

**GENERAL CERTIFICATE OF SECONDARY EDUCATION**

**GATEWAY SCIENCE**

**B741/01**

**CHEMISTRY B**

Unit B741: Chemistry modules C1, C2, C3 (Foundation Tier)

Candidates answer on the question paper  
 A calculator may be used for this paper

**OCR Supplied Materials:**

None

**Duration:** 1 hour 15 minutes

**Other Materials Required:**

- Pencil
- Ruler (cm/mm)

|                    |  |                   |  |
|--------------------|--|-------------------|--|
| Candidate Forename |  | Candidate Surname |  |
|--------------------|--|-------------------|--|

|               |  |  |  |  |  |                  |  |  |  |  |
|---------------|--|--|--|--|--|------------------|--|--|--|--|
| Centre Number |  |  |  |  |  | Candidate Number |  |  |  |  |
|---------------|--|--|--|--|--|------------------|--|--|--|--|

**INSTRUCTIONS TO CANDIDATES**

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

**INFORMATION FOR CANDIDATES**

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- The Periodic Table can be found on the back page.
- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **75**.
- This document consists of **20** pages. Any blank pages are indicated.

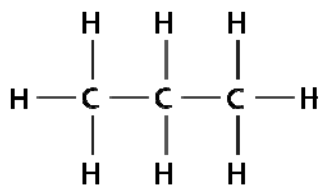
| Examiner's Use Only: |  |    |  |
|----------------------|--|----|--|
| 1                    |  | 8  |  |
| 2                    |  | 9  |  |
| 3                    |  | 10 |  |
| 4                    |  | 11 |  |
| 5                    |  | 12 |  |
| 6                    |  |    |  |
| 7                    |  |    |  |
| <b>Total</b>         |  |    |  |

Answer **all** the questions.

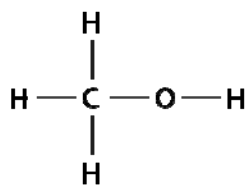
**Section A – Module C1**

1 This question is about carbon compounds.

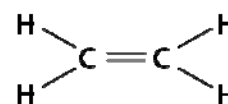
Look at the displayed formulas.



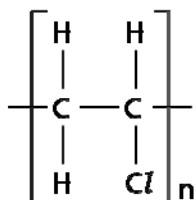
propane



methanol



ethene



poly(chloroethene)



carbon dioxide

(a) Which compound is found in liquefied petroleum gases (LPG)?

Choose from the displayed formulas.

..... [1]

(b) How many atoms are present in the formula for propane?

..... [1]

(c) Write down the **names** of the two elements present in a hydrocarbon.

..... and ..... [1]

**[Total: 3]**

2 Phil is heating his house.



©Robert Brook/Science Photo Library

(a) Phil decides to use natural gas (methane) to heat his house.

Look at the word equation.

It shows what happens during the **complete combustion** of methane.

methane + oxygen  $\longrightarrow$  ..... + water

Finish the word equation.

[1]

(b) Phil uses a gas water heater.

He notices that the water heater is producing lots of soot.

It is important that he gets the gas heater serviced. Explain why.

.....

.....

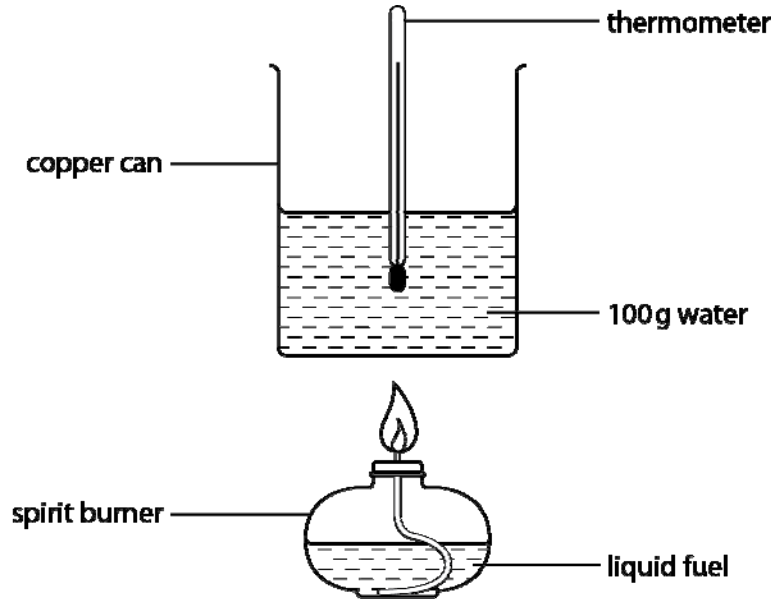
..... [2]

(c) Phil wants to heat his greenhouse.

He decides to test four liquid fuels to see which fuel is the best to use.

Look at the diagram.

It shows the apparatus he uses to measure the energy given out by these fuels.



Look at the table. It shows his results.

| fuel | temperature of water at start in °C | temperature of water at end in °C | cost of fuel burned in pence |
|------|-------------------------------------|-----------------------------------|------------------------------|
| A    | 15                                  | 30                                | 1.0                          |
| B    | 22                                  | 42                                | 2.0                          |
| C    | 20                                  | 25                                | 0.5                          |
| D    | 20                                  | 30                                | 1.5                          |

Phil decides to use fuel **C** to heat his greenhouse.

Evaluate if this is a sensible choice.

