AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.5.1.1

# Energy transfer during exothermic and endothermic reactions

## Mark schemes and examiner comments

| | |
|---|---|
| Tier | **Foundation** |
| Question groups | **64** |
| Available paper years | **2007–2025** |

## Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

**Name:** _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 01 · Mark scheme** January 2007 | CHY1F | Original Q4 | Legacy

**Question 4**

| | answers | extra information | mark |
|---|---|---|---|
| (a) | **1** / one<br><br>**3** / three | | 1<br><br>1 |
| (b)(i) | (wear safety) glasses / masks / gloves | accept do not handle hot objects / use tongs **or** accept other safety points such as, 'tie hair back' | 1 |
| (ii) | calcium oxide | accept quicklime | 1 |
| (iii) | carbon dioxide / $CO_2$ is given off | accept a gas is given off | 1 |
| (c) | any **two** from:<br>• conserves (saves) resources<br>• avoids dumping / landfill<br>• lowers energy requirements / save energy<br>• stops quarries opening<br>• less carbon dioxide / carbon emissions / greenhouse gases<br>• lowers the price of glass<br>• glass is non-biodegradable | <br><br>accept reduces waste<br>do **not** accept speeds up the process<br><br><br><br>do **not** accept cheaper process | 2 |
| (d)(i) | any **two** from:<br>• dust / atmospheric pollution<br>• noise<br>• eyesore<br>• destroys habitats<br>• (extra) traffic<br>• any other named pollution or description of pollution | | 2 |

**Continued on next page**

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 01 · Mark scheme**



| | answers | extra information | mark |
|---|---|---|---|
| (ii) | any **one** from:<br>• employment<br>• increases local trade / makes money<br>• future development of quarry – recreation / park / lake / reservoir | do **not** accept cheaper houses / land / new roads | 1 |
| total | | | 10 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 02 · Mark scheme**

June 2007 | CHY1A | Original Q7 | Legacy

| | | | |
|---|---|---|---|
| Five | **A** | one | **2** |
| | **B** | four | **3** |
| | **C** | five | **1** |
| | **D** | seven | **4** |
| | | | |
| Six | **A** | hard | **3** |
| | **B** | resistant to corrosion | **4** |
| | **C** | easily shaped | **2** |
| | **D** | brittle | **1** |

| | A | B | C | D |
|---|---|---|---|---|
| Seven | **2** | **4** | **3** | **2** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 03 · Mark scheme**



**Question 3**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | gives out (heat) | | 1 |
| (b) | D | | 1 |
| (c) | L | | 1 |
| (d) | magnesium chloride | | 1 |
| total | | | 4 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 03 · Mark scheme** January 2008 | CHY2F | Original Q3 | Legacy

**CHY2F**

**Answer 04 · Mark scheme** January 2008 | CHY2F | Original Q6 | Legacy

**Question 6**

| question | answers | extra information | mark |
|---|---|---|---|
| (a) | sensible line of best fit which goes through or close to all the points **except** the anomalous point | allow wobbly / short double lines<br>± ½ square | 1 |
| (b) | loss of gas / loss of $CO_2$ | idea of gas produced / formed | 1 |

**Answer 05 · Mark scheme** March 2008 | CHY1AP | Original Q5 | Legacy

| | | | |
|---|---|---|---|
| Five | **A** | iron | **2** |
| | **B** | aluminium | **3** |
| | **C** | copper | **4** |
| | **D** | gold | **1** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 06 · Mark scheme**

June 2008 | CHY1F | Original Q7 | Legacy

| question | answers | extra information | mark |
|---|---|---|---|
| **7**(a)(i) | | products can be in either order<br>ignore chemical names other than calcium oxide **or** carbon dioxide | |
| | calcium oxide / CaO | | 1 |
| | carbon dioxide / $CO_2$ | | 1 |
| **7**(a)(ii) | (thermal) decomposition | accept endothermic | 1 |
| **7**(b)(i) | (chemical) reaction / react | accept calcium hydroxide / slaked lime produced<br>ignore incorrect products | 1 |
| | energy / heat released / exothermic | ignore gets hot / heats up<br>if neither mark awarded then allow 'mixing the chemicals heats up the coffee' for **1** mark | 1 |
| **7**(b)(ii) | any **two** from:<br>• foil has been broken<br>• ring pull used | if neither mark awarded accept 'cannot / difficult to repair' for **1** mark<br>ignore button pushed | 2 |
| | • quicklime and / or water mixed / reacted | accept reaction not reversible<br>accept cannot / difficult to replace quicklime / water / chemicals | |
| **Total** | | | **7** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 06 · Mark scheme** June 2008 | CHY1F | Original Q7 | Legacy

**COMPONENT NUMBER: CHY1F**

**COMPONENT NAME: Science B / Chemistry**

**STATUS: Final**

**DATE: June 2008**

**Answer 07 · Mark scheme** June 2008 | CHY2F | Original Q2 | Legacy

| question | answers | extra information | mark |
|---|---|---|---|
| **2**(a) | any **two** from:<br>• increases<br>• until reaches maximum / levels off<br>• quickly at first<br>• then more slowly / rate decreases | <br>owtte allow 'goes up'<br>owtte<br>owtte<br>allow reaction finished<br>ignore rate increases | 2 |
| **2**(b) | use a more concentrated acid<br>use zinc powder | list principle applies | 2 |
| **Total** | | | **4** |

**Answer 07 · Mark scheme** June 2008 | CHY2F | Original Q2 | Legacy

**COMPONENT NUMBER: CHY2F**

**COMPONENT NAME: Additional Science / Chemistry**

**STATUS: Final**

**DATE: June 2008**

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 08 · Mark scheme** June 2008 | CHY2F | Original Q4 | Legacy

| question | answers | extra information | mark |
|---|---|---|---|
| **4**(a) | the bag gets cold because heat energy is taken in from the surroundings | | 1 |
| **4**(b) | endothermic | | 1 |
| **4**(c) | any **two** from:<br>• mix / spread (the ammonium nitrate and water)<br>• dissolve faster<br>• get cold faster **or** so the whole bag gets cold<br>• particles collide more **or** more collisions | allow increase rate **or** quicker reaction | 2 |
| **Total** | | | **4** |

**Answer 08 · Mark scheme** June 2008 | CHY2F | Original Q4 | Legacy

**COMPONENT NUMBER: CHY2F**

**COMPONENT NAME: Additional Science / Chemistry**

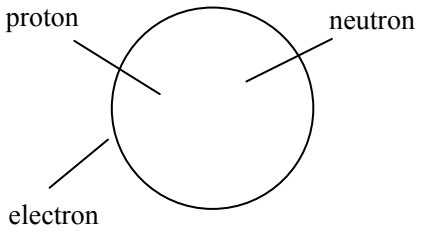
**STATUS: Final**

**DATE: June 2008**

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 09 · Mark scheme**

June 2008 | CHY2F | Original Q5 | Legacy

| question | answers | extra information | mark |
|---|---|---|---|
| **5**(a)(i) |  | all three correct **2** marks<br><br>one correct **1** mark | 2 |
| **5**(a)(ii) | 14 | | 1 |
| **5**(b) | A | | 1 |
| **5**(c)(i) | ammonia can break up to form nitrogen and hydrogen<br><br>ammonia is made from nitrogen and hydrogen | list principle applies | 2 |
| **5**(c)(ii) | air | | 1 |
| **5**(d) | ammonium nitrate | | 1 |
| **Total** | | | **8** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 09 · Mark scheme**

June 2008 | CHY2F | Original Q5 | Legacy

**COMPONENT NUMBER: CHY2F**

**COMPONENT NAME: Additional Science / Chemistry**

**STATUS: Final**

**DATE: June 2008**

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 10 · Mark scheme**

June 2008 | CHY3F | Original Q2 | Legacy

| question | answers | extra information | mark |
|---|---|---|---|
| **2**(a)(i) | floated / (moved on) surface | accept does not sink<br><br>ignore it melted | 1 |
| **2**(a)(ii) | melted / molten | ignore heat is given off | 1 |
| **2**(a)(iii) | hydrogen | allow $H_2$ | 1 |
| **2**(b)(i) | potassium / rubidium / caesium / francium | accept: K / Rb / Cs / Fr | 1 |
| **2**(b)(ii) | they are metals<br><br>they form ions with a 1+ charge | | 1<br><br>1 |
| **2**(c)(i) | atomic weight | | 1 |
| **2**(c)(ii) | similar | | 1 |
| **2**(c)(iii) | groups | | 1 |
| **2**(d) | left gaps owtte | | 1 |
| **Total** | | | **10** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 10 · Mark scheme**

June 2008 | CHY3F | Original Q2 | Legacy

**COMPONENT NUMBER: CHY3F**

**COMPONENT NAME: Chemistry**

**STATUS: Final**

**DATE: June 2008**

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 11 · Mark scheme**

June 2009 | CHY2F | Original Q2 | Legacy

**Question 2**

| question | answers | extra information | mark |
|---|---|---|---|
| **2**(a) | carbon dioxide | must be name<br><br>do **not** accept carbon oxide | 1 |
| **2**(b)(i) | the temperature of the solution will decrease | (list principle) | 1 |
| **2**(b)(ii) | energy is taken in from the surroundings | (list principle) | 1 |
| **Total** | | | **3** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 11 · Mark scheme**

June 2009 | CHY2F | Original Q2 | Legacy

**CHY2F**

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 12 · Mark scheme

June 2009 | CHY2F | Original Q3 | Legacy

## Question 3

| question | answers | extra information | mark |
|---|---|---|---|
| **3**(a) | pressure | | 1 |
| **3**(b) | nitrogen<br><br>hydrogen | | 1<br><br>1 |
| **3**(c) | cooled | | 1 |
| **3**(d) | nitric | | 1 |
| **Total** | | | **5** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 12 · Mark scheme**

June 2009 | CHY2F | Original Q3 | Legacy

**CHY2F**

**Answer 13 · Mark scheme**

November 2009 | CHY1AP | Original Q5 | Legacy

| | | | |
|---|---|---|---|
| Five | **A** | Calcium (Ca) | **2** |
| | **B** | Lithium (Li) | **3** |
| | **C** | Gold (Au) | **1** |
| | **D** | Iron (Fe) | **4** |

| | | | | |
|---|---|---|---|---|
| | **A** | **B** | **C** | **D** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 14 · Mark scheme**

January 2010 | CHY2F | Original Q5 | Legacy

## Question 5

| question | answers | extra information | mark |
|---|---|---|---|
| **5**(a)(i) | 48 | | 1 |
| **5**(a)(ii) | 3 | | 1 |
| **5**(b) | heat / energy<br><br>given out / transfers to surroundings | <br><br>the mark for given out / transfers to cannot be awarded without heat / energy<br><br>allow given off | 1<br><br>1 |
| **5**(c) | it has a low boiling point<br><br>it is made of small molecules | | 1<br><br>1 |
| **Total** | | | **6** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 14 · Mark scheme**

