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EDEXCEL GCSE CHEMISTRY: QUESTIONS BY TOPIC

Separate Chemistry 2 (9)

GCSE Chemistry (Higher) Topic 9

24 questions · 241 marks · Mark schemes included

Pearson Edexcel GCSE (9-1) Chemistry 1CH0, Higher Tier, June 2018 - June 2025

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HOW TO USE THIS BOOKLET

Questions run from the lowest mark tariff to the highest, so similar questions sit together.

Click any row below to jump straight to that question.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

QUESTION	SOURCE	MARKS	PAGE
1. Q1	Paper 2 November 2020	6	4
2. Q1	Paper 2 November 2021	6	5
3. Q1	Paper 2 June 2024	6	6
4. Q1 <i>also Topic 1</i>	Paper 2 June 2025	6	8
5. Q1	Paper 2 June 2022	7	11
6. Q5	Paper 2 June 2018	9	14
7. Q8	Paper 2 June 2018	10	18
8. Q5	Paper 2 November 2020	10	20
9. Q4	Paper 2 November 2020	11	23
10. Q4	Paper 2 November 2021	11	25
11. Q10 <i>also Topic 8</i>	Paper 2 November 2021	11	27
12. Q4	Paper 2 June 2022	11	30
13. Q8	Paper 2 June 2022	11	33
14. Q10 <i>also Topic 8</i>	Paper 2 June 2022	11	36
15. Q4	Paper 2 June 2023	11	39
16. Q7 <i>also Topic 8</i>	Paper 2 June 2023	11	41
17. Q4	Paper 2 June 2024	11	44
18. Q8	Paper 2 June 2024	11	46
19. Q4	Paper 2 June 2025	11	49
20. Q10	Paper 2 June 2025	11	52
21. Q7	Paper 2 November 2021	12	56
22. Q10	Paper 2 June 2023	12	59
23. Q9	Paper 2 June 2025	12	61
24. Q10	Paper 2 November 2020	13	65



QUESTIONS

24 questions · 241 marks · lowest tariff first



6-MARK QUESTIONS

4 questions in this booklet



- 1 (a) A chloride ion, a fluorine atom and a nanoparticle are all types of particle.

Which of the following shows the particles in order of size, starting from the smallest?

(1)

- ☐ A nanoparticle, fluorine atom, chloride ion
- ☐ B nanoparticle, chloride ion, fluorine atom
- ☐ C fluorine atom, nanoparticle, chloride ion
- ☐ D fluorine atom, chloride ion, nanoparticle

- (b) A solution, **X**, is thought to contain chloride, bromide or iodide ions.

- (i) The solution is tested to see whether it contains one of these ions.
In the test, a few drops of **two** different solutions are added to **X**.

Name the two solutions that are added in the test.

(2)

solution 1

solution 2

- (ii) The student carrying out the test records the following result.

A precipitate forms in the test tube. The precipitate is a cream/yellow colour.

Explain why the anion in **X** cannot be known for certain.

(2)

.....

.....

.....

.....

- (iii) The metal ions in **X** could be identified using a flame test.
There is a more sensitive and accurate instrumental method that can be used.

Give the name of an instrument that can be used to identify the metal ions in **X**.

(1)

.....

(Total for Question 1 = 6 marks)



- 1 (a) Figure 1 shows a list of particles.

ethene molecule
nanoparticle
sodium atom
starch molecule

Figure 1

In the spaces below, write the names of these particles in order of increasing particle size.

(2)

smallest particle

.....

.....

largest particle

- (b) Explain a possible risk associated with nanoparticulate materials.

(2)

.....

.....

.....

.....

- (c) Explain the advantage of using catalysts made of nanoparticles rather than larger particles.

(2)

.....

.....

.....

.....

(Total for Question 1 = 6 marks)



- 1 (a) Concrete is a composite material made of cement, sand and stone.

Different types of concrete are produced by changing the ratio of cement, sand and stone.

Figure 1 shows some information about three different types of concrete, **A**, **B** and **C**.

concrete	mixing ratio cement : sand : stone	compressive strength in kPa	example of use
A	1 : 2 : 4	17 250	fence posts
B	1 : 2 : 3	27 600	paving slabs
C	1 : 2 : 2	31 050	flooring

Figure 1

- (i) State how the amount of stone added to the mixture affects the compressive strength of concrete.

(1)

- (ii) What mass of stone is in a sample of concrete **B** containing 5000 kg of sand?

(1)

- ☐ **A** 2500 kg
- ☐ **B** 5000 kg
- ☐ **C** 7500 kg
- ☐ **D** 10 000 kg



(iii) Sand contains silicon dioxide.

Figure 2 shows part of the structure of silicon dioxide.

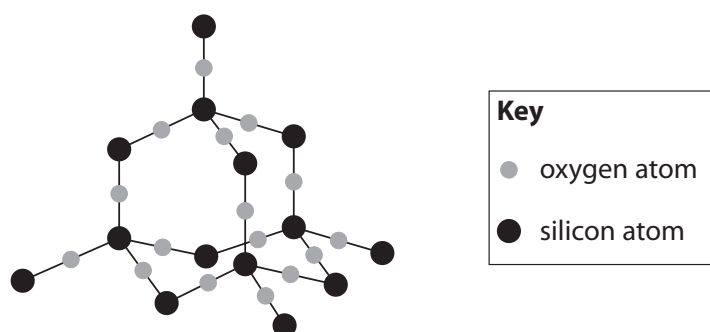


Figure 2

State the type of structure and bonding in silicon dioxide.

(1)

.....

.....

(b) (i) Which statement about nanoparticles is correct?

(1)

- ☐ **A** nanoparticles are smaller than atoms and molecules
- ☐ **B** nanoparticles are smaller than atoms but larger than molecules
- ☐ **C** nanoparticles are larger than atoms but smaller than molecules
- ☐ **D** nanoparticles are larger than atoms and molecules

(ii) Some sunscreens contain nanoparticles of titanium dioxide.

Explain why nanoparticles of titanium dioxide are used in some sunscreens.

(2)

.....

.....

.....

.....

(Total for Question 1 = 6 marks)

- 1 (a) A student carries out a flame test on a salt.
The student observes a yellow flame.

Which ion is in the salt?

(1)

- ☐ A Ca^{2+}
☐ B Cu^{2+}
☐ C Na^{+}
☐ D Li^{+}

- (b) A molecule of a yellow substance is shown in Figure 1.

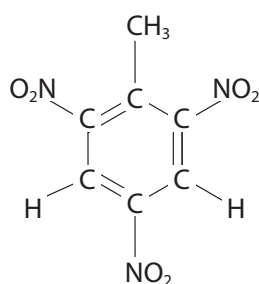


Figure 1

- (i) What is the formula of this molecule?

(1)

- ☐ A $\text{C}_6\text{H}_5(\text{NO}_2)_3$
☐ B $\text{C}_6\text{H}_2(\text{CH}_3)(3\text{NO}_2)$
☐ C $\text{C}_7\text{H}_5\text{N}_3\text{O}_6$
☐ D $\text{C}_7\text{H}_6\text{N}_3\text{O}_6$

- (ii) A bottle of this substance is labelled with the hazard symbol in Figure 2.

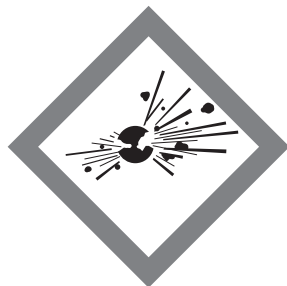


Figure 2

State the danger associated with the contents of this bottle.

(1)

- (c) Yellow bananas emit ethene gas, C_2H_4 .

Draw one molecule of ethene, showing all covalent bonds.

(2)

- (d) Gold has a yellow colour.

A gold nanosphere has a surface area of 305 nm^2 .
The surface area to volume ratio is 1 : 4.60.

Calculate the volume, in nm^3 , of the gold nanosphere.

(1)

volume = ... nm^3

(Total for Question 1 = 6 marks)



7-MARK QUESTIONS

1 question in this booklet



1 (a) Titanium dioxide nanoparticles are used in some sunscreens.

- (i) State one property of titanium dioxide nanoparticles that make them suitable for use in sunscreens.

(1)

- (ii) Suggest one possible risk associated with using nanoparticles.

(1)

- (b) Figure 1 shows the surface area to volume ratio for different diameters of spherical nanoparticles.

diameter of nanoparticle in nm	surface area : volume ratio
10	3:5
20	3:10
30	3:15
40	3:20
50	3:25

Figure 1

- (i) State the trend shown by the data in Figure 1.

(1)



(ii) What is the surface area:volume ratio for a spherical nanoparticle with a diameter of 80 nm?

(1)

☐ A 3:35

☐ B 3:40

☐ C 3:45

☐ D 3:50

(c) A different nanoparticle is cube shaped, as shown in Figure 2.

The length of one side of this cube is 60 nm.

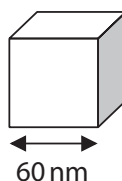


Figure 2

Show that the surface area:volume ratio for this cube is 1:10.

(3)

.....

.....

.....

.....

.....

.....

.....

(Total for Question 1 = 7 marks)

9-MARK QUESTIONS

1 question in this booklet



- 5 (a) Figure 4 shows information about a ceramic and a metal.

	ceramic	metal
flexibility	low	high
hardness	medium	low
reaction with water	no reaction	very slow reaction
density	medium	high

Figure 4

The ceramic, rather than the metal, is a more suitable material for washbasins.

Give a reason for this, using a property from Figure 4.

(1)

.....

.....

.....

- (b) Poly(propene) is an example of a polymer.

The structure of a poly(propene) molecule is shown in Figure 5.

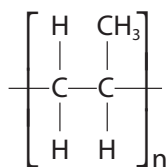


Figure 5

This polymer is made from a monomer.

Draw the structure of the monomer molecule showing all covalent bonds.

(2)



(c) A layer of poly(chloroethene) (PVC) is used to surround the copper in electrical cables.

Explain why poly(chloroethene) is a suitable material for this purpose.

(2)

.....

.....

.....

(d) Some polymers are polyesters.

What type of reaction takes place when polyesters are formed?

(1)

- ☐ **A** addition
- ☐ **B** condensation
- ☐ **C** neutralisation
- ☐ **D** precipitation

(e) The repeating unit in a polyester molecule is shown in Figure 6.

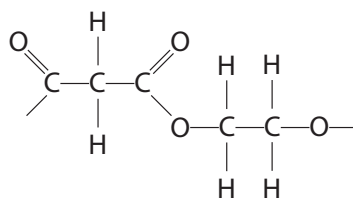


Figure 6

(i) This polymer is made from two different monomers.

Draw a molecule of each monomer showing all covalent bonds.

(2)

(ii) Give the name or formula of the small molecule formed when the monomer molecules react to form an ester link.

(1)

(Total for Question 5 = 9 marks)

10-MARK QUESTIONS

2 questions in this booklet



8 Qualitative tests are used to identify ions in compounds.

(a) Solid **X** contains two ions.

The tests for these ions and their results are shown in Figure 10.

test	result
flame test on solid X	red-orange flame
dilute nitric acid is added to an aqueous solution of X , followed by silver nitrate solution	white precipitate forms

Figure 10

Use the information in Figure 10 to name the cation and the anion in solid **X**.

(2)

name of cation

name of anion

(b) Another solid, **Y**, also contains two ions.

A test was carried out on solid **Y**.

A few drops of sodium hydroxide solution were added to a solution of solid **Y**.
A white precipitate formed.

(i) Give the reason why this test does not identify the cation in solid **Y**.

(1)

.....

.....

.....

.....

(ii) Give the reason why this test does not identify the anion in solid **Y**.

(1)

.....

.....

.....

.....



(c) Instrumental methods are often used for analysis.

Give a reason why instrumental analysis may be better than other methods of analysis.
(1)

(d) Iron(II) sulfate solution reacts with sodium hydroxide solution to form a pale green precipitate of iron(II) hydroxide, $\text{Fe}(\text{OH})_2$.

(i) Write the ionic equation for this reaction.
(3)

(ii) The green iron(II) hydroxide precipitate gradually turns brown when exposed to air.
Explain this observation.
(2)

(Total for Question 8 = 10 marks)



- 5 (a) Figure 3 shows the structure of two monomers.

monomer A	monomer B
$\text{HO}-\text{CH}_2-\text{CH}_2-\text{OH}$	$\text{HOOC}-\text{CH}_2-\text{CH}_2-\text{COOH}$

Figure 3

- (i) Monomer **B** contains a carboxylic acid group.

Describe what you would **see** when a small amount of solid sodium carbonate is added to a solution of monomer **B**.

(2)

.....

.....

.....

- (ii) When monomer **A** and monomer **B** react together they polymerise to form a polymer and one other product.

Name the type of polymerisation that takes place and name the other product.

(2)

type of polymerisation

name of other product

- (iii) A naturally occurring polymer is made by combining monomers called nucleotides.