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 6]

3 This question is about removing nail varnish.

(a) Some solvents can dissolve nail varnish.

Lesley investigates the solubility of different nail varnishes.

Look at the table of the results of her investigation.

| solvent         | colour of nail varnish |      |        |     |       |
|-----------------|------------------------|------|--------|-----|-------|
|                 | black                  | blue | purple | red | white |
| ethanol         | S                      | I    | S      | I   | I     |
| ethyl ethanoate | S                      | S    | S      | S   | S     |
| petrol          | S                      | S    | I      | S   | I     |
| propanone       | S                      | S    | S      | S   | S     |
| water           | I                      | I    | I      | I   | I     |

I = insoluble and S = soluble

(i) Which solvent did not dissolve any of the nail varnishes?

..... [1]

(ii) Why is ethyl ethanoate a better solvent for nail varnishes than petrol?

.....  
 ..... [1]

(b) Finchfield Pharmaceuticals make a new nail varnish remover.

It must be tested before it can be approved for use by humans.

Give **two** examples of risks that should be tested for.

.....  
 .....  
 .....  
 ..... [2]

[Total: 4]

4 (a) Look at the list. It shows some of the gases found in **clean** air.

- oxygen
- carbon dioxide
- water vapour

Write down the name of one **other** gas present in **clean** air.

..... [1]

(b) Sulfur dioxide causes air pollution.

Write about the **effects** of sulfur dioxide pollution.

.....  
.....  
.....  
..... [2]

(c) Some people throw away plastic bottles. This can cause a litter problem.

Explain why throwing away plastic bottles can cause problems.

.....  
.....  
.....  
..... [3]

**[Total: 6]**



## Section B – Module C2

6 This question is about metals.

Look at the table. It shows the properties of some metals.

| metal     | melting point in °C | density in g/cm <sup>3</sup> | relative electrical conductivity | cost per tonne in £ |
|-----------|---------------------|------------------------------|----------------------------------|---------------------|
| aluminium | 660                 | 2.7                          | 40                               | 1350                |
| copper    | 1083                | 8.9                          | 64                               | 3800                |
| iron      | 1535                | 7.9                          | 11                               | 400                 |
| silver    | 962                 | 10.5                         | 67                               | 20 000              |

(a) Which metal would you chose to make a container in which to melt copper?

answer ..... [1]

(b) Pylon wires are made from metal.



pylon wire

Which metal would be most suitable for using for pylon wires?

Use information about each of the metals in the table to explain your answer.

.....  
 .....  
 .....  
 ..... [3]

(c) Brass is made from copper and zinc.

Write down one use of brass.

..... [1]

[Total: 5]





8 This question is about the manufacture of ammonia.

Ammonia is made in the Haber process.

Look at the equation for the Haber process.



(a) There are many different factors that affect the cost of making ammonia.

Look at the table about the costs of making 10 tonnes of ammonia in a factory.

| factor   | cost in £ |
|----------|-----------|
| energy   | 1000      |
| hydrogen | 250       |
| nitrogen | 50        |
| others   | 100       |

(i) Nitrogen is a much cheaper raw material than hydrogen.

Suggest why.

.....  
 ..... [1]

(ii) Calculate what percentage of the total cost of making ammonia is for energy.

Suggest why the energy costs are so high.

.....  
 .....  
 .....  
 .....  
 ..... [2]

(iii) The ammonia made during this reaction is quickly removed to prevent it breaking down.

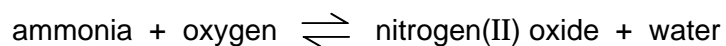
What substances are made when ammonia breaks down?

Use the symbol equation to help you answer.

.....  
 ..... [1]

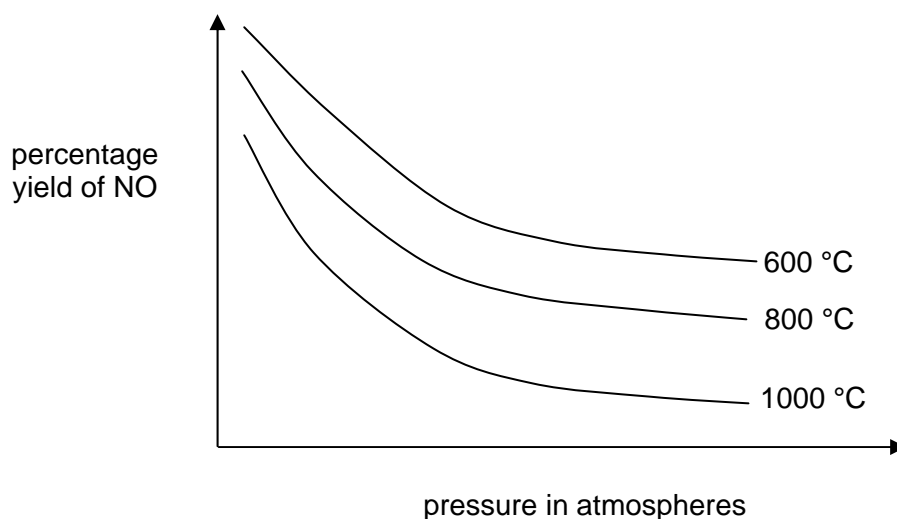
(b) Nitric acid is made from ammonia.

The first reaction in this process involves the oxidation of ammonia.



Look at the sketch graph.

It shows the percentage yield of nitrogen(II) oxide (NO) at different temperatures and pressures.



