



DUNMAN SECONDARY SCHOOL

CANDIDATE
NAME

CLASS

INDEX
NUMBER

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PRELIMINARY EXAMINATION 2024 SECONDARY 4 EXPRESS

CHEMISTRY

Paper 1

6092/01

16 August 2024

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, class and index number on the Answer Sheet in the spaces provided unless this has been done for you.

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 **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer 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 in this booklet.

A copy of the Periodic Table is printed on page 18.

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

- 1 A student investigates the rate of reaction between an excess of acid of different concentrations and known quantity of calcium carbonate granules. During the reaction, the student measures the volume of gas released.

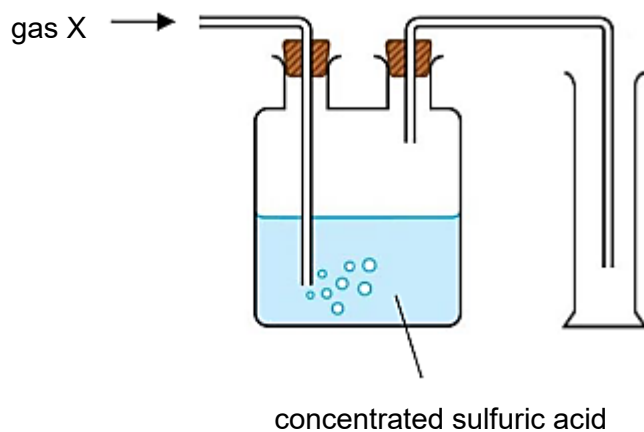
In addition to a conical flask and a balance, the following pieces of apparatus are available.

- 1 gas syringe
- 2 thermometer
- 3 measuring cylinder
- 4 stopwatch

Which pieces of apparatus are needed for this experiment?

- A 1, 3 and 4 only
- B 1 and 3 only
- C 1 and 4 only
- D 2, 3 and 4 only

- 2 The diagram shows an experimental setup to produce and collect a dry sample of gas X.



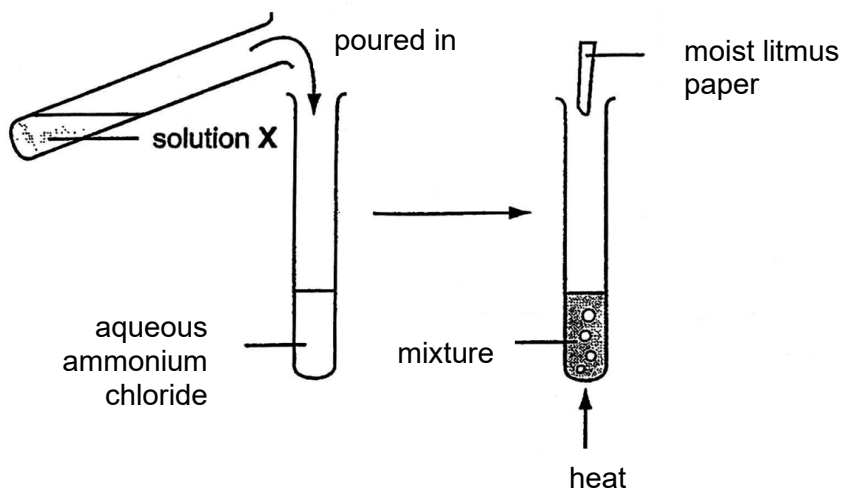
What is gas X?

- A ammonia gas
- B hydrogen chloride gas
- C hydrogen gas
- D steam

- 3 Aluminium sulfate is used in water treatment. Aqueous aluminium sulfate is acidic. The table shows the results of tests on four different samples of treated water. To which sample had an excess of aluminium sulfate been added?

	pH of sample	reaction with an excess aqueous ammonia
A	3	white precipitate
B	3	no reaction
C	11	no reaction
D	11	white precipitate

- 4 The diagrams show an experiment with aqueous ammonium chloride.

