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EDEXCEL GCSE CHEMISTRY: QUESTIONS BY TOPIC

## Separate Chemistry 2 (9)

**GCSE Chemistry (Foundation) Topic 9**

21 questions · 201 marks · Mark schemes included

*Pearson Edexcel GCSE (9-1) Chemistry 1CH0, Foundation 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. <b>Q2</b>   | Paper 2 June 2018                         | 6     | <b>4</b>  |
| 2. <b>Q2</b>   | Paper 2 November 2020                     | 6     | <b>6</b>  |
| 3. <b>Q1</b>   | Paper 2 November 2021                     | 6     | <b>8</b>  |
| 4. <b>Q1</b>   | Paper 2 June 2022                         | 7     | <b>12</b> |
| 5. <b>Q1</b>   | Paper 2 June 2024                         | 7     | <b>15</b> |
| 6. <b>Q2</b>   | Paper 2 June 2025                         | 7     | <b>18</b> |
| 7. <b>Q3</b>   | Paper 2 June 2022                         | 9     | <b>21</b> |
| 8. <b>Q3</b>   | Paper 2 June 2023                         | 9     | <b>23</b> |
| 9. <b>Q3</b>   | Paper 2 June 2024                         | 9     | <b>26</b> |
| 10. <b>Q4</b>  | Paper 2 November 2020                     | 10    | <b>30</b> |
| 11. <b>Q4</b>  | Paper 2 June 2018                         | 11    | <b>34</b> |
| 12. <b>Q10</b> | Paper 2 November 2020                     | 11    | <b>36</b> |
| 13. <b>Q4</b>  | Paper 2 November 2021                     | 11    | <b>38</b> |
| 14. <b>Q10</b> | Paper 2 November 2021                     | 11    | <b>41</b> |
| 15. <b>Q10</b> | Paper 2 June 2022                         | 11    | <b>43</b> |
| 16. <b>Q10</b> | Paper 2 June 2023                         | 11    | <b>46</b> |
| 17. <b>Q10</b> | Paper 2 June 2024                         | 11    | <b>48</b> |
| 18. <b>Q10</b> | Paper 2 June 2025                         | 11    | <b>50</b> |
| 19. <b>Q7</b>  | Paper 2 June 2018                         | 12    | <b>54</b> |
| 20. <b>Q7</b>  | <i>also Topic 7</i> Paper 2 November 2021 | 12    | <b>58</b> |
| 21. <b>Q7</b>  | Paper 2 November 2020                     | 13    | <b>63</b> |



# QUESTIONS

21 questions · 201 marks · lowest tariff first



# 6-MARK QUESTIONS

3 questions in this booklet



2 Figure 3 shows two tests carried out on a white solid and the results of the tests.

|        | test                                                                  | results                                          |
|--------|-----------------------------------------------------------------------|--------------------------------------------------|
| test 1 | flame test carried out                                                | a yellow flame                                   |
| test 2 | dilute hydrochloric acid added<br>gas given off passed into limewater | effervescence occurs<br>the limewater goes milky |

Figure 3

(a) Which ion is shown to be present by the result of test 1?

(1)

- ☐ A lithium
- ☐ B sodium
- ☐ C potassium
- ☐ D calcium

(b) (i) State the name of the gas given off in test 2.

(1)

(ii) State the name of the ion shown to be present in the white solid by the result of test 2.

(1)



- (c) A flame photometer can be used to measure the concentration of potassium ions in a solution.

Figure 4 shows the photometer readings for three different concentrations of potassium ions in solutions.

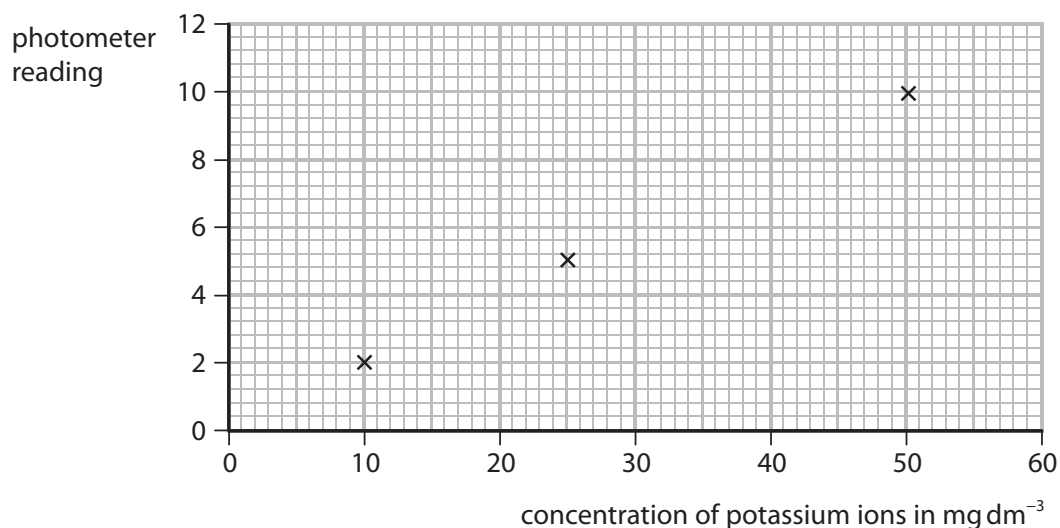


**Figure 4**

- (i) A solution containing a concentration of potassium ions of  $35 \text{ mg dm}^{-3}$  is placed in the photometer.  
The photometer reading is 7.0.

Plot this point on the graph and then draw the straight line of best fit.

(2)

- (ii) Another solution of potassium ions gives a photometer reading of 9.0.

Use the graph to find the concentration of potassium ions in this solution.

(1)

concentration = .....  $\text{mg dm}^{-3}$

**(Total for Question 2 = 6 marks)**

- 2 (a) Figure 2 shows information about three different materials, a composite, a glass and a metal.

|                                | a composite | a glass | a metal |
|--------------------------------|-------------|---------|---------|
| density                        | low         | high    | high    |
| ability to conduct electricity | poor        | poor    | good    |
| resistance to corrosion        | good        | good    | poor    |

**Figure 2**

Explain which material in Figure 2 is the most suitable material to use in electrical circuits.

(2)

.....

.....

.....

.....

- (b) (i) Nanoparticles are very small.

Some nanoparticles have a radius of 17 nm.

The radius of a magnesium atom is 0.16 nm.

Approximately how many times larger is the radius of these nanoparticles than the radius of the magnesium atom?

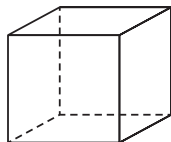
(1)

- ☐ **A** 0.01
- ☐ **B** 0.10
- ☐ **C** 10
- ☐ **D** 100



- (ii) A catalyst contains cube-shaped nanoparticles.  
Figure 3 shows a diagram of a cube-shaped nanoparticle.

The length of each side of the cube is 9 nm.



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**Figure 3**

Calculate the surface area of the cube, in  $\text{nm}^2$ .

(2)

.....

.....

.....

surface area = .....  $\text{nm}^2$

- (iii) Nanoparticles have many uses.  
Some scientists are concerned about the possible risks of using nanoparticles.

Give **one** possible risk of using nanoparticles.

(1)

.....

.....

**(Total for Question 2 = 6 marks)**

- 1 (a) Figure 1 shows a mug made of clay ceramic.

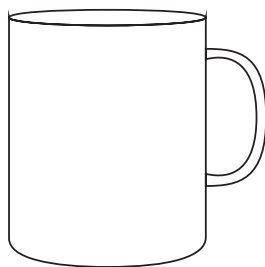


**Figure 1**

Which property of clay ceramic makes it suitable for use as a mug?

(1)

- ☒ **A** is brittle
- ☒ **B** is not transparent
- ☒ **C** does not conduct electricity
- ☒ **D** does not dissolve in water

(b) Figure 2 shows the properties of some materials.

| material     | property |                      |               |             |
|--------------|----------|----------------------|---------------|-------------|
|              | brittle  | conducts electricity | conducts heat | transparent |
| clay ceramic | yes      | no                   | no            | no          |
| glass        | yes      | no                   | no            | yes         |
| metal        | no       | yes                  | yes           | no          |
| polymer      | no       | no                   | no            | no          |

Figure 2

Figure 3 shows an electrical cable.

The electrical cable is made of metal wire coated with another material.

The metal wire inside the electrical cable conducts electricity.

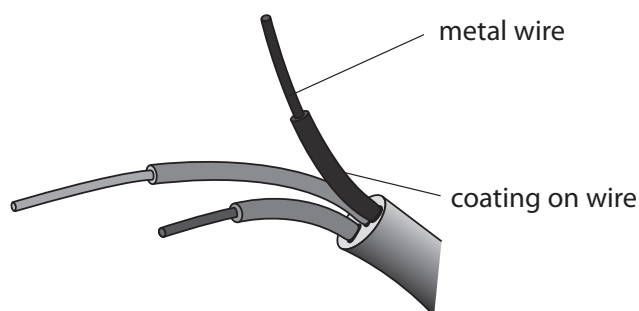


Figure 3

(i) Name a material from Figure 2 that would be suitable for coating the metal wire.

(1)

(ii) Which type of particle moves through the metal wire to allow it to conduct electricity?

(1)

- ☐ A atoms
- ☐ B electrons
- ☐ C neutrons
- ☐ D protons

(c) There are some concerns that nanoparticles may cause harm if they enter the human body.

(i) Suggest one way that nanoparticles can enter the human body.

(1)

(ii) Suggest one possible risk if nanoparticles enter the human body.

(1)

(iii) The surface area of a nanoparticle of gold is  $150 \text{ nm}^2$ .  
The volume of a nanoparticle of gold is  $125 \text{ nm}^3$ .

$$\text{ratio} = \frac{\text{surface area}}{\text{volume}}$$

Calculate the surface area to volume ratio of this nanoparticle of gold.

(1)

surface area to volume ratio = ..... : 1

**(Total for Question 1 = 6 marks)**



# 7-MARK QUESTIONS

3 questions in this booklet



1 Figure 1 shows toothbrushes in a container.

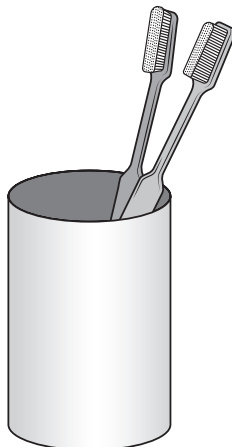


**Figure 1**

(a) The toothbrush handles are made of plastic (polymer).

(i) Give a reason why plastic is a suitable material to make a toothbrush handle.

(1)

.....

.....

(ii) Some toothbrush handles are made of wood, not plastic.

Explain a disadvantage of using plastics.

(2)

.....

.....

(b) The container is made of a ceramic material.

Which is a property of the ceramic that makes it suitable for the container?

(1)

- ☐ **A** it will break if dropped
- ☐ **B** it does not react with water
- ☐ **C** it melts at over 2000 °C
- ☐ **D** it is a good conductor of heat

(c) In some countries, toothpastes contain nanoparticles of silver.

Which statement describes the size of a nanoparticle?

(1)

- ☐ **A** the size of an electron
- ☐ **B** the size of an atom
- ☐ **C** the size of a few hundred atoms
- ☐ **D** the size of 1 million molecules



(d) Toothpastes contain abrasives and other substances to make them effective.

Figure 2 is a pie chart of the percentage composition by volume of one toothpaste.

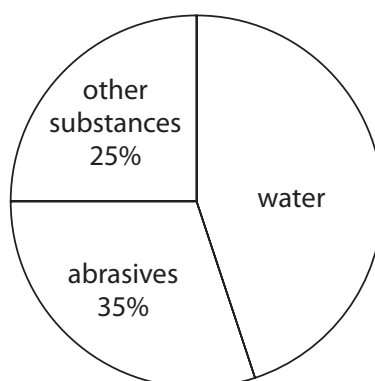


**Figure 2**

Calculate the volume of water in  $150\text{ cm}^3$  of this toothpaste.

(2)

volume of water = .....  $\text{cm}^3$

**(Total for Question 1 = 7 marks)**



- 1 (a) Figure 1 shows a metal spoon.



**Figure 1**

This spoon is made of silver.

- (i) Give a reason why silver is a suitable material to use for making a spoon.

(1)

.....

.....

- (ii) Some spoons are made of wood or plastic, not metal.

The raw material for wooden spoons is trees and the raw material for plastic spoons is crude oil.

Explain an advantage, other than cost, of using wood rather than plastic.

(2)

.....

.....

.....

.....

(b) Some people wear spectacles so that they can see more clearly.

(i) Which property of glass makes it suitable for use in spectacles?

(1)

- ☐ **A** glass does not conduct electricity
- ☐ **B** glass is a poor conductor of heat
- ☐ **C** glass is transparent
- ☐ **D** glass shatters when dropped

(ii) Some spectacles have a coating made of nanoparticles on the glass.

Which statement describes nanoparticles?

(1)

- ☐ **A** nanoparticles are larger than small molecules
- ☐ **B** nanoparticles are a type of atom
- ☐ **C** nanoparticles are very small molecules
- ☐ **D** nanoparticles are the monomers in DNA



(c) One nanoparticle has a cube shape that is shown in Figure 2.

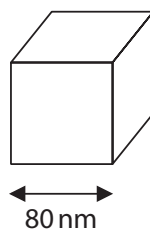


**Figure 2**

Calculate the surface area of this nanoparticle.

surface area = area of one face  $\times$  number of faces

(2)

.....