(i) How does increasing the **temperature** change the percentage yield?

..... [1]

(ii) How does increasing the **pressure** change the percentage yield?

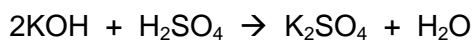
..... [1]

[Total: 6]

9 This question is about fertilisers.

Fertilisers can be made by **neutralisation**.

(a) Look at the equation for a neutralisation reaction to make a fertiliser.



Write down the formula of one **reactant**.

..... [1]

(b) Sodium hydroxide reacts with phosphoric acid.

Construct the **word equation** for this reaction.

..... [1]

(c) Elizabeth is a farmer. She is given some ammonium sulfate to use on her fields.

Elizabeth is deciding whether or not to use the ammonium sulfate on her fields.

What factors should she consider?

.....  
 .....  
 .....  
 ..... [2]

(d) Elizabeth uses a bag of fertiliser that contains only ammonium sulfate,  $(\text{NH}_4)_2\text{SO}_4$ .

Anna uses a bag of fertiliser that is a mixture of potassium nitrate,  $\text{KNO}_3$ , and ammonium phosphate  $(\text{NH}_4)_3\text{PO}_4$ .

Suggest why Anna's bag of fertiliser is better than Elizabeth's.

.....  
 .....  
 ..... [2]

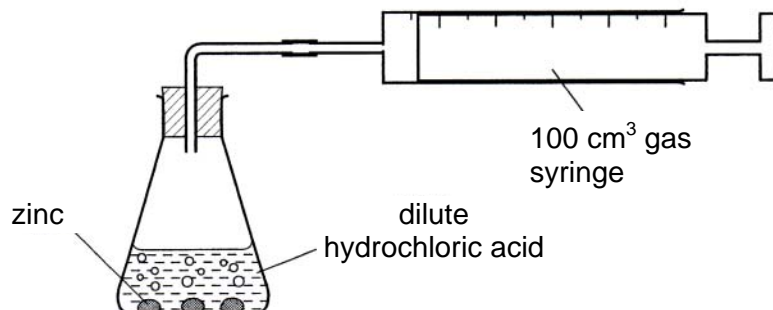
[Total: 6]

## Section C – Module C3

10 Colin and Ann investigate the reaction between zinc lumps and hydrochloric acid.

Hydrogen and a solution of zinc chloride are made.

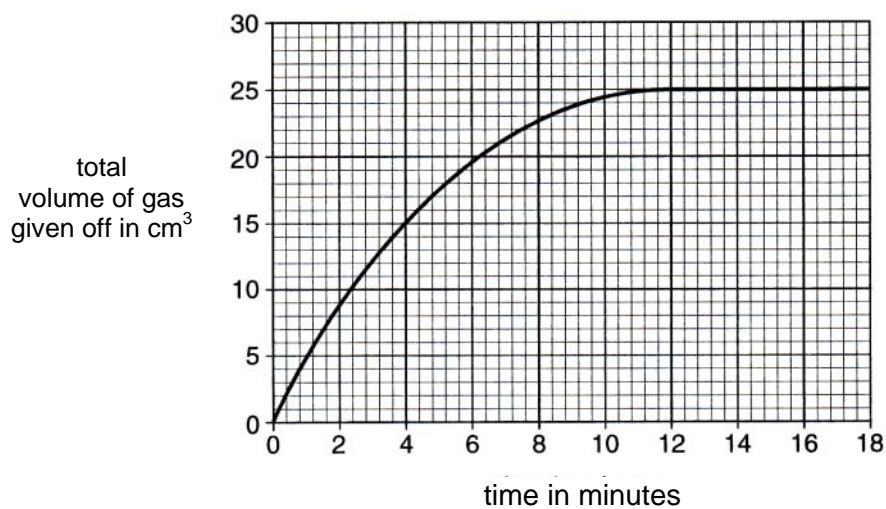
The diagram shows the apparatus they use.



Look at the graph.

It shows their results when 1 g of zinc lumps reacts with 20 cm<sup>3</sup> of dilute hydrochloric acid.

At the end of the experiment almost all of the zinc remained.



(a) How long does it take to make 20 cm<sup>3</sup> of gas?

..... minutes [1]

(b) Why does the reaction stop?

..... [1]



(e) The reaction between zinc and hydrochloric acid goes at a reasonable rate.

Write down the name of one reaction which is **very slow** and one which is **very fast**.

.....

..... [2]

[Total: 12]

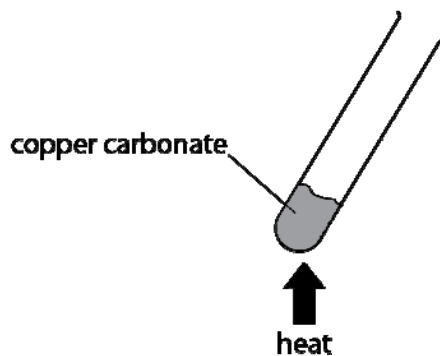
11 Copper carbonate decomposes when heated.

Copper oxide and carbon dioxide are made.



Tim investigates this decomposition.

Look at the apparatus he uses.



Tim heats 1.24 g of copper carbonate in the test-tube.

He uses a yellow Bunsen flame for 1 minute.

(a) Tim finds he only gets an 80% yield of copper oxide.

Suggest why he did not get a 100% yield.

.....  
 ..... [1]

(b) Tim repeats his experiment using 1.24 g of copper carbonate.