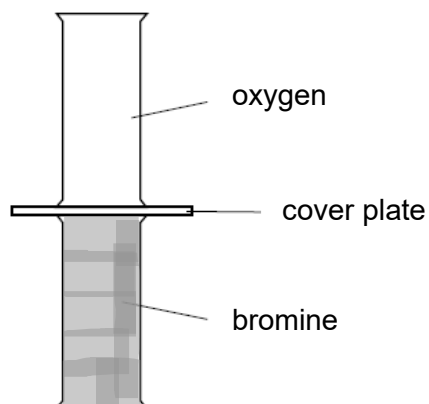


A gas, Y, is produced and the litmus paper changes colour.

What are solution X and gas Y?

	solution X	gas Y
A	aqueous sodium hydroxide	ammonia
B	aqueous sodium hydroxide	chlorine
C	dilute sulfuric acid	ammonia
D	dilute sulfuric acid	chlorine

- 5 The cover plate is removed from the gas jars shown in the diagram. After several days, the colour of the gas is the same in both jars.



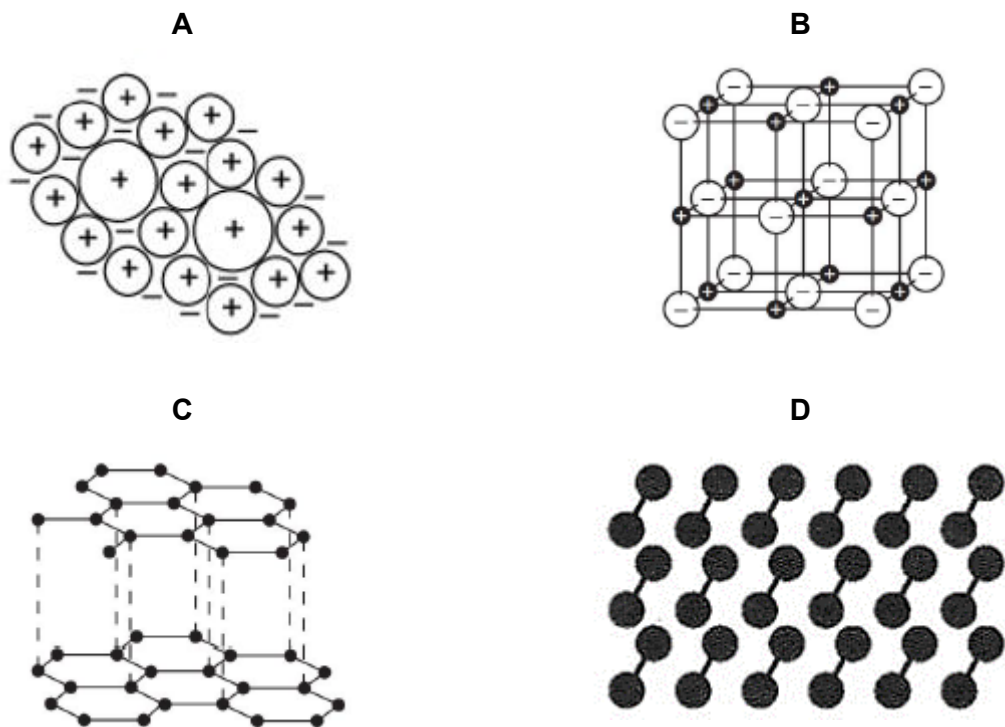
Which statement explains this change?

- A** Equal volumes of oxygen and bromine contain equal numbers of molecules.
B Oxygen and bromine molecules diffuse at the same rate.
C Oxygen and bromine molecules move randomly in all directions.
D Oxygen and bromine gases have equal densities.
- 6 An element J has a nucleon number of 45. The ion, J^{3+} , contains 18 electrons.
How many neutrons are there in an atom of J?
- A** 18
B 21
C 24
D 27
- 7 Phosphorus trichloride, PCl_3 , is a molecule formed when the elements phosphorus and chlorine react together.
How many electrons in the outer shell of the phosphorus atom are not involved in bonding?

- A** 0
B 1
C 2
D 3

- 8 Which statements are correct for both metals and ionic compounds?
- 1 They conduct electricity because electrons flow through the solid materials.
 - 2 They contain positive ions.
 - 3 Most have high melting points.
- A 1, 2 and 3
B 1 and 2 only
C 1 and 3 only
D 2 and 3 only
- 9 Which statement explains why potassium chloride, KCl, has a lower melting point than calcium oxide, CaO?
- A Potassium chloride is covalent but calcium oxide is ionic.
B Potassium is more reactive than calcium.
C The attraction between K^+ and Cl^- is weaker than that between Ca^{2+} and O^{2-} .
D The melting point of potassium is lower than that of calcium.