.....

.....

.....

surface area = ..... nm<sup>2</sup>

**(Total for Question 1 = 7 marks)**

- 2 (a) Flame tests can be used to identify some metal ions.

Draw **one** straight line from each flame colour to the metal ion that produces that flame colour.

(3)

**flame colour**

lilac

orange-red

red

**metal ion**

calcium,  $\text{Ca}^{2+}$

copper,  $\text{Cu}^{2+}$

lithium,  $\text{Li}^+$

potassium,  $\text{K}^+$

sodium,  $\text{Na}^+$



(b) When potassium hydroxide solution is added to copper chloride solution, a precipitate of copper hydroxide and a solution of potassium chloride are formed.

(i) Write the word equation for this reaction.

(2)

.....  
→  
.....

(ii) Copper hydroxide contains copper ions,  $\text{Cu}^{2+}$ .

What colour is copper hydroxide?

(1)

- ☐ **A** yellow
- ☐ **B** red-brown
- ☐ **C** green
- ☐ **D** blue

(iii) The formula of potassium chloride is KCl.

Give the number of ions in the formula KCl.

(1)

.....  
(Total for Question 2 = 7 marks)



# 9-MARK QUESTIONS

3 questions in this booklet



3 Compounds are tested to see if they contain chloride, bromide or iodide ions.

Figure 5 shows a flow chart of this test.

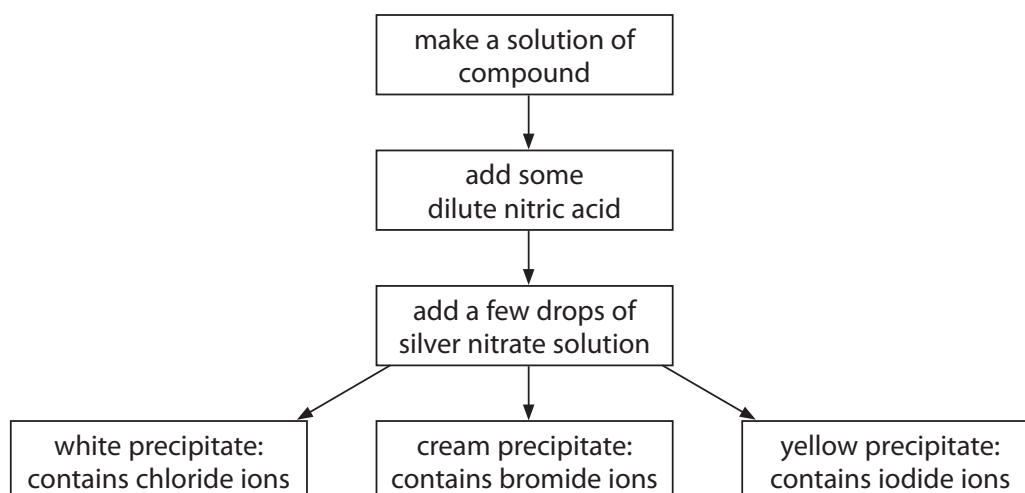


Figure 5

(a) (i) Describe how to make a solution from a solid in a test tube.

(2)

(ii) Give the name of the apparatus that should be used to add a few drops of silver nitrate solution to the test tube.

(1)

(iii) When an equation is written for this reaction, which state symbol is used for the silver nitrate solution?

(1)

- ☐ A aq
- ☐ B g
- ☐ C l
- ☐ D s

- (b) (i) When one compound is tested, a precipitate is seen.

State what you **see** when a precipitate forms.

(1)

- (ii) Using Figure 5, name the ion in the compound that causes a cream precipitate.

(1)

ion .....

- (c) A compound of potassium is tested.  
It forms a white precipitate.

- (i) Using Figure 5, name the compound.

(1)

- (ii) 10.0 g of the solution of the compound of potassium are tested.  
1.0 g of dilute nitric acid is added.  
4 drops of silver nitrate solution are added, each with a mass of 0.2 g.

Calculate the mass of the mixture at the end of the test.

(2)

mass = ..... g

**(Total for Question 3 = 9 marks)**



3 Chemical tests are used to identify unknown substances.

(a) A flame test can be used to identify metal ions in a substance.

(i) Complete step 2 of how to carry out a flame test.

(2)

**step 1** dip a flame test wire in dilute hydrochloric acid and then hold the wire in a roaring Bunsen flame until the flame is colourless

**step 2** .....

.....

.....

**step 3** hold the wire with the substance in a roaring Bunsen burner flame.

(ii) Many metal ions produce a coloured flame in a flame test.

Draw one straight line from each metal ion to its flame colour in a flame test.

(3)

**metal ion**

**flame colour**

|               |   |            |
|---------------|---|------------|
|               | • | blue-green |
| copper ion    | • | lilac      |
| potassium ion | • | orange-red |
| sodium ion    | • | red        |
|               | • | yellow     |



(b) Some metal ions can be identified using sodium hydroxide solution.

Drops of sodium hydroxide solution were added to a solution containing iron(III) ions,  $\text{Fe}^{3+}$ .

What would be seen?

(1)

- ☐ **A** blue solution
- ☐ **B** green liquid
- ☐ **C** red-brown precipitate
- ☐ **D** yellow gas

(c) In the test for carbonate ions, dilute hydrochloric acid is added to the solid carbonate in a test tube.

A gas is given off.

(i) Give the name of this gas.

(1)

(ii) Figure 6 shows the apparatus that a student set up to test for this gas.

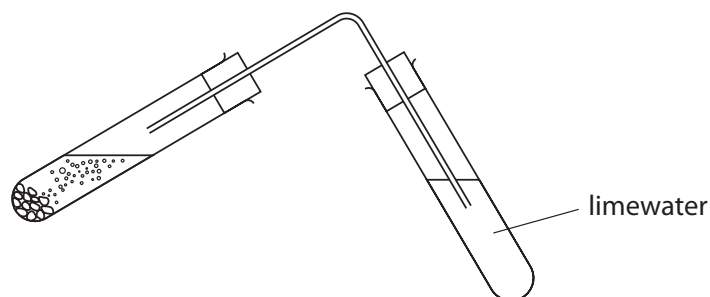


Figure 6

This apparatus will not work.

State what change is needed so that bubbles of the gas can pass through the limewater.

(1)

.....

.....

(d) A compound that contained ammonium ions was dissolved in water.

A solution was formed.

Sodium hydroxide solution was added, and the mixture was heated.

A gas was given off.

This gas was tested with a piece of damp red litmus paper.

The litmus paper turned blue.

Name the gas that was given off.

(1)

.....  
(Total for Question 3 = 9 marks)



3 Compound **A** contains either aluminium ions or copper ions or iron(II) ions.

Figure 5 is a flow chart of the method for the test to identify the ions in compound **A**.

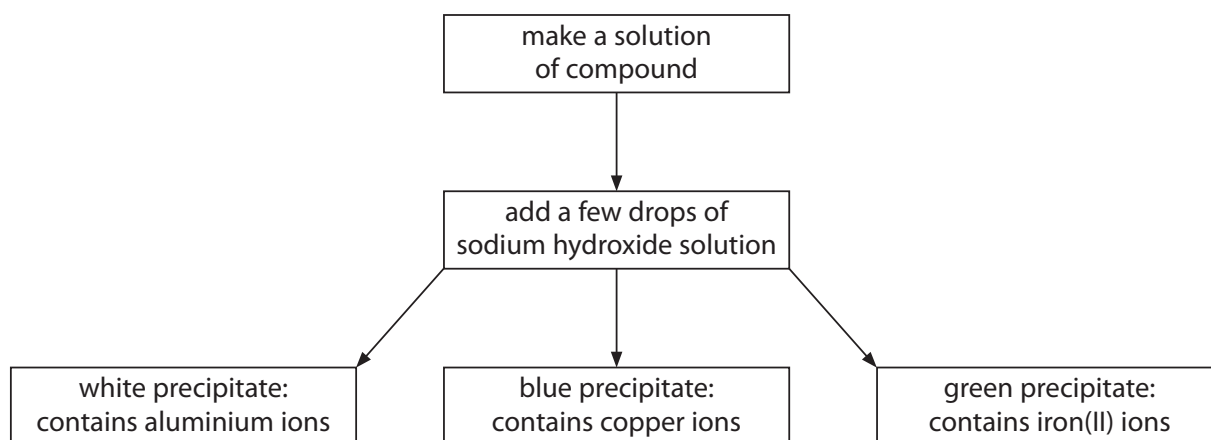


Figure 5

(a) The precipitates formed in this test are solids.

Which state symbol is used for precipitates in equations?

(1)

- ☒ **A** aq
- ☒ **B** g
- ☒ **C** l
- ☒ **D** s

(b) A student is given a container of solid **A** and a bottle of dilute sodium hydroxide solution.

Describe how the student should carry out the test in Figure 5.

Include the names of the apparatus needed.

(3)

.....

.....

.....

.....

.....

.....



(c) Iron(II) chloride is tested using the method in Figure 5.

(i) State what would be **seen** when iron(II) chloride is tested.

(1)

---

---

(ii) What is the formula of an iron(II) ion?

(1)

- ☐ **A**  $\text{Fe}_2$
- ☐ **B**  $\text{Fe}_2^+$
- ☐ **C**  $2\text{Fe}^+$
- ☐ **D**  $\text{Fe}^{2+}$

(d) A different compound is tested using the method in Figure 5.

(i) When the sodium hydroxide solution is added, no precipitate forms.

State what can be concluded from this result.

(1)

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- (ii) In an experiment, the height of the precipitate formed in a reaction is measured using a 10 cm ruler.

The apparatus is shown in Figure 6.

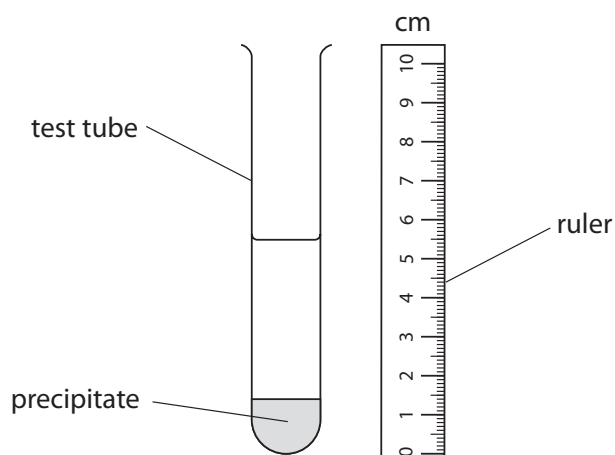


**Figure 6**

Give the height of the precipitate in mm.

(2)

height = ..... mm

**(Total for Question 3 = 9 marks)**

# 10-MARK QUESTIONS

1 question in this booklet



4 Tests are carried out to identify the ions in two solids, **P** and **Q**.

(a) A flame test is used to identify the metal ions in each of these solids.

(i) Describe how to do a flame test.

(2)

.....

.....

.....

.....

.....

.....

(ii) Different metal ions produce different coloured flames.

Draw one straight line from each metal ion to its flame colour.

(2)

**metal ion**

**flame colour**

calcium ●

potassium ●

● green

● yellow

● lilac

● orange-red

● blue-green



(b) **P** and **Q** dissolve in water to form colourless solutions.

Figure 7 shows the results of tests on these solutions.

| test                                                          | results              |                      |
|---------------------------------------------------------------|----------------------|----------------------|
|                                                               | solution of <b>P</b> | solution of <b>Q</b> |
| dilute hydrochloric acid added, then barium chloride solution | a white precipitate  | remains colourless   |
| dilute nitric acid added, then silver nitrate solution        | remains colourless   | a yellow precipitate |

**Figure 7**

(i) The anions in solutions of **P** and **Q** can be identified from the results of the tests shown in Figure 7.

Draw one straight line from each solution to the anion present.

(2)

| solution               | anion       |
|------------------------|-------------|
|                        | ● bromide   |
| solution of <b>P</b> ● | ● carbonate |
|                        | ● chloride  |
| solution of <b>Q</b> ● | ● iodide    |
|                        | ● sulfate   |

(ii) The formula of barium chloride is  $\text{BaCl}_2$ .

Give the total number of ions in the formula  $\text{BaCl}_2$ .

(1)

.....



(c) A few drops of sodium hydroxide solution are added to a solution of iron(II) sulfate. Iron(II) hydroxide is formed.

(i) State what would be **seen**.

(2)

(ii) One other product is formed in this reaction.

What is the name of this other product?

(1)

- ☐ **A** iron(II) chloride
- ☐ **B** sodium chloride
- ☐ **C** sodium sulfate
- ☐ **D** water

(Total for Question 4 = 10 marks)



# 11-MARK QUESTIONS

8 questions in this booklet



4 (a) Nanoparticles are found in some sunscreens.

(i) An atom has a radius of about 0.1 nm.

A nanoparticle might have a radius of about

(1)

- ☐ A 0.01 nm
- ☐ B 0.1 nm
- ☐ C 50 nm
- ☐ D 1 cm

(ii) A useful property of nanoparticles in sunscreens is that they

(1)

- ☐ A have a low surface area to volume ratio
- ☐ B are toxic
- ☐ C are white
- ☐ D prevent harmful UV radiation reaching the skin

(iii) A nanoparticle has a surface area of  $38\,400\text{ nm}^2$  and a volume of  $51\,200\text{ nm}^3$ .

Calculate the surface area to volume ratio.

(2)

.....

.....

.....

.....

surface area to volume ratio = 1.00 : .....