He makes certain he gets a 100% yield.

This time he makes 0.80 g of copper oxide.

What mass of **carbon dioxide** can Tim make by heating 0.62 g of copper carbonate?

.....  
 .....  
 .....  
 ..... [2]



(c) A factory manufactures copper oxide by heating copper carbonate.

The carbon dioxide made is a waste product.

(i) Look at the table of relative formula masses,  $M_r$ .

| substance       | relative formula mass, $M_r$ |
|-----------------|------------------------------|
| $\text{CuCO}_3$ |                              |
| $\text{CuO}$    | 80                           |
| $\text{CO}_2$   | 44                           |

The relative atomic mass for Cu is 64, for C is 12 and for O is 16.

Calculate the relative formula mass for copper carbonate.

Put your answer in the table.

.....  
 .....  
 ..... [1]

(ii) Calculate the atom economy for the manufacture of copper oxide.

.....  
 .....  
 .....  
 .....  
 ..... [2]

(iii) A factory wants as high an atom economy as possible when making a chemical.

Explain why.

.....  
 ..... [1]

(iv) The factory uses a batch process rather than a continuous process.

What is the difference between a batch process and a continuous process?

.....

.....

..... [2]

**[Total: 9]**

12 Diamond and graphite have different properties and different uses.

Look at the table.

It shows some information about the properties of diamond and graphite.

| property                       | diamond                        | graphite          |
|--------------------------------|--------------------------------|-------------------|
| state at room temperature      | solid                          | solid             |
| appearance at room temperature | colourless, clear and lustrous | dull black        |
| melting point                  | .....                          | very high         |
| hardness                       | very hard                      | soft and slippery |
| solubility in water            | insoluble                      | insoluble         |
| electrical conductivity        | .....                          | good conductor    |

(a) Complete the table by describing the

- melting point of diamond
- electrical conductivity of diamond.

[2]

(b) Mark decides to use graphite electrodes in the electrolysis of sodium chloride solution.

Use information in the table and your own knowledge to give reasons for his decision.

.....

.....

..... [2]

[Total: 4]

[Paper Total: 75]

**END OF QUESTION PAPER**



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## PERIODIC TABLE

| 1                                    | 2                                  |   |  |                                      |   |                                       |                                      |   |   |  |   | 3                                  | 4                                  | 5                                  | 6                                    | 7                                    | 0                                 |  |                               |
|--------------------------------------|------------------------------------|---|--|--------------------------------------|---|---------------------------------------|--------------------------------------|---|---|--|---|------------------------------------|------------------------------------|------------------------------------|--------------------------------------|--------------------------------------|-----------------------------------|--|-------------------------------|
|                                      |                                    | <b>Key</b><br>relative atomic mass<br><b>atomic symbol</b><br><small>name</small><br>atomic (proton) number |  |                                      |   |                                       |                                      |   |   |  |   | 1<br><b>H</b><br>hydrogen<br>1     |                                    |                                    |                                      |                                      |                                   |  | 4<br><b>He</b><br>helium<br>2 |
| 7<br><b>Li</b><br>lithium<br>3       | 9<br><b>Be</b><br>beryllium<br>4   |   |  |                                      |   |                                       |                                      |   |   |  |   | 11<br><b>B</b><br>boron<br>5       | 12<br><b>C</b><br>carbon<br>6      | 14<br><b>N</b><br>nitrogen<br>7    | 16<br><b>O</b><br>oxygen<br>8        | 19<br><b>F</b><br>fluorine<br>9      | 20<br><b>Ne</b><br>neon<br>10     |  |                               |
| 23<br><b>Na</b><br>sodium<br>11      | 24<br><b>Mg</b><br>magnesium<br>12 |   |  |                                      |   |                                       |                                      |   |   |  |   | 27<br><b>Al</b><br>aluminium<br>13 | 28<br><b>Si</b><br>silicon<br>14   | 31<br><b>P</b><br>phosphorus<br>15 | 32<br><b>S</b><br>sulfur<br>16       | 35.5<br><b>Cl</b><br>chlorine<br>17  | 40<br><b>Ar</b><br>argon<br>18    |  |                               |
| 39<br><b>K</b><br>potassium<br>19    | 40<br><b>Ca</b><br>calcium<br>20   | 45<br><b>Sc</b><br>scandium<br>21   | 48<br><b>Ti</b><br>titanium<br>22          | 51<br><b>V</b><br>vanadium<br>23     | 52<br><b>Cr</b><br>chromium<br>24       | 55<br><b>Mn</b><br>manganese<br>25    | 56<br><b>Fe</b><br>iron<br>26        | 59<br><b>Co</b><br>cobalt<br>27         | 59<br><b>Ni</b><br>nickel<br>28           | 63.5<br><b>Cu</b><br>copper<br>29        | 65<br><b>Zn</b><br>zinc<br>30   | 70<br><b>Ga</b><br>gallium<br>31   | 73<br><b>Ge</b><br>germanium<br>32 | 75<br><b>As</b><br>arsenic<br>33   | 79<br><b>Se</b><br>selenium<br>34    | 80<br><b>Br</b><br>bromine<br>35     | 84<br><b>Kr</b><br>krypton<br>36  |  |                               |
| 85<br><b>Rb</b><br>rubidium<br>37    | 88<br><b>Sr</b><br>strontium<br>38 | 89<br><b>Y</b><br>yttrium<br>39   | 91<br><b>Zr</b><br>zirconium<br>40         | 93<br><b>Nb</b><br>niobium<br>41     | 96<br><b>Mo</b><br>molybdenum<br>42     | [98]<br><b>Tc</b><br>technetium<br>43 | 101<br><b>Ru</b><br>ruthenium<br>44  | 103<br><b>Rh</b><br>rhodium<br>45       | 106<br><b>Pd</b><br>palladium<br>46       | 108<br><b>Ag</b><br>silver<br>47         | 112<br><b>Cd</b><br>cadmium<br>48   | 115<br><b>In</b><br>indium<br>49   | 119<br><b>Sn</b><br>tin<br>50      | 122<br><b>Sb</b><br>antimony<br>51 | 128<br><b>Te</b><br>tellurium<br>52  | 127<br><b>I</b><br>iodine<br>53      | 131<br><b>Xe</b><br>xenon<br>54   |  |                               |
| 133<br><b>Cs</b><br>caesium<br>55    | 137<br><b>Ba</b><br>barium<br>56   | 139<br><b>La*</b><br>lanthanum<br>57  | 178<br><b>Hf</b><br>hafnium<br>72          | 181<br><b>Ta</b><br>tantalum<br>73   | 184<br><b>W</b><br>tungsten<br>74       | 186<br><b>Re</b><br>rhenium<br>75     | 190<br><b>Os</b><br>osmium<br>76     | 192<br><b>Ir</b><br>iridium<br>77       | 195<br><b>Pt</b><br>platinum<br>78        | 197<br><b>Au</b><br>gold<br>79           | 201<br><b>Hg</b><br>mercury<br>80   | 204<br><b>Tl</b><br>thallium<br>81 | 207<br><b>Pb</b><br>lead<br>82     | 209<br><b>Bi</b><br>bismuth<br>83  | [209]<br><b>Po</b><br>polonium<br>84 | [210]<br><b>At</b><br>astatine<br>85 | [222]<br><b>Rn</b><br>radon<br>86 |  |                               |
| [223]<br><b>Fr</b><br>francium<br>87 | [226]<br><b>Ra</b><br>radium<br>88 | [227]<br><b>Ac*</b><br>actinium<br>89   | [261]<br><b>Rf</b><br>rutherfordium<br>104 | [262]<br><b>Db</b><br>dubnium<br>105 | [266]<br><b>Sg</b><br>seaborgium<br>106 | [264]<br><b>Bh</b><br>bohrium<br>107  | [277]<br><b>Hs</b><br>hassium<br>108 | [268]<br><b>Mt</b><br>meitnerium<br>109 | [271]<br><b>Ds</b><br>darmstadtium<br>110 | [272]<br><b>Rg</b><br>roentgenium<br>111 | Elements with atomic numbers 112-116 have been reported but not fully authenticated |                                    |                                    |                                    |                                      |                                      |                                   |  |                               |