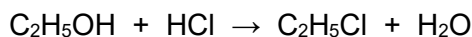
10 Which diagram best represents the structure of a mixture?



11 In which reaction does the biggest percentage change in volume occur?

- A** $\text{C}_3\text{H}_8 (\text{g}) + 5\text{O}_2 (\text{g}) \rightarrow 3\text{CO}_2 (\text{g}) + 4\text{H}_2\text{O} (\text{l})$
- B** $4\text{NH}_3 (\text{g}) + 3\text{O}_2 (\text{g}) \rightarrow 2\text{N}_2 (\text{g}) + 6\text{H}_2\text{O} (\text{l})$
- C** $\text{CH}_4 (\text{g}) + 2\text{O}_2 (\text{g}) \rightarrow \text{CO}_2 (\text{g}) + 2\text{H}_2\text{O} (\text{l})$
- D** $2\text{SO}_2 (\text{g}) + \text{O}_2 (\text{g}) \rightarrow 2\text{SO}_3 (\text{g})$

12 In a reaction between 23 g of ethanol and excess hydrogen chloride, the mass of chloroethane obtained is 20 g.



What is the percentage yield of chloroethane?

[Mr: $\text{C}_2\text{H}_5\text{OH}$, 46; $\text{C}_2\text{H}_5\text{Cl}$, 64.5]

- A** 15% **B** 46% **C** 62% **D** 87%

- 13** 20 cm³ of an aqueous 1.0 mol/dm³ solution of the hydroxide of metal X exactly neutralises 40cm³ of 0.25 mol/dm³ dilute sulfuric acid.

What is the formula for the sulfate of X?

- A** XSO₄ **B** X(SO₄)₂ **C** X₂SO₄ **D** X₂(SO₄)₃

- 14** A volume of ethane, C₂H₆, at room temperature and pressure, has a mass of 20 g.

What is the mass of an equal volume of propene, C₃H₆, at r.t.p.?

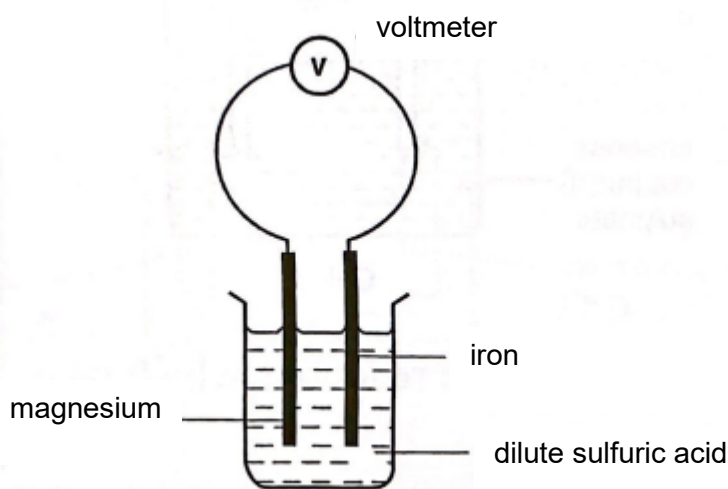
- A** 20 g **B** 21 g **C** 28 g **D** 42 g

- 15** Dilute aqueous sodium chloride and concentrated aqueous sodium chloride are electrolysed using inert electrodes in separate experiments.

Which row shows the products of these experiments?

	dilute aqueous sodium chloride		concentrated aqueous sodium chloride	
	positive electrode	negative electrode	positive electrode	negative electrode
A	chlorine	hydrogen	chlorine	sodium
B	chlorine	oxygen	oxygen	hydrogen
C	oxygen	hydrogen	chlorine	hydrogen
D	oxygen	hydrogen	hydrogen	chlorine

- 16 The diagram shows a simple cell.



Which statements about the cell are correct?

- 1 Electrons pass from magnesium electrode to iron electrode through electrolyte.
- 2 The iron electrode is the negative electrode.
- 3 The magnesium electrode loses electrons.
- 4 Bubbles are formed around iron.

