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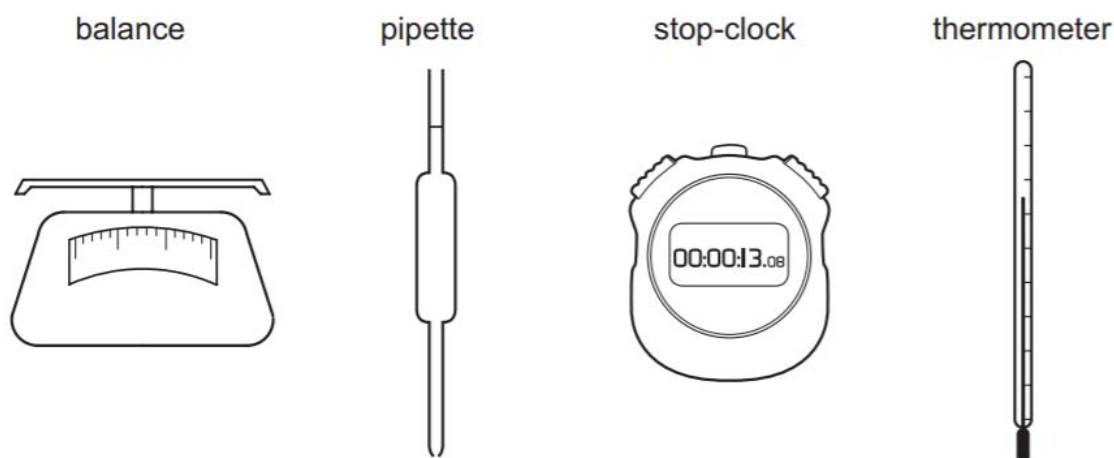


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21 The diagram below shows four pieces of laboratory equipment.



Which equipment is essential to find out if dissolving a salt in water is an exothermic process?

	balance	pipette	stop-clock	thermometer
A	X	X	X	✓
B	✓	X	X	✓
C	X	✓	X	✓
D	✓	X	✓	X

22 A beaker containing solid carbon dioxide is placed in a fume cupboard at room temperature. The carbon dioxide becomes gaseous.

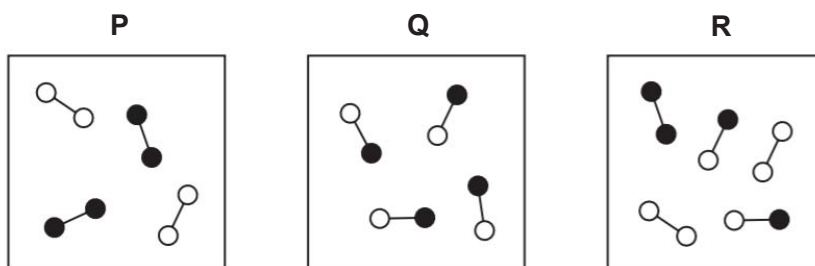
Which process describes this change of state?

- | | |
|----------------------|-----------------------|
| A boiling | B condensation |
| C evaporation | D sublimation |

23 Which statement about paper chromatography is correct?

- A** The solvent should cover the start line.
- B** The start line should be drawn in pencil.
- C** A solvent is needed to dissolve the paper.
- D** Paper chromatography separates mixtures of solvents.

24 Which statement about diagrams **P**, **Q** and **R** is correct?



- A Diagram **P** contains two elements and diagram **Q** contains a mixture.
- B Diagram **Q** contains two compounds and diagram **R** contains a mixture.
- C Diagram **P** contains two elements and diagram **Q** contains one compound.
- D Diagram **P** contains two compounds and diagram **R** contains two elements.

25 Atom **M** has an electronic structure 2,5.
Atom **N** has an electronic structure 2,8,5.

Which statement about element **N** is correct?

- A **N** has more electron shells than **M**.
- B **N** has more electrons in its outer shell than **M**.
- C **N** is in the same period of the Periodic Table as **M**.
- D **N** is in a different group of the Periodic Table from **M**.