\* The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.

**GENERAL CERTIFICATE OF SECONDARY EDUCATION**

**GATEWAY SCIENCE**

**B741/01**

**CHEMISTRY B**

Unit B741: Chemistry modules C1, C2, C3 (Foundation Tier)

**MARK SCHEME**

**Duration:** 1 hour 15 minutes

**MAXIMUM MARK      75**

**Guidance for Examiners**

Additional Guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.
2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.
3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).
4. Abbreviations, annotations and conventions used in the detailed mark scheme:

/ = alternative and acceptable answers for the same marking point

(1) = separates marking points

**not/reject** = answers which are not worthy of credit

**ignore** = statements which are irrelevant - applies to neutral answers

**allow/accept** = answers that can be accepted

(words) = words which are not essential to gain credit

words = underlined words must be present in answer to score a mark

ecf = error carried forward

AW/owtte = alternative wording

ora = or reverse argument

eg mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)

work done = 0 marks

work done lifting = 1 mark

change in potential energy = 0 marks

gravitational potential energy = 1 mark

5. If a candidate alters his/her response, examiners should accept the alteration.
6. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.


| Question     |     | Expected answers               | Marks    | Additional guidance                                 |
|--------------|-----|--------------------------------|----------|---|
| 1            | (a) | propane (1)                    | 1        | <b>allow</b> C <sub>3</sub> H <sub>8</sub>          |
|              | (b) | 11 (1)                         | 1        |   |
|              | (c) | hydrogen <b>and</b> carbon (1) | 1        | <b>not</b> 'hydro and carbon'<br><b>not</b> C and H |
| <b>Total</b> |     |                                | <b>3</b> |   |

| Question     |     | Expected answers  | Marks    | Additional guidance  |
|--------------|-----|---|----------|--|
| 2            | (a) | carbon dioxide (1)  | 1        | <b>allow</b> CO <sub>2</sub> <b>not</b> CO <sub>2</sub> or CO <sup>2</sup> or Co <sub>2</sub><br><b>not</b> carbon dioxide + heat  |
|              | (b) | idea that soot shows that incomplete combustion is happening (1)<br>so poisonous carbon monoxide (may be being) formed / so less energy is being released (1)   | 2        | <b>answers must be linked for 2 marks</b><br>eg poisonous carbon monoxide may be being formed because incomplete combustion is happening shown by soot being made (2)<br><b>allow</b> less heat is produced (1)  |
|              | (c) | fuel <b>C</b> is a sensible choice because it is cheaper than all the others (1)<br><br>evidence of calculation of temperature differences to conclude that fuel <b>C</b> is not a sensible choice because fuel <b>B</b> gives the largest temperature rise / ora (1)<br><b>OR</b><br>evidence of calculation of temperature rise per penny to conclude that fuel <b>C</b> is not a sensible choice because fuel <b>A</b> has the highest temperature rise for 1 pence of fuel burned / ora (2) | 3        | <b>answers must link choice of fuel with evidence to gain credit</b><br><br><b>allow</b> answers in terms of fuel <b>B</b> being a better choice if linked to evidence<br><br><b>allow</b> answers in terms of fuel <b>C</b> being a better choice if linked to evidence |
| <b>Total</b> |     |   | <b>6</b> |  |


