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BENDEMEER SECONDARY SCHOOL

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

Name _____

BENDEMEER SECONDARY SCHOOL 2019 PRELIMINARY EXAMINATION SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC) SCIENCE (CHEMISTRY, BIOLOGY) PAPER 1 5078/01

DATE : 30 Aug 2019
DURATION : 1 hour

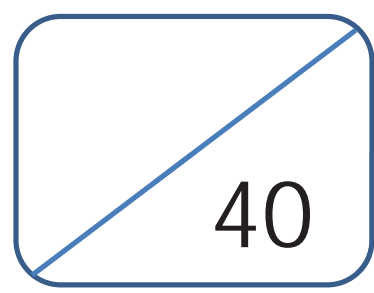
READ THESE INSTRUCTIONS FIRST

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

There are **forty** questions on this paper. Answer **all** questions. For each question, there are four possible answers **A, B, C** and **D**.
Choose the **one** you consider correct and record your choice in 2B pencil on the OTAS sheet.

Read the instructions on the OTAS sheet very carefully.

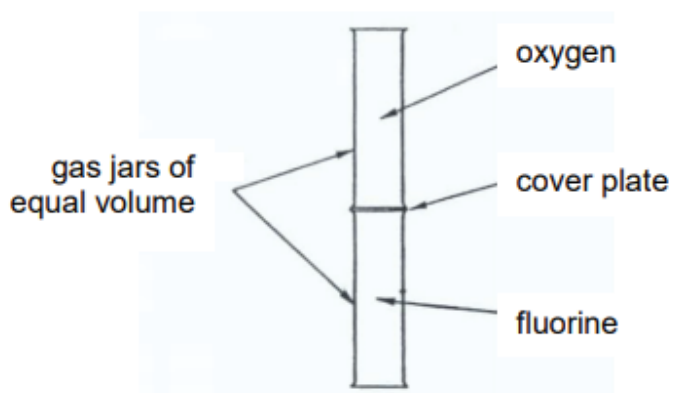
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done on the question paper.
A copy of the Periodic Table is printed on page 18.
The use of an approved scientific calculator is expected, where appropriate.



This document consists of **18** printed pages.

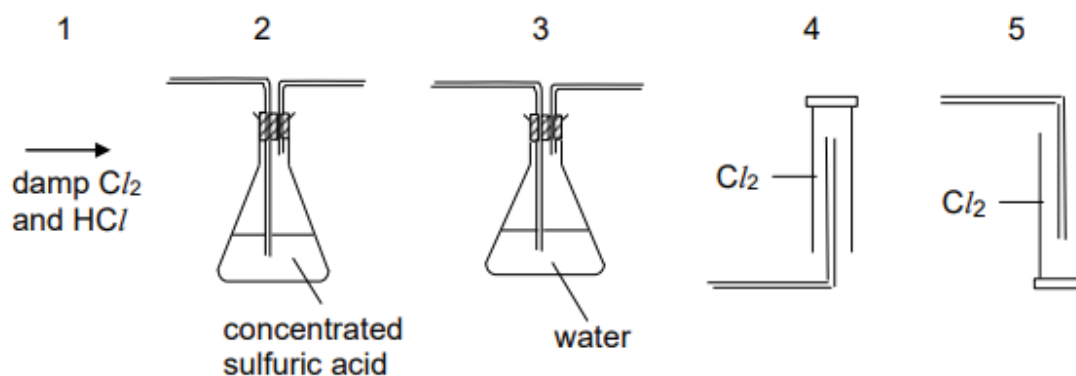
[Turn over

- 1 The cover-plates were removed from the gas jars in the apparatus shown below. It was seen that after several days, the colour of the gas was the same in both jars.



What is the best explanation for this?