January 2010 | CHY2F | Original Q5 | Legacy

**CHY2F**

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 15 · Mark scheme

January 2010 | CHY2F | Original Q6 | Legacy

## Question 6

| question | answers | extra information | mark |
|---|---|---|---|
| **6**(a)(i) | mix (owtte) | accept to allow more collisions / helps particles to collide (owtte)<br><br>idea of more efficient heat transfer<br><br>do **not** allow heat is a catalyst | 1 |
| **6**(a)(ii) | higher **and** more<br><br>powder **and** big<br><br>concentrated **and** more | | 1<br><br>1<br><br>1 |
| **6**(b) | electrons | | 1 |
| **6**(c) | $H^+$ | | 1 |
| **Total** | | | **6** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 15 · Mark scheme**

January 2010 | CHY2F | Original Q6 | Legacy

**CHY2F**

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 16 · Mark scheme

January 2010 | CHY3F | Original Q3 | Legacy

## Question 3

| question | answers | extra information | mark |
|---|---|---|---|
| **3**(a) | electricity / (high) temperatures | allow lightning / heat<br><br>ignore energy | 1 |
| **3**(b) | nitrogen + oxygen → nitrogen oxide / monoxide | allow any oxide of nitrogen | 1 |
| **3**(c) | more than | | 1 |
| **3**(d)(i) | A | | 1 |
| **3**(d)(ii) | C | | 1 |
| **Total** | | | **5** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 16 · Mark scheme**

January 2010 | CHY3F | Original Q3 | Legacy

**CHY3F**

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 17 · Mark scheme**

June 2010 | CHY2F | Original Q1 | Legacy

**Question 1**

| question | answers | extra information | mark |
|---|---|---|---|
| **1**(a) | white to blue | accept colourless to blue | 1 |
| **1**(b) | reversible | | 1 |
| **Total** | | | **2** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 17 · Mark scheme**

June 2010 | CHY2F | Original Q1 | Legacy

**CHY2F**

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 18 · Mark scheme

June 2010 | CHY2F | Original Q3 | Legacy

## Question 3

| question | answers | extra information | mark |
|---|---|---|---|
| **3**(a) | the glow stick is brighter (owtte) | accept glow stick is less bright **at low temperatures** (owtte)<br><br>ignore references to rate / particles | 1 |
| **3**(b) | gave out light for less time | accept use of figures from table for comparison<br><br>allow reference to speed / rate eg quicker / faster reaction | 1 |
| **3**(c) | the particles will collide more often<br><br>the particles will move faster<br><br>the particles will have more energy | | 1<br><br>1<br><br>1 |
| **3**(d) | any **one** from:<br><br>• repeat<br><br>• measure brightness eg use light meter<br><br>• more temperatures **or** wider range<br><br>• improve precision | allow more glow sticks | 1 |
| **Total** | | | **6** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 18 · Mark scheme**

June 2010 | CHY2F | Original Q3 | Legacy

**CHY2F**

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 19 · Mark scheme

June 2010 | CHY2F | Original Q7 | Legacy

**Question 7**

| question | answers | extra information | mark |
|---|---|---|---|
| **7**(a)(i) | (different) properties | allow ideas of different property / behaviour / element | 1 |
| **7**(a)(ii) | any **one** from:<br>• they had high status<br>**or**<br>they were lecturers / doctors / professors / famous scientists<br>• other scientists repeated experiments<br>• they had proof<br>**or**<br>lots of / strong / conclusive / enough / clear evidence | they = Crawford + Cruikshank<br>allow experiment could be repeated<br>allow other scientists showed they had different properties<br>ignore evidence unqualified | 1 |
| **7**(a)(iii) | other scientists obtained similar results / proved it<br>**or**<br>experiments were repeated | | 1 |

**Question 7 continues on the next page**

4.5.1.1 Energy transfer during exothermic and endothermic reactions



**CHY2F**

**Question 7 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| **7**(b)(i) | any **one** from:<br>• mass of solid / strontium (chloride) / barium (chloride)<br>• volume of water<br>• type of container | allow amount / volume<br>allow amount / mass<br>allow initial / starting temperature (of water)<br>ignore room temperature / time / concentration<br>ignore reference to hydrochloric acid | 1 |
| **7**(b)(ii) | 2 **and** takes in heat / energy<br>**or**<br>2 **and** temperature goes down (owtte) | | 1 |
| **7**(b)(iii) | temperature increased for one experiment and decreased for the other (owtte)<br>**or**<br>one was exothermic and one was endothermic (owtte) | accept experiment 1 was exothermic | 1 |
| **7**(c) | any **one** from<br>• positive / + (charge)<br>• opposite (charges) attract | do **not** accept incorrect further qualification eg electrons / atoms / electrodes | 1 |
| **Total** | | | **7** |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 20 · Mark scheme

January 2011 | CHY2F | Original Q5 | Legacy

**Question 5**

| question | answers | extra information | mark |
|---|---|---|---|
| **5(a)(i)** | increase | | 1 |
| **5(a)(ii)** | energy is given out to the surroundings | | 1 |
| **5(b)(i)** | NO | allow 2NO<br>ignore nitrogen oxide<br>do **not** allow equations | 1 |
| **5(b)(ii)** | harmful / poisonous (owtte) | allow dangerous<br>ignore reference to pollution / global warming<br>do **not** accept references to ozone layer | 1 |
| **5(c)** | a catalyst can speed up a chemical reaction<br><br>different reactions need different catalysts | | 1<br><br>1 |
| **5(d)(i)** | smaller | accept less / tiny / very small<br>allow $10^{-9}$<br>do **not** allow small unless qualified | 1 |
| **5(d)(ii)** | reduce cost (owtte) **or**<br><br>save resources / raw materials (owtte) | ignore references to energy | 1 |
| **Total** | | | **8** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 20 · Mark scheme**

January 2011 | CHY2F | Original Q5 | Legacy

**CHY2F**

**Answer 21 · Mark scheme**

March 2011 | CHY1AP | Original Q3 | Legacy

| | | | |
|---|---|---|---|
| Three | **A** | Carbon | **1** |
| | **B** | Gold | **2** |
| | **C** | Magnesium | **4** |
| | **D** | Zinc | **3** |
| | | | |

**Answer 22 · Mark scheme**

March 2011 | CHY1BP | Original Q4 | Legacy

| | | | |
|---|---|---|---|
| Four | **A** | bromine | **2** |
| | **B** | hydrogen | **3** |
| | **C** | nickel | **4** |
| | **D** | water | **1** |
| | | | |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 23 · Mark scheme

June 2011 | CHY1F | Original Q4 | Legacy

## Question 4

| question | answers | extra information | mark |
|---|---|---|---|
| 4(a) | (carbon =) 1<br><br>(oxygen =) 3 | | 1<br><br>1 |
| 4(b)(i) | heated | | 1 |
| 4(b)(ii) | carbon dioxide | | 1 |
| 4(c)(i) | combustion | | 1 |
| 4(c)(ii) | carbon is more reactive than zinc | | 1 |
| 4(c)(iii) | zinc boils (in the furnace / below 1300°C)<br><br>lead does not boil / (only) melts in the furnace / boils above 1300°C | ignore melting point / changes of state<br><br>if no other mark awarded<br>allow zinc has a lower boiling point **or** lead has a higher boiling point<br>**or** they / zinc **and** lead have different boiling points for **1** mark | 1<br><br>1 |
| **Total** | | | **8** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 23 · Mark scheme**

June 2011 | CHY1F | Original Q4 | Legacy

**CHY1F**

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 24 · Mark scheme

June 2011 | CHY2F | Original Q1 | Legacy

## Question 1

| question | answers | extra information | mark |
|---|---|---|---|
| 1(a)(i) | $NH_3$ | | 1 |
| 1(a)(ii) | electrons | | 1 |
| 1(a)(iii) | covalent | | 1 |
| 1(b)(i) | air<br><br>natural gas | | 1<br><br>1 |
| 1(b)(ii) | reversible | | 1 |
| 1(b)(iii) | iron | | 1 |
| 1(c) | nitric acid | | 1 |
| 1(d)(i) | any **one** from:<br>• lost jobs / unemployment<br>• meant that they had to move away from Humberstone **or** no one lives there<br>• loss of income (owtte) | <br><br>allow closed down the town<br><br>ignore it closed the mine unless it is further qualified by some effect of this on the local community | 1 |

**Question 1 continues on the next page**

4.5.1.1 Energy transfer during exothermic and endothermic reactions



**Question 1 continued**

| question | answers | extra information | mark |
|---|---|---|---|
| 1(d)(ii) | any **two** from:<br>• less transport (costs)<br>• less pollution / greenhouse gases / global warming <u>from transport</u><br>• cheaper to make in country than to import<br>• not dependent on Chile for nitrate supplies **or** reliable source<br>• provides employment to workers in Britain<br>• good for British economy<br>• raw materials readily available<br>• continuous process | ignore reference to environment / ecofriendly<br>allow smaller carbon footprint<br>ignore reference to quicker | 2 |
| **Total** | | | **11** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 24 · Mark scheme**

June 2011 | CHY2F | Original Q1 | Legacy

**CHY2F**

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 25 · Mark scheme** June 2011 | CHY2F | Original Q5 | Legacy

## Question 5

| question | answers | extra information | mark |
|---|---|---|---|
| **5(a)** | gives out / releases / transfers to surroundings heat / energy | ignore light / burns<br><br>ignore the wire gets hot | 1 |
| **5(b)** | activation energy | | 1 |
| **5(c)** | (aluminium +) oxygen (→) aluminium oxide | accept correct formulae | 1 |
| **5(d)** | C | | 1 |
| **5(e)(i)** | a negative | | 1 |
| **5(e)(ii)** | loses | | 1 |
| **5(e)(iii)** | gains<br><br>two | | 1<br><br>1 |
| **Total** | | | **8** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 25 · Mark scheme**

June 2011 | CHY2F | Original Q5 | Legacy

**CHY2F**

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 26 · Mark scheme** June 2011 | CHY3F | Original Q2 | Legacy

**Question 2**

| question | answers | extra information | mark |
|---|---|---|---|
| **2(a)** | goes up | | 1 |
| **2(b)(i)** | B | | 1 |
| **2(b)(ii)** | A | | 1 |
| **2(b)(iii)** | a catalyst<br><br>activation energy | | 1<br><br>1 |
| **2(c)(i)** | eg (ensures) complete reaction<br><br>**or** even heating | allow spread heat / energy<br><br>allow mixes properly or mix them together or to get correct temperature<br><br>ignore dissolves | 1 |
| **2(c)(ii)** | lid (on beaker)<br><br>**or**<br><br>insulate (beaker) / use a plastic cup | accept cover beaker | 1 |
| **Total** | | | **7** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 26 · Mark scheme**

June 2011 | CHY3F | Original Q2 | Legacy

**CHY3F**

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 27 · Mark scheme** June 2012 | CH2FP | Original Q1 | Legacy