(b) The molecules of three organic substances **A**, **B** and **C** are shown in Figure 6.

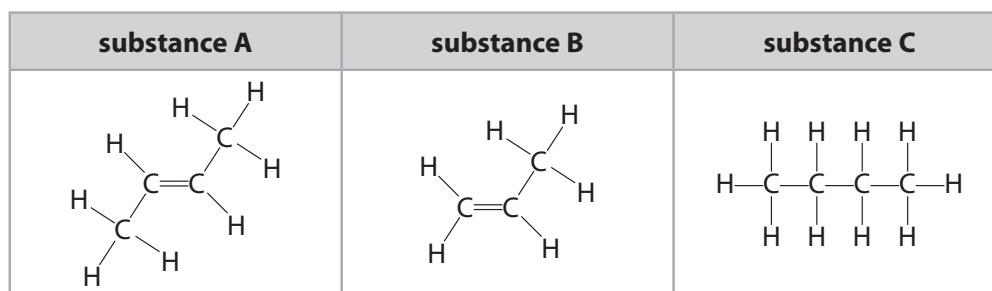


Figure 6

- (i) A small volume of bromine water is added to each of the substances **A**, **B** and **C** and the mixtures shaken.  
Explain why **A** and **B** decolourise bromine water but **C** does not.

(3)

.....

.....

.....

.....

- (ii) Ethane,  $C_2H_6$ , is a hydrocarbon.

Draw a molecule of ethane showing all covalent bonds.

(2)

- (iii) State why ethane is described as a **hydrocarbon**.

(2)

.....

.....

(Total for Question 4 = 11 marks)

10 Figure 16 shows the structure of a molecule of dichloroethene.

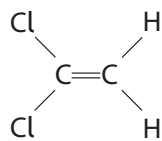


Figure 16

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

(2)

.....

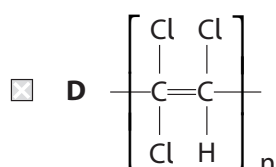
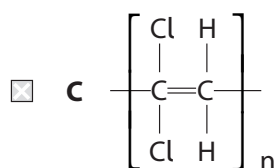
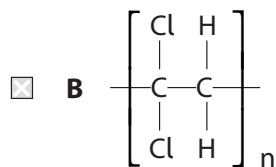
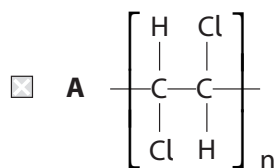
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.....

(ii) Which of these represents the structure of the polymer formed from the monomer in Figure 16?

(1)



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

What would be **seen**?

(1)

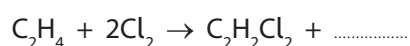
- ☐ **A** both mixtures remain orange
- ☐ **B** only the dichloroethene and bromine water goes colourless
- ☐ **C** only the poly(dichloroethene) and bromine water goes colourless
- ☐ **D** both mixtures go colourless

(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 10 = 11 marks)



4 A student carried out some tests on copper sulfate.

(a) A flame test was carried out on some copper sulfate crystals.

The student used the following method.

**step 1** dip a wire in hydrochloric acid, then hold the wire in a roaring Bunsen burner flame

**step 2** dip the wire in hydrochloric acid again, then dip the wire in the copper sulfate crystals

**step 3** hold the wire with the copper sulfate in the roaring Bunsen burner flame.

(i) State why in step 1 the wire is dipped in hydrochloric acid and held in a roaring Bunsen burner flame.

(1)

(ii) State why in step 2 the wire is dipped in hydrochloric acid again before dipping it in the copper sulfate crystals.

(1)

(iii) What colour should be seen when the flame test is carried out on copper sulfate?

(1)

- ☐ A blue-green
- ☐ B lilac
- ☐ C orange-red
- ☐ D yellow

(b) A solution of the copper sulfate was tested in a flame photometer.

(i) Give an advantage of using a flame photometer, rather than a flame test, to test for copper ions.

(1)



- (ii) Figure 7 shows some values obtained when producing a calibration graph for copper ions in a flame photometer.

Draw a line of best fit through the points.

(1)

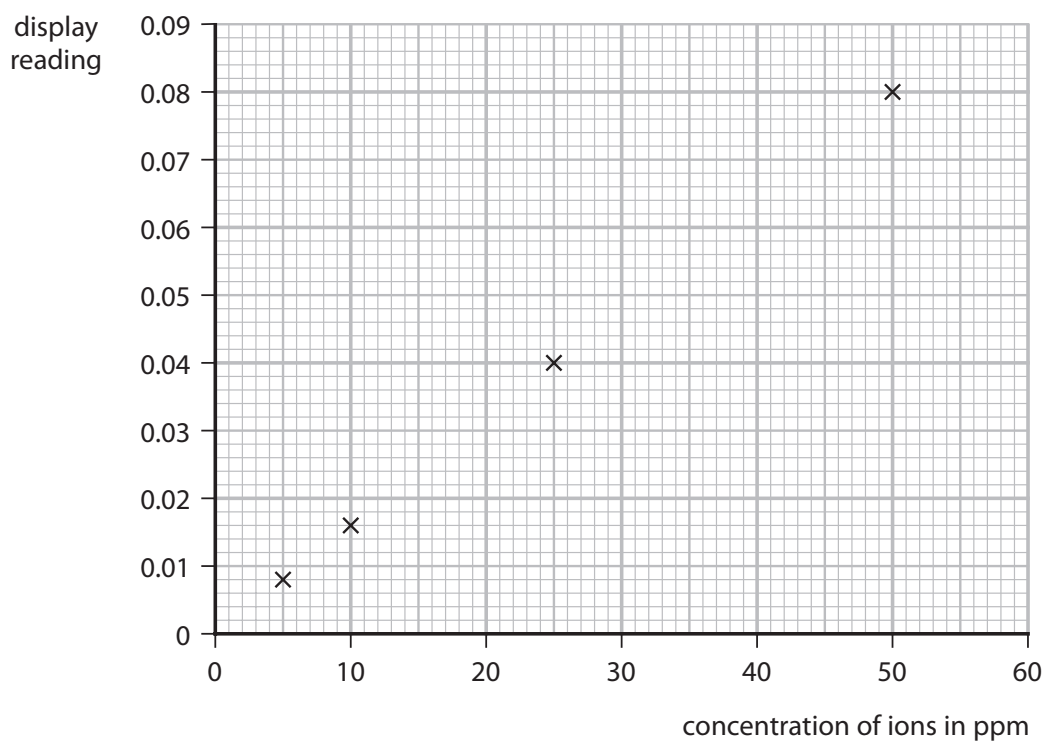


**Figure 7**

- (iii) A solution containing copper ions gave a display reading of 0.030.

Use the calibration graph in Figure 7 to find the concentration of copper ions in this solution.

(1)

concentration of copper ions = ..... ppm



(c) The student tested an unknown solution for sulfate ions by

1. adding a few drops of dilute sulfuric acid to the unknown solution
2. then adding a few drops of barium chloride solution.

A white precipitate was formed.

The student cannot conclude from this result that the unknown solution contains sulfate ions.

Explain what the student should change to obtain a valid result.

(2)

.....

.....

.....

.....

(d) Calculate the percentage by mass of copper in copper sulfate,  $\text{CuSO}_4$ .

(relative atomic masses:  $\text{Cu} = 63.5$   
relative formula mass of  $\text{CuSO}_4 = 159.5$ )

Give your answer to the nearest whole number.

(3)

.....

.....

.....

.....

percentage by mass of copper = .....

**(Total for Question 4 = 11 marks)**



**10** 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 20.

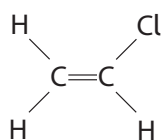


**Figure 20**

(i) On Figure 20, 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 10 = 11 marks)**



**10** (a) Some acids are used in tests for ions.

A bottle of one acid is shown in Figure 17.

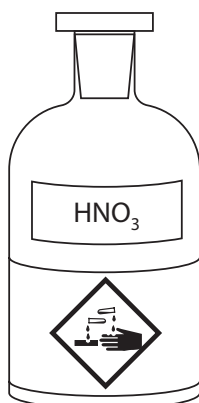


**Figure 17**

(i) The acid in Figure 17 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 17.

**(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 18 shows the results of the flame tests on three compounds, **P**, **Q** and **R**.

| compound | flame colour |
|----------|--------------|
| <b>P</b> | red          |
| <b>Q</b> | lilac        |
| <b>R</b> | blue-green   |

**Figure 18**

Use Figure 18 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  $5.00\text{ cm}^3$  of dilute hydrochloric acid.

$1.00\text{ dm}^3$  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 10 = 11 marks)**



**10** (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 19 shows a cube-shaped nanoparticle with sides of 90 nm.

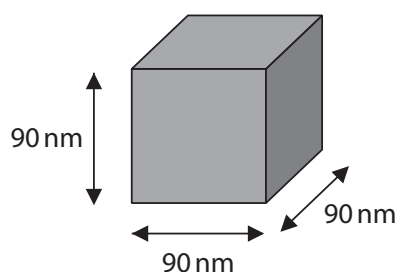


**Figure 19**

(i) What is 90 nm in metres?

(1)

- ☐ **A**  $9.0 \times 10^{-5}$
- ☐ **B**  $9.0 \times 10^{-6}$
- ☐ **C**  $9.0 \times 10^{-8}$
- ☐ **D**  $9.0 \times 10^{-11}$

(ii) Calculate the simplest surface area to volume ratio for the nanoparticle in Figure 19.

Show your working.

(3)

.....

.....

.....

.....

surface area to volume ratio = 1 : .....

(c) Figure 20 shows the structure of a molecule of tetrafluoroethene.

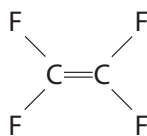


**Figure 20**

(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 Teflon<sup>TM</sup>.

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 10 = 11 marks)**

- 10 (a) Figure 17 shows a poly(ethene) bottle containing substance **K** with one of its hazard symbols showing.

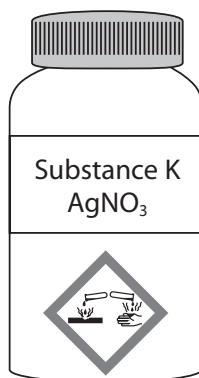


Figure 17

- (i) Explain a safety precaution that should be taken when using a substance with the hazard symbol shown in Figure 17.

(2)

.....

.....

.....

.....

- (ii) Substance **K** has the formula  $\text{AgNO}_3$ . 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)

.....

.....

- (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,  $\text{Na}_2\text{CO}_3$ , is reacted with dilute hydrochloric acid.

Complete and balance the equation for this reaction.

(3)



- (c) The carbonate of element X has the formula  $\text{X}_2\text{CO}_3$ .

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)

.....

.....

.....

relative atomic mass of X = .....

**(Total for Question 10 = 11 marks)**



**10** 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,  $\text{CH}_2\text{CHCH}_3$ .

(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)

.....

.....

.....

.....

(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 15 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 15**



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

Explain, using Figure 15, **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)

.....

.....

.....

.....

mass of water = ..... g



(d) Some crisps contain malic acid.

The structure of one molecule of malic acid is shown in Figure 16.

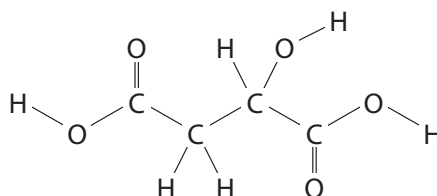


**Figure 16**

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

One type is the  $\text{-COOH}$  functional group.

Give the name of this functional group.

(1)

(ii) Name the other functional group.

(1)

**(Total for Question 10 = 11 marks)**

# 12-MARK QUESTIONS

2 questions in this booklet



- 7 (a) Figure 10 shows information about a glass, a ceramic, a polymer and a metal.

|                         | glass       | ceramic     | polymer     | metal              |
|-------------------------|-------------|-------------|-------------|--------------------|
| flexibility             | low         | low         | high        | high               |
| hardness                | medium      | medium      | low         | low                |
| reaction with water     | no reaction | no reaction | no reaction | very slow reaction |
| electrical conductivity | low         | low         | low         | high               |
| melting point           | high        | high        | medium*     | high               |

\*polymers soften, rather than melt, when heated.

**Figure 10**

Figure 11 shows part of a household wire that connects a kettle to a plug.

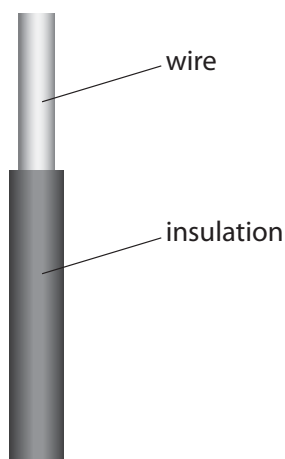


**Figure 11**

- (i) Why is this wire made of metal?

(1)

- ☐ A the metal is hard
- ☐ B the metal reacts with water
- ☐ C the metal is an element
- ☐ D the metal conducts electricity

(ii) Which type of material would be most suitable for the insulation on this household wire?

(1)

- ☐ **A** the glass
- ☐ **B** the ceramic
- ☐ **C** the polymer
- ☐ **D** the metal

(b) Explain, using information from Figure 10, why the ceramic is a suitable material to make a cup that will contain a hot drink of tea or coffee.

(2)

.....

.....

.....

(c) (i) The structure of a molecule of a polymer is shown in Figure 12.