Give the name of this natural polymer.

(1)

.....



(b) Some polymerisation reactions produce ammonia as a waste product.

A student is given a sample of pure, dry ammonia gas.

The student suggests the following method to test for ammonia gas.

step 1 take some dry, blue litmus paper

step 2 place the dry litmus paper into the dry gas

step 3 observe any change in colour of the litmus paper

This test for ammonia will not work.

Give **two** changes that should be made to this test for it to work.

(2)

change 1

change 2

(c) Alcohols can be dehydrated.

Complete the balanced equation for the dehydration of butan-1-ol by drawing the structures of the two products in the boxes. Name the two products.

(3)



butan-1-ol $\rightarrow$ + ...

(Total for Question 5 = 10 marks)



11-MARK QUESTIONS

12 questions in this booklet



4 Figure 2 shows the structure of a molecule of dichloroethene.

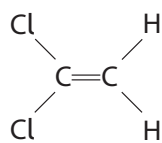


Figure 2

(a) (i) Describe how dichloroethene monomers form a polymer.

(2)

.....

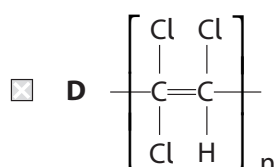
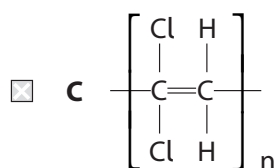
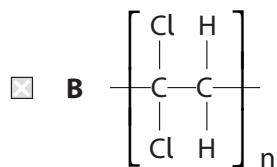
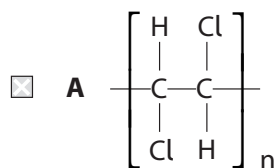
.....

.....

.....

(ii) Which of these represents the structure of the polymer formed from the monomer in Figure 2?

(1)



(iii) Separate samples of dichloroethene and poly(dichloroethene) are shaken with a few drops of bromine water.

What would be **seen**?

(1)

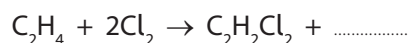
- ☐ **A** both mixtures remain orange
- ☐ **B** only the dichloroethene and bromine water goes colourless
- ☐ **C** only the poly(dichloroethene) and bromine water goes colourless
- ☐ **D** both mixtures go colourless

(b) Dichloroethene is produced from ethene and chlorine.

In the overall reaction, ethene reacts with chlorine and forms dichloroethene and hydrogen chloride.

Complete the balanced equation for the overall reaction.

(2)



(c) Poly(dichloroethene) was used to wrap food to keep it fresh.

Explain **one** property that a plastic food wrapping must have.

(2)

.....

.....

.....

(d) An industrial process uses 500 tonnes of dichloroethene.
In the process only 96.5% of the dichloroethene molecules react.

Calculate the mass of dichloroethene that has **not** reacted.

Give your answer to two significant figures.

(3)

.....

.....

.....

.....

mass = ... tonnes

(Total for Question 4 = 11 marks)



4 This question is about polymers.

(a) (i) State a problem with **recycling** polymers.

(1)

(ii) Describe a problem associated with the **disposal** of polymers.

(2)

(b) Poly(chloroethene) is a polymer made from chloroethene.
A molecule of chloroethene is shown in Figure 5.

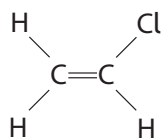


Figure 5

(i) On Figure 5, draw a circle around the functional group in this molecule.

(1)

(ii) Draw a section of a poly(chloroethene) molecule containing three repeating units, showing all bonds.

(3)



(iii) What type of polymer is poly(chloroethene)?

(1)

(iv) Calculate the relative formula mass of a poly(chloroethene) molecule made from 2850 chloroethene molecules, C_2H_3Cl .

(relative atomic masses: $H = 1.00$, $C = 12.0$, $Cl = 35.5$)

Give your answer to three significant figures.

Show your working.

(3)

relative formula mass = ...

(Total for Question 4 = 11 marks)



- 10 (a) Propanol, $\text{C}_3\text{H}_7\text{OH}$, can undergo reactions to form compounds **Y** and **Z** shown in Figure 14.

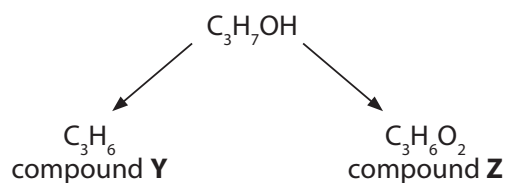


Figure 14

- (i) What happens to propanol when it forms compound **Y**?

(1)

- ☐ **A** propanol undergoes an addition reaction
- ☐ **B** propanol is dehydrated
- ☐ **C** propanol is hydrated
- ☐ **D** propanol is oxidised

- (ii) Compound **Y** can also be formed in the following reaction



Explain how bromine water can be used to distinguish between compound **X** and compound **Y**.

(3)

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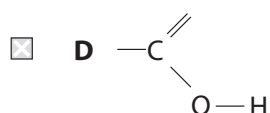
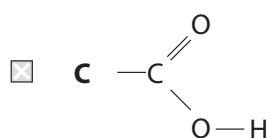
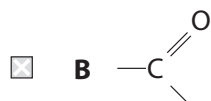
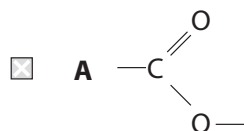
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(iii) Compound **Z** is a carboxylic acid.

Which of the following shows the functional group of a carboxylic acid?

(1)



(iv) Compound **Z** is an acid and turns litmus and universal indicator papers red.
Compound **Z** also shows other acidic properties.

Devise an experiment that would show another acidic property of compound **Z**.

(2)

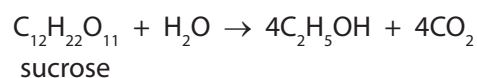
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- (b) The balanced equation for the production of ethanol from the carbohydrate sucrose is



Calculate the minimum mass of sucrose needed to produce 26.9 g of ethanol.

(relative formula masses: $\text{C}_2\text{H}_5\text{OH} = 46$, $\text{C}_{12}\text{H}_{22}\text{O}_{11} = 342$)

(2)

.....

.....

.....

.....

minimum mass of sucrose = ... g

- (c) Calculate the total number of atoms in 10.0 g of sucrose, $\text{C}_{12}\text{H}_{22}\text{O}_{11}$.

(relative formula mass: $\text{C}_{12}\text{H}_{22}\text{O}_{11} = 342$; Avogadro constant = 6.02×10^{23})

(2)

.....

.....

.....

number of atoms = ...

(Total for Question 10 = 11 marks)



- 4 (a) Some acids are used in tests for ions.

A bottle of one acid is shown in Figure 6.

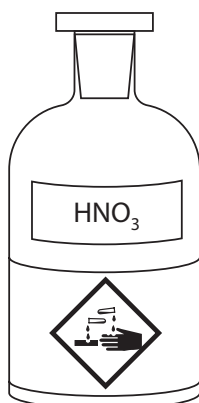


Figure 6

- (i) The acid in Figure 6 can be used in the test for carbonate ions.

Explain, giving the name of the hazard symbol shown, what safety precautions should be taken when using this acid.

(2)

.....

.....

.....

.....

- (ii) Give the name of the acid shown in Figure 6.

(1)

.....

- (iii) State a property of glass that makes it a suitable material to make the container for an acid.

(1)

.....

.....

(b) A teacher conducts a flame test to identify the metal ions in some unknown solids.

- step 1** dip a flame test wire into hydrochloric acid
- step 2** dip the flame test wire into the unknown solid
- step 3** hold the flame test wire above a Bunsen burner flame

(i) This method did not work well.

Explain an improvement that needs to be made to **step 3** to enable a bright flame colour to be produced.

(2)

.....

.....

.....

(ii) Figure 7 shows the results of the flame tests on three compounds, **P**, **Q** and **R**.

compound	flame colour
P	red
Q	lilac
R	blue-green

Figure 7

Use Figure 7 to identify the metal ions in compounds **P**, **Q** and **R**.

(3)

P

Q

R



(c) A flame photometer was used to analyse samples of a solution of metal ions.

Each sample was treated with 5.00 cm^3 of dilute hydrochloric acid.

1.00 dm^3 of the acid contained 219 g of hydrogen chloride.

Calculate the mass of hydrogen chloride in the acid used to test 20 samples.

(2)

.....

.....

.....

.....

mass = ... g

(Total for Question 4 = 11 marks)



8 (a) A precipitate is produced when an alkaline solution is added to a solution containing some metal ions.

(i) Which of these is evidence of a precipitate being produced?

(1)

- ☐ **A** fizzing
- ☐ **B** solid forms in the solution
- ☐ **C** the solution turns purple
- ☐ **D** the solution gets hot

(ii) You are given two solutions, one containing Ca^{2+} ions and the other containing Al^{3+} ions.

Devise a plan to identify which solution is which.

(4)

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(Total for Question 8 = 11 marks)



10 (a) Figure 14 shows the structure of a molecule of hydrocarbon **Z**, C_4H_8 .

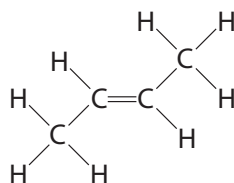


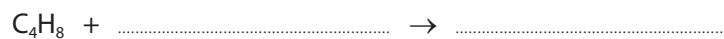
Figure 14

(i) Give the name of hydrocarbon **Z** shown in Figure 14.

(1)

(ii) Complete the balanced equation for the reaction of hydrocarbon **Z**, C_4H_8 , with bromine.

(2)



(iii) Draw the repeating unit of the addition polymer formed when hydrocarbon **Z** undergoes polymerisation.

(2)

(b) Figure 15 shows the arrangement of atoms in a molecule of an alcohol.

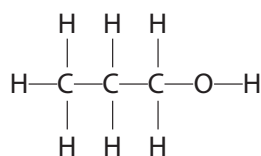


Figure 15

- (i) Give the name of the carbon-containing product formed when the alcohol in Figure 15 undergoes dehydration.

(1)

- (ii) Give the formula of the functional group of the product formed when the alcohol in Figure 15 undergoes oxidation.

(1)

- (iii) A student wants to investigate the amount of energy released when 1.00 g of the alcohol is burned.

They set up the apparatus shown in Figure 16 to measure the temperature rise of the water.

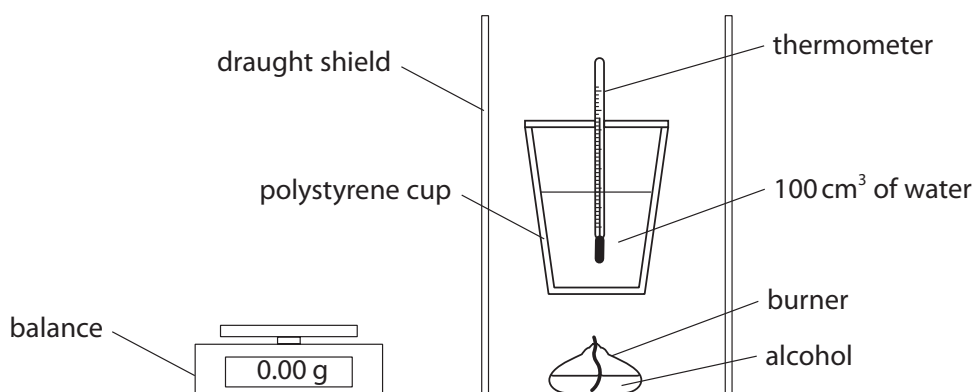


Figure 16

State why this apparatus is not suitable for use in this experiment.

(1)

- (c) Some alcohols can react with some carboxylic acids to form polyesters, which are condensation polymers.

Figure 17 shows the repeating unit of the polyester molecule formed in a reaction between a carboxylic acid and an alcohol.

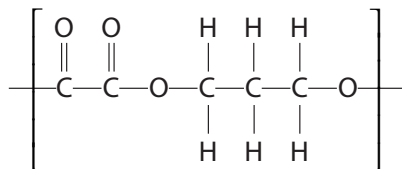


Figure 17

- (i) Give the formula of the other product formed in this reaction.

(1)

- (ii) Draw the structure of one molecule of the alcohol used to produce the polyester shown in Figure 17, showing all covalent bonds.

(2)

(Total for Question 10 = 11 marks)



- 4 (a) Atoms, molecules, nanoparticles and protons are types of particle.

List these four types of particle in order of size from smallest to largest.

(2)

smallest

↓

largest

.....

.....

.....

.....

- (b) Nanoparticles have a large surface area to volume ratio.

Figure 7 shows a cube-shaped nanoparticle with sides of 90 nm.

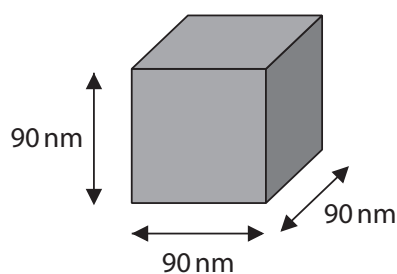


Figure 7

- (i) What is 90 nm in metres?