- A Both gases contain equal numbers of molecules.
 B Both gases have equal densities.
 C Oxygen and fluorine molecules are moving rapidly in all directions.
 D Oxygen and fluorine molecules diffuse at the same rate.
- 2 Hydrogen chloride is very soluble in water whereas chlorine is only slightly soluble in water. In what order should the pieces of apparatus shown be joined together in order to collect pure, dry chlorine from a sample of damp chlorine containing a small amount of hydrogen chloride?



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

[Turn over

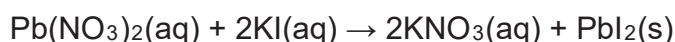
- 3 The boiling points of various gases found in the air are shown below.

| gas | boiling point / °C |
|----------------|--------------------|
| argon | -186 |
| carbon dioxide | -78 |
| nitrogen | -198 |
| oxygen | -183 |

If the air is cooled, the first substance to condense is water.

If the temperature is lowered further, what is the next substance to condense?

- A argon
 B carbon dioxide
 C nitrogen
 D oxygen
- 4 The following reaction can be used to prepare lead(II) iodide.



Which method is used to separate lead(II) iodide from the above mixture?

- A crystallization
 B distillation
 C filtration
 D sublimation
- 5 Hexasulfur was prepared by M.R. Engel in 1891 by reacting concentrated hydrochloric acid with thiosulfate, HS_2O_3^- . It is orange-red and forms a rhombohedral crystal. It has a formula of S_6 .

What can you deduce from the information given above?

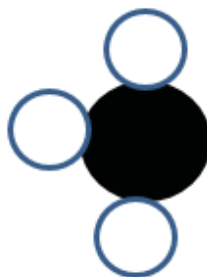
- A Hexasulfur contains only one element.
 B Hexasulfur is a compound which contains 6 atoms.
 C Hexasulfur is a compound which contains 6 elements.
 D Hexasulfur is a mixture which contains 6 elements.
- 6 Three elements, X, Y and Z, have consecutive, increasing proton numbers. If element X is in Group IV, what will be the symbol for the ion of element Z in its compounds?
- A Z^{2-} B Z^- C Z^+ D Z^{2+}

[Turn over



- 7 Element X has 7 protons. Element Y has 8 more protons than X.

Which statement about element Y is not correct?

- A** Y has more electron shells than X.
B Y has the same number of valence electrons as X.
C Y is in the same group of the Periodic Table as X.
D Y is in the same period of the Periodic Table as X.
- 8 Which statement about both chlorine atoms and chloride ions is correct?
- A** They are chemically identical.
B They are isotopes of chlorine.
C They have the same number of protons.
D They have the same physical properties.
- 9 The following diagram shows the structure of one molecule of a substance.



What are the possible electronic configurations for the elements in the above substance?

