ammonia increases.

.....

 [2]

- (d) Calculate the maximum volume of ammonia gas that can be produced if 60 dm³ of hydrogen was made to react with excess nitrogen in the Haber process.
 [All volumes are measured at room temperature and pressure.]

[2]

- (e) Draw a 'dot and cross' diagram to show the arrangement of electrons in one molecule of ammonia. Only the outer shell electrons need to be shown.

[2]

9 Potassium is a Group I metal and it is typically stored in kerosene. When potassium is reacted with oxygen, potassium oxide is formed.

(a) (i) Explain why potassium is stored in kerosene.

..... [1]

(ii) Describe what you will observe when a piece of potassium metal reacts with cold water. Include a balanced chemical equation, with state symbols, to support your answer.

.....

 [4]

(iii) Suggest another use for kerosene.

..... [1]

(b) Draw a 'dot and cross' diagram to show the arrangement of electrons in potassium oxide. Only the outer shell electrons need to be shown.

(c) Potassium oxide exists as a solid at room temperature and pressure. [2]

Use your knowledge of the bonding and structure in potassium oxide to justify this observation.

.....

 [2]

10 Group VII elements, also known as halogens, exist as diatomic molecules.

(a) (i) Define the term *diatomic*.

..... [1]

(ii) Explain why halogens exist as diatomic molecules.

.....
..... [1]

(b) Describe **two** trends, in terms of physical properties, that can be observed in the Group VII elements.

.....
..... [2]

(c) A student wanted to investigate the relative reactivity of two Group VII elements.

Chemicals provided include:

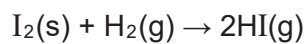
- aqueous sodium bromide
- aqueous sodium iodide
- bromine solution
- iodine solution

No other chemicals are available.

Describe **two** tests which the student can carry out to determine the relative reactivity of bromine and iodine. Include observations that may occur during the tests.

.....
.....
.....
.....
.....
.....
.....
.....
.....
..... [3]

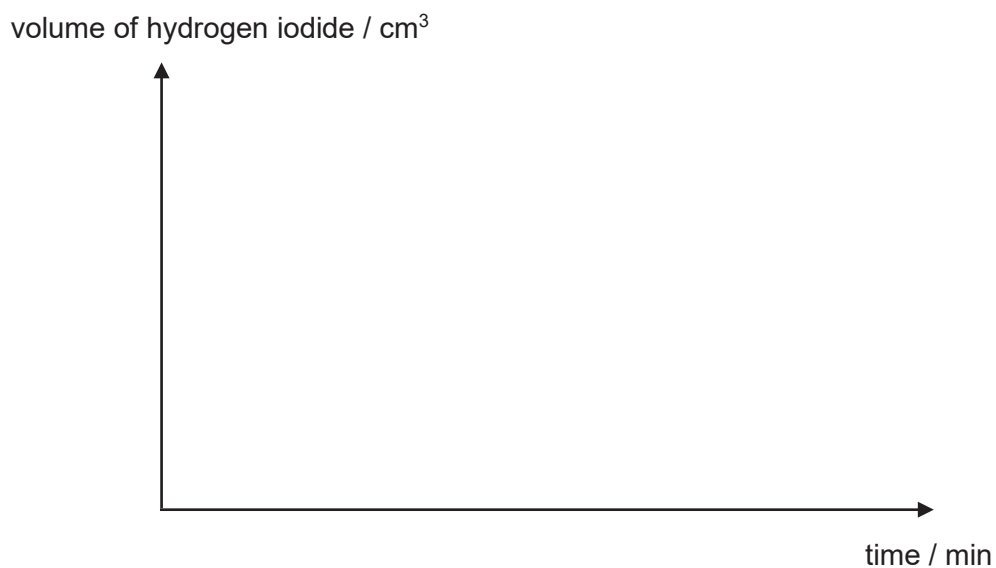
- (d) Iodine can react with hydrogen to form hydrogen iodide, HI.



- (i) Calculate the mass of solid that is required to form 256 g of hydrogen iodide.

[2]

- (ii) Sketch a graph to show how the volume of hydrogen iodide produced changes with time during the experiment.



[1]

End of Paper

Data Sheet**Colours of Some Common Metal Hydroxides**

| | |
|----------------------|------------|
| calcium hydroxide | white |
| copper(II) hydroxide | light blue |
| iron(II) hydroxide | green |
| iron(III) hydroxide | red-brown |
| lead(II) hydroxide | white |
| zinc hydroxide | white |

The Periodic Table of Elements

| Group | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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Key
 proton (atomic) number
 atomic symbol
 name
 relative atomic mass

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lanthanoids

actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