**Question 1**

| question | Answers | extra information | mark |
|---|---|---|---|
| **1(a)** | oxygen **and** water | both needed for mark<br><br>allow hydrogen oxide for water<br><br>in any order<br>ignore formulae | 1 |
| **1(b)(i)** | best fit line, omitting point at 10s | straight line drawn through all correct points | 1 |
| **1(b)(ii)** | circle around point at 10 s | allow any indication | 1 |
| **1(b)(iii)** | 7.5 | allow ecf from candidate's line | 1 |
| **1(b)(iv)** | increases (with time) | accept goes from 0 to 12.5 | 1 |
| **1(c)(i)** | higher | | 1 |
| **1(c)(ii)** | more concentrated | | 1 |
| **1(d)(i)** | share | | 1 |
| **1(d)(ii)** | covalent | | 1 |
| **1(d)(iii)** | simple molecules | | 1 |
| **1(e)** | Water has a boiling point of 100°C<br><br>Water has a melting point lower than room temperature | | 1<br><br>1 |
| **Total** | | | **12** |

**……..**

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 27 · Mark scheme**

June 2012 | CH2FP | Original Q1 | Legacy

**CH2FP**

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 28 · Mark scheme**

June 2012 | CH2FP | Original Q3 | Legacy

**Question 3**

| question | answers | extra information | mark |
|---|---|---|---|
| **3(a)** | 22 | | 1 |
| **3(b)(i)** | exothermic | | 1 |
| **3(b)(ii)** | C<br><br>gives out most heat energy | <br><br>accept has largest temperature change / increase<br><br>allow has highest (final) temperature **or** hottest | 1<br><br>1 |
| **3(c)(i)** | increases | | 1 |
| **3(c)(ii)** | blue | ignore pale / dark etc | 1 |
| **3(c)(iii)** | reversible (reaction) | allow goes both ways **or** two / either way | 1 |
| **3(c)(iv)** | anhydrous copper sulfate | | 1 |
| **Total** | | | **8** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 28 · Mark scheme**

June 2012 | CH2FP | Original Q3 | Legacy

**CH2FP**

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 29 · Mark scheme**

January 2013 | CH2FP | Original Q3 | Legacy

| question | answers | extra information | mark |
|---|---|---|---|
| **3(a)** | exothermic | | 1 |
| **3(b)** | ‘Should people use kelp instead of oil as an energy source?’<br>‘Will kelp be more popular than coal in the next 10 years?’ | | 1<br>1 |
| **3(c)(i)** | any **four** from:<br>• potassium (atom) loses (an electron) and iodine (atom) gains (an electron)<br>• 1 electron<br>• iodide (ion) has negative charge<br>• potassium (ion) has positive charge<br>• electrostatic attraction **or** ionic bonding | If atom or ion omitted = max **3**<br>sharing / covalent / metallic = max **3**<br>ignore reference to full outer shells<br>allow iodine ion<br>accept stable (structure) **or** noble gas (structure) | 4 |
| **3(c)(ii)** | because a solid is formed (from two aqueous solutions) | | 1 |
| **3(c)(iii)** | filtering **or** centrifuging **or** decanting | | 1 |
| **Total** | | | **9** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 29 · Mark scheme**



January 2013

**CH2FP**

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 30 · Mark scheme

June 2013 | CH2FP | Original Q7 | Legacy

## Question 7

| question | Answers | extra information | Mark |
|---|---|---|---|
| 7(a)(i) | the more sodium hydrogencarbonate the greater the temperature change<br>up to 8 spatula measures<br>then the temperature change is constant | accept examples from the table<br>accept any correct indication of when change occurs<br>if no marks awarded allow **1** mark for:<br>the more sodium hydrogencarbonate the lower the final temperature | 1<br>1<br>1 |
| 7(a)(ii) | energy is taken in from the surroundings **or** endothermic | | 1 |
| 7(b)(i) | gas / carbon dioxide / steam / water is produced | accept carbon dioxide is a gas **or** steam / water is a gas<br>allow gas / air expands when heated | 1 |
| 7(b)(ii) | no, because (reaction) is exothermic<br>**or**<br>yes, to start the reaction | allow no, because (reactants) were formed by heating<br>ignore references to cooling | 1 |
| 7(c)(i) | 84 | correct answer with or without working gains **2** marks<br>if no answer or incorrect answer then evidence of 23 +1 + 12 + (3 × 16) gains **1** mark | 2 |
| 7(c)(ii) | 14.29 | accept rounding to 14.3 or 14<br>allow ecf from (c)(i) | 1 |
| **Total** | | | **9** |

**UMS Conversion Calculator**: www.aqa.org.uk/umsconversion

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 31 · Mark scheme

June 2013 | CH3FP | Original Q4 | Legacy

## Question 4

| question | Answers | extra information | Mark |
|---|---|---|---|
| 4(a)(i) | 42 000 | correct answer gains **2** marks with or without working<br>allow 42 kJ<br>if answer incorrect : correct substitution 500 x 4.2 x 20 gains **1** mark | 2 |
| 4(a)(ii) | any **two** from:<br>• eye protection<br>• lab coat<br>• heat-proof mat<br>• (heat-proof) gloves<br>• (long) hair tied back<br>• stand up<br>• secure the beaker | | 2 |
| 4(a)(iii) | Stir the water before measuring the temperature.<br>Place a lid on the beaker. | | 1<br>1 |
| 4(b) | the products → S<br>the activation energy → Q<br>the energy released by the reaction → P | | 1<br>1<br>1 |
| 4(c) | carbon dioxide produced<br>(crude oil / propane) non-renewable | it =propane<br>allow converse arguments<br>allow greenhouse gas / global warming / atmospheric pollution<br>allow crude oil running out | 1<br>1 |
| **Total** | | | **11** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 32 · Mark scheme**

June 2014 | CH2FP | Original Q5 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. | ID |
|---|---|---|---|---|---|
| **5(a)(i)** | ions cannot move | *allow only conducts as a liquid* | 1 | 1 / 2.7.1a | E |
| **5(a)(ii)** | chlorine | | 1 | 2 / 2.7.1b | G |
| **5(a)(iii)** | they are positively / oppositely charged<br>**or**<br>they are attracted | | 1 | 1 / 2.7.1c | E |
| **5(a)(iv)** | 2 | | 1 | 2 / 2.7.1e | G |
| **5(b)(i)** | any **one** from:<br>• not all the magnesium was collected<br>• *used less time* ***or*** *lower current* ***or*** *different battery / power pack* ***or*** *different balance* ***or*** *lower voltage*<br>• error in reading balance<br>• error in recording result | *allow some magnesium was lost* | 1 | 3 / 2.7.1 | E |
| **5(b)(ii)** | 1.11 | correct answer with or without working gains **2** marks.<br>if answer incorrect, allow **1** mark for 0.99<br>**or** for 1.13+1.11+1.09 | 2 | 2 + 3 / 2.7.1 | E |
| **5(c)(i)** | *25 – 25.3* | correct answer with or without working gains **2** marks.<br>If answer incorrect, allow **1** mark for 24/95 | 2 | 2 / 2.3.3a | E |
| **5(c)(ii)** | 71 | | 1 | 2 / 2.3.1f | A |
| **5(d)(i)** | reversible reaction | | 1 | 1 / 2.3.3f | A |
| **5(d)(ii)** | decreases | | 1 | 1 / 2.5.1c | A |
| **Total** | | | **12** | | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 32 · Mark scheme**

June 2014 | CH2FP | Original Q5 | Legacy



### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 33 · Mark scheme**

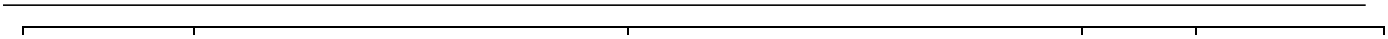
June 2015 | CH2FP | Original Q5 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **5(a)(i)** | the higher the temperature, the greater the rate<br><br>**or**<br>at 40 °C rate is faster than at 20 °C | accept the higher the temperature, the faster the reaction | 1 | **AO3**<br>2.4.1c |
| **5(a)(ii)** | 40 °C curve is steeper<br><br>**or**<br>correct comparison of data from the graph | accept the 40 °C line becomes horizontal sooner<br><br>accept at higher temperatures the reaction finishes sooner<br><br>accept reaction finishes sooner at 40 °C<br><br>accept at higher temperatures the gas is produced faster | 1 | **AO3**<br>2.4.1c |
| **5(a)(iii)** | 2 | | 1 | **AO2**<br>2.4.1a |
| **5(b)(i)** | Concentration of acid<br>Mass of marble chips | | 2 | **AO3**<br>2.4.1e |
| **5(b)(ii)** | increases rate<br><br>(because of) more frequent collisions (between particles) | incorrect reference to energy = max **1**<br><br>accept particles are more likely to collide<br><br>ignore more collisions<br><br>ignore more successful collisions | 1<br><br>1 | **AO1**<br>2.4.1f |
| **5(c)** | any **one** from:<br>• increases rate of reaction<br>• reduces energy required<br>• lower temperature can be used<br>• catalyst is not used up | | 1 | **AO1**<br>2.4.1g,h |
| **Total** | | | **8** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 33 · Mark scheme**

June 2015 | CH2FP | Original Q5 | Legacy



### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 34 · Mark scheme** June 2015 | CH2FP | Original Q6 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **6(a)** | any **one** from:<br>• solution becomes colourless or colour fades<br>• zinc becomes bronze / copper coloured<br>• zinc gets smaller<br>• bubbles or fizzing | <br><br>allow copper (forms) or a solid (forms)<br><br>allow zinc dissolves<br><br>ignore precipitate | 1 | **AO2**<br>2.5.1 |
| **6(b)** | improvement:<br>use a plastic / polystyrene cup or add a lid<br>reason - must be linked<br>reduce / stop heat loss<br>**OR**<br>improvement:<br>use a digital thermometer<br>reason - must be linked<br>more accurate or easy to read or stores data | <br>accept use lagging/insulation<br><br><br><br><br>allow use a data logger<br><br><br>allow more precise or more sensitive<br>ignore more reliable<br>ignore improvements to method, eg take more readings | 1<br><br>1 | **AO3**<br>2.5.1a,b |

**Question 6 continues on the next page**

**Question 6 continued**

| | |
|---|---|
| **6(c)** Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking. | **AO2/AO3**<br>2.5.1a,b |

| 0 marks | Level 1 (1–2 marks) | Level 2 (3–4 marks) | Level 3 (5–6 marks) |
|---|---|---|---|
| No relevant content. | There is a statement about the results. | There are statements about the results.<br>These statements may be linked or may include data. | There are statements about the results with at least one link and an attempt at an explanation. |

Examples of chemistry points made in the response:

**Description:**

**Statements**
Concentration of copper sulfate increases
Temperature change increases
There is an anomalous result
The temperature change levels off
Reaction is exothermic

**Linked Statements**
Temperature change increases as concentration of copper sulfate increases
The temperature change increases, and then remains constant
After experiment 7 the temperature change remains constant

**Statements including data**
The trend changes at experiment 7
Experiment 3 is anomalous

**Attempted Explanation:**
Temperature change increases because rate increases
Temperature change levels off because the reaction is complete