| |  |  |
|----------|---|---|
| A | 1 | 2.3 |
| B | 2.6 | 2.5 |
| C | 2.7 | 2.3 |
| D | 2.8.7 | 2.5 |

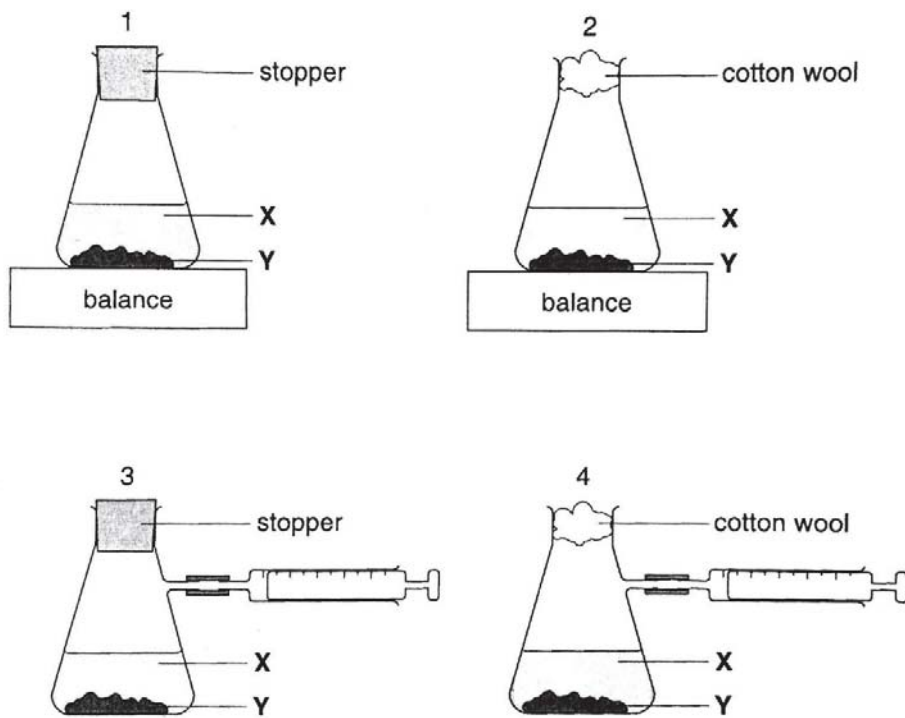
[Turn over

10 A student thinks that element Q is a metal because it has a high melting point and a high boiling point. What other properties could element Q have to show that it is a metal?

- 1 Q conducts electricity when solid.
- 2 Q forms an acidic oxide, QO_2 .
- 3 Q is malleable.

- A** 1, 2 and 3
B 1 and 2
C 1 and 3
D 2 and 3

11 Liquid X reacts with solid Y to form a gas. Which two diagrams show suitable methods for investigating the speed of reaction?



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

[Turn over

- 12 The table gives information about the reactivity of three metals P, Q and R.

| metal | reaction with air | reaction with steam | reaction with dilute hydrochloric acid |
|-------|-----------------------|---------------------|--|
| P | burns with sparks | forms an oxide | forms hydrogen |
| Q | slowly forms an oxide | no reaction | no reaction |
| R | slowly forms an oxide | no reaction | forms hydrogen |

What is the order of reactivity of P, Q and R?

| | most reactive | → | least reactive |
|----------|---------------|---|----------------|
| A | P | Q | R |
| B | P | R | Q |
| C | Q | R | P |
| D | R | Q | P |

- 13 A steel works and a chemical works are built near to a city. The limestone buildings in the city begin to crumble.

Which gas is most likely to cause this damage?

- A** carbon dioxide
- B** carbon monoxide
- C** nitrogen
- D** sulfur dioxide

- 14 Limestone, CaCO_3 , decomposes when heated as shown in the equation.



What is the mass of limestone needed to produce 84 kg of calcium oxide?

- A** 150 kg
- B** 280 kg
- C** 840 kg
- D** 1000 kg

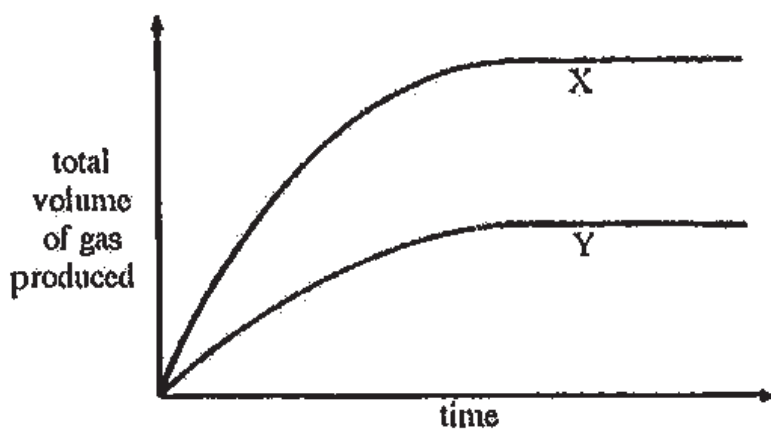
[Turn over

- 15 The reaction between bromine and iodide ions is shown in the equation.



What happens during this reaction?