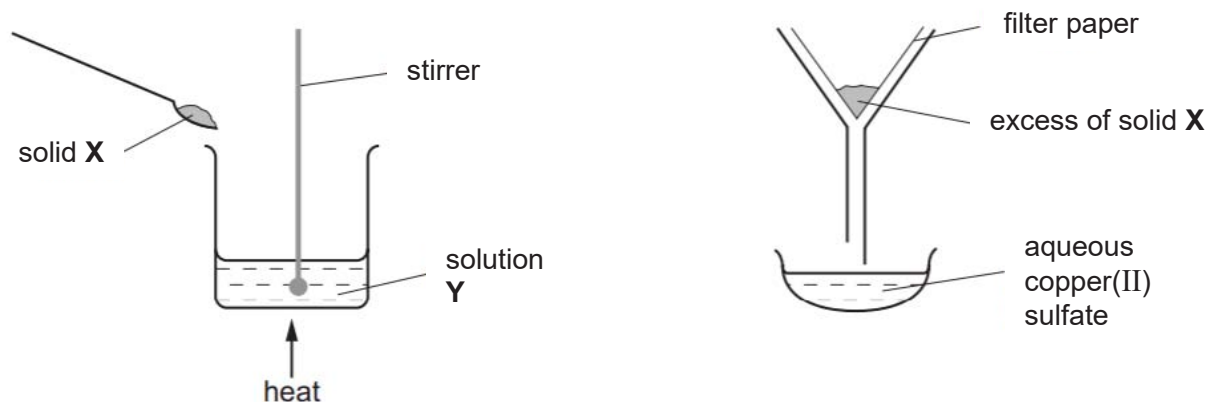
26 **X**, **Y** and **Z** are three elements found in the third period of the Periodic Table. The nature of their oxides is shown in the following table.

element	type of oxide formed
X	acidic
Y	basic
Z	amphoteric

Which of the following shows the order of increasing proton number for the three elements?

- A **X**, **Y**, **Z**
- B **Y**, **Z**, **X**
- C **Z**, **X**, **Y**
- D **Z**, **Y**, **X**

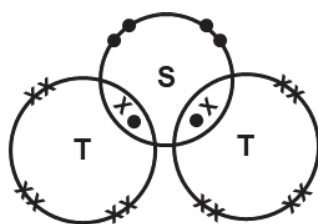
- 27 The apparatus shown is used to prepare aqueous copper(II) sulfate. Solid **X** is added into solution **Y** before the mixture is filtered to remove solid **X** as the residue.



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 **ST**₂.



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?

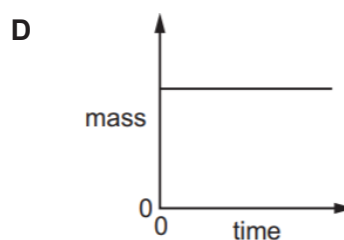
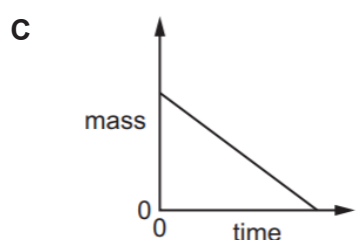
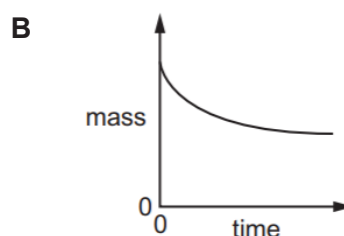
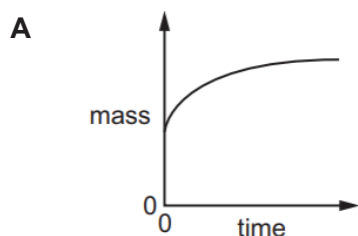
	temperature change	type of reaction
A	decrease	endothermic
B	decrease	exothermic
C	increase	endothermic
D	increase	exothermic

- 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.

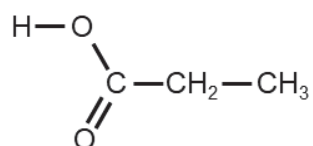
How is ethanol obtained from the fermentation mixture?

- | | |
|-------------------------|----------------------------------|
| A chromatography | B crystallisation |
| C filtration | 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																	
I	II	Key															
		1 H hydrogen 1															
		proton (atomic) number atomic symbol name relative atomic mass															
3 Li lithium 7	4 Be beryllium 9	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	5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24	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	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	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	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	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	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											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												114 F/ flerovium		116 Lv livermorium		
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	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 dm^3 at room temperature and pressure (r.t.p.).



Name	Class	Register No.
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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.