| Question     |     |      | Expected answers  | Marks    | Additional guidance                                   |
|--------------|-----|------|---|----------|---|
| 3            | (a) | (i)  | water (1)   | 1        |   |
|              |     | (ii) | ethyl ethanoate dissolves more of the colours (1)   | 1        | <b>allow</b> ora                                      |
|              | (b) |      | <b>any two from:</b><br>idea that nail varnish remover could irritate skin or nails or hands (1)<br>toxicity / AW (1)<br>does not react with water / sweat / perspiration (1) | 2        | <b>allow</b> idea that could have harmful vapours (1) |
| <b>Total</b> |     |      |   | <b>4</b> |   |

| Question     |     |  | Expected answers  | Marks    | Additional guidance  |
|--------------|-----|--|---|----------|--|
| 4            | (a) |  | nitrogen / helium / neon / argon / krypton (1)  | 1        | <b>allow</b> correct symbols<br><b>allow</b> radon   |
|              | (b) |  | sulfur dioxide causes acid rain (1)<br>which kills plants / kills fish / attacks stonework / corrodes metals (1)  | 2        | <b>allow</b> idea that sulfur dioxide aggravates asthma (1)  |
|              | (c) |  | plastics are non-biodegradable (1)<br>so (plastics) do not rot / decay by bacterial action (1)<br>this means that they need to be disposed of by burning / by landfill / by recycling (1) | 3        | <b>first and second marking points can be in either order</b><br><br><b>allow</b> 'difficult to recycle because difficult to sort' as alternative to the third marking point (1) |
| <b>Total</b> |     |  |   | <b>6</b> |  |



| Question   | Expected answers  | Marks    | Additional guidance  |
|--|---|----------|--|
| 5<br> | <p><b>Level 3</b><br/>           Answer identifies both conditions needed for cracking and applies knowledge of cracking to explain that the decision should be based on both matching supply and demand and molecule size, with examples given from the table. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling.<br/>           (5-6 marks)</p> <p><b>Level 2</b><br/>           Answer identifies at least one correct condition and applies limited knowledge of cracking to explain why at least one fraction from the table could be cracked. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling.<br/>           (3-4 marks)</p> <p><b>Level 1</b><br/>           Answer includes one condition and some idea about using cracking to make more useful products. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science.<br/>           (1-2 marks)</p> <p><b>Level 0</b><br/>           Insufficient or irrelevant science. Answer not worthy of credit.<br/>           (0 marks)</p> | 6        | <p><b>Relevant points include:</b></p> <ul style="list-style-type: none"> <li>• cracking needs a high temperature / heating</li> <li>• cracking needs a catalyst / use of zeolite</li> <li>• cracking converts large hydrocarbon molecules into smaller ones</li> <li>• cracking converts less useful hydrocarbons into more useful hydrocarbons</li> <li>• cracking converts named fractions that are in excess into named fractions that are in short supply eg bitumen or paraffin into petrol or diesel</li> <li>• the table shows that petrol and diesel are in short supply</li> <li>• the table shows that bitumen and paraffin are in excess and that these are large molecules</li> </ul> |
|  | <b>Total</b>  | <b>6</b> |  |


| Question |     | Expected answers   | Marks    | Additional guidance  |
|----------|-----|--|----------|--|
| 6        | (a) | iron (1)   | 1        |  |
|          | (b) | aluminium (no mark)<br>because density too high so wires would sag for copper,<br>iron and/or silver / ora (1)<br>because iron is too poor an electrical conductor / ora (1)<br>because copper and/or silver are too expensive / ora (1) | 3        | <b>answers must support the candidates choice to gain credit if iron or silver max 1 mark</b><br><b>allow</b> idea of wires are heavy<br><br><b>allow</b> reference to just one metal eg silver is expensive<br><b>ignore</b> any comments about corrosion |
|          | (c) | musical instruments / coins / door decorations / horse<br>brasses (1)  | 1        |  |
|          |     | <b>Total</b>   | <b>5</b> |  |