(1)

- ☐ A 9.0×10^{-5}
- ☐ B 9.0×10^{-6}
- ☐ C 9.0×10^{-8}
- ☐ D 9.0×10^{-11}

- (ii) Calculate the simplest surface area to volume ratio for the nanoparticle in Figure 7.

Show your working.

(3)

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surface area to volume ratio = 1 :

(c) Figure 8 shows the structure of a molecule of tetrafluoroethene.

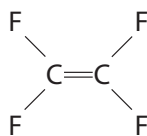


Figure 8

(i) Tetrafluoroethene can form the polymer poly(tetrafluoroethene).

Draw a diagram to show the structure of the repeating unit of this polymer.

(2)

(ii) Poly(tetrafluoroethene) is also known as TeflonTM.

State one use of poly(tetrafluoroethene) and explain how one of its properties makes it suitable for that use.

(3)

use

explanation

(Total for Question 4 = 11 marks)



7 Figure 12 shows the structure of the molecules of three organic compounds.

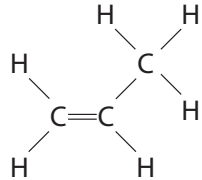
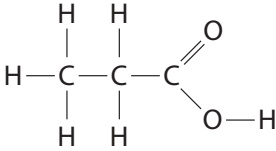
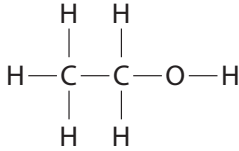
propene	propanoic acid	ethanol
		

Figure 12

(a) (i) Each molecule in Figure 12 contains a different functional group.

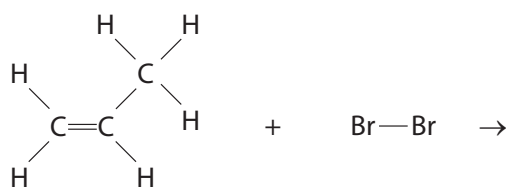
Circle the alkene functional group in **propene**.

(1)

(ii) Propene reacts with bromine water.

Complete the equation for the reaction of propene with bromine by drawing the structure of a molecule of the product.

(2)



propene

bromine

product

(iii) Propanoic acid reacts with calcium carbonate, CaCO_3 , to form calcium propanoate, $\text{Ca}(\text{C}_2\text{H}_5\text{COO})_2$, and two other products.

Name the **two** other products.

(2)

product 1

product 2

* (b) Glucose, $C_6H_{12}O_6$, is a carbohydrate.

A dilute solution of ethanol can be produced from glucose by fermentation.

The dilute solution of ethanol can then be processed to form a concentrated solution of ethanol.

Describe how the fermentation of glucose is carried out and how the dilute solution of ethanol produced can then be processed to form a concentrated solution of ethanol.

You may include diagrams in your answer.

(6)



(Total for Question 7 = 11 marks)



- 4 (a) Figure 6 shows a poly(ethene) bottle containing substance **K** with one of its hazard symbols showing.

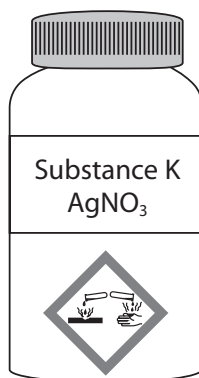


Figure 6

- (i) Explain a safety precaution that should be taken when using a substance with the hazard symbol shown in Figure 6.

(2)

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- (ii) Substance **K** has the formula AgNO_3 . Give the name of substance **K**.

(1)

.....

- (iii) State **one** property of poly(ethene) that makes it a suitable material to make a container for storing substances.

(1)

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.....

- (iv) A student tests a solid for chloride ions.

The student uses the following method.

step 1 dissolve a small amount of the solid in water

step 2 add some dilute hydrochloric acid

step 3 add a few drops of a solution of **K**

step 4 observe whether or not a white precipitate forms.

This method to show whether the solid contains chloride ions will not work.

Explain a change that needs to be made to **step 2** to allow this method to work.

(2)

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- (b) In the test for carbonate ions, the carbonate ions react with an acid.

Sodium carbonate, Na_2CO_3 , is reacted with dilute hydrochloric acid.

Complete and balance the equation for this reaction.

(3)



- (c) The carbonate of element X has the formula X_2CO_3 .

The relative formula mass of this carbonate is 230.

Using this information, calculate the relative atomic mass of X.

(relative atomic masses: C = 12, O = 16)

(2)

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relative atomic mass of X = ...

(Total for Question 4 = 11 marks)



- 8** (a) A solid is known to be either aluminium chloride or aluminium sulfate or calcium chloride.

A few drops of sodium hydroxide solution are added to a solution of the solid and the mixture is shaken.

A white precipitate is seen.

A student concludes that the solid is aluminium sulfate.

- (i) Explain why this conclusion may not be correct.

(2)

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- (ii) Describe a test the student could use to confirm that the solid contains sulfate ions.

(2)

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- (b) A solution containing iron ions is mixed with sodium hydroxide solution.

A green precipitate forms.

After a period of time exposed to air, the precipitate changes colour to brown.

Which statement would explain this change in colour?

(1)

- ☐ **A** iron(II) ions, Fe^{2+} , are oxidised to iron(III) ions, Fe^{3+}
- ☐ **B** iron(II) ions, Fe^{2+} , are reduced to iron(III) ions, Fe^{3+}
- ☐ **C** iron(III) ions, Fe^{3+} , are oxidised to iron(II) ions, Fe^{2+}
- ☐ **D** iron(III) ions, Fe^{3+} , are reduced to iron(II) ions, Fe^{2+}



*(c) A technician has samples of two substances, **R** and **S**.

R is an ionic solid.

Molecules of **S** contain 2 carbon atoms.

The technician carries out some tests on **R** and on a solution of **S**.

The tests and the results obtained are shown in Figure 11.

test	result
add solid R to water and shake	the white solid dissolves to form a colourless solution
add universal indicator to the solution of R	indicator turned blue
flame test with solid R	lilac flame produced
appearance of solution of S	colourless
add universal indicator to solution of S	indicator turns orange
add a small piece of magnesium to solution of S	bubbles of gas released and magnesium disappears
add spatula measure of solid R to solution of S	bubbles of gas released that turn limewater cloudy solid R disappears

Figure 11

Identify **R** and **S**, using all of the data in Figure 11, explaining your reasoning from each test.

(6)

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(Total for Question 8 = 11 marks)



- 4 Crisp packets are often made from poly(propene) coated with a thin layer of aluminium on the inside.

Poly(propene) is a polymer made from the monomer propene, CH_2CHCH_3 .

- (a) (i) What is the relative formula mass of propene?

(relative atomic masses: C = 12, H = 1)

(1)

- ☐ A 9
- ☐ B 39
- ☐ C 42
- ☐ D 75

- (ii) Describe how monomer molecules combine to make polymers.

(2)

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- (b) Crisps go stale when exposed to the atmosphere.

In an experiment some crisp packets were made from aluminium, some from poly(propene) and some from poly(propene) coated with aluminium. These packets were tested.

Figure 5 shows the results.

crisp packet material	relative porosity to water and oxygen	easily recycled?	relative mass	easily torn?
aluminium	low	yes	high	yes
poly(propene)	high	yes	low	no
poly(propene) coated with aluminium	low	no	low	no

Figure 5

Low porosity is an advantage of using poly(propene) coated with aluminium as it prevents the crisps from becoming damp.

Explain, using Figure 5, **one** other advantage of using poly(propene) coated with aluminium.

(2)

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- (c) The aluminium coating can be replaced by a very thin layer of material called a nanosheet.

The nanosheet is made from amino acids and is less than 100 nm thick.

- (i) Explain why the nanosheet layer would be better than aluminium as a coating for crisp packets.

(2)

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- (ii) Nanosheet layers can be made from amino acids.

An equation showing a reaction of an amino acid, $\text{C}_2\text{H}_5\text{NO}_2$, is



Calculate the mass of water formed when 105 g of this amino acid reacts.

(relative formula masses: $\text{C}_2\text{H}_5\text{NO}_2 = 75$, $\text{H}_2\text{O} = 18$)

(2)

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mass of water = ... g



(d) Some crisps contain malic acid.

The structure of one molecule of malic acid is shown in Figure 6.

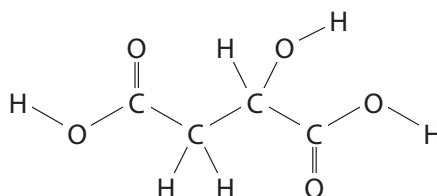


Figure 6

(i) Malic acid has two types of functional group.

One type is the -COOH functional group.

Give the name of this functional group.

(1)

(ii) Name the other functional group.

(1)

(Total for Question 4 = 11 marks)

10 (a) Ethanol can be produced by the fermentation of carbohydrates.

(i) What conditions are necessary for fermentation?

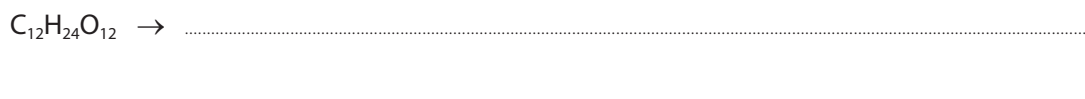
(1)

- ☐ **A** hot temperature, iron catalyst
- ☐ **B** hot temperature, yeast
- ☐ **C** warm temperature, iron catalyst
- ☐ **D** warm temperature, yeast

(ii) A carbohydrate has the formula $C_{12}H_{24}O_{12}$.

Complete the equation for the fermentation of this carbohydrate to make ethanol and carbon dioxide only.

(2)



(b) Ethanol can be oxidised to make ethanoic acid.

One use of ethanoic acid is to make a monomer.

This monomer is polymerised to make the addition polymer PVA, used as a glue.

The structure of the monomer is shown in Figure 14.

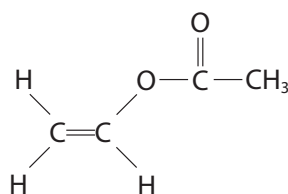


Figure 14

Draw a diagram to show the structure of the repeating unit of PVA.

(2)

*(c) Babies may wear bamboo nappies or disposable nappies. Both types of nappy absorb liquid.

The bamboo in bamboo nappies comes from a fast growing plant. A bamboo nappy can be washed and used again many times. When a bamboo nappy is placed in landfill, it will rot away quickly.

Disposable nappies contain a polymer made using crude oil.
1 g of a typical polymer used in disposable nappies can absorb about 150 g water.
When a disposable nappy is placed in landfill, it may take over 400 years to decompose.

Discuss, using the information given, the advantages and disadvantages of bamboo nappies and disposable nappies. Include in your answer a brief description of how a nappy could be tested to see how much water it will absorb.

(6)



(Total for Question 10 = 11 marks)



12-MARK QUESTIONS

3 questions in this booklet



- 7 (a) A technician was asked to find the concentration of potassium ions in a dilute solution using a flame photometer.
- (i) The technician first produced a calibration curve using solutions with known concentrations of potassium ions.
Figure 9 contains the data for the calibration curve.

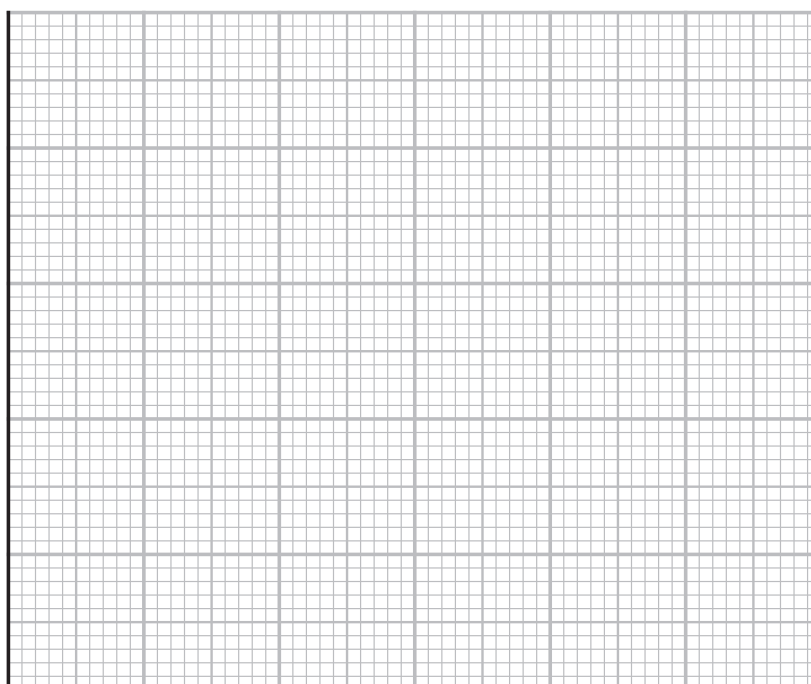
concentration of potassium ions in mol dm^{-3}	display reading
0.025	180
0.050	280
0.100	440
0.200	580
0.500	900

Figure 9

Use the information in Figure 9 to plot the calibration curve on the grid below.