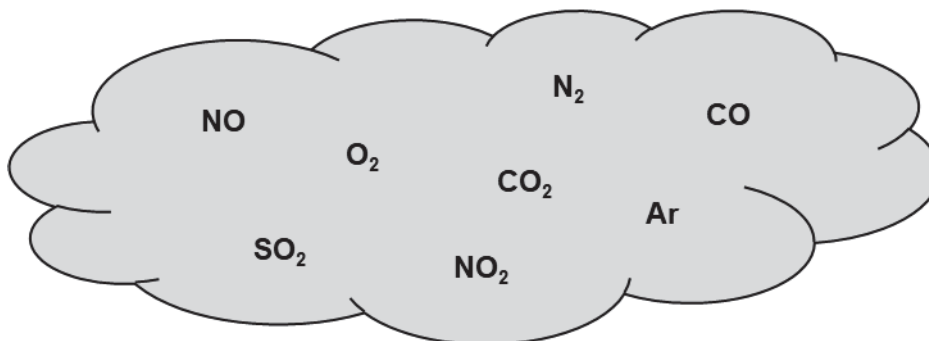


Fig. 1.1

- (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, Ca(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**.

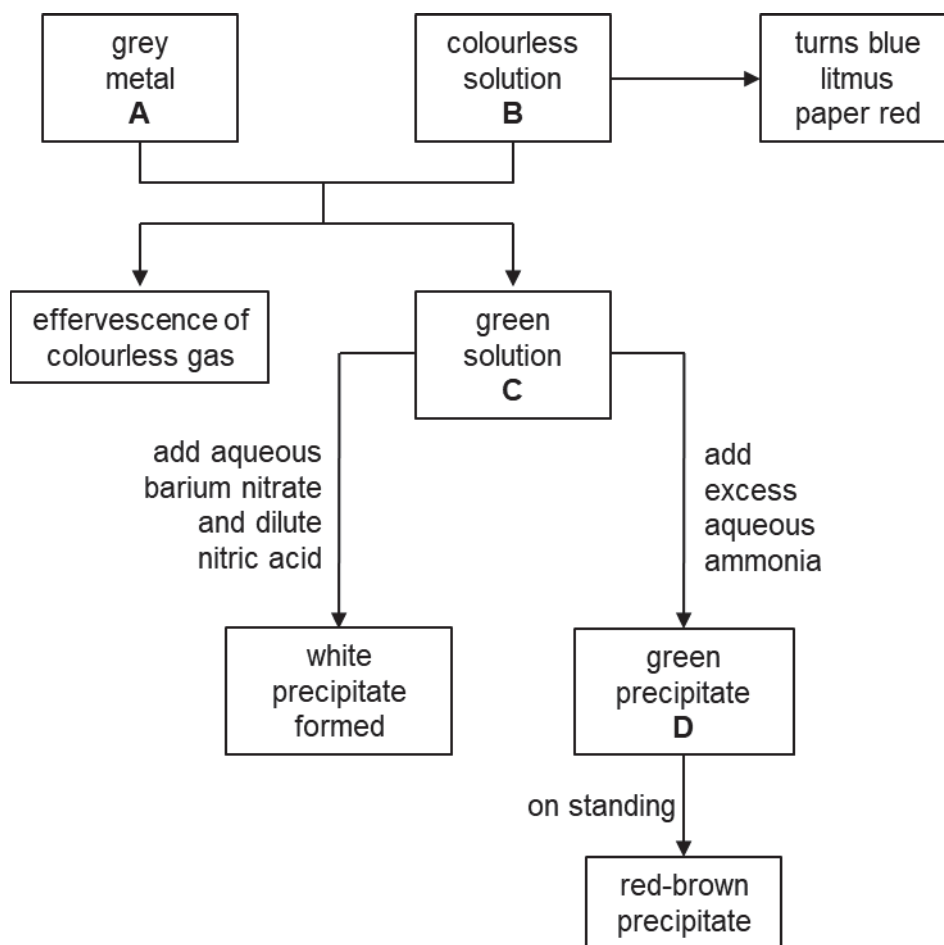


Fig. 4.1

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.