- A Bromine molecules are the oxidising agent.
 - B Bromine molecules are oxidised to bromide ions.
 - C Iodide ions are reduced to iodine molecules.
 - D Iodide ions gain electrons.
- 16 The curve X below represents the results of the reaction between 1.0 g of granulated zinc and an excess of acid at 30 °C.



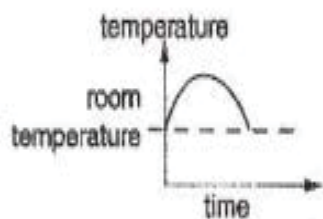
Which of the following changes will produce curve Y?

- A 0.5 g of granulated zinc at 30 °C
- B 0.5 g of powdered zinc at 50 °C
- C 1.0 g of granulated zinc at 30 °C
- D 1.0 g of powdered zinc at 50 °C

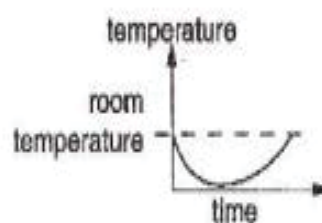
[Turn over

- 17 Dissolving ammonium nitrate in water is endothermic. Which graph shows how the temperature alters as the ammonium nitrate is added to the water and the solution is left to stand?

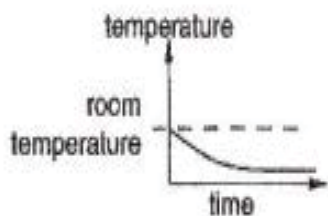
A



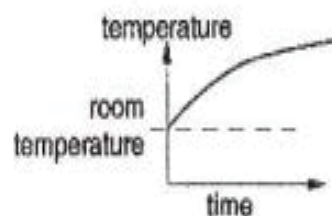
B



C



D



- 18 Lead(II) sulfate is insoluble in water. What should be added to sulfuric acid to prepare lead(II) sulfate?

- A lead(II) carbonate
- B lead(II) chloride
- C lead(II) nitrate
- D lead(II) oxide

- 19 Which statement about the homologous series of alcohols is not true?

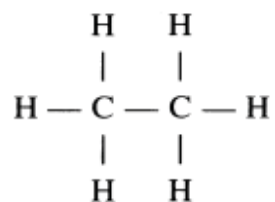
- A Alcohols can be oxidized to acids.
- B All alcohols can be made by the fermentation of sugars and carbohydrates.
- C Complete combustion of alcohols produces carbon dioxide and water only.
- D The relative molecular mass of each member differs from the next member by 14.

[Turn over

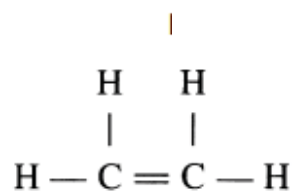
- 20 A hydrocarbon Y with a relative molecular mass of 28 quickly decolourises aqueous bromine in bright sunlight.

What is Y likely to be?

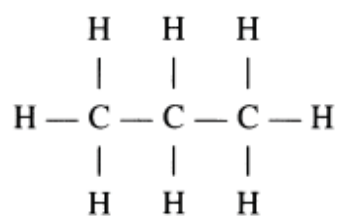
A



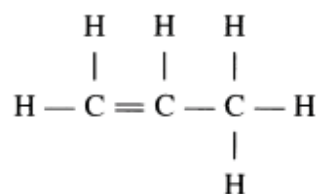
B



C



D



[Turn over

Name _____

Register No.

Class



BENDEMEER SECONDARY SCHOOL
2019 PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)
SCIENCE (CHEMISTRY) PAPER 3
5076/03, 5078/03

DATE : 29 August 2019

DURATION : 1 hour 15 minutes

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on the work you hand in.
You may use a 2B pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
Do not use 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.

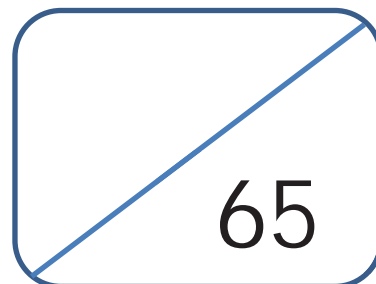
Write your answers in the spaces provided on the question paper.

