

National Qualifications 2019

X813/76/12

Chemistry Paper 1 — Multiple choice

FRIDAY, 10 MAY 9:00 AM – 9:40 AM

Total marks — 25

Attempt ALL questions.

You may use a calculator.

Instructions for the completion of Paper 1 are given on *page 02* of your answer booklet X813/76/02.

Record your answers on the answer grid on *page 03* of your answer booklet.

You may refer to the Chemistry Data Booklet for Higher and Advanced Higher.

Space for rough work is provided at the end of this booklet.

Before leaving the examination room you must give your answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.





Total marks — 25 Attempt ALL questions

- 1. Hydrogen will form a non-polar covalent bond with an element that has an electronegativity value of
 - A 0.9
 - B 1.5
 - C 2·2
 - D 2.5.
- 2. Which of the following is a polar molecule?
 - A CCl₄
 - B NH₃
 - C CO₂
 - D CH₄
- 3. Which of the following is most likely to act as a reducing agent?
 - A CO
 - B MnO₄⁻
 - $C H_2O_2$
 - D Cr₂O₇²⁻
- 4. The following reactions take place when nitric acid is added to zinc.

 $\begin{array}{rll} \mathsf{NO}_3^{-}(\mathsf{aq}) &+& 4\mathsf{H}^+(\mathsf{aq}) &+& 3\mathsf{e}^- \rightarrow \ \mathsf{NO}(\mathsf{g}) &+& 2\mathsf{H}_2\mathsf{O}(\ell) \\ && & & & \\ && & & & \\ \mathsf{Zn}(\mathsf{s}) \rightarrow & \mathsf{Zn}^{2+}\left(\mathsf{aq}\right) &+& 2\mathsf{e}^- \end{array}$

How many moles of Zn(s) are oxidised by one mole of NO_3^- (aq)?

- A 0.67
- B 1.0
- C 1.5
- D 2.0

- 5. Which of the following compounds is a tertiary alcohol?
 - A 2,2-dimethylpropan-1-ol
 - B 2-methylbutan-2-ol
 - C pentan-3-ol
 - D 3-methylbutan-2-ol
- 6. Molecule X has the structure



Which of the following could be produced by partial hydrolysis of X?

$$\begin{array}{cccccc} CH_3 & O & H & CH(CH_3)_2 \\ & & \parallel & \parallel & \parallel \\ C & H_2N - CH - C - N - CH - COOH \end{array}$$

$$\begin{array}{cccc} CH(CH_3)_2 & O & H \\ & & & \parallel & \parallel \\ D & & H_2N - CH - CH_2 - COOH \end{array}$$

- 7. A compound with molecular formula $\rm C_6H_{12}O_2$ could be
 - A pentyl ethanoate
 - B hexan-2-one
 - C 3-methylpentan-2-ol
 - D hexanoic acid.

[Turn over

8. Compound X reacted with hot copper(II) oxide and the resulting product did **not** give a colour change when heated with Fehling's solution.

Compound X could be

- A pentan-1-ol
- B pentan-2-ol
- C pentan-3-one
- D pentanoic acid.
- 9. The structure of pivalic acid is shown.



Which of the following is the correct systematic name of pivalic acid?

- A pentanoic acid
- B 2,2,2-trimethylethanoic acid
- C 2-ethylpropanoic acid
- D 2,2-dimethylpropanoic acid

	Structural formula	Molecular formula
A	$H_{3}C \qquad H_{2}C - CH \qquad \qquad C - CH \qquad \qquad C - CH \qquad \qquad C - CH_{3}$ $H_{2}C \qquad H_{2}C - C \qquad \qquad O$	C ₁₀ H ₁₄ O
В	H_3C HC CH O HC C C $CH_3C HC CH H$	C ₁₀ H ₁₂ O
С	$H_{2}C - CH_{2} OH H_{3}C - C C C C H_{3} H_{3}C - C C C C H_{3} H_{1}C - CH_{2} H_{1}C H_{3}$	C ₁₀ H ₁₈ O
D	HC — CH HC C — CH H HC = CH HC — C	C ₉ H ₈ O

10. The table shows four compounds that contribute to the aroma of spices.Which compound is **not** derived from a terpene?