**Explanation:**
As more copper sulfate reacts, more heat energy is given off
Once copper sulfate is in excess, no further heat energy produced

| | | | |
|---|---|---|---|
| **Total** | | | **9** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 35 · Mark scheme**

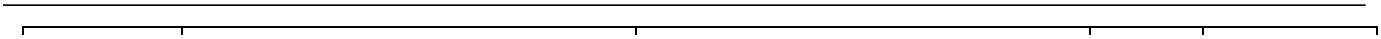
June 2015 | CH3FP | Original Q3 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **3(a)(i)** | 11 | | 1 | **AO2**<br>3.3.1.c |
| **3(a)(ii)** | 4620 (J) | correct answer gains **2** marks with or without working<br>allow 4.62kJ for **2** marks<br>if answer is incorrect:<br>100 x 4.2 x 11 gains 1 mark<br>**or**<br>100 x 4.2 x (their temp. rise) gains **1** mark<br>**or**<br>100 x 4.2 x (their temp. rise) correctly calculated gains **2** marks | 2 | **AO2**<br>3.3.1.c |
| **3(b)** | the temperature increases | allow gets hotter<br>allow heat / energy is given off | 1 | **AO2**<br>3.3.1.c |
| **3(c)(i)** | (energy of) products lower than (energy of) reactants | allow converse<br>allow arrow C points downwards | 1 | **AO2**<br>3.3.1.d |
| **3(c)(ii)** | A | | 1 | **AO2**<br>3.3.1.d |
| **Total** | | | **6** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 35 · Mark scheme**

June 2015 | CH3FP | Original Q3 | Legacy



### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 36 · Mark scheme**

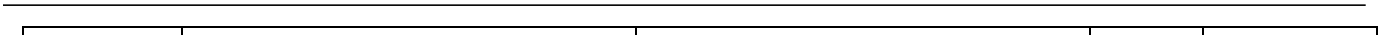
June 2015 | CH3FP | Original Q4 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **4(a)** | natural gas | allow correct answer shown in box if answer line blank | 1 | **AO1** 3.5.1.a |
| **4(b)(i)** | 450 | allow correct answer shown in box if answer line blank | 1 | **AO1** 3.5.1.b |
| **4(b)(ii)** | iron | allow correct answer shown in box if answer line blank | 1 | **AO1** 3.5.1.b |
| **4(b)(iii)** | The catalyst lowers the activation energy. | | 1 | **AO1** 3.3.1.h |
| **4(c)** | (the gases are) cooled | | 1 | **AO1/ AO2** 3.5.1.b |
| | ammonia condenses | allow ammonia liquefies | 1 | |
| | nitrogen and hydrogen are recycled | if no other mark awarded allow ammonia is separated for **1** mark | 1 | |
| **Total** | | | **7** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 36 · Mark scheme**

June 2015 | CH3FP | Original Q4 | Legacy



4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 37 · Mark scheme

June 2016 | CH1FP | Original Q3 | Legacy

**Question 3**

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **3(a)** | because it is a good conductor of electricity. | | 1 | AO1 1.3.3b |
| **3(b)(i)** | 2.1 (%) | | 1 | AO2 1.3.1c |
| **3(b)(ii)** | correct bar for calcium at 3.6 %<br>correct bar for iron at 5.0 % | allow error of +/- 0.05%<br>allow error of +/- 0.05% | 1<br>1 | AO2 1.3.1c |
| **3(c)(i)** | decomposition | | 1 | AO1 1.1.3b; 1.2.1b/c |
| **3(c)(ii)** | carbon dioxide | | 1 | AO1 1.2.1c |
| **3(c)(iii)** | carbon = 1<br>oxygen = 3 | allow one<br>allow three | 1<br>1 | AO2 1.1.3 a |
| **3(c)(iv)** | 44 (g) | allow forty four | 1 | AO2 1.1.3 c |
| **3(d)(i)** | to make alloys for specific uses. | | 1 | AO1 1.3.2a/b/c |
| **3(d)(ii)** | any **three** from:<br>• to conserve resources of iron or iron ore<br>• to avoid the need for quarrying/mining<br>• to conserve energy resources or fossil fuels<br>• to limit the amount of carbon dioxide produced or to reduce global warming<br>• to reduce the amount of landfill | "it" = steel<br>ignore cost and reuse and time and waste<br>allow steel instead of iron or iron ore<br>allow limited resource or non-renewable | 3 | AO1 1.3.1j |
| **Total** | | | **13** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

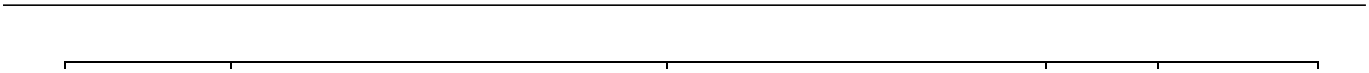
**Answer 38 · Mark scheme** June 2016 | CH2FP | Original Q4 | Legacy

| Question | Answers | Extra information | Mark | AO / SpecRef |
|---|---|---|---|---|
| **4(a)** | sulfur dioxide | accept $SO_2$ | 1 | AO2 2.6.1a |
| **4(b)(i)** | curved line of best fit between the 4 non-anomalous points | | 1 | AO2 2.4.1a |
| **4(b)(ii)** | temperature was lower (than 40 °C) | accept student missed the moment when the cross disappeared<br>accept smaller volume of acid or acid more dilute | 1 | AO3 2.4.1c |
| **4(b)(iii)** | 0.005 **or** 1/200 | correct answer with or without working gains **2** marks<br>if answer incorrect, allow **1** mark for 0.32 / 64 | 2 | AO2 2.4.1a |
| **4(b)(iv)** | The particles move faster.<br>The particles collide with more energy. | | 1<br>1 | AO1 2.4.1c |
| **4(b)(v)** | activation | | 1 | AO1 2.4.1.b |
| **Total** | | | **8** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 38 · Mark scheme**

June 2016 | CH2FP | Original Q4 | Legacy



### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

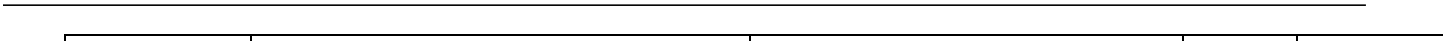
**Answer 39 · Mark scheme** June 2016 | CH2FP | Original Q5 | Legacy

| Question | Answers | Extra information | Mark | AO / SpecRef |
|---|---|---|---|---|
| **5(a)(i)** | 5.75 **or** 5.8 | correct answer with or without working gains **2** marks<br>correct working showing addition of any four results and division by 4 gains **1** mark<br>**OR**<br>6(.04) for **1** mark | 2 | AO2/AO3 2.5.1a,c |
| **5(a)(ii)** | use a polystyrene cup **or** lid<br>to prevent energy/heat gain<br>**OR**<br>use a digital thermometer<br>easier to read (to 0.1°C) | accept insulate the beaker<br>accept to prevent energy/heat transfer<br>do **not** accept energy/heat loss<br>allow use a data logger | 1<br>1 | AO3 2.5.1a,c |
| **5(b)** | (as mass increases) the final temperature increases<br>then stays constant<br>correct reference to a value above 8 g up to and including 10 g as mass when the trend changes | | 1<br>1<br>1 | 2AO2 / 1AO3 2.5.1b |
| **Total** | | | **7** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 39 · Mark scheme**

June 2016 | CH2FP | Original Q5 | Legacy



### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 40 · Mark scheme**

June 2016 | CH2FP | Original Q6 | Legacy

| Question | Answers | Extra information | Mark | AO / SpecRef |
|---|---|---|---|---|
| **6(a)** | endothermic | | 1 | AO1 2.5.1d |
| **6(b)** | 82 (%) | correct answer with working gains **3** marks<br>if 17 or 34 not shown in working **max 2** marks<br>accept 82.4<br>accept 82.35 to full calculator display (82.35294...) correctly rounded to at least 2 sf<br>if no answer or incorrect answer, then<br>($M_r$ =) 17 gains **1** mark **or**<br>14/17 gains **2** marks<br>**OR**<br>($2M_r$ =) 34 gains **1** mark **or**<br>28/34 gains **2** marks<br>**OR**<br>14/their $M_r$ shown gains **1** mark **or**<br>correct calculation of 14/their $M_r$ gains **2** marks | 3 | AO2 2.3.3a, 2.3.1f |
| **6(c)(i)** | 7 / seven | | 1 | AO1 2.6.2d |
| **6(c)(ii)** | $H^+ + OH^- \rightarrow H_2O$ | | 1 | AO1 2.6.2e |
| **6(c)(iii)** | ammonium chloride | allow $NH_4Cl$<br>ignore an incorrect formula | 1 | AO1 2.6.2b |

**Question 6 continues on the next page**

**Question 6 continued**

| Question | Answers | Extra information | Mark | AO / SpecRef |
|---|---|---|---|---|
| 6(d) | | | 6 | 2AO2 / 4AO3 2.6.2c |

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5 and apply a 'best-fit' approach to the marking.

| 0 marks | Level 1 (1–2 marks) | Level 2 (3–4 marks) | Level 3 (5–6 marks) |
|---|---|---|---|
| No relevant content. | Suggestion with a reference to a graph. | Suggestion with reasons referring to more than one graph. | Suggestion with reasons from all three graphs, and linking of ideas which may explain a compromise. |

**Examples of chemistry points made in response:**

A reasonable suggested amount of fertiliser would be in the region of 200 kg (per ha). Accept any suggestion from about 180 kg (per ha) to 500 kg (per ha).

**Yield:**

- Using fertiliser improves yield.
- Yield improved most up to about 200 kg (per ha) of fertiliser.
- Yield only increased slightly above about 200 kg (per ha).

**Profit:**

- About 200 kg of fertiliser gives the most profit.
- Above about 200 kg (per ha) of fertiliser profit declines.

**Run off:**

- Run off is at low levels until about 300 kg (per ha) of fertiliser.
- Above about 300 kg (per ha) of fertiliser, run off increases.

**Examples of linking of ideas:**

- Overall 200 kg gives high crop yield and most profit.
- In conclusion 200 kg gives high crop yield and low run off.
- 200 kg gives most profit and low run off.