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 (45 marks)Answer **all** the questions in the spaces provided.

- 1** From the list below, choose the most suitable answer.
Each substance can be used only once or not at all.

carbon dioxide
carbon monoxide
sodium oxide

chlorine
nitrogen
brass

potassium chloride
argon
water

Which substance

- (a)** can conduct electricity in the aqueous and molten states;

..... [1]

- (b)** is the most abundant in air;

..... [1]

- (c)** produces a black solid when added to potassium iodide;

..... [1]

- (d)** is a monoatomic element;

..... [1]

- (e)** does not contain a fixed percentage composition of its constituents?

..... [1]

2 The group numbers of the elements A, B, C and D are given in Table 2.1.

Table 2.1

| element | group number | period number |
|---------|--------------|---------------|
| A | I | 2 |
| B | IV | 3 |
| C | VI | 3 |
| D | VIII | 4 |

Using the information given, answer the following questions.

(a) Using the electronic structure, explain why element C is a non-metal.

..... [1]

(b) Identify element B.

..... [1]

(c) Which element conducts electricity at room temperature in both solid and liquid states?

..... [1]

(d) Showing all electrons, draw a 'dot and cross' diagram to show the bonding in the compound formed between A and C.

[2]

(e) Does the compound formed in (d) have a high or low melting point? Explain your answer.

.....

..... [2]

- 3 Small pieces of five metals are added to aqueous solutions of the five metal nitrates. The results are recorded in Table 3.1.

✓ indicates reaction takes place
X indicates no reaction takes place

Table 3.1

| solution | metal | | | | |
|----------------------------|------------|---------------|------------|------------|---------|
| | copper, Cu | magnesium, Mg | nickel, Ni | silver, Ag | tin, Sn |
| $\text{Cu}(\text{NO}_3)_2$ | X | ✓ | ✓ | X | ✓ |
| $\text{Mg}(\text{NO}_3)_2$ | X | X | X | X | X |
| $\text{Ni}(\text{NO}_3)_2$ | X | ✓ | X | X | X |
| AgNO_3 | ✓ | ✓ | ✓ | X | ✓ |
| $\text{Sn}(\text{NO}_3)_2$ | X | ✓ | ✓ | X | X |

- (a) Place the five metals in order of reactivity.

Most reactive:

.....

.....

Least reactive:

[2]

- (b) Give two observations to be made when magnesium is added to aqueous copper(II) nitrate.

.....

..... [2]

- (c) When a metal M is added to iron(II) nitrate, a colourless solution is obtained and the oxidation state of M changes from 0 to +2.

- (i) Suggest what metal M might be.

..... [1]

- (ii) Write a balanced equation for the reaction between M and iron(II) nitrate. Use the letter M in your equation.

..... [1]

[Turn over]

- (iii) Explain, in terms of oxidation states, why this reaction is considered to be a redox reaction.

.....

..... [2]

- 4 (a) Ammonium phosphate, $(\text{NH}_4)_3\text{PO}_4$, can be prepared by adding 25.0 cm^3 of 0.5 mol/dm^3 of aqueous ammonium hydroxide, NH_4OH , to 33.5 cm^3 of dilute phosphoric acid, H_3PO_4 .



- (i) Calculate the number of moles of ammonium hydroxide used.

number of moles = [1]

- (ii) Calculate the number of moles of phosphoric acid required.

number of moles = [1]

- (iii) Calculate the concentration of the phosphoric acid used.

concentration of phosphoric acid = mol/dm^3 [2]

- (b) (i) Ammonium phosphate is used as a fertiliser in soils. However it is not advisable to add the fertiliser to acidic soils that has been treated with calcium hydroxide.

Explain why with the help of a balanced equation.

.....