11. Which reaction can be classified as reduction?

- A methanol \rightarrow methanoic acid
- B propanal \rightarrow propanoic acid
- C butan-2-one \rightarrow butan-2-ol
- D propan-2-ol \rightarrow propanone

[Turn over

12. A secondary amine has two carbon atoms directly bonded to the nitrogen atom. Which of the following is a secondary amine?



- 13. The number of moles of ions in 1 mol of copper(II) phosphate is
 - A 1
 - B 2
 - C 3
 - D 5.

- 14. Which of the following gas samples has the same volume as 4.0 g of methane, CH₄? (All volumes are measured at the same temperature and pressure.)
 - A 1.0 g of helium
 - B 1.0 g of hydrogen
 - C 3.5 g of nitrogen
 - D 35.5 g of chlorine
- **15.** Magnesium carbonate reacts with nitric acid.

 $MgCO_{3}(s) + 2HNO_{3}(aq) \rightarrow Mg(NO_{3})_{2}(aq) + H_{2}O(\ell) + CO_{2}(g)$

0.05 mol of magnesium carbonate was added to a solution containing 0.06 mol of nitric acid. Which of the following statements is true?

- A 0.05 mol of carbon dioxide is produced
- B 0.06 mol of magnesium nitrate is produced
- C Magnesium carbonate is in excess by 0.02 mol
- D Nitric acid is in excess by 0.01 mol

[Turn over

16. In which of the following diagrams does the dotted line represent a permanent dipole-permanent dipole interaction between propanone molecules?









17. Iron can be produced from iron(III) oxide.

The atom economy for the production of iron is

- A 69.9%
- B 62.8%
- C 58·2%
- D 32.5%.
- **18.** 100 cm³ of propane is mixed with 600 cm³ of oxygen and the mixture is ignited.

 $C_{3}H_{8}(g) + 5O_{2}(g) \rightarrow 3CO_{2}(g) + 4H_{2}O(\ell)$

At the end of the reaction, the total volume of gas would be

- A 300 cm³
- B 400 cm³
- C 700 cm³
- D 800 cm³.
- **19.** A two-step reaction is shown below.



The first step gave a yield of 60% and the second step a yield of 90%. The overall yield would be

- A 30%
- B 54%
- C 67%
- D 150%.

[Turn over

20. The volume of hydrogen gas given off against time when an excess of zinc lumps is added to 100 cm³ of 1 mol l⁻¹ hydrochloric acid is shown.



Which of the following graphs would show the volume of hydrogen gas given off when an excess of zinc powder was added to 50 cm^3 of $1 \text{ mol } l^{-1}$ hydrochloric acid?



21. Consider the reaction pathway shown below.



According to Hess's Law

- A b = a c d
- B = a + c + d
- $C \quad b = d c + a$
- $D \quad b = d + c a.$
- 22. Which of the following is not a factor that affects the rate of a reaction?
 - A Activation energy
 - B Kinetic energies of reactant molecules
 - C Concentration of reactants
 - D Enthalpy change of reaction
- **23.** In which of the following reactions would the yield of product be increased by lowering the pressure?
 - A $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
 - $B \qquad N_2(g) \ + \ 3H_2(g) \ \rightleftharpoons \ 2NH_3(g)$
 - $C N_2O_4(g) \rightleftharpoons 2NO_2(g)$
 - $\mathsf{D} \quad \mathsf{CO}(\mathsf{g}) \ + \ \mathsf{2H}_2(\mathsf{g}) \rightleftarrows \mathsf{CH}_3\mathsf{OH}(\mathsf{g})$

[Turn over

24. The graph shows the distribution of kinetic energies for a reaction involving two gases.



Which graph would show the effect of increasing temperature?



25. Alkenes react with ozone, O_3 , to form ozonides which can be decomposed to give carbonyl compounds.



Which of the following alkenes would produce a mixture of ethanal and propanone?