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

- 17 Which statement describes what happens when hydrogen and oxygen are used in a fuel cell?

- A** Electricity is generated directly.
B Electricity is used to produce water.
C Hydrogen is burned to form steam.
D Hydrogen reacts to form a hydrocarbon fuel.

- 18 In an electrolysis experiment, the same amount of charge deposited 54.0 g of silver and 5.2 g of chromium.

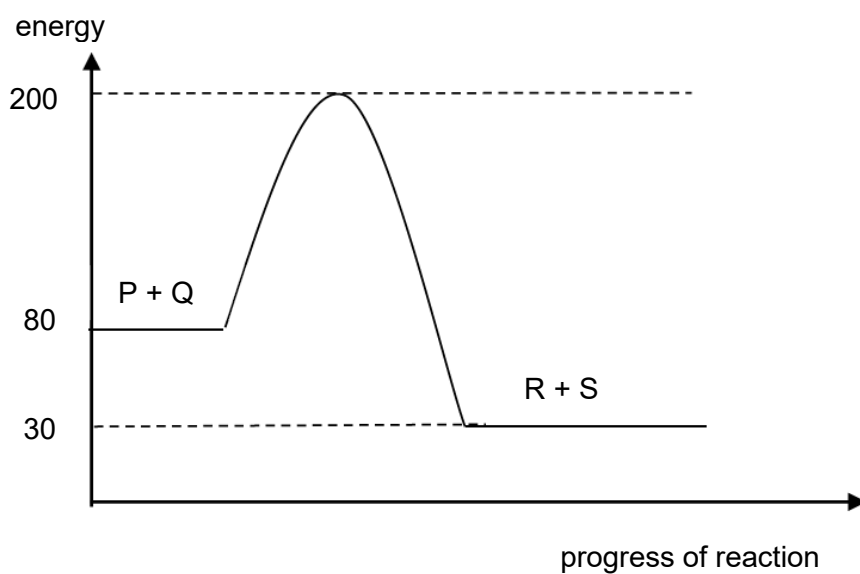
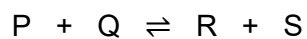
What is the charge on the chromium ion?

- A** +2 **B** +3 **C** +5 **D** +6

19 In which process is energy released?

- A electrolysis of water to form hydrogen and oxygen
- B photosynthesis
- C reaction between dilute sulfuric acid with aqueous sodium hydroxide
- D thermal decomposition of calcium carbonate

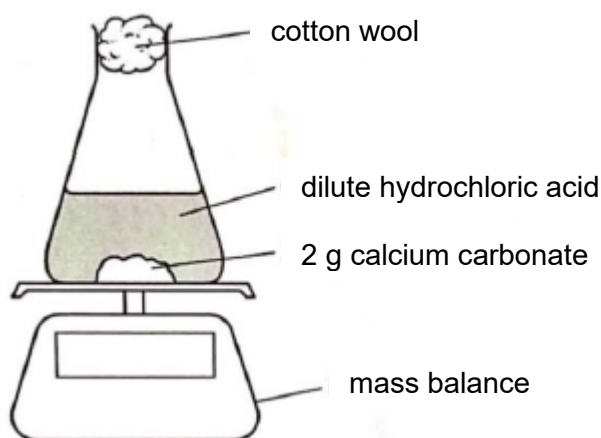
20 The equation and the energy profile diagram for a reversible reaction are shown.



What is the enthalpy change of reaction, ΔH and activation energy, E_a for the **reverse** reaction?