- (ii) [2]
Write an ionic equation, including state symbols, for the reaction between ammonium hydroxide and phosphoric acid.

..... [1]

- 5 Cold packs are used to reduce swelling, inflammation and pain by removing the heat. A list of chemicals from a science laboratory is shown below:

ammonium chloride dilute hydrochloric acid water
anhydrous sodium carbonate sodium hydroxide

- (a) From the list of chemicals provided above, select a pair of chemicals that can be used for making a cold pack in a science laboratory.

..... [1]

- (b) Explain your answer in (a) and state the type of energy change.

.....

..... [1]

- 6 P, Q, R and S are samples of water taken from different places thought to be polluted. Tables 6.1 and 6.2 show the observations made when each sample of water is tested.

Table 6.1

| tests for sulfate ions | observations | | | |
|--|------------------|---------------------|------------------|---------------------|
| | sample P | sample Q | sample R | sample S |
| add a few drops of dilute hydrochloric acid, then add several drops of aqueous barium chloride | white ppt formed | no visible reaction | white ppt formed | no visible reaction |

Table 6.2

| tests for chloride ions | observations | | | |
|---|---------------------|------------------|------------------|---------------------|
| | sample P | sample Q | sample R | sample S |
| add a few drops of dilute nitric acid, then add several drops of aqueous silver nitrate | no visible reaction | white ppt formed | white ppt formed | no visible reaction |

Use the results of the tests to help you answer the following questions.

- (a) Which water sample is polluted with both sulfate and chloride ions?

..... [1]

[Turn over]

(b) One of the samples is known to contain only ammonium sulfate.

(i) Which sample is it?

..... [1]

(ii) Give a reason for your answer.

.....
 [1]

(c) Which sample appears to be the least polluted?

..... [1]

7 A series of experiments were carried out to compare the rates of the reaction of hydrochloric acid with marble (calcium carbonate) under different conditions. In each experiment, excess marble was reacted with 25 cm³ of acid. The conditions for each experiment were shown in Table 7.1.

Table 7.1

| experiment | marble | acid concentration (mol/dm ³) |
|------------|-------------|---|
| A | large chips | 0.1 |
| B | large chips | 0.2 |
| C | small chips | 0.1 |
| D | small chips | 0.2 |
| E | powder | 0.2 |

The gas given off was collected and its total volume was measured every 15 seconds for 6 minutes. The results obtained were plotted as shown in Fig. 7.2.

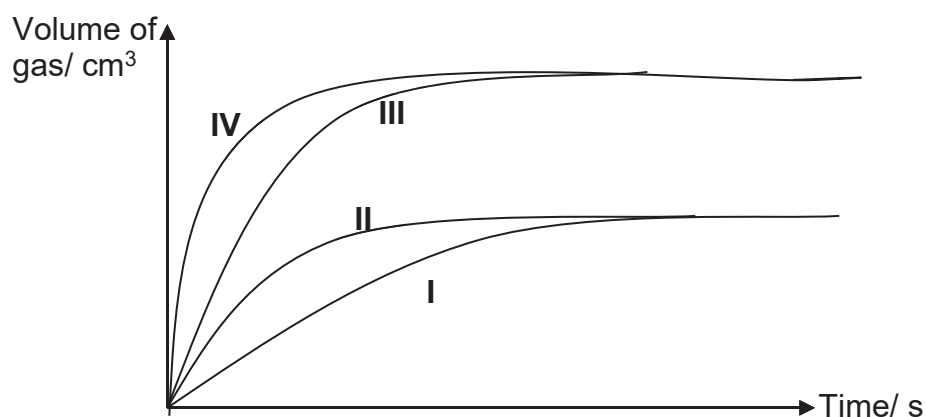


Fig. 7.2

(a) Write an equation for the reaction which occurred.

[Turn over]

..... [1]

- (b) For each of the experiments A to D, state which of the curves I to IV corresponds to the results obtained in Fig. 7.2.