A
$$CH_3CH=CHCH_2CH_3$$

B $CH_3CH=CHCH_3$
C $CH_3C=CH_2$
 CH_3
D $CH_3CH=CCH_3$
 CH_3

[END OF QUESTION PAPER]

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

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Please note that the answer grid for the objective (multiple-choice) test cannot be completed digitally and is not provided in a digital version for the examination. Under examination conditions, the paper copy of the answer grid is completed and passed to the Invigilator with the print-out of the digital script. The following answer booklet is a copy of the print version.

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Record your answers on the answer grid on page 03.

Use **blue** or **black** ink.

Before leaving the examination room you must give your answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.





The questions for Paper 1 are contained in the question paper X813/76/12.

Read these and record your answers on the answer grid on page 03.

Use **blue** or **black** ink. Do NOT use gel pens or pencil.

- 1. The answer to each question is **either** A, B, C or D. Decide what your answer is, then fill in the appropriate bubble (see sample question below).
- 2. There is **only one correct** answer to each question.
- 3. Any rough working should be done on the space for rough work at the end of the question paper X813/76/12.

Sample question

To show that the ink in a ball-pen consists of a mixture of dyes, the method of separation would be:

- A fractional distillation
- B chromatography
- C fractional crystallisation
- D filtration.

The correct answer is B — chromatography. The answer B bubble has been clearly filled in (see below).



Changing an answer

If you decide to change your answer, cancel your first answer by putting a cross through it (see below) and fill in the answer you want. The answer below has been changed to **D**.



If you then decide to change back to an answer you have already scored out, put a tick (\checkmark) to the **right** of the answer you want, as shown below:





Chemistry

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Attempt ALL questions.

You may use a calculator.

You may refer to the Chemistry Data Booklet for Higher and Advanced Higher.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers and rough work is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting. Any rough work must be written in this booklet. Score through your rough work when you have written your final copy.

Use blue or black ink.

Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.







1

sodium thiosulfate and water a cross drawnon paper stop timing whenthe cross disappears (i) The equation for the reaction is $Na_2S_2O_3(aq) + HCl(aq) \rightarrow S(s) + SO_2(g) + NaCl(aq) + H_2O(\ell)$ Balance the equation.

X 8 1 3 7 6 0 1 0 2 *

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1. (a) (continued)

(ii) In one set of experiments, the effect of varying the concentration of sodium thiosulfate was investigated.

Experiment	Volume of 0·15 mol l ⁻¹ Na₂S₂O₃ (cm³)	Volume of water (cm ³)	Rate (s⁻¹)
А	50	0	0.0454
В	40		0.0370
С	30		0.0285
D	20		0.0169
E	10	40	0.0063

- (A) Complete the table to show the volumes of water that would have been used to vary the concentration of sodium thiosulfate.
- (B) Calculate the time, in seconds, for the cross to disappear in experiment C.

[Turn over



1. (a) (continued)

(iii) The reaction can also be used to investigate the effect of changing temperature on the rate of reaction.

1

2

THIS

The results from an investigation are shown in the graph below.



Use the graph to determine the temperature rise, in °C, required to double the rate of the reaction.

(b) Collision theory states that for particles to react they must first collide with each other.

State **two** conditions necessary for the collisions to result in the formation of products.





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1

- 2. 2019 is the 150th anniversary of the periodic table's creation by Dmitri Mendeleev. The patterns identified by Mendeleev form the basis of the modern periodic table. The major periodic trends include ionisation energy and covalent radius.
 - (a) The first ionisation energies of elements with atomic number 1 to 20 are shown in the graph.



(i) Explain why the first ionisation energy shows an increase going from lithium to neon.

(ii) Explain why the first ionisation energy of potassium is less than the first ionisation energy of lithium.