**Examples of compromise:**

- Profits go down after about 200 kg (per ha) of fertiliser because cost of fertiliser is not covered by increased yield.
- 200 kg gives the highest profit although it is not the highest yield.
- 500 kg gives the best yield but has the most runoff.

| Total | | | 13 |
|---|---|---|---|

## 4.5.1.1 Energy transfer during exothermic and endothermic reactions

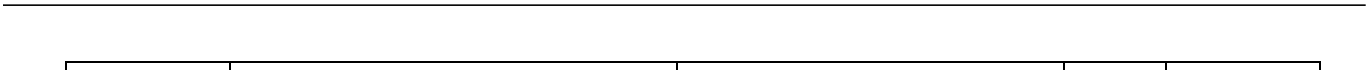
**Answer 41 · Mark scheme** June 2016 | CH3FP | Original Q3 | Legacy

| Question | Answers | Extra information | Mark | AO / SpecRef |
|---|---|---|---|---|
| **3(a)** | water / $H_2O$ | allow steam or hydrogen oxide | 1 | AO1 3.3.1i |
| **3(b)(i)** | A | | 1 | AO2 3.3.1d |
| **3(b)(ii)** | exothermic<br>products (energy) lower than reactants (energy) | | 1<br>1 | AO2/AO3 3.3.1d,e |
| **3(b)(iii)** | 1860 (kJ) | | 1 | AO2 3.3.1d |
| **3(c)(i)** | 22.5<br>38.7<br>16.2 | <br><br>allow ecf for correct subtraction | 1<br>1<br>1 | AO2 3.3.1a |
| **3(c)(ii)** | 50 (g) | | 1 | AO2 3.3.1a |
| **3(c)(iii)** | 20.1 (kJ) | allow propanol<br>ignore 3 | 1 | AO3 3.3.1a |
| **3(c)(iv)** | as the number of carbon atoms (in one molecule of alcohol) increases the heat energy given out increases (when the alcohol is burned) | | 1 | AO3 3.3.1a |
| **3(c)(v)** | any **two** from:<br>• no lid<br>• no insulation<br>• no draught shield<br>• incomplete combustion<br>• inaccurate measurement<br>• no repeats (to calculate a mean) | Allow heat / energy loss to surroundings for any one of these marks | 2 | AO3 3.3.1a |
| **3(c)(vi)** | -O-H | | 1 | AO1 3.6.1a |
| **Total** | | | **14** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 41 · Mark scheme**

June 2016 | CH3FP | Original Q3 | Legacy



### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 42 · Mark scheme** June 2017 | CH2FP | Original Q4 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 4(a) | 58.5 | | 1 | AO2<br>2.5.1b |
| 4(b) | water | | 1 | AO2<br>2.3.3a |
| 4(c)(i) | prevents loss of thermal energy | allow prevents heat loss | 1 | AO1<br>2.6.1 |
| 4(c)(ii) | 13/thirteen | | 1 | AO3<br>2.5.1 |
| 4(c)(iii) | temperature changes/results are all similar | accept no anomalous results<br>allow they are all similar<br>do **not** accept temperature | 1 | AO2<br>2.5.1 |
| 4(c)(iv) | exothermic | allow giving out energy | 1 | AO3<br>2.5.1 |
| 4(d)(i) | ions move | allow they move<br>ignore free ions<br>do not accept movement of electrons | 1 | AO1<br>2.7.1a<br>2.2.2b |
| 4(d)(ii) | (chloride ions are) negative | accept opposites attract<br>do **not** accept chlorine is negative | 1 | AO1<br>2.7.1c |
| 4(d)(iii) | Tick (✓) by:<br>soap | | 1 | AO1<br>2.7.1i |
| 4(d)(iv) | 1 bonding pair of electrons<br>6 unbonded electrons on Cl | accept dot, cross, e or – or any combination | 1<br>1 | AO2<br>2.1 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 42 · Mark scheme**

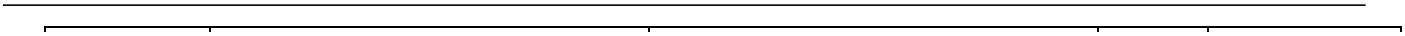


| | | | | |
|---|---|---|---|---|
| **4(d)(v)** | Tick (✓) by:<br>$\frac{1}{36.5}$ x 100 | | 1 | **AO2**<br>2.3.3a |
| **Total** | | | **12** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 42 · Mark scheme**

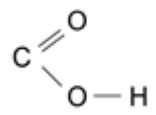
June 2017 | CH2FP | Original Q4 | Legacy



### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 43 · Mark scheme**

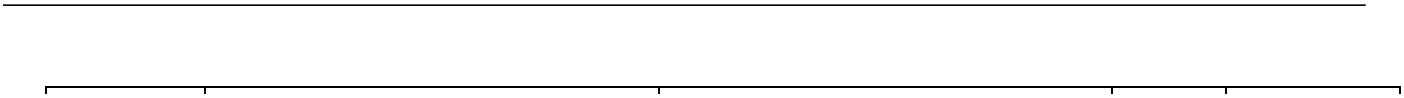
June 2017 | CH3FP | Original Q1 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 1 (a)(i) | numbers | allow number<br>allow numbers circled in the box | 1 | AO1<br>3.1.2b |
| 1 (a)(ii) | electrons | allow electron<br>allow electrons circled in the box | 1 | AO1<br>3.1.2b |
| 1 (b)(i) | Cl/chlorine | allow CL / cL / cl | 1 | AO1<br>3.1.3f |
| 1 (b)(ii) | Cu/copper | allow CU / cU / cu | 1 | AO2<br>3.1.3c |
| 1 (b)(iii) | 7/seven | | 1 | AO1<br>3.1.3e |
| 1(c)(i) | tick (✓) by:<br>displacement | | 1 | AO1<br>3.1.3g |
| 1(c)(ii) | tick (✓) by:<br>Fluorine | | 1 | AO3<br>3.1.3g |
| 1(d) | tick (✓) by:<br>yellow | | 1 | AO1<br>3.4.1e |
| 1(e)(i) | circle around:<br> | | 1 | AO2<br>3.6.2a |
| 1(e)(ii) | carbon dioxide | allow carbon dioxide circled in the box | 1 | AO2<br>3.6.2b |
| 1(e)(iii) | esters | allow esters circled in the box<br>allow ethers | 1 | AO2<br>3.6.2b |
| Total | | | 11 | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 43 · Mark scheme**

June 2017 | CH3FP | Original Q1 | Legacy



### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

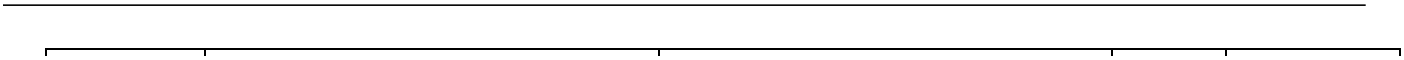
**Answer 44 · Mark scheme** June 2017 | CH3FP | Original Q3 | Legacy

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **3(a)(i)** | air | allow air circled in the box | 1 | **AO1** 3.5.1.a |
| **3(a)(ii)** | tick (✓) by:<br>lowers the activation energy | | 1 | **AO1** 3.3.1h |
| **3(a)(iii)** | (gases) cooled<br>(ammonia) condensed | <br>ignore turn to a liquid<br><br>if no other mark, allow fractional distillation for 1 mark | 1<br>1 | **AO1**<br>**AO2** 3.5.1b |
| **3(b)** | hydrogen<br>ammonia | must be in correct order | 1 | **AO1** 3.5.1b |
| **3(c)(i)** | all points correctly plotted | allow 1 mark for **3** correct points<br>allow +/- one small square | 2 | **AO2** 3.5.1b |
| **3(c)(ii)** | correctly drawn line | | 1 | **AO2** 3.5.1b |
| **3(c)(iii)** | line extrapolated to at least 300°C<br>0.50 - 0.60 | | 1<br>1 | **AO2** 3.5.1b |
| **3(c)(iv)** | increases | | 1 | **AO2** 3.5.1b |
| **Total** | | | **11** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 44 · Mark scheme**

June 2017 | CH3FP | Original Q3 | Legacy



**Answer 45 · Mark scheme**

June 2018 | 8462/1F | Original Q6

The full source mark scheme begins on page 110. Follow original question 6 in that document.

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 46 · Mark scheme** June 2018 | 8462/2F | Original Q10

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.1** | hydrogen | allow $H_2$ | 1 | AO1 4.10.4.1 |
| **10.2** | 450 °C<br><br>200 atm / atmospheres | allow values in the range 400– 500 °C<br><br>allow values in the range 150– 250 atm / atmospheres<br><br>allow **1** mark if both values within range but no units given | 1<br><br>1 | AO1 4.10.4.1 |
| **10.3** | ammonia has a higher boiling point | allow the other gases have lower boiling points<br><br>ignore references to melting point | 1 | AO3 4.10.4.1 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 46 · Mark scheme**

June 2018 | 8462/2F | Original Q10

| Question | Answers | | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.4** | **Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account. | | 5–6 | AO2 |
| | **Level 2:** Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear. | | 3–4 | AO1 |
| | **Level 1:** Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking. | | 1–2 | AO1 |
| | **No relevant content** | | 0 | |
| | **Indicative content**<br><br>**changes**<br><br>• carbon dioxide has decreased<br>• oxygen has increased<br><br>**processes**<br><br>• volcanic activity released water vapour<br>• the water vapour condensed to form oceans<br>• carbon dioxide dissolved in oceans<br>• carbonates produce sediments<br>• carbon locked up in sedimentary rocks<br><br>• algae and plants evolved / appeared<br>• algae / plants absorbed carbon dioxide<br>• by photosynthesis<br>• which also released oxygen<br><br>• carbon locked up in fossil fuels | | | 4.9.1.2<br>4.9.1.3<br>4.9.1.4 |
| **10.5** | any **one** from:<br>• occurred 4.6 billion years ago<br><br>• limited or no evidence | allow any indication of billions of years<br>allow limited or no proof<br><br>ignore there was nobody there | 1 | AO1<br>4.9.1.2 |
| **Total** | | | **11** | |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 47 · Mark scheme

June 2019 | 8462/1F | Original Q7

## Question 7

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.1** | sports injury pack | | 1 | AO1 4.5.1.1 |
| **07.2** | D | | 1 | AO1 4.5.1.1 |
| **07.3** | systematic error | | 1 | AO1 4.5.1.1 |
| **07.4** | polystyrene cup | allow other insulating containers | 1 | AO1 4.5.1.1 |
| **07.5** | all six points plotted correctly<br><br>line of best fit<br><br>line extrapolated correctly to y-axis | allow a tolerance of ± ½ a small square<br>allow **1** mark for at least 3 points plotted correctly<br><br>ignore extrapolation to y-axis | 2<br><br>1<br><br>1 | AO2 4.5.1.1 |
| **07.6** | 20.4 (°C) | allow ecf from question **07.5**<br>allow a tolerance of ± ½ a small square | 1 | AO2 4.5.1.1 |
| **07.7** | the mixture was not stirred<br><br>too little sulfuric acid was added | | 1<br><br>1 | AO3 4.5.1.1 |
| **Total** | | | **11** | |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 48 · Mark scheme