(3)

display reading



concentration of potassium ions
in mol dm^{-3}

(Total for Question 7 = 12 marks)



10 (a) A student carried out a flame test on a sample of solid potassium chloride.

The student followed this method.

step 1 dip a dry wooden splint into water

step 2 then dip the wooden splint into the sample of potassium chloride

step 3 hold the wooden splint in a roaring Bunsen burner flame

step 4 observe the colour seen in the flame.

(i) The student made the following observation and conclusion.

'I saw that the flame colour was yellow so the sample must contain sodium ions.'

Due to the way the student carried out the experiment, this is not a valid conclusion.

Explain **one** improvement that the student could make to their method to obtain a valid conclusion.

(2)

improvement

reason

(ii) What colour should the student have seen in the flame if the test had been carried out correctly?

(1)

☐ **A** blue-green

☐ **B** lilac

☐ **C** orange-red

☐ **D** red

(b) A sample of the potassium chloride was also tested for chloride ions.

Describe the test for chloride ions.

(3)

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.....

(c) (i) A student was asked to test a sample of aluminium sulfate for sulfate ions.

The student needed 25 cm^3 of barium chloride solution of concentration 83 g dm^{-3} for the test.

Calculate the mass of barium chloride that must be dissolved in water to make 25 cm^3 of solution of this concentration.

Give your answer to 2 significant figures.

(3)

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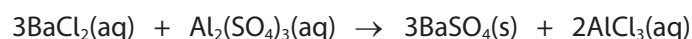
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mass of barium chloride = ... g

(ii) When the barium chloride solution was added to the aluminium sulfate solution, a precipitate was formed.

The balanced equation for this reaction is



Write the ionic equation for this reaction.

(3)

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(Total for Question 10 = 12 marks)



- 9 (a) Figure 12 shows the calibration graph of a flame photometer for the concentration of calcium ions in a solution.

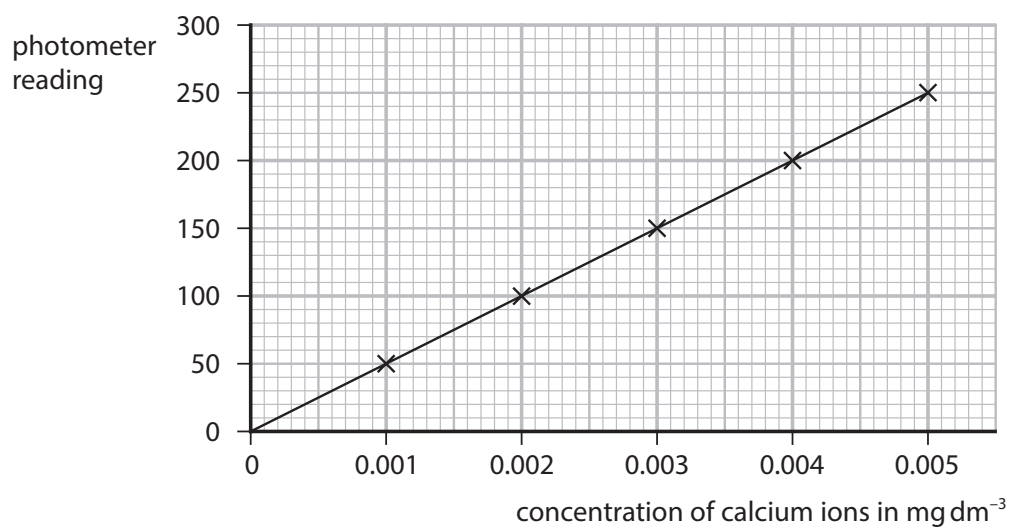


Figure 12

Use Figure 12 to find the concentration of calcium ions when the photometer reading is 175.

(1)

concentration = ... mg dm^{-3}



- (b) A flame photometer was used to measure the concentration of sodium ions in tap water and three types of bottled water.

The results are shown in Figure 13.

type of water	concentration of sodium ions in mg dm^{-3}
tap water	6.47
bottled water A	0.68
bottled water B	0.78
bottled water C	0.41

Figure 13

- (i) Calculate the mean concentration of sodium ions in the three **bottled** waters.

(1)

.....

.....

mean concentration = ... mg dm^{-3}

- (ii) Calculate the volume of **tap** water, in dm^3 , that contains 3 moles of sodium ions.

(relative atomic mass: Na = 23)

(3)

.....

.....

.....

.....

volume = ... dm^3



- (c) A student is given two test tubes, one containing solid aluminium chloride and the other containing solid calcium chloride.

Describe the test the student should use to show which solid is in which test tube, giving the observation for each compound.

(4)

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- (d) Silver carbonate and silver bromide are both insoluble solids.

A student tests a solution to see if it contains bromide ions.
The student adds a few drops of silver nitrate solution.
A precipitate forms.

The student repeats the test but adds some dilute nitric acid before adding the silver nitrate solution.
The mixture fizzes and no precipitate forms.

Explain what conclusion the student can draw from these results.

(3)

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(Total for Question 9 = 12 marks)



13-MARK QUESTIONS

1 question in this booklet



- 10 (a) Figure 10 shows a flask fitted with a cotton wool plug. The flask contains an aqueous solution of a carbohydrate.

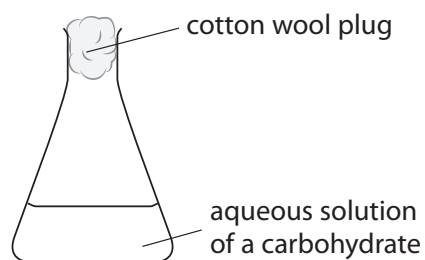


Figure 10

- (i) State **two** steps that need to be taken to turn the solution of the carbohydrate in the flask into a solution of ethanol.

(2)

1

2

- (ii) The apparatus in Figure 11 is used to increase the concentration of the dilute solution of ethanol.

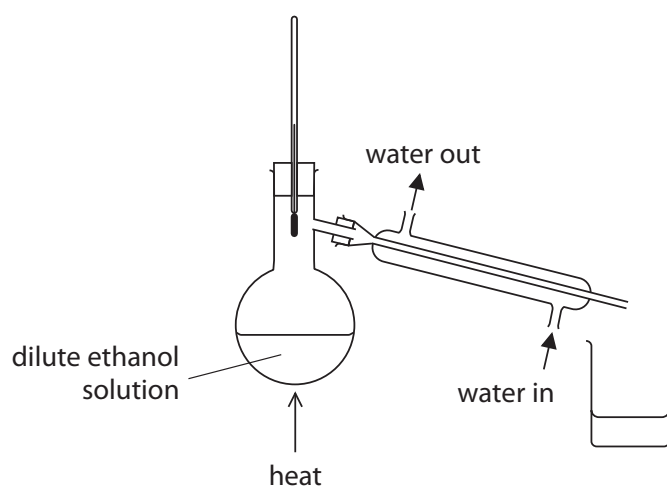


Figure 11

This apparatus did not produce a very concentrated solution of ethanol.

Describe how the apparatus can be altered to produce a more concentrated solution of ethanol.

(2)

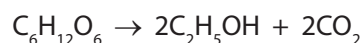
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- (b) The equation for the fermentation of a carbohydrate is



Calculate the maximum mass of carbon dioxide that could be produced if 135 g of this carbohydrate is fully fermented.

(relative formula masses: $\text{CO}_2 = 44$; $\text{C}_6\text{H}_{12}\text{O}_6 = 180$)

(3)

.....

.....

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.....

mass of carbon dioxide = ... g

(Total for Question 10 = 13 marks)



MARK SCHEMES

official Pearson Edexcel mark schemes



Question number	Answer	Mark
1(a)	D fluorine atom, chloride ion, nanoparticle is the only correct answer. A and B are not correct because the smallest particle is the atom C is not correct because the largest particle is the nanoparticle	(1)

Question number	Answer	Mark
1(b)(i)	in either order: - silver nitrate / AgNO_3 (1) - nitric acid / HNO_3 (1)	(2)

Question number	Answer	Additional guidance	Mark
1(b)(ii)	An explanation to include any two from - bromides give a cream (precipitate) (1) - iodides give a yellow (precipitate) (1) - other ions also may give these colours (1)	allow 'bromine' for bromide allow 'iodine' for iodide allow there are {2 colours/ mix of colours} so there is more than one ion (1) allow it could be bromide or iodide (1)	(2)

Question number	Answer	Additional guidance	Mark
1(b)(iii)	flame photometer (1)	allow any suitable method except flame test	(1)



Question number	Answer	Additional guidance	Mark
1(a)	smallest - sodium atom ethene molecule starch molecule largest - nanoparticle (2)	Any 3 particles in correct order (1)	(2) AO1

Question number	Answer	Additional guidance	Mark
1(b)	An explanation linking two from - do not know the risks fully / long term risk not yet known (1) - because they have not been used for a long time / are new technology / no long term research (1) - might pass into the body / through cell membranes / enter the skin / enter the bloodstream (1) - could {change / catalyse} reactions in body (1)	allow 'cause a change'	(2) AO1

Question number	Answer	Mark
1(c)	An explanation linking two from - catalyst particles have much larger surface area (when made from nanoparticles) (1) - leads to increased reaction rate (1)	(2) AO1

Total for Question 1 = 6 marks



Question number	Answer	Additional guidance	Mark
1(a)(i)	the less stone there is, the stronger the concrete/ more stone, less strength	take 'it' to mean amount of stone	(1) AO3 1

Question number	Answer	Mark
1(a)(ii)	C 7500 kg is the only correct answer. A, B and D are incorrect because the sand: stone ratio is not 2:3	(1) AO3 1

Question number	Answer	Additional guidance	Mark
1(a)(iii)	giant covalent / macromolecular	giant and covalent required ignore lattice reject ionic	(1) AO3 1

Question number	Answer	Mark
1(b)(i)	D nanoparticles are larger than atoms and molecules is the only correct answer. A, B and C are incorrect because nanoparticles are made of a few hundred atoms	(1) AO1 1

Question number	Answer	Additional guidance	Mark
1(b)(ii)	an explanation linking any two from {reflect/ absorb/ block/ protects from} UV (light) (1) - so prevent {sunburn/ skin damage} (1) - nanoparticles are {<u>very</u> small/ <100nm/ <1 x 10⁻⁷m } (1)	ignore sun/ sunlight/ sun's rays/ IR allow prevents (skin) cancer/ cell damage; ignore 'protects the skin' allow large SA: vol ratio ignore large surface area	(2) AO1 1

	so better skin coverage/ cannot be seen on skin/ is clear/ is colourless (1)	allow no white marks/ residue/ streaks; ignore absorbs well into skin	
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Total for question 1 = 6 marks

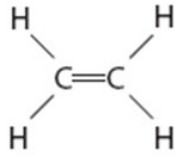
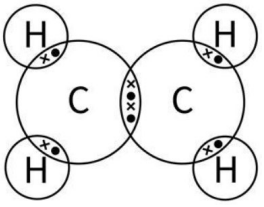


Question number	Answer	Mark
1(a)	C Na^+ is the only correct answer. A (brick red), B (green blue) and D (red) are not correct as these ions do not give a yellow flame.	(1) A01 2 MCQ

Question number	Answer	Mark
1(b)(i)	C $\text{C}_7\text{H}_5\text{N}_3\text{O}_6$ is the only correct answer. A and B are incorrect as they have too few carbons; D is incorrect because it has too many hydrogens	(1) A02 1

Question number	Answer	Additional Guidance	Mark
1(b)(ii)	(they are) explosive / can explode	allow 'blows up' ignore other hazards such as toxic	(1) A03-3



Question number	Answer	Additional Guidance	Mark
1(c)	 (2) or $>C=C<$ (1) then rest of molecule correct (1)	allow 'h' allow dot and cross diagram:  (2) 4 electrons between 2 carbon atoms (1) rest of molecule correct (1) in both cases, MP2 depends on MP1 ignore bond angles	(2) A03-2
Question number	Answer	Additional Guidance	Mark
1(d)	1403 nm ³	allow 1400	(1) A02-1

Total for Question 1 = 6 marks

Question number	Answer	Additional guidance	Mark
1(a)(i)	colourless / absorbs UV / non-toxic / large SA : vol ratio	allow transparent / does not leave white marks allow reflects UV	(1) A02 1

Question number	Answer	Additional guidance	Mark
1(a)(ii)	long term effects not known/ may build up in {living things/ water supplies/ environment}	allow specific examples of effects on health but ignore 'health risks' allow may get into the body and cause harm	(1) A01 1

Question number	Answer	Additional guidance	Mark
1(b)(i)	as the diameter of the nanoparticle increases the surface area volume ratio decreases	ORA allow negative correlation/inversely proportional ignore that as volume increases surface area also increases	(1) A03 1