[Turn over



2.	(co	ntinued)	ARKS	DO NOT WRITE IN THIS MARGIN	
	(c)	lonic radius is a measure of the size of an ion.			
		Explain fully why the ionic radius of phosphorus is greater than the ionic radius of aluminium.	2		







		MARKS	DO NOT WRITE IN THIS
3.	The melting point of non-metal elements depends on structure and bonding.		MARGIN
	Using your knowledge of chemistry, comment on this statement.	3	

Γ

L



MARKS DO NOT THIS Cider is made from apples in a process that involves crushing and pressing the 4. apples, converting the sugars into alcohol, maturing and bottling. (a) Brewers add yeast, which contains a mixture of enzymes to convert the sugars in the apples into alcohol and carbon dioxide. (i) State what is meant by the term enzyme. 1 (ii) The % mass of alcohol in the cider can be calculated using the formula % mass of alcohol = $\frac{\text{mass of alcohol}}{\text{mass of cider}} \times 100$ A 50.0 cm^3 sample of cider was found to contain 3.05 g of alcohol. 1.0 cm^3 of the cider weighed 1.36 g. Calculate the % mass of alcohol in the cider. 1 (b) During the maturing process malic acid is converted to lactic acid and another product. HO H₃C OH СH Х OH OH malic acid lactic acid (i) Name compound X. 1

X 8 1 3 7 6 0 1 1 1

4. (b) (continued)

(ii) The maturing process in cider samples can be monitored using thin layer chromatography.

Samples of lactic acid, malic acid and ciders A, B, C, and D are spotted on a silica plate and the solvent allowed to travel up the plate. The chromatogram obtained is shown below. DO NOT WRITE IN THIS MARGIN



Number	Sample applied	Distance moved by spot(s) (cm)
1	lactic acid	8.2
2	malic acid	4.1
3	cider A	4.1, 8.2
4	cider B	8.2
5	cider C	4.1
6	cider D	4.1, 8.2



4. (b) (ii) (continued)

The retention factor, $\rm R_{\rm f},$ for a substance can be a useful method of identifying the substance.

 $R_f = \frac{\text{distance moved by the substance}}{\text{distance moved by the solvent}}$

(A) Calculate the $\rm R_{\rm f}$ value of malic acid.

(B) The maturing process is complete when all of the malic acid has been converted to lactic acid. The cider is now ready to be bottled.

Use the chromatogram to determine which cider is ready to be bottled.

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(continued) 4.

MARKS DO NOT WRITE IN THIS MARGIN Glycerol can be added to cider before bottling to produce a sweeter (c) tasting cider.

State the systematic name for glycerol.

- (d) Cider contains many naturally occurring compounds that affect taste and aroma.
 - (i) Procyanidin B2 provides a bitter taste to cider.



procyanidin B2

Explain fully why procyanidin B2 is water soluble.

2

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(d) (continued) MARKS DO NOT (ii) Cider smells of apples because it contains ethyl 2-methylbutanoate. Н Н | | || c—c—c н—С--0-— Н - C -- C -Н Н CH₃ Н н ethyl 2-methylbutanoate Name the carboxylic acid used to make ethyl 2-methylbutanoate. 1 (iii) Farnesene is a terpene responsible for the ripe apple aroma of cider. $\begin{array}{c|c} & & & \\ C & & CH_2 & C & CH_2 & C \\ \hline CH & CH_2 & CH & CH & CH \\ \hline CH & CH_2 & CH & CH & CH \end{array}$ farnesene Name the molecule on which terpenes are based. 1 (e) Ethanol in cider can be oxidised to ethanal, spoiling the aroma. H₂C ethanal (i) Name the functional group circled in the ethanal molecule. 1 (ii) Further oxidation of ethanal can produce another product that spoils the flavour of cider. Name this product. 1



page 15

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WRTE IN
TARKNThe combustion reactions of methane and heptane can be studied in
different ways.(a) The combustion of methane produces carbon dioxide and water vapour
when carried out at temperatures above 100 °C.
 $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$ (i) Using bond enthalpies and mean bond enthalpies from the data
booklet, calculate the enthalpy change, in kJ mol⁻¹, for this reaction.2

5.

(ii) Explain the difference between bond enthalpy and mean bond enthalpy.





5. (a) (continued)

(iii) Calculate the mass, in g, of carbon dioxide produced by combustion of 200 cm³ methane in excess oxygen.