	ΔH in kJ / mol	E_a in kJ / mol
A	- 50	120
B	+ 50	120
C	- 50	170
D	+ 50	170

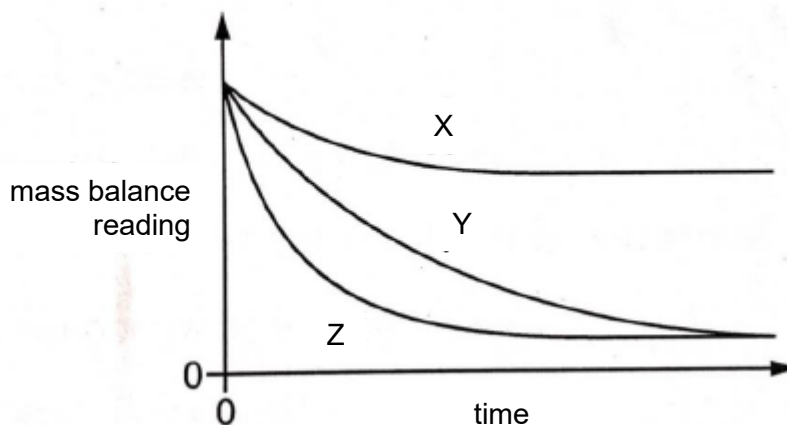
- 21 The rate of reaction between calcium carbonate and hydrochloric acid is measured in three separate experiments.



The conditions at which each experiment is performed are as follows:

experiment	particle size of calcium carbonate	volume of acid	concentration of acid (mol/dm ³)
1	powdered	in excess	2.0
2	lumps	in excess	2.0
3	lumps	not in excess	1.0

The results of these experiments are shown.



Which row shows the correct curve for the experiments?

	experiment 1	experiment 2	experiment 3
A	X	Y	Z
B	Y	Z	X
C	Z	X	Y
D	Z	Y	X

22 Which chemical changes represent reduction?

- 1 $\text{Br}_2 \rightarrow 2\text{Br}^-$
- 2 $\text{Fe} \rightarrow \text{Fe}^{2+}$
- 3 $2\text{NO}_2 \rightarrow \text{N}_2\text{O}_5$
- 4 $\text{Cr}_2\text{O}_7^{2-} \rightarrow 2\text{Cr}^{3+}$

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

23 What are the colour changes observed?

	when potassium iodide is oxidised	when acidified potassium manganate(VII) is reduced
A	brown to colourless	colourless to purple
B	brown to colourless	purple to colourless
C	colourless to brown	colourless to purple
D	colourless to brown	purple to colourless

24 The statements below show some reactions of dilute sulfuric acid.

- 1 A white precipitate is formed when aqueous barium chloride is added.
- 2 Addition of Universal indicator shows that the solution has a pH value of less than 7.0.
- 3 The solution turns anhydrous copper(II) sulfate from white to blue.
- 4 The solution reacts with magnesium and effervescence is observed.

Which statements confirm the acidic nature of the solution?

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

25 Which statement about the Haber process is **not** correct?

- A** A catalyst of iron is used.
- B** Hydrogen is obtained from fractional distillation of liquid air.
- C** The reaction is reversible.
- D** Each nitrogen molecule reacts with three hydrogen molecules to form two molecules of ammonia.

26 Rubidium, Rb, is in the same group of the Periodic Table as sodium.

Which statement about rubidium is **not** correct?

- A** It forms ionic bonds with halogens.
- B** It forms rubidium hydroxide when reacted with water.
- C** It reacts more explosively with water than sodium.
- D** Its melting point is higher than sodium.

27 Which statement describes the change in the elements from left to right across a period of the Periodic Table?

- A** The ability to conduct electricity increases.
- B** The metallic property decreases.
- C** The number of electron shells increases.
- D** The number of protons in an atom decreases.

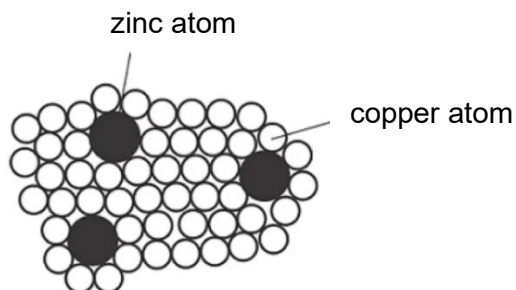
28 Elements X and Y are in Group 17 of the Periodic Table.

X is a liquid at room temperature while Y is a solid at room temperature.

Which statement is correct?