Question number	Answer	Mark
1(b)(ii)	B 3 : 40 is the only correct answer. A is the correct ratio for a 70nm diameter sphere C is the correct ratio for a 90nm diameter sphere D is the correct ratio for a 100nm diameter sphere	(1) A03 1

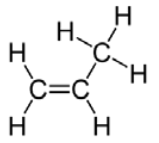


Question number	Answer	Additional guidance	Mark
1(c)	calculate surface area $60 \times 60 \times 6 (= 21\,600)$ (1) calculate volume $60 \times 60 \times 60 (= 216\,000)$ (1) s.a : vol ratio $\frac{216000}{21600}$ (1) (= 10)	allow 10 : 1 (or multiples of) with calculation ignore = instead of :	(3) A02 1

(Total for question 1 = 7 marks)

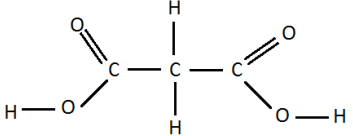
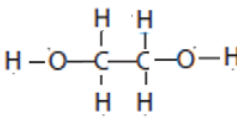
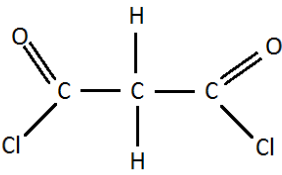


Question Number	Answer	Additional guidance	Mark
5(a)	(ceramic) has no reaction with water (1)		(1) AO 3 1a

Question Number	Answer	Additional guidance	Mark
5(b)	 (2) one C=C bond in a three consecutive carbon atom molecule (1) all other atoms and bonds correct (1) MP2 is dependent on MP1	ignore bond angles reject CH₃ for MP2	(2) AO 2 1

Question Number	Answer	Additional guidance	Mark
5(c)	An explanation linking - low ability to conduct electricity / does not conduct electricity/ insulator (1) - separates user from {current / electricity} / prevents shock electric / prevents electrocution (1)	allow - high flexibility/bendable (1) - less likely to break easily (than other materials) (1) OR - inert/unreactive/waterproof/weatherproof (1) - separates the wire from surrounding water (1)	(2) AO 1 1

Question Number	Answer	Mark
5(d)	B condensation The only correct answer is B <i>A is not correct because this is not an addition reaction</i> <i>C is not correct because this is not a neutralisation reaction</i> <i>D is not correct because this is not a precipitation reaction</i>	(1) AO 1 1

Question Number	Answer	Additional guidance	Mark
5(e)(i)	 (1)  (1)	either order allow  accept –OH in place of –O–H on both structures.	(2) AO 3 2a AO 3 2b

Question Number	Answer	Additional guidance	Mark
5(e)(ii)	water/H ₂ O	or hydrogen chloride/HCl if diacid chloride shown as monomer	(1) AO 1 1

(Total for Question 5 = 9 marks)



Question Number	Answer	Additional guidance	Mark
8(a)	- calcium (1) - chloride (1)	allow Ca^{2+} allow Cl^-	(2) AO 3 2a AO 3 2b

Question Number	Answer	Additional guidance	Mark
8(b)(i)	more than one cation gives white precipitate	allow answers referring to specified cations that give a white precipitate (aluminium, calcium, magnesium, zinc, lead). Ignore incorrect ionic charges. reject incorrect cations	(1) AO 1 2

Question Number	Answer	Additional guidance	Mark
8(b)(ii)	(sodium hydroxide) is not used to test for anions	allow (sodium hydroxide) (only) tests for cations	(1) AO 1 2

Question Number	Answer	Additional guidance	Mark
8(c)	improve sensitivity / accuracy / speed (of tests)	ignore clearer/better/precise/efficient/reliable/valid results	(1) AO 1 1

Question Number	Answer	Additional guidance	Mark
8(d)(i)	$\text{Fe}^{2+} + 2\text{OH}^- \rightarrow \text{Fe}(\text{OH})_2$ left hand side (1) right hand side (1) balancing of correct species (1)	allow multiples ignore incorrect state symbols	(3) AO 2 1



Question Number	Answer	Additional guidance	Mark
8(d)(ii)	An explanation linking {iron(II) hydroxide / iron(II) ions / Fe^{2+}} oxidised (by air) (1) (it goes brown due to formation of) {iron(III) hydroxide / iron(III) ions / Fe^{3+}} (1)	'it' = iron(II) hydroxide 'precipitate' = iron(II) hydroxide Fe^{2+} is oxidised to Fe^{3+} OR Iron(II) is oxidised to iron(III) both score 2 $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + \text{e}^-$ scores 1 mark for MP2 ignore rusting	(2) AO 3 2a AO 3 2b

(Total for Question 8 = 10 marks)



Question number	Answer	Additional guidance	Mark
5(a)(i)	A description including any 2 of - effervescence / fizzing (1) - solid disappears (1) - colourless solution forms (1)	allow bubbles	(2)

Question number	Answer	Additional guidance	Mark
5(a)(ii)	type of polymerisation condensation (1) name of other product water / H ₂ O (1)	reject addition	(2)

Question number	Answer	Additional guidance	Mark
5(a)(iii)	DNA (1)	allow RNA / deoxyribonucleic acid	(1)

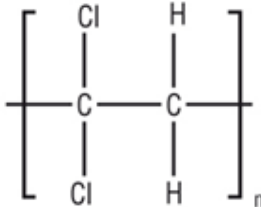
Question number	Indicative content	Mark
5(b)	An answer to include, in either order - use red litmus paper (1) - make litmus paper damp (1)	(2)



Question number	Answer	Mark
5(c)	$\text{CH}_3\text{—CH}_2\text{—CH=CH}_2$ + H—O—H → <u>but-1-ene</u> + <u>water</u> structure of but-1-ene (1) name of but-1-ene (1) structure or formula and name of water (1)	(3)



Question number	Answer	Additional guidance	Mark
4(a)(i)	A description to include any two from - double bond (in monomer) {breaks/ opens up} (1) {monomers/ molecules} {link/ join} together (1) - to form a (long) chain (1)	diagrams can score MP1, 2 or 3 ignore mention of addition or condensation	(2)

Question number	Answer	Additional guidance
4(a)(ii)	 B is the only correct answer. A is not correct as it is poly(1,2-dichloroethene) C is not correct as it has a double bond D is not correct as it is poly(1,1,2-trichloroethene)	(1)

Question number	Answer	Additional guidance
4(a)(iii)	B only the dichloroethene and bromine water goes colourless is the only correct answer A is incorrect because the alkene decolourises bromine water C is incorrect because the polymer does not decolourise bromine water but the alkene does D is not correct because the polymer does not decolourise bromine water	(1)



Question number	Answer	Additional guidance
4(b)	$\text{C}_2\text{H}_4 + 2\text{Cl}_2 \rightarrow \text{C}_2\text{H}_2\text{Cl}_2 + 2\text{HCl}$ HCl (1) 2 (1)	(2)

Question number	Answer	Additional guidance	Mark
4(c)	An explanation to a property with a linked reason non-toxic (1) so stops food being poisonous (1) OR unreactive (1) so it does not react with the food (1) OR flexible (1) so it can wrap all around the food (1)	<u>MP2 depends on MP1</u> allow impermeable to air (1) stops food {oxidation / reaction with air} (1) ignore 'stops food going off' impermeable to water (1) stops dampening of food (1) high melting point (1) so can wrap hot food (without melting) (1) ignore: strong/ tough/ transparent/ cheap/ can seal	(2)

Question number	Answer	Additional guidance	Mark
4(d)	18 as final answer with or without working scores 3 100 - 96.5 = 3.5 (1) 500 x 3.5/100 (=17.5) (1) = 18 (tonnes to 2 s.f.) (1)	480 as final answer scores 2 482.5 / 483 as final answer scores 1 answer with working using 96.5 and 500 and rounded correctly to 2 s.f. scores 1	(3)



Question number	Answer	Additional guidance	Mark
4(a)(i)	Any one from • need to sort polymers into different types • polymers often need to be separated from other polymers • takes time to sort by hand • containers may need to be washed before recycling • difficult to break down into their monomers • some not recyclable • requires a lot of energy		(1) AO1

Question number	Answer	Additional guidance	Mark
4(a)(ii)	A description to include • polymers persist in landfill / landfill site fills up too quickly • polymers degrade very slowly or • combustion produces gases • which may be toxic	accept polymers persist in the environment / harmful to wildlife not biodegradable / hard to decompose	(2) AO1

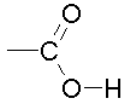
Question number	Answer	Additional guidance	Mark
4(b)(i)	circle around C=C	or circle around C-Cl	(1) AO1



Question number	Answer	Additional guidance	Mark
4(b)(ii)	$ \begin{array}{cccccc} \text{H} & \text{Cl} & \text{H} & \text{Cl} & \text{H} & \text{Cl} \\ & & & & & \\ -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C} & -\text{C}- \\ & & & & & \\ \text{H} & \text{H} & \text{H} & \text{H} & \text{H} & \text{H} \end{array} $ (3)	chain containing 6 C atoms (1) single bonds between C atoms (1) rest of structure complete (1) allow alternative arrangements allow max 2 for $ \left[\begin{array}{cc} \text{H} & \text{Cl} \\ & \\ -\text{C} & -\text{C}- \\ & \\ \text{H} & \text{H} \end{array} \right]_3 $	(3) AO2
Question number	Answer	Additional guidance	Mark
4(b)(iii)	addition (polymer)		(1) AO1
Question number	Answer	Additional guidance	Mark
4(b)(iv)	relative formula mass $\text{C}_2\text{H}_3\text{Cl} = 62.5$ (1) 2850×62.5 (1) (=178125) 178000 (to 3 sig figs) (1)	without working 178000 (3) 178125 / 178127 (2) allow TE on incorrect relative formula mass answer to 3 sig fig from calculation (1) (stand alone mark)	(3) AO2

Total for Question 4 = 11 marks



Question number	Answer	Mark
10(a)(i)	B propanol is dehydrated is the only answer Reaction B involves loss of water, A, C and D do not involve loss of water	(1) AO1
10(a)(ii)	An explanation linking • bromine water is yellow (1) • with compound X, yellow colour remains / no change of colour (1) • with compound Y, bromine water turns colourless (1) or • bromine water and compound X – no change in colour of bromine water (1) • bromine water and compound Y – bromine water changes from yellow (1) to colourless (1)	(3) AO2
10(a)(iii)	C  is the only answer. A, B and D are not correct	(1) AO1

Question number	Answer	Additional guidance	Mark
10(a)(iv)	Any suitable reaction and result such as • add a piece of magnesium ribbon (1) • bubbles of gas form (1) • add a (metal) carbonate (1) • bubbles of gas form (1) • add a metal oxide and warm (1) • metal oxide reacts to form a solution (1) • measure pH (1) • pH less than 7 (1) • add an alkali (1) • a neutral solution produced (1)	ignore add any metal but allow MP2 ignore using other indicators	(2) AO3

Question number	Answer	Mark
10(b)	moles of sucrose = $\frac{\text{moles of ethanol}}{4}$ (1) (= $\frac{26.9}{4 \times 46} = 0.146$) mass of sucrose = $\frac{\text{moles of ethanol}}{4} \times 342$ (1) (= $\frac{26.9 \times 342}{4 \times 46} = 49.999$ g) allow 50 g for 2 marks	(2) AO2

Question number	Answer	Mark
10(c)	moles sucrose = $\frac{10.0}{342}$ (1) (=0.029) number of atoms = $10.0 \times 45 \times 6.02 \times 10^{23}$ (1)	(2) AO2



	$\frac{342}{(= 7.92 \times 10^{23})}$	
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Total for Question 10 = 11 marks



Question number	Answer	Additional guidance	Mark
4(a)(i)	An explanation linking - corrosive (1) - so wear gloves/ (safety) goggles (1)	allow safety glasses/ safety spectacles / eye protection ignore glasses and any other precautions mark independently	(2) A03 3a

Question number	Answer	Mark
4(a)(ii)	nitric acid	(1) A01 1

Question number	Answer	Additional guidance	Mark
4(a)(iii)	inert/ unreactive/ does not corrode	reject 'is not corrosive' allow acid will not dissolve/ react with glass ignore 'acid won't burn through' ignore references to clear / strong	(1) A02 1

Question number	Answer	Additional guidance	Mark
4(b)(i)	An explanation linking - hold the wire in the flame / at the tip of the (blue) cone (1) (as) it is hotter (1)	if the wire has been placed <u>in the flame</u> then any colour of flame is allowed. if the wire has not been placed in the flame then allow use of a blue/roaring flame/open air hole, but NOT any other specified colours of roaring flame.	(2) A01 2



Question number	Answer	Additional guidance	Mark
4(b)(ii)	P: lithium / Li (1) Q: potassium / K (1) R: copper / Cu (1)	for P allow strontium / Sr ignore any charges, even if incorrect (e.g. allow Li ⁺ , Li ²⁺) do not penalise incorrect capital/small letters (e.g. allow CU, li)	(3) AO1 2