| Question |  | Expected answers  | Marks    | Additional guidance   |
|----------|--|---|----------|---|
| 7        | (a)<br> | <p><b>Level 3</b><br/>Detailed description of Earth structure, including all the main parts of the Earth, and the effects of plate movement. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling.<br/>(5-6 marks)</p> <p><b>Level 2</b><br/>Limited description of Earth structure with some reference to the effects of plate movement. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling.<br/>(3-4 marks)</p> <p><b>Level 1</b><br/>Identifies some parts of the Earth and recognises that tectonic plates move. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science.<br/>(1-2 marks)</p> <p><b>Level 0</b><br/>Insufficient or irrelevant science. Answer not worthy of credit.<br/>(0 marks)</p> | 6        | <p><b>Relevant points include:</b></p> <ul style="list-style-type: none"> <li>• Earth is a sphere</li> <li>• Earth is made up of core, thin, rocky crust and mantle</li> <li>• core contains iron</li> <li>• beneath the surface there is molten rock called magma</li> <li>• tectonic plates move (very slowly or about 2.5cm per year)</li> <li>• tectonic plate movement causes volcanoes</li> <li>• tectonic plate movement causes earthquakes</li> <li>• idea of over millions of years movement results in the formation of continents</li> </ul> <p><b>allow</b> tectonic plate movement causes mountain ranges to be formed<br/><b>allow</b> higher level answers involving convection currents in the mantle, that crust is less dense than the mantle or a description of the lithosphere</p> |
| 7        | (b)  | theory explains the evidence (1)<br>discussed and tested by a number of scientists (1)  | 2        | <b>allow</b> idea of peer review or results published in scientific publications and conferences enables results to be checked (1) as alternative to second mark  |
|          |  | <b>Total</b>  | <b>8</b> |   |

| Question |     |       | Expected answers  | Marks    | Additional guidance   |
|----------|-----|-------|---|----------|---|
| 8        | (a) | (i)   | because nitrogen comes from the air (1)   | 1        | <b>allow</b> higher level answers above target demand eg nitrogen does not need to be extracted from air at high cost |
|          |     | (ii)  | 71.4% (1)<br>because energy is needed to heat the reaction /<br>maintain high pressure / AW (1) | 2        | <b>allow</b> 71% (1)  |
|          |     | (iii) | nitrogen <b>and</b> hydrogen (1)  | 1        | both needed for mark<br><b>allow</b> N <sub>2</sub> and H <sub>2</sub>  |
|          | (b) | (i)   | yield decreases / AW (1)  | 1        |   |
|          |     | (ii)  | yield decreases / AW (1)  | 1        |   |
|          |     |       | <b>Total</b>  | <b>6</b> |   |

| Question |     | Expected answers   | Marks    | Additional guidance   |
|----------|-----|--|----------|---|
| 9        | (a) | KOH / H <sub>2</sub> SO <sub>4</sub> (1)   | 1        |   |
|          | (b) | sodium hydroxide + phosphoric acid → sodium phosphate + water (1)  | 1        |   |
|          | (c) | benefits: fertilisers can increase food supply / AW (1)<br>problems: fertilisers can kill aquatic organisms / eutrophication / can cause water pollution / AW (1)  | 2        | <b>allow</b> idea of whether her use will be 'excessive' and therefore have negative impacts (1)<br><b>allow</b> idea of benefits and problems with no specific references for 1 mark |
|          | (d) | ammonium sulfate contains only, one essential element / nitrogen, so the mixture is better because it contains <b>all three</b> essential elements / nitrogen, phosphorous <b>and</b> potassium (2)<br><br><b>OR</b><br><br>the mixture contains more essential elements than the ammonium sulfate / ora (1) | 2        | <b>answers must be a comparison in terms of specific numbers/names of essential elements in order to gain 2 marks</b>   |
|          |     | <b>Total</b>   | <b>6</b> |   |

| Question |     | Expected answers   | Marks | Additional guidance  |
|----------|-----|--|-------|--|
| 10       | (a) | 6 (minutes) (1)  | 1     | <b>allow</b> range 6-6.4 minutes or 6 minutes-6 minutes 25 seconds |
|          | (b) | hydrochloric acid runs out (1)   | 1     |  |
|          | (c) | with 100 cm <sup>3</sup> of acid the volume of gas produced should be 125 cm <sup>3</sup> (1)<br><br>the volume of gas produced will be greater than the volume of the gas syringe (1) | 2     |  |

| Question   | Expected answers   | Marks     | Additional guidance  |
|--|--|-----------|--|
| 10 (d)  | <p><b>Level 3</b><br/>Answer applies understanding of the reacting particle model and rates of reaction to explain comprehensively two ways of increasing the rate of reaction. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling.<br/>(5-6 marks)</p> <p><b>Level 2</b><br/>Answer applies limited understanding of the reacting particle model and rates of reaction to explain partially two ways of increasing the rate of reaction or explain comprehensively one way of increasing the rate of reaction. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling.<br/>(3-4 marks)</p> <p><b>Level 1</b><br/>Answer gives two ways in which the rate of reaction can be increased. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science.<br/>(1-2 marks)</p> <p><b>Level 0</b><br/>Insufficient or irrelevant science. Answer not worthy of credit.<br/>(0 marks)</p> | 6         | <p><b>Relevant points include:</b></p> <ul style="list-style-type: none"> <li>• more collisions between zinc and acid particles results in faster reaction</li> <li>• increase the temperature of acid increases rate of reaction</li> <li>• increase the concentration of acid increases the rate of acid</li> <li>• increase the surface area of the zinc increases the rate of reaction</li> </ul> <p><b>temperature of hydrochloric acid</b></p> <ul style="list-style-type: none"> <li>• idea that acid particles move faster / acid particles have more energy / more successful collisions between acid and zinc particles / collisions between acid particles and zinc particles are more energetic</li> <li>• idea of increased collisions (frequency) between acid particles and zinc</li> </ul> <p><b>concentration of hydrochloric acid</b></p> <ul style="list-style-type: none"> <li>• idea of more crowded acid particles / more acid particles in the same volume / more H<sup>+</sup> ions in the same volume</li> <li>• idea of increased collisions (frequency)</li> </ul> <p><b>ignore</b> reference to 'more particles'</p> <p><b>powdered zinc</b></p> <ul style="list-style-type: none"> <li>• idea of increased surface area of zinc / more zinc particles exposed to the acid</li> <li>• idea of increased collision (frequency) between zinc and acid particles</li> </ul> |
| 10 (e)   | <p>slow reaction – rusting / corrosion (1)<br/>fast reaction – any explosion (1)</p>   | 2         | <p><b>allow</b> other very slow reactions<br/><b>allow</b> reactions of alkali metals with water</p>   |
|  | <b>Total</b>   | <b>12</b> |  |