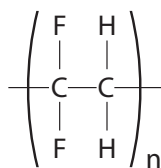
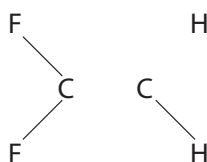


**Figure 12**

Complete the structure of a molecule of the monomer used to make this polymer by adding the missing covalent bonds.

(2)



- \*(ii) Poly(ethene) has many uses in everyday life.  
Large amounts of poly(ethene) are manufactured from ethene produced by cracking fractions obtained from crude oil.

Poly(ethene) is used to make many objects.  
After use it is necessary to dispose of the large amounts of poly(ethene) in these objects.

Explain some of the problems associated with the manufacture and disposal of poly(ethene).

(6)

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(Total for Question 7 = 12 marks)



7 This question is about alcohols.

- (a) (i) Figure 14 shows an incomplete diagram of the structure of a molecule of propanol,  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ .

Complete the structure of the molecule of propanol in Figure 14.

(2)

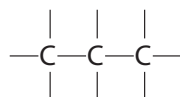


Figure 14

- (ii) Propanol can be converted into propanoic acid.

What happens to propanol in this reaction?

(1)

- ☐ A it is dehydrated
- ☐ B it is neutralised
- ☐ C it is oxidised
- ☐ D it is polymerised

- (b) A student used an alcohol burner to find the mass of different alcohols needed to raise the temperature of  $100\text{ cm}^3$  of water by  $20^\circ\text{C}$ .

Figure 15 shows their results.

| alcohol  | initial mass of alcohol burner and alcohol in g | final mass of alcohol burner and alcohol in g | mass of alcohol used in g |
|----------|-------------------------------------------------|-----------------------------------------------|---------------------------|
| ethanol  | 122.51                                          | 122.02                                        | 0.49                      |
| propanol | 168.55                                          | 168.13                                        | 0.42                      |
| butanol  | 152.62                                          | 152.23                                        |                           |
| pentanol | 67.22                                           | 66.86                                         | 0.36                      |

**Figure 15**

- (i) Calculate the mass of butanol used.

(1)

mass of butanol = ..... g

- \*(ii) Figure 16 shows equipment that can be used to obtain the results shown in Figure 15.

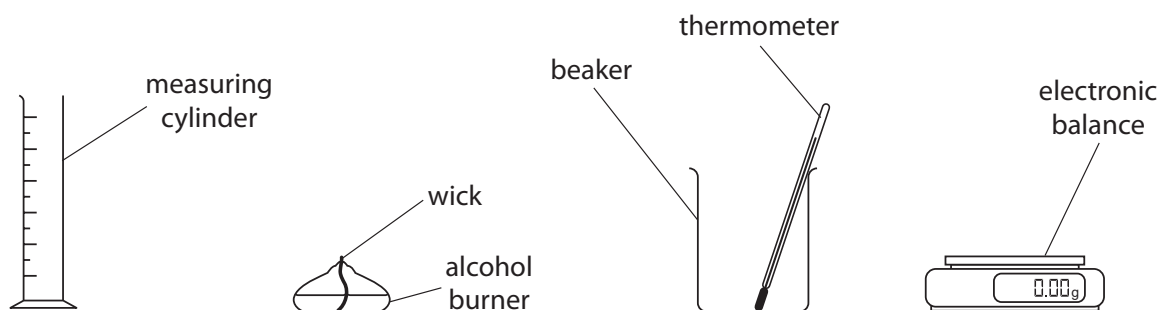


**Figure 16**

Describe an experiment, using the equipment in Figure 16, that could be used to obtain results like those shown in Figure 15.

(6)

Handwriting practice area with 25 horizontal dotted lines.



(iii) The results show that 0.36 g of pentanol was needed to raise the temperature of the water by 20°C.

Calculate the mass of pentanol needed to raise the temperature of water by 1°C.

Give your answer to 2 decimal places.

Show your working.

(2)

.....

.....

.....

mass of pentanol = ..... g

**(Total for Question 7 = 12 marks)**



# 13-MARK QUESTIONS

1 question in this booklet



- 7 (a) Ethanol can be produced by the fermentation of glucose solution.

Which of these shows the word equation for the fermentation of glucose solution?

(1)

- ☐ A glucose → ethanol + water
- ☐ B glucose → ethanol + carbon dioxide
- ☐ C glucose → ethanol + hydrogen
- ☐ D glucose → ethanol + water + carbon dioxide

- (b) The names and formulae of the first four alcohols in the homologous series of alcohols are given in Figure 12.

| name of alcohol | formula                          |
|-----------------|----------------------------------|
| methanol        | CH <sub>3</sub> OH               |
| ethanol         | C <sub>2</sub> H <sub>5</sub> OH |
| propanol        | C <sub>3</sub> H <sub>7</sub> OH |
| butanol         | C <sub>4</sub> H <sub>9</sub> OH |

Figure 12

- (i) Pentanol is the next member of this series.  
A molecule of pentanol contains five carbon atoms.

Suggest the formula of a molecule of pentanol.

(1)

.....

- (ii) Draw the structure of a molecule of ethanol.  
Show all bonds.

(2)

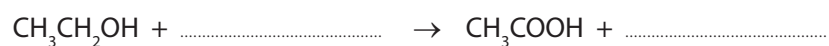


(c) Ethanol is present in alcoholic drinks, such as wine.

When a bottle of wine is left open some of the ethanol reacts with the oxygen in the air to form ethanoic acid,  $\text{CH}_3\text{COOH}$ , and water.

(i) Complete the equation for this reaction.

(2)



(ii) Which calculation shows the percentage by mass of hydrogen in ethanoic acid?

(relative atomic mass of hydrogen,  $\text{H} = 1$ ,  
relative formula mass of ethanoic acid,  $\text{CH}_3\text{COOH} = 60$ )

(1)

☐ **A**  $\frac{1}{60} \times 100$

☐ **B**  $\frac{3}{60} \times 100$

☐ **C**  $\frac{4}{60} \times 100$

☐ **D**  $\frac{60}{1} \times 100$





(Total for Question 7 = 13 marks)



# MARK SCHEMES

official Pearson Edexcel mark schemes



| Question Number | Answer                                                                                                                                                                                                                                                                    | Mark                            |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 2(a)            | <p><b>B</b> sodium</p> <p><b>The only correct answer is B</b></p> <p><i>A is not correct because lithium gives red flame</i></p> <p><i>C is not correct because potassium gives lilac flame</i></p> <p><i>D is not correct because calcium gives red-orange flame</i></p> | <p><b>(1)</b></p> <p>AO 1 1</p> |

| Question Number | Answer         | Additional Guidance                                 | Mark                            |
|-----------------|----------------|-----------------------------------------------------|---------------------------------|
| 2(b)(i)         | carbon dioxide | Allow CO <sub>2</sub><br>Reject carbon monoxide/ CO | <p><b>(1)</b></p> <p>AO 1 1</p> |

| Question Number | Answer                                    | Mark                            |
|-----------------|-------------------------------------------|---------------------------------|
| 2(b)(ii)        | carbonate / CO <sub>3</sub> <sup>2-</sup> | <p><b>(1)</b></p> <p>AO 1 1</p> |

| Question Number | Answer                                                                                                      | Additional guidance                                                                                                                                                                                                                                                                                                                                   | Mark                            |
|-----------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 2(c)(i)         | <ul style="list-style-type: none"> <li>point plotted correctly (1)</li> <li>line of best fit (1)</li> </ul> | <p>Point must be on correct line (35 mg dm<sup>-3</sup>), +/- half a square, i.e. between 6.8-7.2 inclusive</p> <p>Line of best fit must be one <b>single ruler-drawn</b> line that goes through 3 printed points (allow within +/- half a square of every point). Ignore any extrapolation below first printed point or above last printed point</p> | <p><b>(2)</b></p> <p>AO 2 1</p> |

| Question Number | Answer                             | Additional guidance                                                                                                                                                                                                             | Mark                            |
|-----------------|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 2(c)(ii)        | value taken from candidate's graph | <p>Examiner to read value from candidates' line of best fit (whether correct line or not) and allow +/- 1 mg dm<sup>-3</sup></p> <p>If no best fit line at all, or if best fit line does not reach 9, then no marks scored.</p> | <p><b>(1)</b></p> <p>AO 2 1</p> |

**(Total for Question 2 = 6 marks)**



| Question number | Answer                                                                                                                          | Additional guidance | Mark |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------|---------------------|------|
| 2(a)            | An explanation linking <ul style="list-style-type: none"> <li>metal (1)</li> <li>good conductor (of electricity) (1)</li> </ul> |                     | (2)  |

| Question number | Answer                                                                                                                            | Mark |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------|------|
| 2(b)(i)         | D 100<br>D is the only correct answer because $17 / 0.16 \approx 100$<br>A, B and C are incorrect because $17 / 0.16 \approx 100$ | (1)  |

| Question number | Answer                                                                                                                                                                                                                               | Additional guidance                                                                                                               | Mark |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------|
| 2(b)(ii)        | allow 2 for correct answer with or without working<br><br>surface area of 1 side of cube<br>= $9 \times 9$ (1) (= $81 \text{ (nm}^2\text{)})$<br>total area of cube<br>= $6 \times (9 \times 9)$ (1) (= $486 \text{ (nm}^2\text{)})$ | allow $9 \times 9$ (1) $\times 9$<br>(= $729 \text{ (nm}^2\text{)})$<br><br>allow $6 \times 9$ (1) (= $54 \text{ (nm}^2\text{)})$ | (2)  |

| Question number | Answer                                                                                                                     | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------|------|
| 2(b)(iii)       | damages cells/heart problems/get into the bloodstream/pass into cells/catalysing harmful reactions/harmful to aquatic life | (1)  |

(Total for Question 2 = 6 marks)



| Question number | Answer                                                               | Mark       |
|-----------------|----------------------------------------------------------------------|------------|
| 1(a)            | D does not dissolve in water<br>A, B and C are not factually correct | (1)<br>AO2 |

| Question number | Answer  | Mark       |
|-----------------|---------|------------|
| 1(b)(i)         | polymer | (1)<br>AO3 |

| Question number | Answer                                                                                                                                                                                                                                                         | Mark       |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 1(b)(ii)        | B electrons<br><br>A is not correct because atoms do not move through the metallic structure.<br>C is not correct because neutrons do not move through the metallic structure.<br>D is not correct because protons do not move through the metallic structure. | (1)<br>AO1 |

| Question number | Answer                                                                           | Mark       |
|-----------------|----------------------------------------------------------------------------------|------------|
| 1(c)(i)         | breathed in / absorbed by the skin / consumed within food and drink / medication | (1)<br>AO2 |

| Question number | Answer                                                     | Mark       |
|-----------------|------------------------------------------------------------|------------|
| 1(c)(ii)        | catalyse (harmful) reactions / build up and form blockages | (1)<br>AO1 |

|           | Answer  | Mark       |
|-----------|---------|------------|
| 1(c)(iii) | 1.2 : 1 | (1)<br>AO2 |

| Question number | Answer                                                                     | Additional guidance                                                                                                                                                                                                                    | Mark                       |
|-----------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| <b>1(a)(i)</b>  | strong /<br>unreactive (with water/air) /<br>non-toxic /<br>can be moulded | allow: flexible;<br>allow: waterproof, insoluble<br><br>ignore: hard, tough, durable, won't break<br>ignore: Doesn't corrode/ rust<br><br>ignore: easy to make, cheap<br><br>ignore lightweight and any other properties/ descriptions | <b>(1)</b><br><b>A01 1</b> |

| Question number  | Answer                                                                                                                                                                                                                                                                                         | Additional guidance                                                                                                                                                                                                                                                                                                   | Mark                       |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| <b>1(a) (ii)</b> | an explanation linking <ul style="list-style-type: none"> <li>plastics made from (crude) oil (1)</li> <li>which is {finite/ non-sustainable} (1)</li> </ul> OR <ul style="list-style-type: none"> <li>the plastic is non-biodegradable (1)</li> <li>plastic ends up in landfill (1)</li> </ul> | MP2: allow non-renewable<br><br>MP3: allow: {takes a long time/hard} to {decompose/ break down}<br><br>MP4: allow: {hard to/ cannot be} recycled / may give toxic fumes if incinerated<br>ignore any reference to effect on wildlife<br>ignore general answers such as 'harmful to environment'<br>mark independently | <b>(2)</b><br><b>A02 1</b> |



| Question number | Answer                                                                                                                                                      | Mark         |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1(b)            | <p>B it does not react with water is the only correct answer</p> <p>A, C are not correct because they are not useful</p> <p>D is an incorrect statement</p> | (1)<br>AO1 1 |

| Question number | Answer                                                                                                                                                                                                      | Mark         |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1(c)            | <p>C the size of a few hundred atoms is the only correct answer</p> <p>A and B are incorrect because nanoparticles are made of more than one atom</p> <p>D is incorrect as there are too many molecules</p> | (1)<br>AO1 1 |

| Question number | Answer                                                                                                                                                                 | Additional guidance                                                                                                                                                                                                                                         | Mark         |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1(d)            | <ul style="list-style-type: none"> <li>% water = <math>100 - 35 - 25 = 40\%</math> (1)</li> <li><math>40\% \times 150 = 60 \text{ (cm}^3\text{)}</math> (1)</li> </ul> | <p>60 <b>with no working at all</b> scores 2<br/> <math>35 + 25 = 60</math> scores 0.</p> <p>with ANY working shown:</p> <p>MP1 – for 40(%) (do not need to show how calculated). Can be shown on pie chart.</p> <p>allow 0.4 or 2/5</p> <p>ECF for MP2</p> | (2)<br>AO2 1 |

| Question number | Answer                                                                                                                           |                                                          | Mark         |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------------|
| 1(a)(i)         | strong / does not react (with water) / non-toxic / malleable / durable / shiny / high melting point / will not {corrode/oxidise} | ignore rust / colour change<br>ignore references to cost | (1)<br>AO1 1 |

| Question number | Answer                                                                                                                                                                                                                                                                                                         | Additional guidance                                                                                                                                                                          | Mark         |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1(a)(ii)        | an explanation linking any two from: <ul style="list-style-type: none"> <li>trees can be regrown / wood is {renewable / sustainable} / crude oil is finite (1)</li> <li>trees absorb carbon dioxide when growing (1)</li> <li>wood will (bio)degrade in landfill / plastic persists in landfill (1)</li> </ul> | ignore generic answers such as 'pollution', 'bad for the environment', 'less energy' etc.<br><br><br><br><br><br><br><br><br><br>plastic takes many years to decompose<br>allow descriptions | (2)<br>AO2 1 |

| Question number | Answer                                                                                                                                                      | Mark         |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1(b)(i)         | <b>C</b> glass is transparent is the only correct answer<br><br><b>B</b> is not correct because it is not relevant<br><b>A, D</b> are not useful properties | (1)<br>AO1 1 |

| Question number | Answer                                                                                                                                                                     | Mark         |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1(b)(ii)        | <b>A</b> nanoparticles are larger than atoms or small molecules is the only correct answer<br><b>B, C, and D</b> are incorrect because these are not made of nanoparticles | (1)<br>AO1 1 |



| Question number | Answer                                                                                                                                                                            | Additional guidance                      | Mark         |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|--------------|
| 1(c)            | 38400 with or without working scores 2<br><ul style="list-style-type: none"><li>• <math>80 \times 80 = 6400</math> (1)</li><li>• <math>6 \times 6400 = 38400</math> (1)</li></ul> | $80 \times 6 = 480$ (1)<br><br>allow ecf | (2)<br>AO2 1 |