Experiment A: curve

Experiment B: curve

Experiment C: curve

Experiment D: curve

[2]

- (c) Sketch the result obtained for experiment E in Fig. 7.2 and label it with "V."

[1]

- (d) State one condition which must be kept constant during the experiments.

..... [1]

- 8 A chemical process is carried out by oil companies to produce high grade petrol (an eight carbon hydrocarbon). The process is carried out by using aluminium oxide catalyst.

- (a) (i) A typical reaction for this process is:



Name this chemical process.

..... [1]

- (ii) Describe a simple chemical test to distinguish between the two products shown in the equation.

.....

.....

..... [2]

Section B

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

Write your answer in the spaces provided.

- 9** A colourless gas X with an empirical formula CH_2 produces a neutral organic liquid W of molecular mass 46 upon hydration (addition of steam).

X reacts with (i) hydrogen to give a gas Y of molecular mass 30 and
(ii) bromine to give a liquid Z of molecular mass 188.

- (a)** Give the names and molecular formulae of compounds W, X, Y and Z.

W:

X:

Y:

Z:

[4]

- (b)** Write a balanced equation for the hydration of X and briefly describe how this reaction could be carried out in the laboratory.

.....

.....

[2]

- (c)** Describe, with a balanced equation, one reaction of W other than combustion.

.....

.....

.....

[2]

- (d)** 0.42 g of W is vaporized by heating to 100°C at room temperature and pressure. Calculate the volume occupied by the vapour under these conditions.

volume of W = dm^3 [2]

[Turn over]

10 Thermal decomposition of compounds breaks them down into smaller substances when sufficient heat is applied.

- (a) Air bags are used to protect passengers in a car during an accident. When the crash sensor detects an impact, it causes a mixture of chemicals to be heated to a high temperature. Reactions take place which produce nitrogen gas. The nitrogen fills the air bag. This is shown in Fig. 10.1.

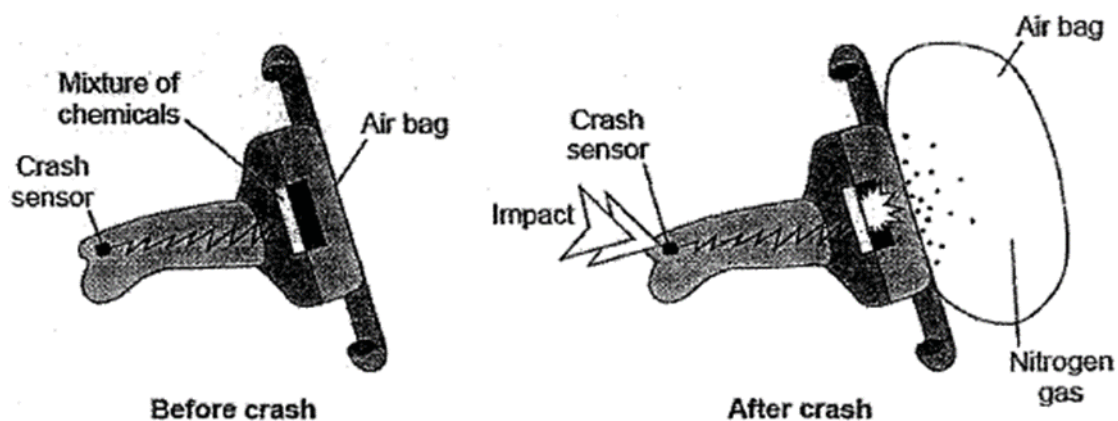


Fig. 10.1

The mixture of chemicals contains solid sodium azide, NaN_3 which decomposes to form sodium and nitrogen as follows:



- (i) Balance the chemical equation and complete the state symbols in the chemical equation above. [2]
- (ii) Draw the electronic structure of nitrogen gas. Show outer electrons only.

- (iii) An air bag consists of 130 g of sodium azide. When the sodium azide decomposed, 60 dm³ of nitrogen was obtained at room temperature and pressure.