Question number	Answer	Additional guidance	Mark
4(c)	$20 \times 5/1000 \times 219$ (2) (= 21.9 g) $5/1000$ (= 0.005) (1) $20 \times 0.005 \times 219$ (1) (= 21.9 g)	overall calculation is $5 \times 219 \times 20 / 1000$ deduct 1 mark per error allow ECF for MP2 21900 scores 1 (has not /1000) 219 with working scores 1 (has used 100 not 1000)	(2) AO2 1

(Total for question 4 = 11 marks)



Question number	Answer	Mark
8(a)(i)	B solid forms in the solution is the only correct answer. A , C , and D are incorrect because a precipitate is a solid (of any colour)	(1) AO2 2

Question number	Answer	Additional guidance	Mark
8(a)(ii)	A plan including - add named alkaline solution / sodium hydroxide (solution) / potassium hydroxide (solution) (1) - white precipitate forms (in both) (1) - white precipitate dissolves with excess (alkali) indicates Al^{3+} (1) - white precipitate does not dissolve in excess (alkali) indicates Ca^{2+} (1)	accept correct formulae ignore 'alkaline solution' accept Al / Ca without charges mark independently as alternative tests allow - flame test - will show orange red / brick red for Ca^{2+} for max 2 marks or - sulfuric acid - white precipitate for calcium ions for max 2 marks	(4) AO1 2

Question number	Indicative content	Mark
*8(b)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. V • does not contain transition metal • because it is white • has ionic bonding • because does not have low melting point, is soluble in water and only conducts when dissolved W • it is alkaline gas as litmus turned blue • pungent and alkaline so is ammonia X • X is insoluble • it contains bromide ions as a cream ppt formed • which is silver bromide Identity of V • V contains ammonium ions • V contains bromide ions • V is ammonium bromide	(6) A01 1 / A03 2



Level	Mark	Additional Guidance	General additional guidance – the decision between levels
	0	No rewardable material.	Read whole answer and ignore all incorrect material/ discard any contradictory material then:
Level 1	1-2	<u>Additional Guidance</u> Correctly identifies at least one of the three compounds OR Correctly deduces information about at least one of the three compounds	<u>Possible Candidate Responses</u> V is an ionic compound because it has a high melting point. W is ammonia X is (silver) bromide because a cream precipitate is formed on reaction with silver nitrate
Level 2	3-4	<u>Additional Guidance</u> Correctly identifies two of the three compounds and gives reasons for at least one of the three. OR Correctly identifies one of the three compounds and gives positive deductions for at least two of the three	<u>Possible Candidate Responses</u> W is ammonia because it turns red litmus paper blue. X is silver bromide. V does not contain a transition metal because it is a white solid. W is ammonia. X contains bromide ions because it forms a cream precipitate.
Level 3	5-6	<u>Additional Guidance</u> Correctly identifies V and W and gives positive deductions for at least 1 AND That X is (silver) bromide/the solution contains bromide ions	<u>Possible Candidate Responses</u> W is ammonia because it turns damp red litmus paper blue. X is silver bromide because a cream precipitate formed on reaction with silver nitrate. Therefore V must be ammonium bromide.



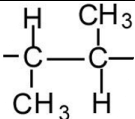
Level	Mark	Descriptor
	0	No awardable content
Level 1	1-2	- Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail. (AO1) - Presents an explanation with some structure and coherence. (AO1)
Level 2	3-4	- Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed. (AO1) - Presents an explanation that has a structure which is mostly clear, coherent and logical. (AO1)
Level 3	5-6	- Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas is detailed and fully developed. (AO1) - Presents an explanation that has a well-developed structure which is clear, coherent and logical. (AO1)

(Total for question 8 = 11 marks)



Question number	Answer	Additional guidance	Mark
10(a)(i)	but-2-ene	allow 2-butene	(1) AO1 1

Question number	Answer	Additional guidance	Mark
10(a)(ii)	$C_4H_8 + Br_2 \rightarrow C_4H_8Br_2$ fully correct equation (2) if equation not fully correct, then correct formula of product $C_4H_8Br_2$ (1)	reject charges on formulae reject superscript numbers allow incorrect lower and upper case letters	(2) AO2 2

Question number	Answer	Additional guidance	Mark
10(a)(iii)	 2 neighbouring carbon atoms with single bond and continuation bonds shown (1) rest of repeating unit correct (1)	allow CH_3 or  ignore brackets and n MP2 depends on MP1	(2) AO2 1

Question number	Answer	Additional guidance	Mark
10(b)(i)	propene	accept prop-1-ene / 1-propene	(1) AO2 1



Question number	Answer	Additional guidance	Mark
10(b)(ii)	-COOH / COOH /	allow CO ₂ H allow displayed formula	(1) AO2 1

Question number	Answer	Additional guidance	Mark
10(b)(iii)	the polystyrene cup {is a poor conductor of heat / will melt / will burn}	ignore reference to any equipment other than the polystyrene cup (e.g. clamp stand)	(1) AO1 2

Question number	Answer	Mark
10(c)(i)	H ₂ O	(1) AO1 1

Question number	Answer	Additional guidance	Mark
10(c)(ii)	$ \begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & & & \\ & & & & & & \\ \text{H} & -\text{O}-\text{C} & -\text{C} & -\text{C}-\text{O}-\text{H} \\ & & & & & & \\ & \text{H} & \text{H} & \text{H} & & & \end{array} $ fully correct diagram scores (2) if not scores (1) for 3 single bonded carbon atoms / 2 OH groups	allow OH or O-H reject any double bonds	(2) AO2 1

(Total for question 10 = 11 marks)

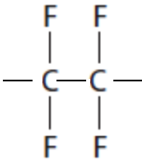
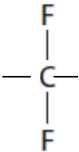


Question number	Answer	Additional guidance	Mark
4(a)	proton atom molecule nanoparticle in the correct order (2)	allow proton molecule atom nanoparticle (1)	(2) AO1-1

Question number	Answer	Mark
4(b)(i)	C 9.0×10^{-8} is the only correct answer A is incorrect as it is 90000 nanometres B is incorrect as it is 9000 nanometres D is incorrect as it is 0.09 nanometres	(1) AO2-1

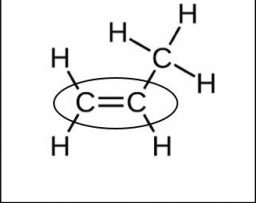
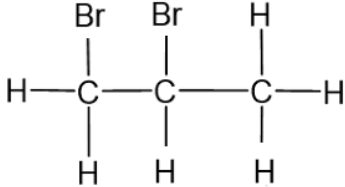
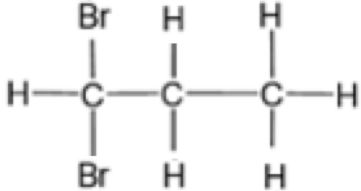
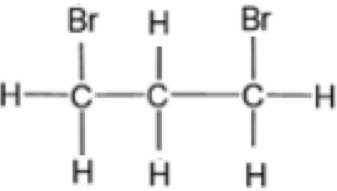


Question number	Answer	Additional guidance	Mark
4(b)(ii)	1:15 with or without working 3 marks surface area = $90 \times 90 \times 6 = 48\,600$ (1) volume = $90 \times 90 \times 90 = 729\,000$ (1) $\frac{729\,000}{48\,600} = 15$ (1) answer = 1 : 15	allow ecf <u>surface area calculated</u> correctly evaluated (1) volume calculated ratio 1:90 scores 2 $\frac{48600}{729000} = 0.066$ (2) $\frac{729000}{8100} = 90$ (2) $\frac{8100}{729000} = 0.011$ (1)	(3) AO3-2

Question number	Answer	Additional guidance	Mark
4(c)(i)	 (2) OR repeat unit including: - no double bond (1) - rest of repeat unit with linking bonds (1)	allow lowercase f allow diagram to show 1, 2, 4 or 6 carbon atoms eg  2 marks ignore brackets around repeat unit and n	(2) AO2-1

Question number	Answer	Additional guidance	Mark
4(c)(ii)	Use (1) Property (1) Reason (1) (Property & reason MUST depend on use) Examples: - for coating (frying) pans (1) - because it is {slippery/non stick} (1) - food will not stick to the (frying) pan (1) OR - clothing /carpets (1) - because it is non-stick (1) - easy to clean / will not stain (1) OR - bottom of skis (1) - because it is slippery (1) - less friction on snow (1)	USES allow: pans / saucepans / tennis rackets / named kitchen equipment / piping / skis ignore: sports equipment (in general) / 'kitchenware' / windows / window ledge / toothpaste PROPERTIES allow: slippery / smooth / non-stick / unreactive / does not conduct electricity / non-toxic / high melting point ignore: strong / lightweight / high boiling point other reasonable uses include: lubricants - reduces friction graft material in surgery – inert/non-reactive prevent insects from climbing surfaces - slippery insulation of wiring & electrical circuits – does not conduct electricity/high melting point plumbers' tape – flexible/waterproof bottles – inert/non-reactive raincoat / rainjacket – waterproof Goretex™ clothing - waterproof Umbrella – water repellant flame retardant material (2) – high melting point hair straighteners – non-stick/no hair damage allow any reasonable use	(3) AO1-1



Question number	Answer	Additional guidance	Mark
7(a)(i)	propene 	ignore any circles drawn on other molecules must not include hydrogen	(1) AO1-1
7(a)(ii)	 Br on neighbouring carbon atoms (1) rest of molecule correct with no double bond, two bromines and no extra products (1)	allow CH₂BrCHBrCH₃ (1) OR  (1) OR  (1) ignore the molecular formula	(2) AO2-1

Question number	Answer	Additional guidance	Mark
7(a)(iii)	water (1) carbon dioxide (1)	allow H ₂ O allow CO ₂ allow answers in either order allow lowercase/non subscripts	(2) AO2-1

Question number	Indicative content	Mark
*7(b)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 6 marks FERMENTATION • dissolve glucose in water to form a solution • place glucose solution in a suitable flask • add yeast to glucose solution • place fermentation mixture in warm room/water bath / 25-40°C • fit air lock or equivalent in neck of flask • reaction stops when bubbles stop • decant ethanol solution from yeast/ethanol mixture or filter out yeast CONCENTRATION • fractional distillation • place the dilute ethanol in round bottom flask /suitable vessel • add a fractionating column onto the round bottom flask /suitable vessel • and a thermometer on top of the of fractionating column • add condenser to top of fractionating column • run water into bottom of condenser • heat round bottom flask/vessel • to above boiling point of ethanol / below the boiling point of water • collect concentrated ethanol from end of condenser Allow labelled diagrams	(6)



Level	Mark	Descriptor
	0	No rewardable material.
Level 1 a basic description of either process or a very basic description of both	1–2	add yeast to glucose (1) concentrate the ethanol using fractional distillation (1) add yeast to glucose then use fractional distillation (2) use fractional distillation, heat the ethanol solution to above boiling point of ethanol (2)
Level 2 A detailed description of one of the processes or a basic description of both processes	3–4	add yeast to glucose solution and keep in at 25–35°C then use fractional distillation to concentrate (3) mix glucose in water to form a solution and add yeast and keep warm, cotton wool in neck of flask, decant yeast when bubbles stop (4) Use fractional distillation, place the dilute ethanol in round bottom flask, add a fractionating column with a thermometer add condenser to top of fractionating column. Heat the round bottom flask to above boiling point of ethanol (4)
Level 3 both processes described with one described in detail	5–6	put glucose and yeast into conical flask and warm to 35°C, use an airlock to prevent oxygen, decant ethanol solution from mixture then use fractional distillation (5) put glucose solution and yeast into conical flask and warm to around 30°C, use an airlock to prevent oxygen entering flask, decant ethanol solution from mixture then use fractional distillation, place the dilute ethanol in round bottom flask, add a fractionating column onto the round bottom flask and heat, collect concentrated ethanol from top of fractionating column (6)

Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	- Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) - Presents a description which is not logically ordered and with significant gaps. (AO1)
Level 2	3–4	- Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) - Presents a description of the procedure that has a structure which is mostly clear, coherent and logical with minor steps missing. (AO1)
Level 3	5–6	- Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) - Presents a description that has a well-developed structure which is clear, coherent and logical. (AO1)



Question number	Answer	Additional guidance	Mark
4(a)(i)	An explanation linking - wear gloves/ goggles (1) - because it is corrosive (1)	mark independently allow <u>safety</u> glasses/ <u>safety</u> spectacles ignore eye protection ignore burns/ corrodes allow caustic	(2) A03 3a

Question number	Answer	Mark
4(a)(ii)	silver nitrate	(1) AO1 1

Question number	Answer	Additional guidance	Mark
4(a)(iii)	inert/ unreactive/ does not corrode / does not break (if dropped)	allow can be moulded into shape / waterproof / non-brittle ignore durable / strong/ malleable/ rigid/ flexible/ transparent/ cost reject 'is not corrosive'/ non-corrosive	(1) AO2 1