**Total for question 1 = 7 marks**



| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Additional guidance                                          | Mark             |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|------------------|
| 2(a)            | <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>flame colour</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 10px;">lilac</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 10px;">orange-red</div> <div style="border: 1px solid black; padding: 2px;">red</div> </div> <div style="text-align: center;"> <p>metal ion</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 10px;">calcium, Ca<sup>2+</sup></div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 10px;">copper, Cu<sup>2+</sup></div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 10px;">lithium, Li<sup>+</sup></div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 10px;">potassium, K<sup>+</sup></div> <div style="border: 1px solid black; padding: 2px;">sodium, Na<sup>+</sup></div> </div> </div> | if more than one line comes from any box, ignore these lines | <b>A01 1 (3)</b> |

| Question number | Answer                                                                                                                                                                                                                                                                                                                          | Additional guidance                                                                                                                                      | Mark             |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 2(b)(i)         | <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>potassium hydroxide<br/>(+)<br/>copper chloride</p> </div> <div>→</div> <div style="text-align: center;"> <p>copper hydroxide<br/>(+)<br/>potassium chloride</p> </div> </div> <p>LHS (1)<br/>RHS (1)</p> | <p>reject chlorine for chloride in each case</p> <p>reactants can be in either order<br/>products can be in either order</p> <p>ignore state symbols</p> | <b>A02 1 (2)</b> |

| Question number | Answer                                                                                                                         | Mark             |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------|------------------|
| 2(b)(ii)        | <p><b>D</b> blue is the only correct answer</p> <p><b>A, B</b> and <b>C</b> are incorrect because copper hydroxide is blue</p> | <b>A02 1 (1)</b> |

| Question number | Answer  | Mark                 |
|-----------------|---------|----------------------|
| 2(b)(iii)       | 2 / two | <b>A02 1<br/>(1)</b> |

**Total for Question 2 = 7 marks**



| Question number | Answer                                                                                                                | Additional guidance                                                                                                                                                                     | Mark         |
|-----------------|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 3(a)(i)         | A description to include <ul style="list-style-type: none"> <li>• add water (1)</li> <li>• shake/ stir (1)</li> </ul> | allow: solvent / liquid<br>Ignore: acid or alkali for MP1 but can score MP2<br><br>allow: mix; ignore dissolve<br><br>MP2 depends on MP1<br>reject whole answer if referring to melting | (2)<br>AO1 2 |

| Question number | Answer            | Mark         |
|-----------------|-------------------|--------------|
| 3(a)(ii)        | pipette / dropper | (1)<br>AO1 2 |

| Question number | Answer                                                                                                                       | Mark         |
|-----------------|------------------------------------------------------------------------------------------------------------------------------|--------------|
| 3(a)(iii)       | <b>A</b> aq is the only correct answer<br><br><b>B, C</b> and <b>D</b> are incorrect as the substance is a solution in water | (1)<br>AO2 2 |

| Question number | Answer             | Additional guidance                                                                                                                                                             | Mark         |
|-----------------|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 3(b)(i)         | solid/ goes cloudy | allow forms of solid e.g. powder/ sediment / goes milky<br>ignore substance<br>ignore any colours/ colour change<br><br>reject answers involving fixing/ bubbles/ effervescence | (1)<br>AO1 2 |



| Question number | Answer  | Additional guidance                                                                          | Mark         |
|-----------------|---------|----------------------------------------------------------------------------------------------|--------------|
| 3(b)(ii)        | bromide | reject bromine<br>allow $\text{Br}^-$ (allow $\text{br}^-$ , $\text{BR}^-$ , $\text{bR}^-$ ) | (1)<br>A03 2 |

| Question number | Answer             | Additional guidance                                                     | Mark         |
|-----------------|--------------------|-------------------------------------------------------------------------|--------------|
| 3(c)(i)         | potassium chloride | allow KCl<br>(must be capital K, capital C and small l with no charges) | (1)<br>A03 2 |

| Question number | Answer                                                                                                                                                                                         | Additional Guidance                                                                                          | Mark         |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|--------------|
| 3(c)(ii)        | 11.8 (g) with or without working scores 2<br><br><ul style="list-style-type: none"> <li>• <math>0.2 \times 4 (= 0.8)</math> (1)</li> <li>• <math>10 + 1 + 0.8 = 11.8</math> (g) (1)</li> </ul> | allow $0.2 + 0.2 + 0.2 + 0.2 / 0.8$ (no working needed)<br><br>ECF for MP2 if 11 + incorrect mass of 4 drops | (2)<br>A02 1 |



| Question number | Answer                                                                                              | Additional guidance                                                                                                                                                                                     | Mark         |
|-----------------|-----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 3(a)(i)         | {dip/put} flame test wire into dilute hydrochloric acid, (1)<br><br>then into {substance / ion} (1) | allow dip wire into water<br><br>mark independently<br>ignore metal in place of substance<br>ignore use of spatula<br><br>OR<br>make solution of substance (1)<br>dip {wire / splint} into solution (1) | (2)<br>AO1-2 |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                | Additional guidance | Mark         |  |            |            |       |               |            |            |     |  |        |                                                                                      |              |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--------------|--|------------|------------|-------|---------------|------------|------------|-----|--|--------|--------------------------------------------------------------------------------------|--------------|
| 3(a)(ii)        | <table><thead><tr><th>metal ion</th><th>flame colour</th></tr></thead><tbody><tr><td></td><td>blue-green</td></tr><tr><td>copper ion</td><td>lilac</td></tr><tr><td>potassium ion</td><td>orange-red</td></tr><tr><td>sodium ion</td><td>red</td></tr><tr><td></td><td>yellow</td></tr></tbody></table> <p>one mark for each line</p> | metal ion           | flame colour |  | blue-green | copper ion | lilac | potassium ion | orange-red | sodium ion | red |  | yellow | do not award mark if more than one line join a left hand box with those on the right | (3)<br>AO1-1 |
| metal ion       | flame colour                                                                                                                                                                                                                                                                                                                          |                     |              |  |            |            |       |               |            |            |     |  |        |                                                                                      |              |
|                 | blue-green                                                                                                                                                                                                                                                                                                                            |                     |              |  |            |            |       |               |            |            |     |  |        |                                                                                      |              |
| copper ion      | lilac                                                                                                                                                                                                                                                                                                                                 |                     |              |  |            |            |       |               |            |            |     |  |        |                                                                                      |              |
| potassium ion   | orange-red                                                                                                                                                                                                                                                                                                                            |                     |              |  |            |            |       |               |            |            |     |  |        |                                                                                      |              |
| sodium ion      | red                                                                                                                                                                                                                                                                                                                                   |                     |              |  |            |            |       |               |            |            |     |  |        |                                                                                      |              |
|                 | yellow                                                                                                                                                                                                                                                                                                                                |                     |              |  |            |            |       |               |            |            |     |  |        |                                                                                      |              |



| Question number | Answer                                                                                                                     | Mark                       |
|-----------------|----------------------------------------------------------------------------------------------------------------------------|----------------------------|
| 3(b)            | <b>C</b> red-brown precipitate is the only correct answer.<br><b>A, B</b> and <b>D</b> are incorrect results for this test | <b>(1)</b><br><b>AO1-2</b> |

| Question number | Answer         | Additional guidance                                    | Mark                       |
|-----------------|----------------|--------------------------------------------------------|----------------------------|
| 3(c)(i)         | carbon dioxide | allow CO <sub>2</sub><br>do not accept CO <sup>2</sup> | <b>(1)</b><br><b>AO1-2</b> |

| Question number | Answer                                                                   | Additional guidance                                              | Mark                       |
|-----------------|--------------------------------------------------------------------------|------------------------------------------------------------------|----------------------------|
| 3(c)(ii)        | {remove / loosen / slacken} {bung / stopper/lid} of right-hand test tube | allow any change that allows gas to bubble through the limewater | <b>(1)</b><br><b>AO3-3</b> |

| Question number | Answer  | Additional guidance                                                          | Mark                       |
|-----------------|---------|------------------------------------------------------------------------------|----------------------------|
| 3(d)            | ammonia | allow NH <sub>3</sub> / NH <sub>3</sub><br>reject ammonium / NH <sup>3</sup> | <b>(1)</b><br><b>AO1-2</b> |

**Total for Question 3 = 9 marks**



| Question number | Answer                                                                                                                 | Mark         |
|-----------------|------------------------------------------------------------------------------------------------------------------------|--------------|
| 3(a)            | <b>D</b> is the only correct answer<br><br><b>A</b> , <b>B</b> and <b>C</b> are incorrect as the substance is a solid. | (1)<br>AO1 1 |

| Question number | Answer                                                                                                                                                                                                                                                          | Additional guidance                                                                                                                                                                                            | Mark         |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 3(b)            | a description including <ul style="list-style-type: none"> <li>any suitable scientific apparatus for making solution / adding sodium hydroxide (1)</li> <li>dissolve solid A in <b>water</b> (1)</li> <li>{mix / swirl / stir / shake} (the mixture)</li> </ul> | allow any suitable scientific container<br>ignore 'add sodium hydroxide' alone<br>ignore references to PPE<br><br>allow add solid A to <b>water</b><br>ignore 'make a solution'<br><br>mix solid and water (2) | (3)<br>AO1 2 |

| Question number | Answer                                                                                                      | Additional guidance                                                                           | Mark         |
|-----------------|-------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|--------------|
| 3(c)(i)         | <b>green</b> AND {solid/ precipitate}<br><br>OR<br><br><b>green</b> solution {becomes paler / decolourises} | allow any shade of green but reject other colours<br>ignore any other products / observations | (1)<br>AO1 2 |



| Question number | Answer                                                                 | Additional guidance                              | Mark         |
|-----------------|------------------------------------------------------------------------|--------------------------------------------------|--------------|
| 3(d)(i)         | the compound does not contain {aluminium / copper / iron((II))} (ions) | allow 'contains no ions that form a precipitate' | (1)<br>A03 2 |

| Question number | Answer                                                                                 |                                                                                                                  | Mark         |
|-----------------|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|--------------|
| 3(d)(ii)        | 14 mm with or without working scores 2<br><br>1.4 cm (1)<br><br>1.4 x 10 (= 14 mm) (1) | <br><br>allow measurements in the range 1.3 – 1.5 cm<br><br>allow ecf for height of solution or precipitate only | (2)<br>A02 2 |