Show, using calculations, if the thermal decomposition of sodium azide has been efficient in producing nitrogen to fill up the air bag.

[3]

- (b) A student used the apparatus in Fig. 10.2 to investigate what happens when liquid paraffin is heated to a high temperature.

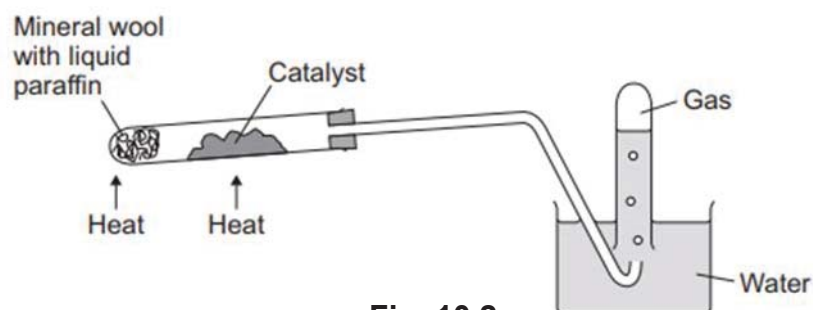


Fig. 10.2

Liquid paraffin contains alkanes. The most abundant alkane has a chemical formula of C₂₀H₄₂.

Name the reaction shown in Fig. 10.2. Describe, with the aid of a chemical equation, what happens to the alkane molecules in the reaction.

.....

.....

.....

.....

.....

[3]

[Turn over]

11 Bromine, chlorine and iodine belong to the same group of elements.

(a) (i) What is the name given to this group of elements?

..... [1]

(ii) A student was asked to perform the following experiments to show the trend in the reactivity of the above three elements.

Experiment 1: bromine solution + aqueous potassium iodide

Experiment 2: chlorine solution + aqueous potassium bromide

Experiment 3: iodine solution + aqueous potassium chloride

Describe, with balanced equations, what you will observe in the three experiments.

..... [3]

(iii) Using your answer in (a)(ii), arrange the elements in order of increasing reactivity and explain how reactivity changes when going down the group.

..... [2]

(b) (i) State the reagents used to prepare magnesium chloride.

..... [1]

(ii) Describe how dry crystals of magnesium chloride is produced in the laboratory.

..... [3]

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 | VIII | IX | X | XI | XII | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 Li lithium 7 | 4 Be beryllium 9 | <div style="border: 1px solid black; padding: 5px; display: inline-block;"> Key proton (atomic) number atomic symbol name relative atomic mass </div> | | | | | | | | | | 2 He helium 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 Na sodium 23 | 12 Mg magnesium 24 | | | | | | | | | | | 5 B boron 11 | 6 C carbon 12 | 7 N nitrogen 14 | 8 O oxygen 16 | 9 F fluorine 19 | 10 Ne neon 20 | 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 - | 114 Fl flerovium - | 116 Lv livermorium - | 118 Og oganeson - | 119 Uu ununium - | 120 Uub ununbium - | 121 Uut ununtrium - | 122 Uuq ununquadium - | 123 Uub ununhexium - | 124 Uuq ununseptium - | 125 Uub ununoctium - | 126 Uut ununnonium - | 127 Uuq unundecium - | 128 Uub ununduodecium - | 129 Uut ununtridecium - | 130 Uuq ununquadradecium - | 131 Uub ununhexadecium - | 132 Uut ununheptadecium - | 133 Uuq ununoctadecium - | 134 Uub ununnonadecium - | 135 Uut ununtriacontium - | 136 Uuq ununtriacontium - | 137 Uub ununtriacontium - | 138 Uut ununtriacontium - | 139 Uuq ununtriacontium - | 140 Uub ununtriacontium - | 141 Uut ununtriacontium - | 142 Uuq ununtriacontium - | 143 Uub ununtriacontium - | 144 Uut ununtriacontium - | 145 Uuq ununtriacontium - 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