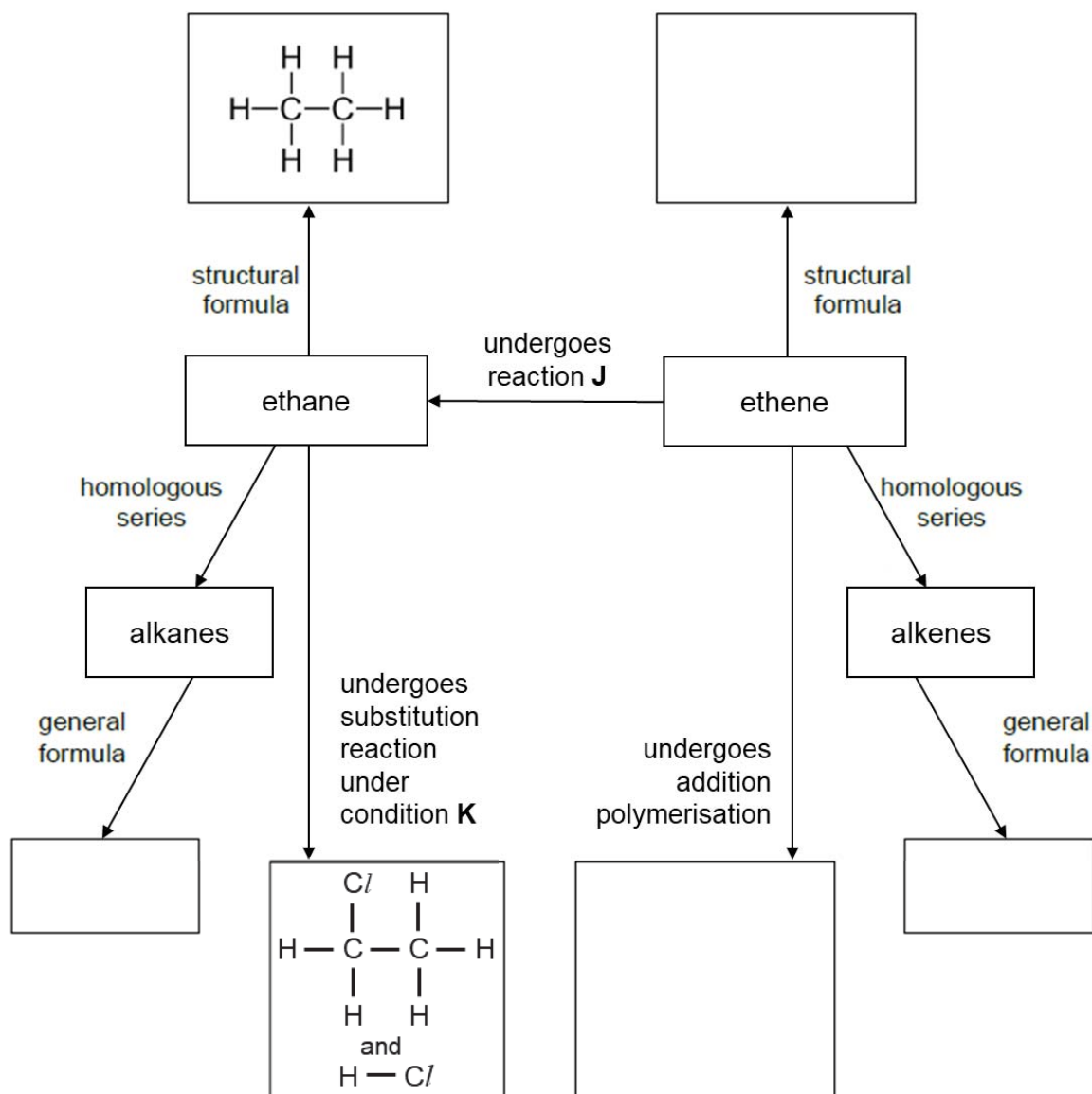


Fig. 6.1

- (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]

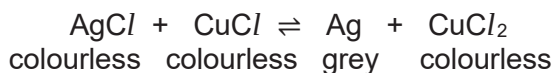
- (d) Both ethane and ethene exist as colourless gases at room temperature and pressure. Describe a test which can be used to distinguish between these two gases.

.....

 [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:

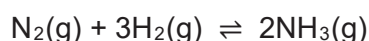


Fig. 8.1 shows the percentage yield of ammonia when different temperatures and pressures are used during the manufacture of ammonia.