Take the volume of 1 mole of methane gas to be 24 litres.

 $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$ $GFM = 44 \cdot 0 g$

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5. (continued)

(b) The enthalpy of combustion of heptane, C_7H_{16} , can be determined using a calorimeter.



The following results were obtained.

Mass of heptane burned (g)	1.1
Mass of 1 mole of heptane (g)	100.0
Volume of water used (cm ³)	400
Initial temperature of water (°C)	26
Final temperature of water (°C)	49

(i) State the measurements required to calculate the mass of heptane burned in this experiment.



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5.	(b)	(cont	cinued)	MARKS	DO NOT WRITE IN THIS MARGIN
		(ii)	Calculate the enthalpy of combustion, in $kJ \mod^{-1}$, for heptane from the experimental results given.	3	
		(iii)	The theoretical value for the enthalpy of combustion of heptane is significantly higher than the experimental value.		
			Suggest why the experimental value is different to the theoretical value.	1	
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- 6. Thiols are compounds that contain an –SH functional group. They often have very strong, unpleasant odours.
 - (a) Ethanethiol is used to add a smell to gaseous fuels in order to give warnings of gas leaks.



ethanethiol

(i) A student used the boiling points of ethanethiol and propan-1-ol to compare the strength of intermolecular forces.



(A) State the reason why propan-1-ol was a suitable alcohol to compare with ethanethiol.

(B) Explain why propan-1-ol has a higher boiling point than ethanethiol. Your answer should include the names of the intermolecular forces broken when each liquid boils.

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MARKS DO NOT THIS (b) (continued) 6. (ii) Thiols can be made by the addition of hydrogen sulfide to alkenes. 2-methyl-2-propanethiol can be made by the addition reaction shown. н н SH H с=с—н + s → H--Н H-Ή Ή Н CH₃ H CH₃ H Н 2-methylpropene 2-methyl-2-propanethiol GFM = 90.1 g $GFM = 56 \cdot 0 g$ (A) Draw the structure for the other isomer formed in this addition reaction. 1

(B) A chemist obtained an 84% yield of 2-methyl-2-propanethiol after starting with $30.5 \, g$ of 2-methylpropene.

Calculate the mass, in g, of 2-methyl-2-propanethiol made by the chemist.

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- 7. Esters can be synthetic or natural.
 - (a) The synthetic polyester PET, poly(ethylene terephthalate), has many ester links. PET can break down by a free radical reaction.

One of the steps involved in breaking down PET is shown.



- (i) State the name for this step.
- (ii) Name the component of sunlight that can cause plastics such as PET to break down.
- (iii) Name the type of substance that can be added to plastics to prevent them breaking down in this way.

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7. (continued)

(b) (i) Natural cyclic esters called lactones can be formed from hydroxycarboxylic acids.

5-hydroxypentanoic acid is a hydroxycarboxylic acid that when heated, with dilute acid, will form a cyclic ester.

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Name product Y in this reaction.

(ii) Draw the structure for the cyclic compound formed when 4-hydroxypentanoic acid is heated with dilute acid.



4-hydroxypentanoic acid





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- 8. Gelatin is a soluble protein that can be added to different food products.
 - (a) A structure for a section of a protein chain in gelatin is shown.



- (i) State the number of amino acids that joined together to form the section of the protein chain shown.
- (ii) Name the weakest van der Waals' force between water and gelatin molecules.
- (b) A student was investigating the viscosity of different concentrations of gelatin solution.
 - (i) The student was asked to prepare a 2% gelatin solution, which is a solution that contains 2 g of gelatin per 100 cm³ of solution.

The student prepared this solution by adding 100 cm^3 of distilled water into a volumetric flask, then adding 2 g of gelatin.

Describe how the student **should** have made up the solution.

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8. (b) (continued)

(ii) The results obtained from the student's viscosity experiment are shown.

Concentration of gelatin solution (%)	Viscosity (units)
2.0	1.0
4∙0	2.0
6.0	4.0
8.0	7.0
10.0	

Predict the student's result for the viscosity, in units, of a 10.0% gelatin solution.