**Total for question 3 = 9 marks**



| Question number | Answer                                                                                                                                                   | Additional guidance                                                                                                                    | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------|
| 4(a)(i)         | A description including <ul style="list-style-type: none"> <li>• put (clean) wire into solid (1)</li> <li>• hold (wire) in (Bunsen) flame (1)</li> </ul> | put (damp) splint into solid (1)<br><br>hold splint in (Bunsen) flame (1)<br><br>ignore: hold over flame<br>reject use of yellow flame | (2)  |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 4(a)(ii)        | <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <b>metal ion</b><br/><br/> <div style="border: 1px solid black; padding: 5px; width: 100px; margin: 10px auto;">calcium</div> <div style="border: 1px solid black; padding: 5px; width: 100px; margin: 10px auto;">potassium</div> </div> <div style="text-align: center;"> <b>flame colour</b><br/> <div style="border: 1px solid black; padding: 5px; width: 100px; margin: 10px auto;">green</div> <div style="border: 1px solid black; padding: 5px; width: 100px; margin: 10px auto;">yellow</div> <div style="border: 1px solid black; padding: 5px; width: 100px; margin: 10px auto;">lilac</div> <div style="border: 1px solid black; padding: 5px; width: 100px; margin: 10px auto;">orange-red</div> <div style="border: 1px solid black; padding: 5px; width: 100px; margin: 10px auto;">blue-green</div> </div> </div> <p>Each line 1 mark</p> <p>Do not award mark if more than one line join the left hand boxes with those on the right</p> | (2)  |

| Question number | Answer                                                                                                                                                                                                                                                  | Mark |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 4(b)(i)         | <p><b>solution</b></p> <p><b>anion</b></p> <p>bromide</p> <p>• carbonate</p> <p>• chloride</p> <p>• iodide</p> <p>• sulfate</p> <p>Each line 1 mark</p> <p>Do not award mark if more than one line join the left hand boxes with those on the right</p> | (2)  |

| Question number | Answer    | Mark |
|-----------------|-----------|------|
| 4(b)(ii)        | 3 / three | (1)  |

| Question number | Answer                                                                                                   | Additional Guidance                                                                         | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|------|
| 4(c)(i)         | <ul style="list-style-type: none"> <li>green (1)</li> <li>precipitate / (insoluble) solid (1)</li> </ul> | allow any shades of green e.g. light green, grey green, blue green but no other colours (1) | (2)  |

| Question number | Answer                                                                                                                    | Mark |
|-----------------|---------------------------------------------------------------------------------------------------------------------------|------|
| 4(c)(ii)        | <p><b>C</b> sodium sulfate</p> <p><b>A,B</b> and <b>D</b> are incorrect because they are not products of the reaction</p> | (1)  |

(Total for Question 4 = 10 marks)



| Question Number | Answer                                                                                                                                                                                                                                      | Mark                            |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 4(a)(i)         | <p><b>C</b> 50 nm</p> <p><b>The only correct answer is C</b></p> <p><i>A is not correct because this is too small</i></p> <p><i>B is not correct because this is too small</i></p> <p><i>D is not correct because this is too large</i></p> | <p><b>(1)</b></p> <p>AO 1 1</p> |

| Question Number | Answer                                                                                                                                                                                                                                                                             | Mark                            |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 4(a)(ii)        | <p><b>D</b> prevent harmful UV radiation reaching the skin</p> <p><b>The only correct answer is D</b></p> <p><i>A is not correct because ratio is high</i></p> <p><i>B is not correct because this is not useful</i></p> <p><i>C is not correct because this is not useful</i></p> | <p><b>(1)</b></p> <p>AO 1 1</p> |

| Question Number | Answer                                                                                                             | Additional guidance                                                                                                                               | Mark                            |
|-----------------|--------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 4(a)(iii)       | <p>allow 2 for correct answer with or without working</p> <p><u>51200</u> (1)</p> <p>38400</p> <p>1 : 1.33 (1)</p> | <p>allow 2 marks for 3:4</p> <p>allow 1.3, 1.333...</p> <p>Allow 1 mark for final answer</p> <p>1.00: 0.75 or 4:3</p> <p>Ignore 'rec' or dots</p> | <p><b>(2)</b></p> <p>AO 2 1</p> |

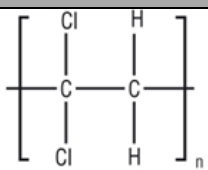
| Question Number | Answer                                                                                                                                                                                                                                                                                                                    | Additional guidance                      | Mark                                            |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|-------------------------------------------------|
| 4(b)(i)         | <p>An explanation that includes</p> <ul style="list-style-type: none"> <li>A is {an alkene/ unsaturated/ has C=C/ has double bond} (1)</li> <li>B is {an alkene/ unsaturated/ has C=C/ has double bond} (1)</li> <li>C {is alkane/ is saturated/ no C=C/ has no double bond/ has <b>only</b> single bonds} (1)</li> </ul> | <p>Do not accept alkynes for alkenes</p> | <p><b>(3)</b></p> <p>AO 3 2a</p> <p>AO 3 2b</p> |

| Question Number | Answer                                                                                                                                                                                   | Additional guidance                                                                                                                                                                                   | Mark                            |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 4(b)(ii)        | $\begin{array}{cc} \text{H} & \text{H} \\   &   \\ \text{H}-\text{C} & -\text{C}-\text{H} \\   &   \\ \text{H} & \text{H} \end{array}$ <p>Fully correct with all capital letters (2)</p> | <p>Allow 1 if fully correct but any small letters</p> <p>allow 1 for any molecule containing 2 carbon atoms and one single C-C bond</p> <p>Reject ethene (=0)</p> <p>Allow Dot-and-cross diagrams</p> | <p><b>(2)</b></p> <p>AO 1 1</p> |

| Question Number | Answer                                                                                   | Additional guidance                                                                                                                   | Mark                            |
|-----------------|------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 4(b)(iii)       | <p>contains carbon and hydrogen (atoms) (1)<br/>only (1)</p> <p>MP2 dependent on MP1</p> | <p>Allow 1: contains carbon and hydrogen molecules <b>only</b></p> <p>Allow 1: Element containing carbon and hydrogen <b>only</b></p> | <p><b>(2)</b></p> <p>AO 1 1</p> |

**(Total for Question 4 = 11 marks)**

| Question number | Answer                                                                                                                                                                                                                  | Additional Guidance                                                                     | Mark |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|------|
| 10(a)(i)        | <p>A description to include any two from</p> <ul style="list-style-type: none"> <li>double bond (in monomer) breaks (1)</li> <li>{monomers/ molecules} link together (1)</li> <li>to form a (long) chain (1)</li> </ul> | <p>diagrams can score MP1, 2 or 3</p> <p>ignore mention of addition or condensation</p> | (2)  |

| Question number | Answer                                                                                                                                                                                                                                                                                                     | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 10(a)(ii)       |  <p><b>B</b><br/>B is the only correct answer.</p> <p>A is not correct as it is poly(1,2-dichloroethene)</p> <p>C is not correct as it has a double bond</p> <p>D is not correct as it is poly(1,1,2-trichloroethene)</p> | (1)  |

| Question number | Answer                                                                                                                                                                                                                                                                                                                        | Mark |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 10(a)(iii)      | <p><b>B</b> only the dichloroethene and bromine water goes colourless</p> <p>A is incorrect because the alkene decolourises bromine water</p> <p>C is incorrect because the polymer does not decolourise bromine water but the alkene does</p> <p>D is not correct because the polymer does not decolourise bromine water</p> | (1)  |

| Question number | Answer                                                                                                                                    | Mark |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------|------|
| 10(b)           | <p><math>C_2H_4 + 2Cl_2 \rightarrow C_2H_2Cl_2 + 2HCl</math></p> <ul style="list-style-type: none"> <li>HCl (1)</li> <li>2 (1)</li> </ul> | (2)  |

| Question number | Answer                                                                                                                                                                                                                                                                                                            | Additional Guidance                                                                                                                                                                                                                                                                                                                                                                           | Mark       |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 10(c)           | <p>An explanation to a property with a linked reason</p> <p>non-toxic <b>(1)</b><br/>so stops food being poisonous <b>(1)</b></p> <p>OR</p> <p>unreactive <b>(1)</b><br/>so it does not react with the food <b>(1)</b></p> <p>OR</p> <p>flexible <b>(1)</b><br/>so it can wrap all around the food <b>(1)</b></p> | <p>MP2 depends on MP1</p> <p>allow</p> <p>impermeable to air <b>(1)</b><br/>stops food {oxidation / reaction with air} <b>(1)</b><br/>ignore 'stops food going off'</p> <p>impermeable to water <b>(1)</b><br/>stops dampening of food <b>(1)</b></p> <p>high melting point (1)<br/>so can wrap hot food (without melting) (1)</p> <p>ignore: strong/ tough/ transparent/ cheap/ can seal</p> | <b>(2)</b> |

| Question number | Answer                                                                                                                                                                                                                  | Additional guidance                                                                                                                                                  | Mark       |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 10(d)           | <p>18 as final answer with or without working scores 3</p> <p><math>100 - 96.5 = 3.5</math> <b>(1)</b><br/> <math>500 \times 3.5/100 (=17.5)</math> <b>(1)</b><br/> <math>= 18</math> (tonnes to 2 s.f.) <b>(1)</b></p> | <p>480 as final answer scores 2<br/> 482.5 / 483 as final answer scores 1</p> <p>answer with working using 96.5 and 500 and rounded correctly to 2 s.f. scores 1</p> | <b>(3)</b> |

**(Total for Question 10 = 11 marks)**



| Question number | Answer                                                 | Mark       |
|-----------------|--------------------------------------------------------|------------|
| 4(a)(i)         | to clean the wire / to prevent contamination of sample | (1)<br>AO1 |

| Question number | Answer                                                                           | Mark       |
|-----------------|----------------------------------------------------------------------------------|------------|
| 4(a)(ii)        | so that the solid vaporises more easily / so that the solid sticks onto the wire | (1)<br>AO1 |

| Question number | Answer                                                                                                                                                                      | Mark       |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| 4(a)(iii)       | A blue-green<br><br>B is incorrect as potassium gives a lilac flame<br>C is incorrect as calcium gives an orange-red flame<br>D is incorrect as sodium gives a yellow flame | (1)<br>AO2 |

| Question number | Answer                                 | Additional guidance                         | Mark       |
|-----------------|----------------------------------------|---------------------------------------------|------------|
| 4(b)(i)         | more {accurate / sensitive / reliable} | requires no judgement / can be quantitative | (1)<br>AO1 |

| Question number | Answer                                          | Mark       |
|-----------------|-------------------------------------------------|------------|
| 4(b)(ii)        | single straight line of best fit through points | (1)<br>AO3 |

| Question number | Answer                                             | Mark       |
|-----------------|----------------------------------------------------|------------|
| 4(b)(iii)       | value consistent with candidate's line of best fit | (1)<br>AO3 |

| Question number | Answer                                                                                                                                  | Additional guidance                             | Mark       |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|------------|
| 4(c)            | An explanation linking<br><br>use hydrochloric acid (rather than sulfuric acid) (1)<br><br>(as) sulfuric acid contains sulfate ions (1) | Allow nitric acid<br>allow use a different acid | (2)<br>AO3 |

| Question number | Answer                                                                                            | Mark       |
|-----------------|---------------------------------------------------------------------------------------------------|------------|
| 4(d)            | $\frac{63.5}{159.5}$ (= 0.39811912) (1)<br><br>$0.398 \times 100$ (= 39.811912) (1)<br><br>40 (1) | (3)<br>AO2 |



| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                      | Mark           |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 10(a)(i)        | Any one from <ul style="list-style-type: none"> <li>• need to sort polymers into different types</li> <li>• polymers often need to be separated from other polymers</li> <li>• takes time to sort by hand</li> <li>• containers may need to be washed before recycling</li> <li>• difficult to break down into their monomers</li> <li>• some not recyclable</li> <li>• requires a lot of energy</li> </ul> | (1)<br><br>AO1 |

| Question number | Answer                                                                                                                                                                                                                                                                                                | Additional guidance                                                                                       | Mark           |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|----------------|
| 10(a)(ii)       | A description to include <ul style="list-style-type: none"> <li>• polymers persist in landfill / landfill site fills up too quickly</li> <li>• polymers degrade very slowly</li> </ul> or <ul style="list-style-type: none"> <li>• combustion produces gases</li> <li>• which may be toxic</li> </ul> | accept polymers persist in the environment / harmful to wildlife<br>not biodegradable / hard to decompose | (2)<br><br>AO1 |

| Question number | Answer            | Additional guidance   | Mark           |
|-----------------|-------------------|-----------------------|----------------|
| 10(b)(i)        | circle around C=C | or circle around C-Cl | (1)<br><br>AO2 |

| Question number | Answer                                                                                                                                                                                                                                                                                                              | Additional guidance                                                                                                                                                                                                                                                                                            | Mark           |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 10(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)<br>single bonds between C atoms (1)<br>rest of structure complete (1)<br><br>allow alternative arrangements<br><br>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)<br><br>AO1 |

| Question number | Answer             | Mark           |
|-----------------|--------------------|----------------|
| 10(b)(iii)      | addition (polymer) | (1)<br><br>AO1 |

| Question number | Answer                                                                                                                  | Additional guidance                                                                                          | Mark           |
|-----------------|-------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|----------------|
| 10(b)(iv)       | relative formula mass $C_2H_3Cl = 62.5$ (1)<br><br>$2850 \times 62.5$ (1) (=178125)<br><br>$178000$ (to 3 sig figs) (1) | without working<br>$178000$ (3)<br>$178125 / 178127$ (2)<br><br>allow ECF on incorrect relative formula mass | (3)<br><br>AO2 |



| Question number | Answer                                                                                                                               | Additional guidance                                                                                                            | Mark          |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------|
| 10(a)(i)        | An explanation linking <ul style="list-style-type: none"> <li>corrosive (1)</li> <li>so wear gloves/ (safety) goggles (1)</li> </ul> | allow safety glasses/ safety spectacles / eye protection<br>ignore glasses and any other precautions<br><br>mark independently | (2)<br>A03 3a |

| Question number | Answer      | Mark         |
|-----------------|-------------|--------------|
| 10(a)(ii)       | nitric acid | (1)<br>A01 1 |

| Question number | Answer                              | Additional guidance                                                                                                                                                | Mark         |
|-----------------|-------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 10(a)(iii)      | inert/ unreactive/ does not corrode | reject 'is not corrosive'<br><br>allow acid will not dissolve/ react with glass<br><br>ignore 'acid won't burn through'<br><br>ignore references to clear / strong | (1)<br>A02 1 |