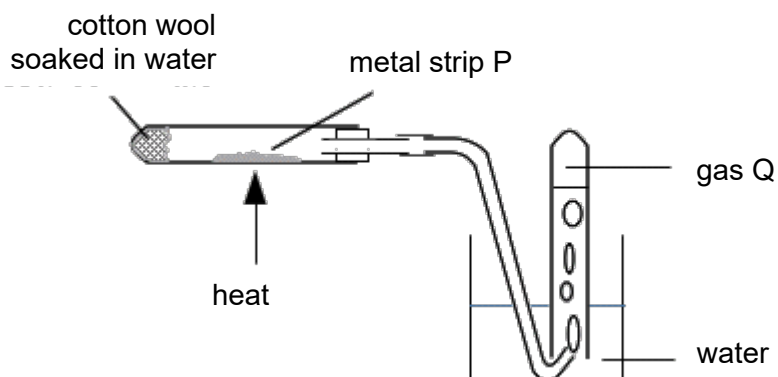
- A** X displaces Y from aqueous solutions of Y^- ions.
- B** X has a higher boiling point than Y.
- C** X has darker colour than Y.
- D** X has more protons in its atom than an atom of Y.

- 29 The diagram shows the structure of brass.



Why is brass harder than pure copper?

- A** The zinc atoms form strong covalent bonds with copper atoms.
B The zinc atoms prevent layers of copper atoms from slipping over each other easily.
C The zinc atoms prevent the 'sea of electrons' from moving freely in the lattice.
D Zinc atoms have more electrons than copper atoms.
- 30 In the experiment shown below, a strip of metal P was heated in a glass tube. Gas Q is collected.



Which are substances P and Q?

	P	Q
A	calcium	oxygen
B	lead	hydrogen
C	silver	oxygen
D	zinc	hydrogen

- 31 In what way do chlorofluorocarbon, methane and sulfur dioxide affect the atmosphere and the environment?

	chlorofluorocarbons	methane	sulfur dioxide
A	depletion of the ozone layer	global warming	acid rain
B	depletion of the ozone layer	photochemical smog	global warming
C	global warming	depletion of the ozone layer	photochemical smog
D	photochemical smog	global warming	acid rain

- 32 A catalytic converter in a car exhaust system changes pollutants into less harmful products. Which change does **not** occur in a catalytic converter?

- A** carbon dioxide → carbon
- B** carbon monoxide → carbon dioxide
- C** nitrogen oxides → nitrogen
- D** unburned hydrocarbons → carbon dioxide and water

- 33 Which statement about the fractional distillation of petroleum is correct?

- A** Only one compound is collected at each level in the column.
- B** The higher up the column, the greater the temperature.
- C** The molecules obtained at the bottom of the column are the most flammable
- D** The molecules obtained at the top of the column have the smallest relative molecular mass.

- 34 Which molecular formulae have exactly two isomers?

- 1 C₃H₈
- 2 C₄H₈
- 3 C₄H₁₀

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

- 35 The cracking of one mole of X, a large alkane, produces three moles of ethane, two moles of propene and one mole of propane.

How many carbon atoms does one molecule of X contain?

- A** 6 **B** 8 **C** 12 **D** 15

- 36 Which comparison of the properties of hexane, C_6H_{14} , and butane is true?

- A** Butane has a higher melting point.
B Butane has a lower boiling point.
C Butane is less flammable.
D Butane is more viscous.

- 37 Which row shows the products of the complete combustion of ethane and the products of the reaction of ethane with chlorine?

	products of complete combustion	products of reaction with chlorine
A	carbon dioxide and water	a chlorine compound and hydrogen chloride
B	carbon dioxide only	a chlorine compound and hydrogen chloride
C	carbon dioxide and water	a chlorine compound only
D	carbon dioxide only	no reaction

- 38 Which statement about a polyunsaturated vegetable oil is correct?

- A** It has double bonds between carbon and hydrogen atoms.
B It reacts with hydrogen to form a solid compound.
C It reacts with steam to form margarine.
D It turns aqueous bromine from colourless to brown.

- 39 X reacts with steam to form Y.

Y is oxidised to Z.



If Z is butanoic acid, what is the formula of X?

- A** C_3H_6 **B** C_3H_8 **C** C_4H_8 **D** C_4H_{10}

- 40 The table shows the type and uses of the polymers nylon and poly(ethene).

Which row correctly matches the type and use of the polymer?

	polymer	type	use
A	nylon	addition	fishing lines
B	nylon	condensation	parachutes
C	poly(ethene)	addition	fishing lines
D	poly(ethene)	condensation	parachutes

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The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

The Avogadro constant, $L = 6.02 \times 10^{23} \text{ mol}^{-1}$