- (c) Bromelain is a mixture of enzymes found in pineapple that aid digestion.
 - (i) Adding raw pineapple to gelatin results in the gelatin molecules being hydrolysed. The rate of hydrolysis is reduced if the pineapple is cooked.

Explain why the rate of hydrolysis is reduced.

(ii) Bromelain can be purchased as tablets that contain 500 mg of bromelain. The flesh from a pineapple contains 13.2 mg of bromelain per gram.

Calculate the mass, in g, of this pineapple that would be needed to provide 500 mg of bromelain.

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9. (continued)

(b) One laboratory method for the preparation of chlorine gas involves adding concentrated hydrochloric acid to potassium permanganate. The chlorine gas produced also contains small amounts of hydrogen chloride gas. To remove the hydrogen chloride gas the gases are bubbled through water. Finally, insoluble chlorine gas is collected.



potassium permanganate

Complete a labelled diagram to show an apparatus suitable for carrying out this preparation.

(An additional diagram, if required, can be found on page 41)



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9. (continued)

(c) Carbon tetrachloride, CCl_4 , is prepared by the reaction of chlorine gas, Cl_2 , with methane, CH_4 .

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$$CH_4(g) + 4Cl_2(g) \rightarrow CCl_4(g) + 4HCl(g)$$

Calculate the enthalpy change, in $kJ \mod^{-1}$, for this reaction using the following information.

$C(s) + 2H_2(g) \rightarrow C$	$H_4(g)$ $\Delta H = -75$	kJ mol ⁻¹
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 $C(s) + 2Cl_2(g) \longrightarrow CCl_4(g) \Delta H = -98 \text{ kJ mol}^{-1}$

 $\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \longrightarrow HCl(g) \Delta H = -92 \text{ kJ mol}^{-1}$



[Turn over for next question

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10. A student investigated the purity of a sample of magnesium chloride, $MgCl_2$. The sample was dissolved in water and then an excess of silver nitrate, $AgNO_3$, was added to produce a precipitate of silver chloride, AgCl. The precipitate was collected, dried and weighed.

 $MgCl_2(aq) + 2AgNO_3(aq) \rightarrow 2AgCl(s) + Mg(NO_3)_2(aq)$

(a) The student prepared the magnesium chloride solution by dissolving 2.503 g of impure magnesium chloride in water.

Explain why the student should use distilled or deionised water, rather than tap water, when preparing the solution.

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(b) (i) Complete the table to show the **most appropriate** piece of apparatus that could be used to measure the required volumes.

Measurement	Apparatus
20·0 cm ³ (accurately)	
35 cm ³ (approximately)	

- (ii) The steps required to collect, dry and weigh the precipitate are listed below. However, the steps are in the **wrong order**.
 - A. Weigh the precipitate and the filter paper
 - B. Wash the precipitate with water to remove any impurities
 - C. Filter the precipitate
 - D. Dry the precipitate in an oven
 - E. Weigh the filter paper

Complete the flow chart below to show the correct order of steps the student should carry out to collect, dry and weigh the precipitate.



(An additional diagram, if required, can be found on page 41)



			MARKS	DO NOT WRITE IN THIS MARGIN
10.	(b)	(continued)		
		(iii) 1.393 g of silver chloride precipitate was produced from the magnesium chloride solution.		
		$MgCl_2(aq) + 2AgNO_3(aq) \rightarrow 2AgCl(s) + Mg(NO_3)_2(aq)$		
		$GFM = 95 \cdot 3 g \qquad \qquad GFM = 143 \cdot 4 g$		
		Calculate the mass of magnesium chloride, in g, present in the magnesium chloride solution.	2	
	(c)	The average mass of magnesium chloride in 2.503 g of the original impure sample was calculated to be 2.403 g.		
		Calculate the % of magnesium chloride present in the original sample.	1	
		[Turn over		



11. Differences in physical and chemical properties can be used to distinguish one compound from another.

The compounds extracted from orange juice include antioxidants, flavour molecules, essential oils, aroma molecules and coloured molecules.