Question number	Answer	Additional guidance	Mark
4(a)(iv)	An explanation linking • use {a different / sulfuric/ nitric} acid (1) • (as) hydrochloric acid contains chloride/Cl^- (ions) (1)	mark independently MP1 is not scored if any additional substances are added except silver nitrate or "K" allow because otherwise silver chloride forms reject 'contains chlorine' allow chlorine ions/ Cl ions	(2) AO1 2

Question number	Answer	Additional guidance	Mark
4(b)	$\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$ (3) fully correct, balanced equation (3) all three formulae only (2) any two correct formulae (1)	allow incorrect cases/ subscripts	(3) AO2 1

Question number	Answer	Additional guidance	Mark
4(c)	85 with or without working scores 2 $\text{CO}_3 = 12 + 3 \times 16 = 60$ (1) $\frac{230 - 60}{2} = 85$ (1)	final answer of 85 2 marks 170 1 mark allow ecf for MP2 from C+ O value worked out using 12 and 16	(2) AO2 1

Total for question 4 = 11 marks



Question number	Answer		Mark
8(a)(i)	An explanation linking - other cations give (white) precipitate (1) - so can't be certain that it is aluminium (ions)/ it could be a calcium (compound) (1) OR - need to add more NaOH (1) - to show that precipitate dissolves (so aluminium ions) (1) OR - could be (sulfate or) <u>chloride</u> (1) - because no anion test has been carried out (1)	MP2 depends on MP1 in each pair allow for 1 only <u>calcium chloride</u> also give white ppt calcium (ions) also give a white ppt scores 2 allow aluminium chloride also gives white precipitate allow for this MP: no sulfate test/ full test for sulfate ions if no other marks scored: allow they all give white precipitate (1)	(2) AO1 2

Question number	Answer	Additional guidance	Mark
8(a)(ii)	A description including - add (HCl and) barium chloride (1) - white precipitate (1)	reject additional substances added e.g. sulfuric acid allow barium nitrate MP2 dependent on mention of barium chloride/ nitrate even if MP1 not scored	(2) AO2 1



Question number	Answer	Mark
8(b)	A iron(II) ions, Fe^{2+}, have been oxidised to iron(III) ions, Fe^{3+} is the only correct answer B, C and D are as the brown colour is caused by Fe^{3+} caused by oxidation	(1) AO3 1
Question number	Answer	Mark
*8(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. R • has a pH greater than 7 as UI turns blue: therefore R is an alkali/ base • lilac flame test indicates potassium compound • gas evolved when mixed with S is carbon dioxide: therefore R is a carbonate • R is white so not transition metal compound • R is potassium carbonate S • has a pH less than 7 as UI turns orange: therefore S is a (weak) acid • bubbles with magnesium are hydrogen: therefore S is an acid • S molecule has 2 carbon atoms and a weak acid: therefore is a carboxylic acid, ethanoic acid Mixing R and S • neutralisation reaction • carbon dioxide released • R is a carbonate and S is an acid	(6) AO2 2 AO3 2

Total for question 8 = 11 marks



Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	The explanation attempts to link and apply knowledge and understanding of scientific enquiry, techniques and procedures, flawed or simplistic connections made between elements in the context of the question. Lines of reasoning are unsupported or unclear. (AO2) Deconstructs scientific information but understanding and connections are flawed. An unbalanced or incomplete argument that provides limited synthesis of understanding. Judgements are supported by limited evidence. (AO3)
Level 2	3–4	The explanation is mostly supported through linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, some logical connections made between elements in the context of the question. Lines of reasoning mostly supported through the application of relevant evidence. (AO2) Deconstructs scientific information and provides some logical connections between scientific concepts. An imbalanced argument that synthesises mostly relevant understanding, but not entirely coherently. Judgements are supported by evidence occasionally. (AO3)
Level 3	5–6	The explanation is supported throughout by linkage and application of knowledge and understanding of scientific enquiry, techniques and procedures, logical connections made between elements in the context of the question. Lines of reasoning are supported by sustained application of relevant evidence. (AO2) Deconstructs scientific information and provide logical connections between scientific concepts throughout. A balanced, well-developed argument that synthesises relevant



		understanding coherently. Judgements are supported by evidence throughout. (AO3)
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Level	Mark	Descriptor
		Discard all incorrect material and reject contradictory material.
	0	No awardable content
Level 1	1-2 Additional Guidance Candidate makes correct explained deduction about R or S	• blue means pH above 7, so R is an alkali (2) • R is alkali (1) • lilac flame test means potassium (ions/ compound) (1) • lilac flame means R is potassium (0) • orange means pH below 7, so S is an acid (2) • orange means S is a weak acid (2) • the gas given off with R and S is carbon dioxide so R is a carbonate (2) • the gas given off with R and S is carbon dioxide (1) • R contains potassium and S is an acid (2) • S is an acid because it reacts with magnesium (2)
Level 2	3-4 Additional Guidance R or S correctly identified AND fully justified AND statement about other substance	• R is potassium carbonate because it is an alkali because a blue colour means a pH above 7, and the lilac flame means it is a potassium compound and S is an acid (4) • R is potassium compound because it has a lilac flame test and S is ethanoic acid because it gives off hydrogen with magnesium so it is acidic and has two carbons (4) • R is potassium carbonate (3) • R is potassium carbonate and S is an acid (3)



Question number	Answer	Mark
4(a)(i)	C 42 is the only correct answer A, B and D are not correct because they are not 42	(1) A02-1

Question number	Answer	Additional guidance	Mark
4(a)(ii)	A description including: - the <u>double</u> bond breaks (1) (monomers) {link / bond / join / attach} (to form long chain) (1)	allow <u>double</u> bond 'opens up' ignore monomers combine / react ignore addition / condensation polymerisation reject joins by ionic bonds	(2) A01-1 Exp

Question number	Answer	Additional guidance	Mark
4(b)	An explanation linking: (advantage) low relative mass (1) (so) less energy to <u>transport</u> (1) or (advantage) it does not tear (1) (so) (crisps) won't go stale / won't be exposed to {water/air/oxygen} / prevents oxidation of crisps / (1)	allow cheaper to <u>transport</u> allow remain sealed allow (crisps) won't fall out ignore crisps won't be damaged ignore anything about recycling	(2) A03-2 Exp



Question number	Answer	Additional guidance	Mark
4(c)(i)	an explanation linking - less material used (1) (so) resources conserved (1)	allow lower mass / lightweight ignore thinner allow costs less ignore recycling	(2) A03-2 Exp

Question number	Answer	Additional guidance	Mark
4(c)(ii)	ratio $3 \times 75 (=225)$ and $2 \times 18 (=36)$ (1) $\frac{105}{225} \times 36 = 16.8$ g (1)	16.8 / 17 g with or without working scores 2. allow 225 and 36 seen (1) $\frac{105}{75} (= 1.4)$ moles amino acid and $\frac{2}{3} \times 1.4 = 0.933$ moles H ₂ O (1) so mass of water = $0.933... \times 18 = 16.8$ (g) (1) allow with working: (1) 0.467 / 8.4 / 8.57 / 25.2 / 37.80 / 50.4 / 3780	(2) A02-1 Exp

Question number	Answer	Additional guidance	Mark
4(d)(i)	carboxyl / carboxylic acid		(1) A01-1



Question number	Answer	Additional guidance	Mark
4(d)(ii)	alcohol	allow hydroxyl	(1) A02-1

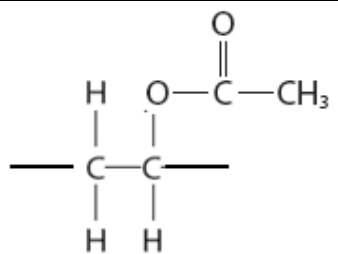
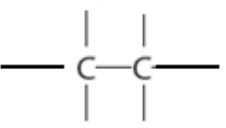
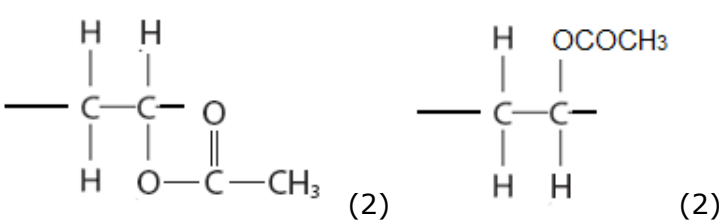
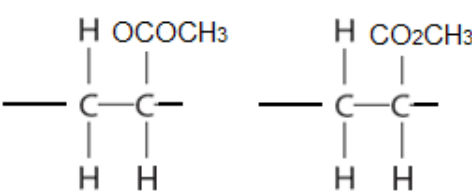
Total for Question 4 = 11 marks



Question number	Answer	Mark
10(a)(i)	D warm temperature, yeast is the only correct answer A and C are not correct because an iron catalyst is not used; B is not correct because the temperature is too hot	(1) A01-2

Question number	Answer	Additional guidance	Mark
10(a)(ii)	$C_{12}H_{24}O_{12} \rightarrow 4\{C_2H_5OH / CH_3CH_2OH / C_2H_6O\} + 4CO_2$ (2) both product formulae and no other (1) balancing correct formulae (1)	allow elements in any order ignore any brackets	(2) A02-1



Question number	Answer	Additional guidance	Mark
10(b)	 (2) or  (1) rest of repeating unit correct (1)	allow any orientation around C-C bond eg  (2) Ignore brackets around repeat unit allow side chain as CO₂CH₃ or OCOCH₃ or CH₃COO or C₂H₃O₂ (or in any order) allow bond from C to anywhere on side chain, eg  ignore presence of 'n' to lower right of repeat unit	(2) A01-1

Question number	Indicative content	Mark
*10(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. A02 (3 marks) A03 (3 marks) ADVANTAGES OF BAMBOO NAPPIES • plants absorb carbon dioxide when growing • plants are renewable • not made from non-renewable crude oil • decompose more quickly than disposable nappies DISADVANTAGES OF BAMBOO NAPPIES • uses water to wash • uses energy to heat washing water • not as absorbent as disposable nappies ADVANTAGES OF DISPOSABLE NAPPIES • very absorbent • can be disposed of after one use • do not need to be washed • easier to fit child as range of sizes DISADVANTAGES OF DISPOSABLE NAPPIES • cannot be reused • made from non-renewable crude oil resource • very slow to / do not decompose in land fill EXPERIMENT • measure mass of nappy on balance • add water in measured amounts • keep adding water until no more absorbed	(6) A02-1 A03-3



Level	Mark	Descriptor	Additional Guidance
	0	No rewardable material.	Read whole answer and ignore all incorrect material/ discard any contradictory material then: eg Bamboo nappies are made from fast growing plants (0)
Level 1	1–2	<u>Additional Guidance</u> ONLY give ONE way that bamboo is better OR worse than disposable nappies OR ONLY describes how to test for absorbency	<u>Possible candidate response</u> (information from question) – identified as advantage/disadvantage (1) – impact (1) - Outline method which may not yield results
Level 2	3–4	<u>Additional Guidance</u> Explains ways in which bamboo is better OR worse than disposable nappies OR gives a simple method on how to test for absorbency.	<u>Possible candidate response</u> (information from question) – identified as advantage/disadvantage – impact – explained/reasoned - compared with other type of nappy for upper end of this level - outline method which yields some results
Level 3	5–6	<u>Additional Guidance</u> Gives ways in which bamboo is better AND worse than disposable nappies AND gives a quantitative method on how to test for absorbency.	<u>Possible candidate response</u> (Several pieces of information from question) – identified as advantage/disadvantage – impact – explained/reasoned - compared with other type of nappy for upper end of this level - described method which yield quantitative results / identified independent & dependent variables



Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	- The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2) - Analyses the scientific information but understanding and connections are flawed. An incomplete plan that provides limited synthesis of understanding. (AO3)
Level 2	3–4	- The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2) - Analyses the scientific information and provides some logical connections between scientific enquiry, techniques and procedures. A partially completed plan that synthesises mostly relevant understanding, but not entirely coherently. (AO3)
Level 3	5–6	- The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2) - Analyses the scientific information and provide logical connections between scientific concepts throughout. A well-developed plan that synthesises relevant understanding coherently. (AO3)

Total for Question 10 = 11 marks



Question number	Answer	Additional guidance	Mark
7(a)(i)	display reading concentration of potassium ions in mol dm⁻³	suitable scale on axes using more than half axis in both directions (1) correctly plotted points (1) best fit curve (1)	(3) AO2
7(a)(ii)	reading of concentration from graph (1) (about 0.070 - 0.080 mol dm⁻³)		(1) AO3



Question number	Answer	Additional guidance	Mark
7(b)	$\text{Ag}^+ + \text{Cl}^- \rightarrow \text{AgCl}$ (2)	$\text{Ag}^+ + \text{Cl}^- \rightarrow$ (1) $\rightarrow \text{AgCl}$ (1) allow (1) max for equation with no ionic charges	(2) AO2