| Question |         | Expected answers  | Marks    | Additional guidance   |
|----------|---------|---|----------|---|
| 11       | (a)     | not all copper carbonate decomposes because not heated for long enough / not all copper carbonate decomposes because the temperature was not high enough (1)  | 1        |   |
|          | (b)     | 0.22 g (2)<br><b>OR</b><br>idea that carbon dioxide made from 1.24g is 0.44g (1)  | 2        | <b>allow</b> full marks for 0.22g with no working, correct working for 1 mark<br><b>allow</b> use of molecular masses and moles to calculate eg $0.62/124 = 0.005$ moles (1)  |
|          | (c) (i) | 124 (1)   | 1        | <b>allow</b> 123.5  |
|          | (ii)    | 64.51 % (2)<br><b>OR</b><br>if correct answer not given<br>atom economy = $\frac{\text{M of desired products}}{\text{sum of M of all products}} \times 100 /$<br><br>atom economy = $\frac{80}{124} \times 100$ (1) | 2        | <b>allow</b> full marks for the correct answer even if the equation for atom economy is not stated<br><b>allow</b> 65 / 64.5 / up to the calculator value<br><b>allow</b> ecf / 64.8 % if answer given for (i) is 123.5 |
|          | (iii)   | because fewer atoms lost as waste so it is a greener process / because fewer atoms lost as waste so it is a more sustainable process (1)  | 1        |   |
|          | (iv)    | continuous – chemicals made all the time / chemicals made 24/7 (1)<br>whereas in batch – chemicals made on demand (and not all the time) (1)  | 2        |   |
|          |         | <b>Total</b>  | <b>9</b> |   |



| Question |     | Expected answers  | Marks    | Additional guidance  |
|----------|-----|---|----------|--|
| 12       | (a) | very high (1)<br>does not conduct (1)   | 2        |  |
|          | (b) | graphite is a good electrical conductor so will be able to transfer the electrical current without loss (from the wires to the electrolyte) (1)<br>graphite has a high melting point / solid / insoluble / inert, so will not, dissolve / melt / react, during electrolysis (mixing with the electrolyte) (1) | 2        | <b>allow</b> higher level answers relating to the structure of graphite eg delocalised electrons allow current to flow (1) |
|          |     | <b>Total</b>  | <b>4</b> |  |

## Assessment Objectives (AO) Grid

(includes quality of written communication )

| Question  | AO1       | AO2       | AO3      | Total     |
|---|-----------|-----------|----------|-----------|
| 1(a)  | 1         |           |          | 1         |
| 1(b)  |           | 1         |          | 1         |
| 1(c)  | 1         |           |          | 1         |
| 2(a)  | 1         |           |          | 1         |
| 2(b)  |           | 2         |          | 2         |
| 2(c)  |           | 1         | 2        | 3         |
| 3(a)(i)   |           | 1         |          | 1         |
| 3(a)(ii)  |           | 1         |          | 1         |
| 3(b)  |           | 2         |          | 2         |
| 4(a)  | 1         |           |          | 1         |
| 4(b)  | 2         |           |          | 2         |
| 4(c)  | 3         |           |          | 3         |
| 5        | 3         | 3         |          | 6         |
| 6(a)  |           | 1         |          | 1         |
| 6(b)  |           | 1         | 2        | 3         |
| 6(c)  | 1         |           |          | 1         |
| 7(a)   | 6         |           |          | 6         |
| 7(b)  | 2         |           |          | 2         |
| 8(a)(i)   |           | 1         |          | 1         |
| 8(a)(ii)  |           | 2         |          | 2         |
| 8(a)(iii)   |           | 1         |          | 1         |
| 8(b)(i)   |           | 1         |          | 1         |
| 8(b)(ii)  |           | 1         |          | 1         |
| 9(a)  |           | 1         |          | 1         |
| 9(b)  |           | 1         |          | 1         |
| 9(c)  | 2         |           |          | 2         |
| 9(d)  |           | 2         |          | 2         |
| 10(a)   |           | 1         |          | 1         |
| 10(b)   |           | 1         |          | 1         |
| 10(c)   |           | 2         |          | 2         |
| 10(d)  | 2         | 4         |          | 6         |
| 10(e)   | 2         |           |          | 2         |
| 11(a)   | 1         |           |          | 1         |
| 11(b)   |           | 2         |          | 2         |
| 11(c)(i)  |           | 1         |          | 1         |
| 11(c)(ii)   | 1         | 1         |          | 2         |
| 11(c)(iii)  | 1         |           |          | 1         |
| 11(c)(iv)   | 2         |           |          | 2         |
| 12(a)   | 2         |           |          | 2         |
| 12(b)   |           |           | 2        | 2         |
|   | <b>34</b> | <b>35</b> | <b>6</b> | <b>75</b> |

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