| Question number | Answer                                                                                                                                                                        | Additional guidance                                                                                                                                                                                                                                  | Mark         |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 10(b)(i)        | An explanation linking <ul style="list-style-type: none"> <li>Hold the wire <b>in</b> the flame / at the tip of the (blue) cone (1)</li> <li>(as) it is hotter (1)</li> </ul> | if the wire has been placed <u>in the flame</u> then any colour of flame is allowed.<br><br>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)<br>A01 2 |



| Question number | Answer                                                                                 | Additional guidance                                                                                                                                                                         | Mark                       |
|-----------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| 10(b)(ii)       | <b>P:</b> lithium / Li (1)<br><b>Q:</b> potassium / K (1)<br><b>R:</b> copper / Cu (1) | for P allow strontium / Sr<br>ignore any charges, even if incorrect (e.g. allow Li <sup>+</sup> , Li <sup>2+</sup> )<br>do not penalise incorrect capital/small letters (e.g. allow CU, li) | <b>(3)</b><br><b>A01 2</b> |

| Question number | Answer                                                                                                                                                                                     | Additional guidance                                                                                                                                                                                       | Mark                       |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| 10(c)           | $20 \times 5/1000 \times 219$ (2) (= 21.9 g)<br><br><ul style="list-style-type: none"> <li>5/1000 (= 0.005) (1)</li> <li><math>20 \times 0.005 \times 219</math> (1) (= 21.9 g)</li> </ul> | overall calculation is $5 \times 219 \times 20 / 1000$<br>deduct 1 mark per error<br><br>allow ECF for MP2<br><br>21900 scores 1 (has not /1000)<br><br>219 with working scores 1 (has used 100 not 1000) | <b>(2)</b><br><b>A02 1</b> |



| Question number | Answer                                                              | Additional guidance                                         | Mark         |
|-----------------|---------------------------------------------------------------------|-------------------------------------------------------------|--------------|
| 10(a)           | proton<br>atom<br>molecule<br>nanoparticle in the correct order (2) | allow<br><br>proton<br>molecule<br>atom<br>nanoparticle (1) | (2)<br>AO1-1 |

| Question number | Answer                                                                                                                                                                                                              | Mark         |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 10(b)(i)        | <b>C</b> $9.0 \times 10^{-8}$ is the only correct answer<br><br><b>A</b> is incorrect as it is 90000 nanometres<br><b>B</b> is incorrect as it is 9000 nanometres<br><b>D</b> is incorrect as it is 0.09 nanometres | (1)<br>AO2-1 |



| Question number | Answer                                                                                                                                                           | Additional guidance                                                                                                                                                                                                                                                                                       | Mark         |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 10(b)(ii)       | surface area = $90 \times 90 \times 6$ (1) = 48 600<br>volume = $90 \times 90 \times 90$ (1) = 729 000<br>$\frac{729\,000}{48\,600} = 15$ (1)<br>answer = 1 : 15 | correct answer of 1:15 without working 3 marks<br><br>allow ecf<br><u>surface area calculated</u> correctly evaluated (1)<br><u>volume calculated</u><br><br>ratio 1:90 scores 2<br><br>$\frac{48600}{729000} = 0.066$ (2)<br><br>$\frac{729000}{8100} = 90$ (2)<br><br>$\frac{8100}{729000} = 0.011$ (1) | (3)<br>AO3-2 |

| Question number | Answer                                                                                                                                                                                                                                                                                                | Additional guidance                                                                                                                                                                                                          | Mark         |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 10(c)(i)        | $  \begin{array}{cc}  \text{F} & \text{F} \\    &   \\  -\text{C} & -\text{C}- \\    &   \\  \text{F} & \text{F}  \end{array}  $ (2)<br><br>OR<br><br>repeat unit including: <ul style="list-style-type: none"> <li>no double bond (1)</li> <li>rest of repeat unit with linking bonds (1)</li> </ul> | allow lowercase f<br>allow diagram to show 1, 2, 4 or 6 carbon atoms eg<br><br>$  \begin{array}{c}  \text{F} \\    \\  -\text{C}- \\    \\  \text{F}  \end{array}  $ 2 marks<br><br>ignore brackets around repeat unit and n | (2)<br>AO2-1 |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Additional guidance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Mark         |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 10(c)(ii)       | <p>Use (1)<br/>Property (1)<br/>Reason (1)<br/>(Property &amp; reason <b>MUST</b> depend on use)</p> <p>Examples:</p> <ul style="list-style-type: none"> <li>for coating (frying) pans (1)</li> <li>because it is {slippery/non stick} (1)</li> <li>food will not stick to the (frying) pan (1)</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>clothing /carpets (1)</li> <li>because it is non-stick (1)</li> <li>easy to clean / will not stain (1)</li> </ul> <p>OR</p> <ul style="list-style-type: none"> <li>bottom of skis (1)</li> <li>because it is slippery (1)</li> <li>less friction on snow (1)</li> </ul> | <p>USES<br/>allow: pans / frying pans / saucepans / tennis rackets / named kitchen equipment / piping / skis</p> <p>ignore: sports equipment (in general) / 'kitchenware' / windows / window ledge / toothpaste</p> <p>PROPERTIES<br/>allow: slippery / smooth / non-stick / unreactive / does not conduct electricity / non-toxic / high melting point</p> <p>ignore: strong / lightweight / high boiling point</p> <p>Other reasonable uses include:</p> <p>lubricants - reduces friction<br/>graft material in surgery – inert/non-reactive<br/>prevent insects from climbing surfaces - slippery<br/>insulation of wiring &amp; electrical circuits – does not conduct electricity/high melting point<br/>plumbers' tape – flexible/waterproof<br/>bottles – inert/non-reactive<br/>raincoat / rainjacket – waterproof<br/>Goretex clothing - waterproof<br/>Umbrella – water repellant<br/>flame retardant material (2) – high melting point<br/>hair straighteners – non-stick/no hair damage</p> <p>Allow any reasonable use</p> | (3)<br>A01-1 |

Total for Question 10 = 11 marks



| Question number | Answer                                                                                                                                        | Additional guidance                                                                                                                                     | Mark                                  |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|
| 10(a)(i)        | An explanation linking <ul style="list-style-type: none"> <li>wear gloves/ goggles (1)</li> <li>because it is <b>corrosive</b> (1)</li> </ul> | mark independently<br><br>allow <u>safety</u> glasses/ <u>safety</u> spectacles<br>ignore eye protection<br><br>ignore burns/ corrodes<br>allow caustic | <b>(2)</b><br><b>A03</b><br><b>3a</b> |

| Question number | Answer         | Mark                       |
|-----------------|----------------|----------------------------|
| 10(a)(ii)       | silver nitrate | <b>(1)</b><br><b>A01 1</b> |

| Question number | Answer                                                            | Additional guidance                                                                                                                                                                      | Mark                       |
|-----------------|-------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| 10(a)(iii)      | inert/ unreactive/ does not corrode / does not break (if dropped) | allow can be moulded into shape / waterproof / non-brittle<br><br>ignore durable / strong/ malleable/ rigid/ flexible/ transparent/ cost<br><br>reject 'is not corrosive'/ non-corrosive | <b>(1)</b><br><b>A02 1</b> |



| Question number | Answer                                                                                                                                                                                                                  | Additional guidance                                                                                                                                                                                                                                       | Mark         |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 10(a)(iv)       | <p>An explanation linking</p> <ul style="list-style-type: none"> <li>• use {a different / sulfuric/ nitric} acid (1)</li> <li>• (as) hydrochloric acid contains chloride/<math>\text{Cl}^-</math> (ions) (1)</li> </ul> | <p>mark independently</p> <p>MP1 is not scored if any additional substances are added except silver nitrate or "K"</p> <p>allow because otherwise silver chloride forms<br/>reject 'contains chlorine'<br/>allow chlorine <b>ions</b>/ Cl <b>ions</b></p> | (2)<br>AO1 2 |

| Question number | Answer                                                                                                                                                                                                                                | Additional guidance                      | Mark         |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|--------------|
| 10(b)           | <p><math>\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2</math> (3)</p> <p>fully correct, balanced equation (3)<br/>all three formulae only (2)<br/>any two correct formulae (1)</p> | <p>allow incorrect cases/ subscripts</p> | (3)<br>AO2 1 |

| Question number | Answer                                                                                                                                                 | Additional guidance                                                                                                      | Mark         |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|--------------|
| 10(c)           | <p>85 with or without working scores 2</p> <p><math>\text{CO}_3 = 12 + 3 \times 16 = 60</math> (1)</p> <p><math>\frac{230 - 60}{2} = 85</math> (1)</p> | <p>final answer of<br/>85 2 marks<br/>170 1 mark</p> <p>allow ecf for MP2 from C+ O value worked out using 12 and 16</p> | (2)<br>AO2 1 |

**Total for question 10 = 11 marks**



| Question number | Answer                                                                                                         | Mark             |
|-----------------|----------------------------------------------------------------------------------------------------------------|------------------|
| 10(a)(i)        | <b>C</b> 42 is the only correct answer<br><br><b>A, B</b> and <b>D</b> are not correct because they are not 42 | <b>A02 1 (1)</b> |

| Question number | Answer                                                                                                                                                                                  | Additional guidance                                                                                                                                                        | Mark             |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 10(a)(ii)       | a description including: <ul style="list-style-type: none"> <li>the <u>double</u> bond breaks (1)</li> <li>(monomers) {link / bond / join / attach} (to form long chain) (1)</li> </ul> | allow <u>double</u> bond 'opens up'<br><br>ignore monomers combine / react<br><br>ignore addition / condensation polymerisation<br><br>reject joins by ionic bonds for MP2 | <b>A01 1 (2)</b> |



| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                      | Additional guidance                                                                                                                                                        | Mark             |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>10(b)</b>    | an explanation linking: <ul style="list-style-type: none"> <li>• (advantage) low relative mass (1)</li> <li>• (so) less energy to <u>transport</u> (1)</li> </ul> <p><b>or</b></p> <ul style="list-style-type: none"> <li>• (advantage) it does not tear (1)</li> <li>• (so) (crisps) won't go stale / won't be exposed to {water/air/oxygen} / prevents oxidation of crisps (1)</li> </ul> | allow cheaper to <u>transport</u><br><br>allow remain sealed<br><br>allow (crisps) won't fall out<br>ignore crisps won't be damaged<br><br>ignore anything about recycling | <b>A03 2 (2)</b> |

| Question number | Answer                                                                                                                                    | Additional guidance                                                                              | Mark             |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|------------------|
| <b>10(c)(i)</b> | an explanation linking <ul style="list-style-type: none"> <li>• less material used (1)</li> <li>• (so) resources conserved (1)</li> </ul> | allow lower mass / lightweight<br>ignore thinner<br><br>allow costs less<br><br>ignore recycling | <b>A03 2 (2)</b> |



| Question number | Answer                                                                                           | Additional guidance                                                                                                                                                                                                                                                                                               | Mark             |
|-----------------|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| 10(c)(ii)       | ratio<br>3 x 75 (=225) <b>and</b> 2 x 18 (=36) (1)<br><br>$\frac{105}{225} \times 36 = 16.8$ (1) | 16.8 / 17 with or without working scores 2.<br>allow 225 and 36 seen (1)<br>$\frac{105}{75}$ (= 1.4) moles amino acid and $\frac{2}{3} \times 1.4 = 0.933$ moles H <sub>2</sub> O (1)<br>so mass of water = 0.933... x 18 = 16.8 (1)<br>allow with working<br>0.467 / 8.4 / 8.57 / 25.2 / 37.80 / 50.4 / 3780 (1) | <b>A02 1 (2)</b> |

| Question number | Answer                     | Additional guidance | Mark             |
|-----------------|----------------------------|---------------------|------------------|
| 10(d)(i)        | carboxyl / carboxylic acid |                     | <b>A02 1 (1)</b> |

| Question number | Answer             | Additional guidance | Mark             |
|-----------------|--------------------|---------------------|------------------|
| 10(d)(ii)       | hydroxyl / alcohol |                     | <b>A02 1 (1)</b> |