June 2019 | 8462/1F | Original Q8

## Question 8

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 08.1 | any **one** from:<br>• so elements / iodine / tellurium were in groups with similar properties<br>• iodine has similar properties to Br / Cl / F / Group 7<br>• iodine has different properties to Se / S / O / Group 6 | ignore reference to atomic structure<br>ignore references to Cr, Mn and Mo<br><br>allow corresponding argument in terms of tellurium | 1 | AO1<br>4.1.2.2 |
| 08.2 | Mendeleev had predicted properties of missing elements<br><br>elements were discovered (that filled the spaces / gaps)<br><br>properties (of these elements) matched Mendeleev's predictions | ignore reference to atomic structure<br><br><br>allow atomic weights (of these elements) fitted in the spaces / gaps<br><br>if no other mark awarded, allow **1** mark for in previous versions of the periodic table the pattern of similar properties broke down | 1<br><br>1<br><br>1 | AO1<br>4.1.2.2 |
| 08.3 | relative atomic mass | | 1 | AO1<br>4.1.1.6 |
| 08.4 | (increasing) atomic / proton number | ignore (increasing) electron number<br>do **not** accept relative atomic / proton number | 1 | AO1<br>4.1.2.1 |
| 08.5 | (formula) $At_2$<br><br>(state) solid | ignore incorrect state symbol<br><br>allow (s)<br>ignore s | 1<br><br>1 | AO1<br>4.1.2.6 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 48 · Mark scheme**



| | | | | |
|---|---|---|---|---|
| **08.6** | any **two** from:<br>• flame<br>• (white) solid forms<br>• colour of gas / chlorine disappears / fades | allow burns<br>allow (white) smoke forms | 2 | AO1<br>4.1.2.5 |
| **Total** | | | **10** | |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 49 · Mark scheme

June 2019 | 8462/2F | Original Q3

## Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.1** | (equation contains a) ⇌ (symbol) | allow description of arrow / symbol | 1 | AO1 4.6.2.1 |
| **03.2** | exothermic | | 1 | AO1 4.6.2.2 |
| **03.3** | to reduce costs<br><br>to use less energy | | 1<br><br>1 | AO3 4.6.1.4 |
| **03.4** | (the world production of ammonia) increased<br><br>(the increase was) not steady / linear | <br><br>do **not** accept decreases<br>ignore levels off | 1<br><br>1 | AO2 4.10.4.1 |
| **03.5** | the demand for food changed<br><br>the world population changed | | 1<br><br>1 | AO2<br>AO3<br>4.10.4.2 |
| **03.6** | **C** and **D** | | 1 | AO3 4.10.4.2 |
| **03.7** | **D** | | 1 | AO3 4.10.4.2 |
| **Total** | | | **10** | |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 50 · Mark scheme

June 2019 | 8462/2F | Original Q10

## Question 10

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.1** | (aq) | allow aqueous / aq | 1 | AO1<br>4.2.2.1<br>4.2.2.2 |
| **10.2** | (gas) syringe<br><br>stopclock / stopwatch | allow measuring cylinder (and water trough)<br>allow balance<br><br>allow timer / clock / watch | 1<br><br>1 | AO1<br>4.6.1.1 |
| **10.3** | all points plotted correctly<br><br>line of best fit | allow a tolerance of ± ½ a small square<br><br>allow at least 3 points plotted correctly for **1** mark.<br><br>allow correctly drawn line of best fit for incorrectly plotted points | 2<br><br>1 | AO2<br>4.6.1.1 |
| **10.4** | (rate) decreases<br><br>(rate decreases) more slowly as time increases<br><br>(rate) becomes zero at 60 s | allow slows down<br><br>allow (rate decreases) at a non-linear rate<br><br>allow the reaction stops at 60 s<br>allow ecf from question **10.3** | 1<br><br>1<br><br>1 | AO3<br>4.6.1.1 |
| **10.5** | more bubbles were produced in the first 10 seconds<br><br>the magnesium was used up more quickly | | 1<br><br>1 | AO2<br>4.6.1.2 |
| **Total** | | | **11** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 51 · Mark scheme** November 2020 | 8462/1F | Original Q1

## Question 1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.1** | gas | | 1 | AO2<br>4.1.2.6<br>4.2.2.1 |
| **01.2** | -35 (°C) | allow any value between -35 °C and -100 °C | 1 | AO2<br>4.1.2.6<br>4.2.2.1 |
| **01.3** | increase<br><br>increase | <br><br>allow become stronger | 1<br><br>1 | AO1<br>AO2<br>4.1.2.6<br>4.2.2.4 |
| **01.4** | chlorine gas is toxic | | 1 | AO3<br>4.1.2.6 |
| **01.5** | increased<br><br>chlorine (atoms) are now part of the solid (iron chloride)<br>**or**<br>the mass of the chlorine (atoms) is now also measured | | 1<br><br>1 | AO2<br>4.1.2.6<br>4.3.1.3 |
| **01.6** | burns very vigorously | allow burns violently<br>allow brighter (orange) glow<br>allow (orange) flame<br>allow explodes | 1 | AO3<br>4.1.2.1<br>4.1.2.6 |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 51 · Mark scheme



**Question 1 continued**

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.7** | $2\ Fe + 3\ Br_2 \longrightarrow 2\ FeBr_3$ | allow multiples | 1 | AO2<br>4.1.1.1<br>4.1.2.6 |
| **01.8** | 56 + (3 × 80)<br><br>= 296 | <br><br>ignore units | 1<br><br>1 | AO2<br>4.3.1.2 |
| **Total** | | | **11** | |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 52 · Mark scheme

November 2020 | 8462/1F | Original Q6

## Question 6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.1** | $C_6H_8O_7$ | | 1 | AO2<br>4.2.1.4 |
| **06.2** | covalent | | 1 | AO1<br>4.2.1.4 |
| **06.3** | shows (single and) double bonds<br><br>shows which atoms are which element | | 1<br><br>1 | AO3<br>4.2.1.4 |
| **06.4** | temperature decreases (during the reaction) | allow (the solution) gets colder | 1 | AO3<br>4.5.1.1<br>RPA 4 |
| **06.5** | all six points plotted correctly<br><br>line of best fit<br><br>extrapolation to meet the printed line | allow a tolerance of ± ½ small square<br>allow **1** mark for four / five points plotted correctly | 2<br><br>1<br><br>1 | AO2<br>4.5.1.1<br>RPA 4 |
| **06.6** | 22.6 – 20.2<br><br>= 2.4 (°C) | allow ecf from question **06.5**<br><br>ignore sign<br><br>if no other mark awarded allow **1** mark for 2.2 (°C) | 1<br><br>1 | AO2<br>4.5.1.1<br>RPA 4 |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 52 · Mark scheme

November 2020 | 8462/1F | Original Q6

**Question 6 continued**

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.7** | temperature of solution | | 1 | AO1<br>4.5.1.1<br>RPA 4 |
| **Total** | | | **12** | |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 53 · Mark scheme

November 2020 | 8462/2F | Original Q2

## Question 2

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.1** | acid rain | | 1 | AO1<br>4.9.3.2 |
| **02.2** | oxygen<br>carbon | must be in this order | 1<br>1 | AO1<br>4.9.3.1 |
| **02.3** | dimming | | 1 | AO1<br>4.9.3.1<br>4.9.3.2 |
| **02.4** | $2\ CH_4 + 3\ O_2 \rightarrow$ **2** $CO + 4\ H_2O$ | allow multiples | 1 | AO2<br>4.3.1.1<br>4.9.3.1 |
| **02.5** | air<br>oxygen<br>oxides of nitrogen | must be in this order | 1<br>1<br>1 | AO1<br>4.9.3.1 |
| **Total** | | | **8** | |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 54 · Mark scheme

November 2021 | 8462/1F | Original Q4

## Question 4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.1 | $\frac{54 + 50 + 55}{3}$<br>= 53 (°C) | if no other mark awarded allow **1** mark for<br>$\frac{54 + 50 + 37 + 55}{4}$ = 49 (°C) | 1<br>1 | AO3<br>AO2<br>4.4.1.2<br>4.5.1.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.2 | (most reactive) magnesium<br>zinc<br>(least reactive) cobalt | allow ecf from question **04.1** | 1 | AO3<br>4.4.1.2<br>4.5.1.1<br>RPA4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.3 | (18 ±) 2 (°C) | | 1 | AO2<br>4.3.1.4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.4 | control | | 1 | AO1<br>4.4.1.2<br>4.5.1.1<br>RPA4 |

4.5.1.1 Energy transfer during exothermic and endothermic reactions



**Question 4 continued**

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.5** | use the same mass of metal / powder | | 1 | AO3<br>4.4.1.2<br>4.5.1.1<br>RPA4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.6** | (A) progress of reaction<br><br>(B) activation energy<br><br>(C) products | | 1<br><br>1<br><br>1 | AO1<br>4.5.1.2 |

| Total | | | 9 |
|---|---|---|---|

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 55 · Mark scheme

June 2022 | 8462/1F | Original Q10

## Question 10

| Question | Answers | Mark | AO/ Spec. Ref |
|---|---|---|---|
| 10.1 | **Level 3:** The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced. | 5–6 | AO1 4.5.1.1 RPA 4 |
| | **Level 2:** The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced. | 3–4 | |
| | **Level 1**: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear. | 1–2 | |
| | **No relevant content.** | 0 | |
| | **Indicative content**<br>• **measure volume of (hydrochloric) acid**<br>• with a measuring cylinder<br>• pour (hydrochloric) **acid into a suitable container** eg polystyrene cup<br>• measure the initial temperature (of hydrochloric acid)<br>• with a thermometer<br>• **add a known mass of sodium carbonate**<br>• measured with a balance<br>• stir<br>• **measure the highest temperature reached**<br>• **repeat with different masses of sodium carbonate or add successive masses of sodium carbonate to the same mixture**<br>• repeat the whole investigation<br>• use the same starting temperature<br>• use the same volume of (hydrochloric) acid each time<br>• use the same concentration of (hydrochloric) acid each time | | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 55 · Mark scheme**

June 2022 | 8462/1F | Original Q10

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.2 View with Figure 17** | change in highest temperature | allow a tolerance of ± ½ a small square | 1 | AO2 4.5.1.1 RPA4 |
| | corresponding change in mass | allow a tolerance of ± ½ a small square | 1 | |
| | (gradient =) $\frac{\text{change in highest temperature}}{\text{change in mass}}$ | allow correct use of an incorrectly determined change in highest temperature and / or change in mass | 1 | |
| | (gradient =) 1.6 | | 1 | |
| | °C/g | allow °C/gram(s) | 1 | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.3 View with Figure 17** | extrapolates line to the *y*-axis | | 1 | AO2 4.5.1.1 RPA4 |
| | 20.6 (°C) | allow a tolerance of ± ½ a small square<br>allow a correctly determined value from an incorrectly extrapolated line | 1 | |
| | **alternative approach:** | | | |
| | (highest temperature at 1.0 g – change in highest temperature per gram =)<br>22.2 – 1.6 (1) | allow correct use of value determined for gradient in question**10.2** | | |
| | = 20.6 (°C) (1) | | | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 55 · Mark scheme**



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.4** | **C** | | 1 | AO3<br>4.5.1.1<br>RPA4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.5** | (**X**) energy<br><br>(**Y**) (overall) energy change | | 1<br><br>1 | AO1<br>4.5.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.6** | (level of) products is below (level of) reactants | allow the energy decreases (overall)<br><br>allow energy is transferred to the surroundings<br><br>ignore references to bond making / breaking | 1 | AO1<br>4.5.1.2 |

| | | |
|---|---|---|
| **Total Question 10** | | **17** |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 56 · Mark scheme