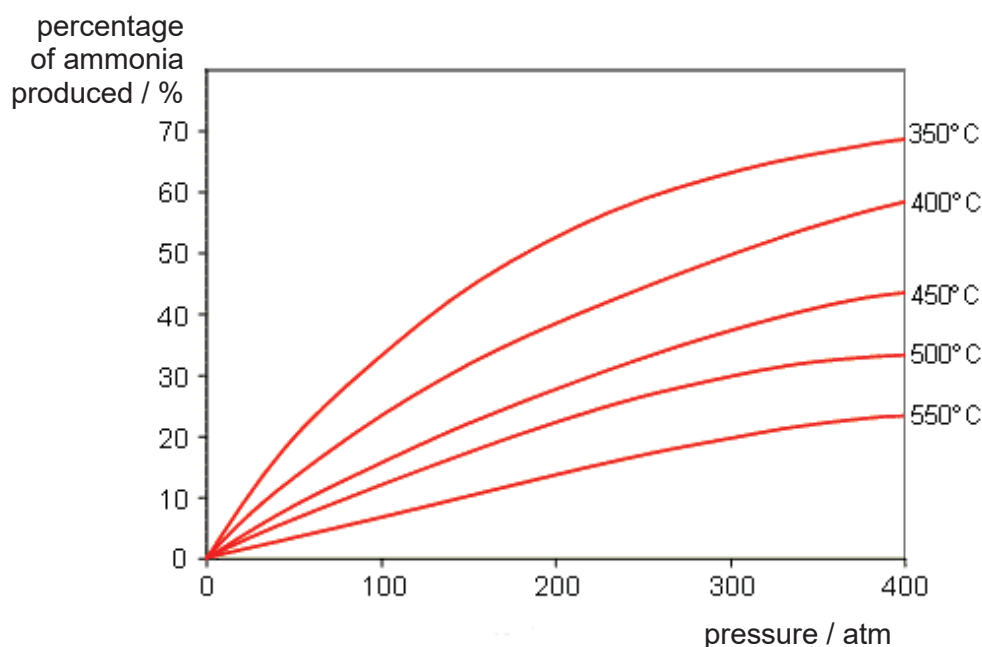


Fig. 8.1

- (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:

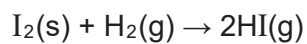
- aqueous sodium bromide
- aqueous sodium iodide
- bromine solution
- iodine solution

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]

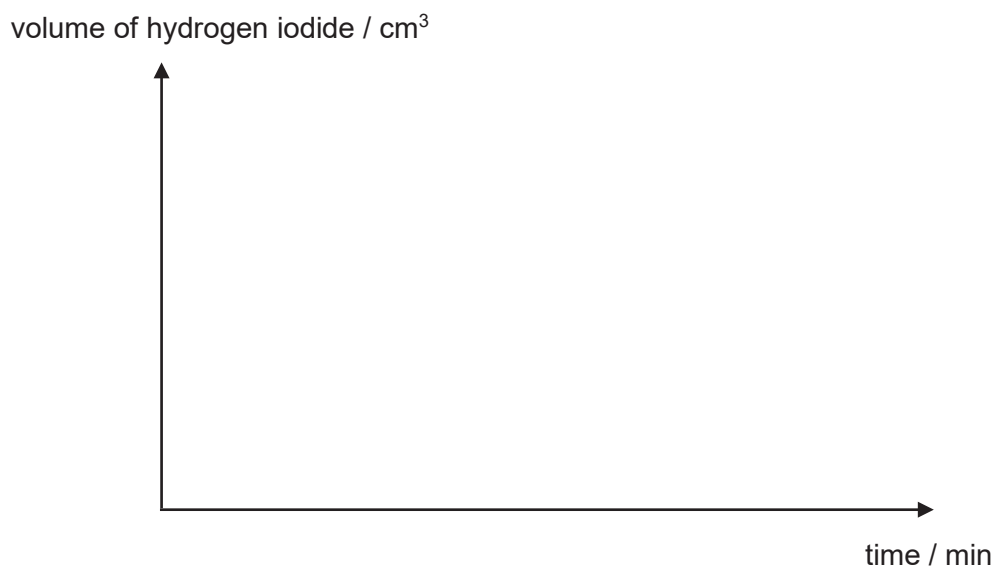
- (d) Iodine can react with hydrogen to form hydrogen iodide, HI.



- (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

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