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Some examples of these are shown below.





11. (continued)

Using your knowledge of chemistry, comment on how the differences in physical and chemical properties can be used to distinguish between the compounds extracted from orange juice.

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12. The label from a bottle of pine fresh bleach cleaner is shown.

and remove stainsMaIngredients:gaaqua, sodium hypochlorite, sodiumDAhydroxide, less than 5% anionicKesurfactants, non-ionic surfactants,ofsoap, perfumeof	ANGER eep out freach children corrosive
---	--

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(a) Surfactant molecules are added to bleach cleaner to act as detergents, soaps or emulsifiers.

Information on three of the surfactants in the bleach cleaner is shown in the table.

Surfactant structure	Type of surfactant	Head group
Compound A		
H_3C CH_2 CH_2 CH_2 CH_2 CH_2 CH_2 CH_2 $O-H$ CH_2 CH_2 CH_2 CH_2 CH_2 CH_2 O CH_2	non-ionic	polar
Compound B NH ₃ ⁺ Cl ⁻		
H ₃ C, CH ₃ CH CH ₃		
$\begin{array}{ccccc} CH_2 & CH_2 & CH_2 & CH_2 & CH_2 & CH_2 & CH_2 \\ H_3C & CH_2 & CH_2 & CH_2 & CH_2 & CH_2 & CH_2 \\ \end{array}$		
Compound C O-Na ⁺		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	ionic	negatively charged







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12. (a) (continued)

(iii) The structure of an emulsifier molecule is shown below.



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State how emulsifiers are made from edible oils.

(b) Sodium hypochlorite, Na⁺OCl⁻, is the main active compound in bleach.

|--|

Sodium hypochlorite, $\rm Na^+OCl^-,$ is produced by reacting chlorine with sodium hydroxide solution.

 $Cl_2(g) + 2Na^+OH^-(aq) \rightarrow Na^+OCl^-(aq) + Na^+Cl^-(aq) + H_2O(\ell)$

(i) A chlorine molecule has a pure covalent bond.

Explain what is meant by a pure covalent bond.



12. (b) (continued) (ii) When the chlorine is reacted with sodium hydroxide solution an excess of sodium hydroxide is used. (iii) When the chlorine is reacted with sodium hydroxide solution an excess of sodium hydroxide is used. 1 (c) In the bleach cleaner an equilibrium exists. 1 $2H^+(aq) + OCl^-(aq) + Cl^-(aq) \rightleftharpoons Cl_2(g) + H_2O(\ell)$ 1 The label warns that the bleach cleaner should not be used with other products as it may release chlorine gas. 2

[Turn over for next question



12. (continued)

(d) The concentration of hypochlorite, OCl⁻, in bleach can be determined by a redox reaction that involves two steps.

Step 1

An excess of acidified potassium iodide is added to the bleach. This converts the iodide ions into iodine.

 $OCl^{-}(aq) + 2l^{-}(aq) + 2H^{+}(aq) \rightarrow I_{2}(aq) + Cl^{-}(aq) + H_{2}O(\ell)$

Step 2

The iodine produced in step 1 is titrated with sodium thiosulfate, $Na_2S_2O_3$.

 $I_2(aq) + 2Na_2S_2O_3(aq) \rightarrow 2Nal(aq) + Na_2S_4O_6(aq)$

(i) Write the ion-electron equation for the reduction reaction taking place in **Step 1**.

(ii) A 25 cm³ sample of a diluted bleach was transferred into a conical flask and excess acidified potassium iodide added. The iodine produced was titrated with $0.098 \text{ mol } l^{-1} \text{ Na}_2\text{S}_2\text{O}_3$, requiring an average volume of 9.0 cm^3 to reach the end point.

Calculate the concentration, in $moll^{-1}$, of sodium hypochlorite in the diluted bleach.

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[END OF QUESTION PAPER]



ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional diagram for question 1 (c)



reaction patimay

Additional diagram for question 9 (b)



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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK



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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK



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