June 2022 | 8462/2F | Original Q6

## Question 6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.1** | $Na_2S_2O_3 + 2\,HCl \rightarrow$ **2** $NaCl + H_2O + SO_2 + S$ | allow multiples | 1 | AO2<br>4.1.1.1<br>4.3.1.1<br>4.6.1.2<br>RPA5 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.2** | (s) | | 1 | AO1<br>4.2.2.2<br>4.6.1.2<br>RPA5 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.3** | a cross on a piece of paper | | 1 | AO1<br>4.6.1.2<br>RPA5 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.4** | the rate of reaction decreased | | 1 | AO3<br>4.6.1.1<br>4.6.1.2<br>RPA5 |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 56 · Mark scheme

June 2022 | 8462/2F | Original Q6

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.5 | one of the reactants was used up | | 1 | AO3<br>4.6.1.2<br>RPA5 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.6 | initially the line of best fit would be steeper | | 1 | AO2<br>4.6.1.2<br>RPA5 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.7 | fewer reactant particles have the activation energy<br><br>the reactant particles move more slowly | | 1<br><br>1 | AO2<br>4.6.1.2<br>4.6.1.3 |

| Total Question 6 | | 8 |
|---|---|---|

## Question 10

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.1** | (independent variable)<br>mass (of ammonium nitrate)<br><br>(dependent variable)<br>(lowest) temperature (reached by solution) | <br><br><br>allow change in temperature (of solution) | 1<br><br><br>1 | AO1<br>4.5.1.1<br>RPA4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.2** | all 6 points plotted correctly<br><br><br><br>line of best fit | allow a tolerance of ± ½ a small square<br><br>allow **1** mark for 4 or 5 points plotted correctly | 2<br><br><br><br>1 | AO2<br><br><br><br>AO3<br><br>4.5.1.1<br>RPA4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.3** | line extrapolated to *y*-axis<br><br>(initial temperature)<br>value for temperature where extrapolated line meets *y*-axis | <br><br>allow a tolerance of ± ½ a small square | 1<br><br>1 | AO3<br><br>AO2<br><br>4.5.1.1<br>RPA4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.4** | temperature decreased | ignore correct references to energy transfer | 1 | AO1<br>4.5.1.1<br>RPA4 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 57 · Mark scheme**



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.5** | (0.3 °C) is the uncertainty<br><br>(because 0.3 °C) is the range about the mean value | <br><br>allow values are (a maximum of) 0.3 (°C) either side of the mean<br><br>allow (because)<br>16.8 = 16.5 + 0.3<br>**and**<br>16.2 = 16.5 – 0.3 | 1<br><br>1 | AO2<br>4.3.1.4<br>4.5.1.1<br>RPA4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.6** | random error | | 1 | AO3<br>4.5.1.1<br>RPA4 |

| | |
|---|---|
| **Total Question 10** | **11** |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 58 · Mark scheme

June 2023 | 8462/2F | Original Q1

## Question 1

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.1 | Mars | | 1 | AO1 4.9.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.2 | 20% | | 1 | AO1 4.9.1.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.3 | algae and plants evolved<br><br>photosynthesis took place | | 1<br><br>1 | AO1 4.9.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.4 | (*y*-axis labelled) 5, 10, 15, (20)<br><br>oxygen bar drawn to 16% | allow (*y*-axis labelled) 4, 8, 12, 16, (20)<br><br>ignore correct intermediate values<br><br>allow a tolerance of ± ½ a small square | 1<br><br>1 | AO2 4.9.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 01.5 | test tube **A** | | 1 | AO2 4.6.1.2 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 58 · Mark scheme**



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.6** | a glowing splint | | 1 | AO1<br>4.8.2.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.7** | manganese dioxide is a catalyst in this reaction | | 1 | AO2<br>4.6.1.4 |

| | |
|---|---|
| **Total Question 1** | **9** |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 59 · Mark scheme

June 2023 | 8462/2F | Original Q4

## Question 4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.1 | water (vapour) is colourless<br><br>(calcium hydroxide and calcium oxide are) both white (powders / solids)<br>**or**<br>there is no change in the appearance of the powder / solids | allow water vapour cannot be seen | 1<br><br>1 | AO3<br>4.6.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.2 | the stopper would be pushed out | allow test tube may break | 1 | AO3<br>4.6.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.3 | the mass of the empty test tube | | 1 | AO2<br>4.6.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.4 | 5 minutes | | 1 | AO2<br>4.6.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.5 | (mass =) 2.00 – 1.51<br><br>= 0.49 (g) | | 1<br><br>1 | AO2<br>4.3.1.1<br>4.6.2.1 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 59 · Mark scheme**

June 2023 | 8462/2F | Original Q4

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.6** | 5.90 kJ | | 1 | AO2 4.6.2.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.7** | endothermic | | 1 | AO2 4.6.2.2 |

| | |
|---|---|
| **Total Question 4** | **9** |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 60 · Mark scheme

June 2024 | 8462/1F | Original Q3

## Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.1 | displacement | | 1 | AO1 4.4.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.2 | (percentage =) $\frac{63.5}{159.5} \times 100$ | | 1 | AO2 4.3.1.2 |
| | = 39.81191 (%) | | 1 | |
| | = 39.8 % | allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses both the values in the question | 1 | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.3 | volume of copper sulfate solution | | 1 | AO1 4.5.1.1 RPA4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 03.4 | 0.8(0) g | | 1 | AO3 4.5.1.1 RPA4 |

## 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 60 · Mark scheme**



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.5** | (maximum temperature change) = 47 – 22 (ºC)<br><br>= 25 (ºC) | <br><br>allow correct use of incorrectly determined value(s) from the graph | 1<br><br>1 | AO2<br>4.5.1.1<br>RPA4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.6** | (conversion 25 $cm^3$ =) 0.025 $dm^3$<br><br>(concentration =) $\frac{6.75}{0.025}$ ($g/dm^3$)<br><br>= 270 ($g/dm^3$) | <br><br>allow correct use of an incorrectly determined or unconverted volume | 1<br><br>1<br><br>1 | AO2<br>4.3.2.5 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.7** | line of best fit using the first five points<br><br>line of best fit using the last four points | max **1** mark if the lines do not intersect | 1<br><br>1 | AO2<br>4.5.1.1<br>RPA4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.8** | energy is **taken in from** the surroundings so the reaction is **endothermic** | | 1 | AO3<br>4.5.1.1<br>RPA4 |

| **Total Question 3** | **14** |
|---|---|

4.5.1.1 Energy transfer during exothermic and endothermic reactions

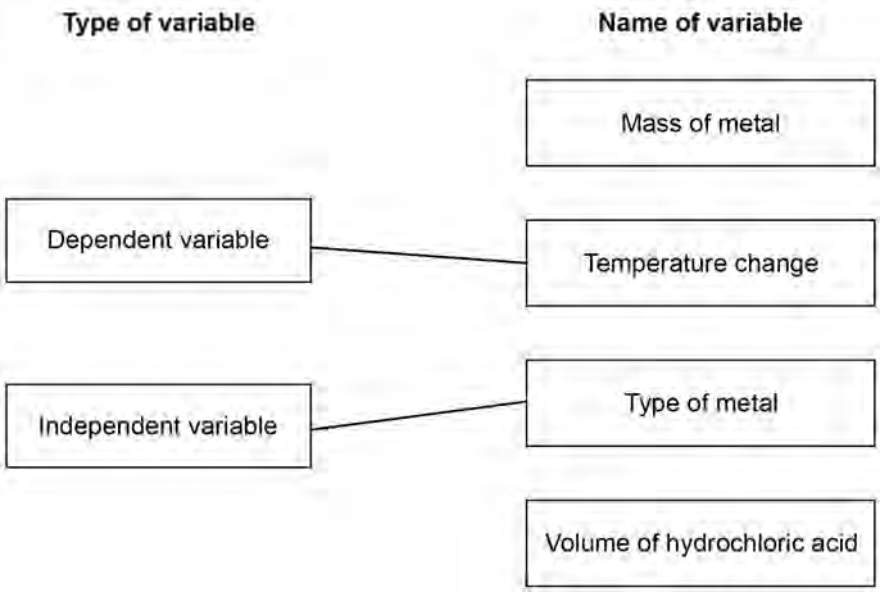
Answer 61 · Mark scheme

June 2025 | 8462/1F | Original Q2

## Question 2

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.1** | magnesium chloride | | 1 | AO2<br>4.4.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.2** | hydrogen | | 1 | AO1<br>4.4.2.1 |

| Question | Answers | Mark | AO / Spec. Ref. |
|---|---|---|---|
| **02.3** | <br>do **not** accept more than one line from a box on the left | 1<br><br>1 | AO1<br>4.5.1.1<br>RPA4 |

Answer 61 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.4 | a polystyrene cup | | 1 | AO3<br>4.5.1.1<br>RPA4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.5 | 2 °C | | 1 | AO3<br>4.5.1.1<br>RPA4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.6 | increases | | 1 | AO1<br>4.5.1.1<br>RPA4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.7 | **A** | | 1 | AO1<br>4.5.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.8 | **C** | | 1 | AO1<br>4.5.1.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.9 | **B** | | 1 | AO1<br>4.5.1.2 |

| Total Question 2 | 10 |
|---|---|

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 62 · Mark scheme

June 2025 | 8462/2F | Original Q2

## Question 2

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.1** | propene | | 1 | AO1<br>4.7.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.2** | 9 | | 1 | AO2<br>4.1.1.1<br>4.7.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.3** | making a polymer | | 1 | AO1<br>4.7.1.4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.4** | (*y*-axis 0, 20), 40, 60, 80, (100) | ignore intermediate values | 1 | AO2<br>4.7.2.1 |
| | carbon bar drawn to 86% | allow a tolerance of ± ½ a small square | 1 | |
| | carbon bar labelled | | 1 | |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 62 · Mark scheme