Question number	Indicative content	Mark
7(c)	Answers will be credited according to candidate's deployment of knowledge and understanding of the material in relation to the qualities and skills outlined in the generic mark scheme. The indicative content below is not prescriptive and candidates are not required to include all the material that is indicated as relevant. Additional content included in the response must be scientific and relevant. - ions present – NH_4^+, Fe^{2+}, SO_4^{2-} - dissolve solid in (distilled / deionised) water - add drops of sodium hydroxide solution - green / grey-green / dirty green - precipitate shows Fe^{2+} ion - precipitate is iron(II) hydroxide $\text{Fe}^{2+} + 2\text{OH}^- \rightarrow \text{Fe}(\text{OH})_2$ - warm mixture of salt solution and sodium hydroxide solution - hold damp (red litmus / universal / pH indicator) paper above mixture - indicator paper turns (blue / purple) - test shows ammonia gas formed - ammonia gas comes from NH_4^+ ions present $\text{NH}_4^+ + \text{OH}^- \rightarrow \text{NH}_3 + \text{H}_2\text{O}$ - to second portion of salt solution add drops of dilute hydrochloric acid - add drops of barium chloride solution (or lead nitrate solution) - white - precipitate forms - precipitate is barium sulfate (or lead sulfate) $\text{Ba}^{2+}(\text{or } \text{Pb}^{2+}) + \text{SO}_4^{2-} \rightarrow \text{Ba}(\text{or } \text{Pb})\text{SO}_4$	(6) AO1 AO2



Level	Mark	Additional Guidance	General additional guidance – the decision within levels Eg - At each level, as well as content, the scientific coherency of what is stated backed up by detail will help place the answer at the top, or the bottom, of that level.
	0	No rewardable material.	
Level 1	1–2	<u>Additional guidance</u> - names an ion present in the compound or - attempts test to identify an ion	<u>Possible candidate responses</u> - Ion present in compound NH_4^+ / Fe^{2+} / SO_4^{2-} - Adds compound to water (to make a solution) - Adds sodium hydroxide solution to solution of compound - Adds barium chloride solution to solution of compound
Level 2	3–4	<u>Additional guidance</u> - names at least two ions present And - describes at least one test to identify one of those ions – with positive result	<u>Possible candidate responses</u> - Adds sodium hydroxide solution to solution of compound - green ppt shows Fe^{2+} ion present or - adds dilute hydrochloric acid and barium chloride solution to solution of compound - white ppt shows SO_4^{2-} ion present or - adds sodium hydroxide solution to solution of compound and warms gently - pungent gas given which turns damp universal indicator purple shows presence of NH_4^+
Level 3	5–6	<u>Additional guidance</u> - Identifies all 3 ions And - Describes at least two tests for those ions – with positive results And - Suitable equations for at least two tests of ions	<u>Possible candidate responses</u> - adds sodium hydroxide solution to solution of compound - green ppt shows Fe^{2+} ion present $\text{Fe}^{2+} + 2 \text{OH}^- \rightarrow \text{Fe}(\text{OH})_2$ - adds dilute hydrochloric acid and barium chloride solution to solution of compound - white ppt shows SO_4^{2-} ion present $\text{Ba}^{2+} + \text{SO}_4^{2-} \rightarrow \text{BaSO}_4$ - adds sodium hydroxide solution to solution of compound and warms gently - pungent gas given which turns damp universal indicator purple shows presence of NH_4^+ ions in compound $\text{NH}_4^+ + \text{OH}^- \rightarrow \text{NH}_3 + \text{H}_2\text{O}$



Level	Mark	Descriptor
	0	No rewardable material.
Level 1	1–2	• Demonstrates elements of chemical understanding, some of which is inaccurate. Understanding of scientific, enquiry, techniques and procedures lacks detail. (AO1) • Lines of reasoning are unsupported or unclear. (AO2)
Level 2	3–4	• Demonstrates chemical understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas, enquiry, techniques and procedures is not fully detailed and/or developed. (AO1) • Lines of reasoning mostly supported through the application of relevant evidence. (AO2)
Level 3	5–6	• Demonstrates accurate and relevant chemical understanding throughout. Understanding of the scientific ideas, enquiry, techniques and procedures is detailed and fully developed. (AO1) • Lines of reasoning are supported by sustained application of relevant evidence. (AO2)

Total for Question 7 = 12 marks



Question number	Answer	Additional guidance	Mark
10 (a)(i)	An explanation linking one pair from: • use a (nichrome) wire instead of a wooden splint (1) • so the wood does not burn / as the wire will not interfere with the flame colour (1) OR • leave the wooden splint to soak in water longer (1) • so that the wooden splint does not burn when testing the sample (1)	allow metal loop / metal rod / platinum loop / (metal) inoculating loop allow use hydrochloric acid (instead of water) (1) so that the sample vaporises more easily (1) ignore (use hydrochloric acid) to remove impurities / sterilise ignore use a photometer	(2) A03-3b

Question number	Answer	Mark
10 (a)(ii)	B lilac is the only correct answer A is incorrect as this is the colour for copper C is incorrect as this is the colour for calcium D is incorrect as this is the colour for lithium	(1) AO1-1

Question number	Answer	Additional guidance	Mark
10 (b)	A description including : • add (dilute) nitric acid (1) • add silver nitrate (solution) (1) • a white <u>precipitate</u> (1)	ignore warming reject hydrochloric acid /sulfuric acid for MP1 MP3 is dependent on addition of silver nitrate	(3) AO1-1

Question number	Answer	Additional guidance	Mark
10 (c)(i)	2.1 scores 3 with or without working $\frac{25}{1000} = 0.025 \text{ (1)}$ $0.025 \times 83 = 2.075 \text{ (1)}$ $= 2.1 \text{ (1)}$	allow ECF throughout	(3) A02-1

Question number	Answer	Additional guidance	Mark
10 (c)(ii)	$\text{Ba}^{2+} + \text{SO}_4^{2-} \rightarrow \text{BaSO}_4 \text{ (3)}$ Ba²⁺ (1) SO₄²⁻ (1) → BaSO₄ (1)	allow $3\text{Ba}^{2+} + 3\text{SO}_4^{2-} \rightarrow 3\text{BaSO}_4$ incorrect balancing of correct species max 2 reject Cl^- reject Al^{3+} reject AlCl_3 ignore any state symbols even if incorrect	(3) A02-1

Question number	Answer	Additional guidance	Mark
9(a)	0.0035 or 3.5×10^{-3}	allowable answers 0.0034, 3.4×10^{-3} , 0.0036 or 3.6×10^{-3}	(1) A03-1

Question number	Answer	Additional guidance	Mark
9(b)(i)	$\frac{(0.68 + 0.78 + 0.41)}{3} = 0.6233 \text{ (mg dm}^{-3}\text{) (1)}$	answer = 0.6233333 allow 2 or more significant figures	(1) A01-2

Question number	Answer	Additional guidance	Mark
9(b)(ii)	$\frac{6.47}{1000} = 0.00647 \text{ g sodium ions in } 1 \text{ dm}^3 \quad (1)$ then either $\frac{0.00647}{23} = 2.81... \times 10^{-4} \text{ mol sodium ions in } 1 \text{ dm}^3 \quad (1)$ volume = $\frac{3.00}{2.81 \times 10^{-4}} = 10664.6(0587) \text{ dm}^3 \quad (1)$ or $23 \times 3 = 69 \quad (1)$ volume = $\frac{69}{0.00647} = 10664.6(0587) \text{ dm}^3 \quad (1)$	10664.6(0587) with or without working (3) (to at least 3 sig figs) allow ecf throughout allow with working $\frac{6.47 \times 23}{1000} = 0.14881 / 0.149 \quad (1)$ $3/6.47 = 0.46368 / 0.4637 / 0.464 \quad (1)$ $10.66 / 10.7 \quad (2)$ $23/0.00647 = 3554.87 \quad (2)$	(3) A02-2



Question number	Answer	Additional guidance	Mark
9(c)	A description including (dissolve the solids and) add {sodium / potassium} hydroxide solution (1) - white precipitate/solid forms (1) - aluminium (hydroxide) precipitate does dissolve in excess sodium hydroxide - calcium (hydroxide) precipitate does not dissolve in excess sodium hydroxide (1)	please read the whole answer first. Testing for chloride ion BEFORE the metal ions: If candidate has described a test to identify the chloride AND THEN used a fresh sample of the solids to identify the Al^{3+} and Ca^{2+}, then IGNORE the halide test. If candidate has described a test to identify the chloride BUT then adds NaOH(aq) (to identify the metal ions) to the mixture, score 0. Testing for chloride ion AFTER the metal ions: No change to marking adding incorrect reagent eg dil HCl score 0 for whole answer Note : observations of EACH test are required to score MP3 and MP4 Flame test: clean the flame test wire / use of damp wood splint (1) description of flame test : hold in {blue / hottest part of} flame (1) calcium chloride would give a orange-red / brick-red / dull red flame colour (1) aluminium chloride – no flame colour (1)	(4) AO1-2



Question number	Answer	Additional guidance	Mark
9(d)	overall conclusion: • solution contains carbonate (ions) AND does not contain bromide (ions) (1) and any two of (conclusion from test 1) • precipitate <u>could be</u> silver carbonate or silver bromide (conclusion from test 2) • fizzing is carbon dioxide (1) • carbonate has reacted with acid (1)	allow precipitate (in test 1) is silver carbonate (1) allow halide ion in place of bromide ion in MP1 do not allow bromine ions Allow acid reacts with carbonate to form CO₂ allow acid removes carbonate ions	(3) A01-2

Total for Question 9 = 12 marks



Question number	Answer	Additional guidance	Mark
10(a)(i)	- add yeast (1) - warm (1)	accept zymase / enzymes accept any sensible method of warming eg waterbath reject boiling allow 'heat' only if temperature range within 20-45°C specified	(2)

Question number	Answer	Additional guidance	Mark
10(a)(ii)	A description to include - add fractional distillation column/fractionating column (1) - in neck of flask/between flask and condenser (1)	allow use fractional distillation for MP1	(2)

Question number	Answer	Additional guidance	Mark
10(b)	66 (g) as final answer with or without working scores 3 - mol carbohydrate = $135/180 = 0.75$ mol (1) - mol of carbon dioxide = $0.75 \times 2 = 1.5$ mol (1) - mass = $1.5 \times 44 = 66$(g) (1) OR 180g carbohydrate → 2×44g (=88g) carbon dioxide (1) 135g carbohydrate → $135/180 \times 2 \times 44$g carbon dioxide (1) = 66(g) (1)	33 scores 2.	(3)



Question number	Indicative content	Mark
*10(c)	Answers will be credited according to candidates' deployment of knowledge and understanding of the material in relation to the qualities and skills outlines in the generic markscheme. The indicative content below is not prescriptive and candidates are not required to include all the material which is indicated as relevant. Additional content included in the response must be scientific and relevant. AO1 (3) and AO2 (3) Formula • same general formula • $C_nH_{2n+1}COOH$ • same functional group • functional group is $-COOH$ • members differ by CH_2 • formula mass increases by 14 • they are carboxylic acids Physical properties • trend in physical properties • density falls • boiling point increases Chemical properties • similar chemical {properties/ reactions} • all react with alcohols • form esters • all react with sodium hydroxide solution • form sodium salts • they are all acids	(6)



Level	Mark	Descriptor	Additional Guidance
	0	No rewardable material.	e.g. they all have similar reactions they all have high/low density they have similar densities
Level 1	1–2	- Interpretation and evaluation of the information attempted but will be limited with a focus on mainly just one variable. Demonstrates limited synthesis of understanding. (AO3) - The explanation attempts to link and apply knowledge and understanding of scientific ideas, flawed or simplistic connections made between elements in the context of the question. (AO2) States information from the table or states that are carboxylic acids.	they all have COOH (1) they are carboxylic acids because they all have COOH (2) they all react with alcohols and sodium hydroxide (2)
Level 2	3–4	- Interpretation and evaluation of the information on both variables, synthesising relevant understanding. (AO3) - The explanation is mostly supported through linkage and application of knowledge and understanding of scientific ideas, some logical connections made between elements in the context of the question. (AO2) Uses the table to draw deductions	The formula show that they differ by CH ₂ each time and they all have the same functional group, COOH, so they are carboxylic acids (4) they all react with alcohols to form an ester and water, they all react with sodium hydroxide and they all have the same functional group (4)
Level 3	5–6	- Interpretation and evaluation of the information, demonstrating throughout the skills of synthesising relevant understanding. (AO3) - The explanation is supported throughout by linkage and application of knowledge and understanding of scientific ideas, logical connections made between elements in the context of the question. (AO2) Uses the table to draw deductions and describes a pattern	e.g. they all react with alcohols to form an ester and water, they all react with sodium hydroxide and they all have the same functional group and as molecules get bigger.... density falls boiling point rises