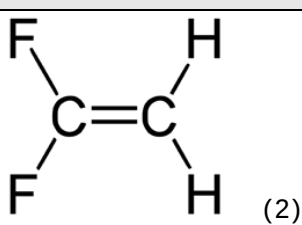
**Total for Question 10 = 11 marks**



| Question Number | Answer                                                                                                                                                                                                                                                                     | Mark                            |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 7(a)(i)         | <p><b>D</b> the metal conducts electricity</p> <p><b>The only correct answer is D</b></p> <p><i>A is not correct because metals are not hard</i></p> <p><i>B is not correct because this is not useful</i></p> <p><i>C is not correct because this is not relevant</i></p> | <p><b>(1)</b></p> <p>AO 2 1</p> |

| Question Number | Answer                                                                                                                                                                                                                                                    | Mark                             |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 7(a)(ii)        | <p><b>C</b> the polymer</p> <p><b>The only correct answer is C</b></p> <p><i>A is not correct because this is not flexible</i></p> <p><i>B is not correct because this is not flexible</i></p> <p><i>D is not correct because this is a conductor</i></p> | <p><b>(1)</b></p> <p>AO 3 1a</p> |

| Question Number | Answer                                                                                                                                                                                                                                                                                                                                                         | Additional guidance                                                                                                               | Mark                                         |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| 7(b)            | <p>Correct property</p> <ul style="list-style-type: none"> <li>no reaction with water/unreactive/ high melting point / low flexibility (1)</li> </ul> <p>Linked to correct reason</p> <ul style="list-style-type: none"> <li>drinks contain water/will not react with drink/ ceramic will not melt / cup will not distort / cup will keep shape (1)</li> </ul> | <p>No property given = no marks</p> <p>If more than one property given Ignore any incorrect properties and associated reasons</p> | <p><b>(2)</b></p> <p>AO 3 1a<br/>AO 3 1b</p> |

| Question Number | Answer                                                                                                                                                                       | Mark                            |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 7(c)(i)         |  <p>(2)</p> <p>1 mark for each correct bond</p> <p>-1 for each <u>additional</u> bond</p> | <p><b>(2)</b></p> <p>AO 2 1</p> |

| Question Number | Indicative content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Mark                            |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| *7(c)(ii)       | <p>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.</p> <p>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.</p> <p><b>Aspect 1: MANUFACTURE</b></p> <ul style="list-style-type: none"> <li>• crude oil is a raw material</li> <li>• crude oil is finite</li> <li>• cracking requires a lot of energy</li> <li>• generation of energy for fractional distillation and cracking may cause release of carbon dioxide</li> <li>• carbon dioxide is a greenhouse gas and may lead to global warming</li> </ul> <p><b>Aspect 2: DISPOSAL</b></p> <ul style="list-style-type: none"> <li>• some polymers disposed of in landfill sites</li> <li>• non-biodegradable</li> <li>• persists in landfill</li> <li>• landfill space runs out</li> <li>• some plastic ends up as litter/ in oceans</li> <li>• this may be hazardous to wildlife</li> <li>• some polymers are recycled</li> <li>• polymers must be sorted into different types</li> <li>• public must make effort to sort/ recycle</li> <li>• some polymers are burnt</li> <li>• produces carbon dioxide</li> <li>• carbon dioxide is a greenhouse gas</li> <li>• greenhouse gases may cause global warming</li> <li>• toxic gases may be produced</li> </ul> <p>Ignore all irrelevant material<br/>Ignore general statements such as 'disposal of polymers is harmful to the environment'<br/>If carbon dioxide/ greenhouse effect etc. mentioned in both aspects, only credit once</p> | <p><b>(6)</b></p> <p>AO 1 1</p> |
| Level           | Descriptor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                 |
|                 | No rewardable material.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                 |
| Level 1         | <ul style="list-style-type: none"> <li>• Demonstrates elements of biological understanding, some of which is inaccurate. Understanding of scientific ideas lacks detail.</li> <li>• Presents an explanation with some structure and coherence.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                 |

|         |                                                                                                                                                                                                                                                                                                                                    |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Level 2 | <ul style="list-style-type: none"><li>• Demonstrates biological understanding, which is mostly relevant but may include some inaccuracies. Understanding of scientific ideas is not fully detailed and/or developed.</li><li>• Presents an explanation that has a structure which is mostly clear, coherent and logical.</li></ul> |
| Level 3 | <ul style="list-style-type: none"><li>• Demonstrates accurate and relevant biological understanding throughout. Understanding of the scientific ideas is detailed and fully developed.</li><li>• Presents an explanation that has a well-developed structure which is clear, coherent and logical.</li></ul>                       |

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**(Total for Question 7 = 12 marks)**



| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Additional guidance                                            | Mark                  |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------|
| 7(a)(i)         | <div style="text-align: center;"> <math display="block">\begin{array}{ccccccc} &amp; \text{H} &amp; \text{H} &amp; \text{H} &amp; &amp; &amp; \\ &amp;   &amp;   &amp;   &amp; &amp; &amp; \\ \text{H} &amp; -\text{C} &amp; -\text{C} &amp; -\text{C} &amp; -\text{O} &amp; -\text{H} \\ &amp;   &amp;   &amp;   &amp; &amp; &amp; \\ &amp; \text{H} &amp; \text{H} &amp; \text{H} &amp; &amp; &amp; \end{array}</math> </div> <p>(2)</p> <p>OR</p> <p>hydroxyl group on a carbon (1)</p> <p>rest of molecule correct (1)</p> | <p>allow OH for O-H</p> <p>reject any multiple bonds drawn</p> | <p>(2)</p> <p>AO1</p> |

| Question number | Answer                                                                                                  | Mark                  |
|-----------------|---------------------------------------------------------------------------------------------------------|-----------------------|
| 7(a)(ii)        | <p><b>C</b> it is oxidised</p> <p><b>A, B and D</b> are incorrect as this is an oxidation reaction.</p> | <p>(1)</p> <p>AO2</p> |

| Question number | Answer                                                                                             | Mark                  |
|-----------------|----------------------------------------------------------------------------------------------------|-----------------------|
| 7(b)(i)         | <p>0.39 with or without working scores 1 mark</p> <p><math>152.62 - 152.23 (= 0.39)</math> (1)</p> | <p>(1)</p> <p>AO2</p> |

| Question number | Indicative content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Mark |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| *7(b)(ii)       | <p>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.</p> <p><b>AO1 (6 marks)</b></p> <ul style="list-style-type: none"> <li>• measure 100 cm<sup>3</sup> of water into a beaker.</li> <li>• place the beaker above the burner</li> <li>• place draft shields around the equipment</li> <li>• weigh the (alcohol) burner containing the alcohol</li> <li>• record this mass and the name of the alcohol.</li> <li>• place a thermometer in the water</li> <li>• record the initial temperature of the water</li> <li>• place a lid on beaker</li> <li>• light the wick.</li> <li>• heat the water so the temperature rises by 20°C.</li> <li>• extinguish the flame.</li> <li>• re-weigh the (alcohol) burner</li> <li>• subtract final mass from initial mass of burner and alcohol/ calculate the mass of alcohol used.</li> <li>• repeat with the next alcohol</li> <li>• using same volume of water</li> <li>• keep the height of the beaker the same</li> </ul> | (6)  |

| Level   | Mark | Descriptor                                                                                                                                                                                                                                                                                                                                                |
|---------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|         | 0    | No rewardable material.                                                                                                                                                                                                                                                                                                                                   |
| Level 1 | 1–2  | Heat the water by 20°C and then subtract the final mass from the initial mass of the burner and alcohol                                                                                                                                                                                                                                                   |
| Level 2 | 3–4  | Measure 100 cm <sup>3</sup> of water into a conical flask, allow the alcohol to heat the water so the temperature rises by about 20°C. re-weigh the spirit burner and cap then calculate the mass of alcohol used.                                                                                                                                        |
| Level 3 | 5–6  | Measure 100 cm <sup>3</sup> of water into a conical flask/beaker. Weigh the burner and cap containing the alcohol. Record the initial temperature of the water in the flask. Allow the alcohol to heat the water so the temperature rises by about 20°C. Re-weigh the spirit burner and cap, subtract final mass from initial mass of burner and alcohol. |

| Question number | Answer                                                                                                               | Mark                         |
|-----------------|----------------------------------------------------------------------------------------------------------------------|------------------------------|
| 7(b)(iii)       | <p>0.02 with or without working scores 2 marks</p> <p><math>\frac{0.36}{20} = (0.018)</math> (1)</p> <p>0.02 (1)</p> | <p>(2)</p> <p><b>AO2</b></p> |

| Question number | Answer                                                                                                                                                                                                                                                                             | Mark |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 7(a)            | <p><b>B</b> glucose → ethanol + carbon dioxide</p> <p><b>B</b> is the only correct answer.</p> <p><b>A</b> is incorrect because water is not produced</p> <p><b>C</b> is incorrect because hydrogen is not produced</p> <p><b>D</b> is incorrect because water is not produced</p> | (1)  |

| Question number | Answer                            | Additional guidance                    | Mark |
|-----------------|-----------------------------------|----------------------------------------|------|
| 7(b)(i)         | C <sub>5</sub> H <sub>11</sub> OH | allow C <sub>5</sub> H <sub>12</sub> O | (1)  |

| Question number | Answer                                                                                                                                                                           | Additional guidance                                                                                                                                                                                 | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 7(b)(ii)        | $  \begin{array}{c}  \text{H} \quad \text{H} \\    \quad   \\  \text{H}-\text{C}-\text{C}-\text{O}-\text{H} \\    \quad   \\  \text{H} \quad \text{H}  \end{array}  $ <p>(2)</p> | <p>allow 1 for any molecule containing 2 carbon atoms and one single C-C bond OR any molecule containing one C-O-H</p> <p>allow the OH without bond between</p> <p>allow dot-and-cross diagrams</p> | (2)  |

| Question number | Answer                                                                                                                                             | Additional guidance                                  | Mark |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|------|
| 7(c)(i)         | <p>C<sub>2</sub>H<sub>5</sub>OH + O<sub>2</sub> → CH<sub>3</sub>COOH + H<sub>2</sub>O (2)</p> <p>left hand side (1)</p> <p>right hand side (1)</p> | <p>correct formulae with incorrect balancing (1)</p> | (2)  |

| Question number | Answer                                                                                                                                                                                                                                                                                                                                                                   | Mark |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 7(c)(ii)        | <p><b>C</b> 4/60 × 100</p> <p><b>C</b> is the only correct answer.</p> <p><b>A</b> is incorrect because there are four atoms of hydrogen in ethanoic acid</p> <p><b>B</b> is incorrect because there are four atoms of hydrogen in ethanoic acid</p> <p><b>D</b> is incorrect because the fraction is inverted and there are four atoms of hydrogen in ethanoic acid</p> | (1)  |



| Question number | Indicative content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Mark |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| *7(c)           | <p>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.</p> <p>A description to include some of the following points</p> <p><b>(reasons for the uses)</b></p> <p><b>poly(ethene) :</b></p> <ul style="list-style-type: none"> <li>plastic bags / plastic bottles - flexible/bendable, inert/unreactive, waterproof/weatherproof, light</li> </ul> <p><b>poly(chloroethene) :</b></p> <ul style="list-style-type: none"> <li>window frames / gutters / waterpipes - tough/hard, long-lasting, durable/good insulator, waterproof/weatherproof, inert/unreactive</li> <li>insulation for electrical wires - flexible /bendable, good insulator, waterproof/weather proof, inert/unreactive</li> </ul> <p><b>poly(tetrafluoroethene):</b></p> <ul style="list-style-type: none"> <li>coating for frying pans - slippery, non-stick, tough, high melting point/heat resistant, inert/unreactive</li> <li>stain-proofing clothing and carpets - slippery</li> </ul> <p><b>(problems of disposal)</b></p> <p><b>landfill</b></p> <ul style="list-style-type: none"> <li>non-biodegradable</li> <li>persist in landfill/very long time to degrade</li> <li>fill up land/new landfill sites needed</li> <li>harmful to animal habitats</li> </ul> <p><b>recycling</b></p> <ul style="list-style-type: none"> <li>plastics need to be sorted/time consuming</li> <li>transport to collection area/recycling point uses fuel</li> <li>collection point may cause litter problem/eyesore etc</li> </ul> <p><b>burning</b></p> <ul style="list-style-type: none"> <li>toxic substances released</li> <li>hydrogen chloride/acid gas produced from burning PVC</li> <li>carbon dioxide released contributing to global warming</li> <li>carbon monoxide released</li> <li>toxic ash/solids formed</li> </ul> | (6)  |



| Level   | Mark | Additional Guidance                                                                                                                                                                                                                                                                                                                                               | General additional guidance – the decision within levels<br>Eg - At each level, as well as content, the scientific coherency of what is stated backed up by planning 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> <ul style="list-style-type: none"> <li>gives simple statements about problems in disposal of polymers OR</li> <li>link a use of one polymer to its properties</li> </ul>                                                                                                                                                               | <u>Possible candidate responses</u> <ul style="list-style-type: none"> <li>polymers are not biodegradable</li> <li>not all polymers can be recycled</li> <li>polythene is used in plastic bags because it is flexible</li> <li>PTFE is used in frying pans because it is non-stick</li> <li>Statement with detail scores upper mark of level</li> </ul>                                                                                                                                                                                                                           |
| Level 2 | 3–4  | <u>Additional guidance</u> <ul style="list-style-type: none"> <li>links uses of at least two polymers to their properties OR</li> <li>describes at least two problems associated with disposing of polymers OR</li> <li>links a use of at least one polymer to its properties AND describes at least one problem associated with disposing of polymers</li> </ul> | <u>Possible candidate responses</u> <ul style="list-style-type: none"> <li>PVC is used as insulation in electrical wires because it does not conduct electricity. PTFE is used in frying pans because it is non-stick.</li> <li>Polymers will be present in landfill for a long time. Incineration of polymers releases toxic gases.</li> <li>Poly(ethene) is used in plastic bags because it is flexible, but it is not biodegradable.</li> <li>All statements with detail scores upper mark of level</li> </ul>                                                                 |
| Level 3 | 5–6  | <u>Additional guidance</u> <ul style="list-style-type: none"> <li>links uses of at least two polymers to their properties AND explains at least one problem associated with disposing of polymers OR</li> <li>links uses of at least one polymer to its properties AND explains at least two problems associated with disposing of polymers</li> </ul>            | <u>Possible candidate responses</u> <ul style="list-style-type: none"> <li>PTFE is used in stainproof clothing and carpets because it is non-stick so stains are easily removed. PVC is used in window frames because it is waterproof. Polymers last for a long time in landfill sites.</li> <li>Poly(ethene) is used in plastic bottles because it is inert so will not react with food. However, it is not biodegradable and releases carbon dioxide when burnt, which contributes to global warming</li> <li>All statements with detail scores upper mark of level</li> </ul> |

**Total for Question 7 = 13 marks**