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.5 | (test)<br>add bromine (water)<br><br>(result)<br>(bromine water) turns (from orange to) colourless | <br><br><br>allow (bromine water) decolorises<br><br>ignore clear<br><br>MP2 is dependent upon MP1 being awarded | 1<br><br>1 | AO1<br>4.7.1.4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.6 | $C_{10}H_{22} \longrightarrow C_3H_6 + C_7H_{16}$ | | 1 | AO2<br>4.1.1.1<br>4.7.1.4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.7 | fuels | | 1 | AO1<br>4.7.1.4 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.8 | the molecules collide more frequently at 750 °C | | 1 | AO2<br>4.6.1.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 02.9 | (at 750 °C the rate of reaction is) higher | allow (at 450 °C the rate of reaction is) lower | 1 | AO2<br>4.6.1.2 |

| Total Question 2 | 12 |
|---|---|

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 63 · Mark scheme

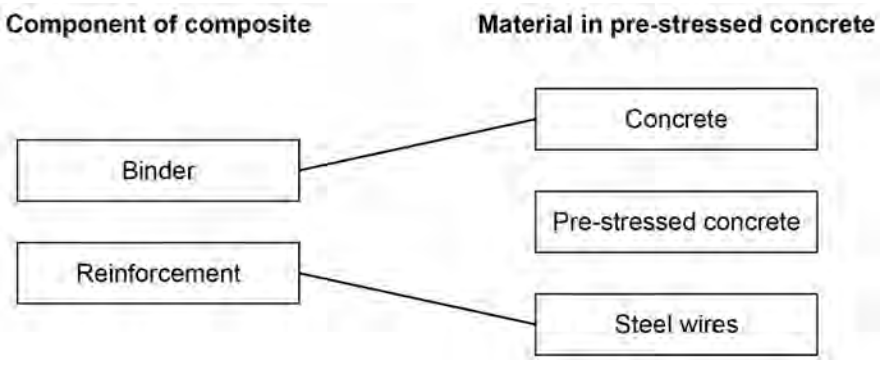
June 2025 | 8462/2F | Original Q3

## Question 3

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.1** | (the sign) ⇌ | allow a description of the reversible sign | 1 | AO1 4.6.2.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.2** | endothermic | allow (thermal) decomposition | 1 | AO1 4.6.2.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.3** | (energy released =) $\frac{4}{20} \times 23$<br><br>= 4.6 (kJ) | | 1<br><br>1 | AO2 4.6.2.2 |

| Question | Answers | Mark | AO / Spec. Ref. |
|---|---|---|---|
| **03.4** | <br>do **not** accept more than one line from a box on the left | 1<br><br>1 | AO2 4.10.3.3 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.5** | iron | allow Fe | 1 | AO1 4.10.3.2 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 63 · Mark scheme**



| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.6** | clay | | 1 | AO1 4.10.3.3 |

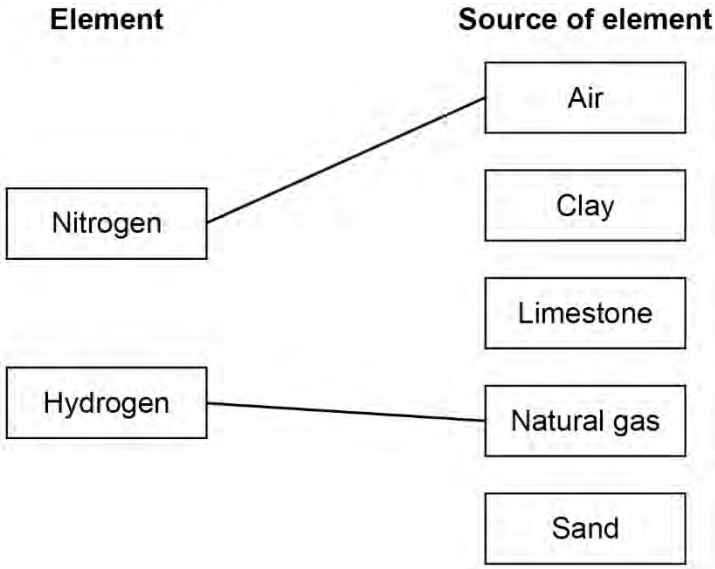
| | |
|---|---|
| **Total Question 3** | **8** |

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 64 · Mark scheme

June 2025 | 8462/2F | Original Q4

## Question 4

| Question | Answers | Mark | AO / Spec. Ref. |
|---|---|---|---|
| 04.1 | <br>do **not** accept more than one line from a box on the left | 1<br><br>1 | AO1<br>4.10.4.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.2 | cooling | | 1 | AO3<br>4.2.2.1<br>4.10.4.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.3 | catalyst | | 1 | AO1<br>4.10.4.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 04.4 | (world production of ammonia) increased | | 1 | AO3<br>4.10.4.1 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.5** | (change in mass = 165 – 130 =) 35 (arbitrary units) | | 1 | AO2 4.10.4.1 |
| | (number of years = 2020 – 2000 =) 20 | | 1 | |
| | (mean change = ) $\frac{35}{20}$ | allow correct use of incorrectly determined change in mass and / or number of years | 1 | |
| | = 1.75 (arbitrary units per year) | allow 1.75 (arbitrary units per year) correctly rounded to at least 2 significant figures | 1 | |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.6** | change in world population | | 1 | AO3 4.10.4.1 4.10.4.2 |

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.7** | $Ca(NO_3)_2$ | | 1 | AO2 4.1.1.1 4.10.4.2 |
| | $(NH_4)_2SO_4$ | | 1 | |

| **Total Question 4** | **12** |
|---|---|

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



AQA

# GCSE
# CHEMISTRY

## 8462/1F - PAPER 1 FOUNDATION TIER

## Mark scheme

8462

June 2018

Version/Stage: 1.0 Final

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

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MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

# Information to Examiners

## 1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

## 2. Emboldening and underlining

**2.1** In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

**2.2** A bold **and** is used to indicate that both parts of the answer are required to award the mark.

**2.3** Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

**2.4** Any wording that is underlined is essential for the marking point to be awarded.

## 3. Marking points

### 3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

**[1 mark]**

| Student | Response | Marks awarded |
|---|---|---|
| 1 | green, 5 | 0 |
| 2 | red*, 5 | 1 |
| 3 | red*, 8 | 0 |

Example 2: Name two planets in the solar system.

**[2 marks]**

| Student | Response | Marks awarded |
|---|---|---|
| 1 | Neptune, Mars, Moon | 1 |
| 2 | Neptune, Sun, Mars, Moon | 0 |

### 3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

### 3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

### 3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

### 3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

### 3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

### 3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

### 3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

### 3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

### 3.10 Do not accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

## 4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

**Step 1: Determine a level**

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

**Step 2: Determine a mark**

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this.

The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



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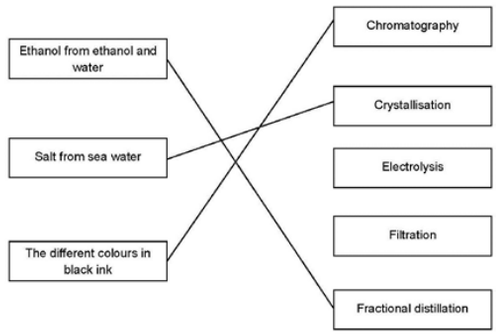
| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.1** |  | | 1<br>1<br>1 | AO1<br>4.1.1.2 |
| **01.2** | include a (filter) funnel | allow funnel drawn on the diagram<br>ignore clamp stand | 1 | AO3<br>4.1.1.2 |
| **01.3** | evaporate<br>condense | must be this order | 1<br>1 | AO1<br>4.1.1.2 |
| **01.4** | $\frac{2}{20} \times 100$<br>= 10 (%) | an answer of 10 (%) scores **2** marks<br>an answer of 11.1(%) **or** 90 (%) scores **1** mark | 1<br>1 | AO2<br>4.2.2.7 |
| **01.5** | an alloy | | 1 | AO1<br>4.2.2.7 |
| **01.6** | the layers in the mixture are distorted | | 1 | AO1<br>4.2.2.7 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



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| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **01.7** | 8000 $nm^3$ | | 1 | AO2 4.2.4.1 |
| **Total** | | | **11** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.1** | 7 | | 1 | AO1<br>4.1.2.6 |
| **02.2** | small molecule | | 1 | AO2<br>4.1.2.6<br>4.2.2.4 |
| **02.3** | $F_2$ | | 1 | AO1<br>4.1.1.1<br>4.1.2.6 |
| **02.4** | the reactivity decreases (going down Group 7) | allow the reactivity decreases from chlorine to iodine | 1 | AO1<br>4.1.2.6 |
| | (because) chlorine displaces bromine and iodine | allow (because) chlorine has two reactions<br><br>allow (because) neither bromine nor iodine can displace chlorine | 1 | AO3<br>4.1.2.6 |
| | (and) bromine displaces iodine **or** iodine does not react | allow (and) bromine has one reaction<br>**or** iodine has no reactions<br><br>allow (and) iodine cannot displace bromine | 1 | AO3<br>4.1.2.6 |
| **02.5** | 80 | | 1 | AO2<br>4.3.1.2 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **02.6** | (1.2 kg =) 1200 (g)<br>**or** (900 g =) 0.9 (kg) | an answer of 75 (%) scores **2** marks | 1 | AO2<br>4.3.3.1 |
| | $(\frac{900}{1200} \times 100) = 75(\%)$<br>**or**<br>$(\frac{0.9}{1.2} \times 100) = 75(\%)$ | allow an answer correctly calculated from:<br>$(\frac{900}{\text{incorrect attempt at conversion of 1.2}} \times 100)$<br>**or**<br>$(\frac{\text{incorrect attempt at conversion of 900}}{1.2} \times 100)$ | 1 | |
| **Total** | | | **9** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **03.1** | nucleus<br>neutron<br>neutron<br>electron<br>proton | must be in this order | 1<br>1<br>1<br>1<br>1 | AO1<br>4.1.1.3<br>4.1.1.4<br>4.1.1.5 |
| **03.2** | $(A_r)\ \frac{(63 \times 70) + (65 \times 30)}{100}$<br>= 63.6 | an answer of 63.6 scores **2** marks | 1<br>1 | AO2<br>4.1.1.6 |
| **03.3** | copper / Cu | allow ecf from answer to question **03.2** | 1 | AO2<br>4.1.1.1 |
| **03.4** | $\frac{1.2 \times 10^{-10}}{10\,000}$<br>**or**<br>$1.2 \times 10^{-10} \times 1 \times 10^{-4}$<br>$= 1.2 \times 10^{-14}$ (m) | an answer of $1.2 \times 10^{-14}$ (m) scores **2** marks<br>a correct answer not in standard form scores **1** mark | 1<br>1 | AO2<br>4.1.1.5 |
| **Total** | | | **10** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **04.1** | 3.6 ($cm^3$) | | 1 | AO2<br>4.4.3.4 |
| **04.2** | hydrogen line only | | 1 | AO3<br>4.4.3.4 |
| **04.3** | both lines | | 1 | AO3<br>4.4.3.4 |
| **04.4** | graphite has delocalised electrons | | 1 | AO1<br>4.2.3.2 |
| **04.5** | **cathode** zinc (1) **anode** chlorine (1)<br><br>hydrogen (1) bromine (1) | do **not** accept chloride<br><br>allow **1** mark if chlorine and zinc the wrong way around<br><br>do **not** accept bromide<br><br>allow **1** mark if bromine and hydrogen the wrong way around | 1+1<br><br>1+1 | AO2<br>4.4.3.2<br>4.4.3.4 |
| **Total** | | | **8** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **05.1** | gas | | 1 | AO1<br>4.2.2.2 |
| **05.2** | the gas escapes | allow carbon dioxide escapes<br><br>do **not** accept references to evaporation | 1 | AO1<br>4.3.1.3 |
| **05.3** | 5.12 (g) | | 1 | AO2<br>4.3.1.3 |
| **05.4** | 4.00 (g) trial 1 | allow 2.89 written in either space, or ringed in the table, unless contradicted by mass of copper carbonate or trial number | 1 | AO3<br>4.3.1.3 |
| **05.5** | reheat<br><br>(and reweigh) until constant mass | <br><br>an answer of heat to constant mass scores **2** marks<br><br>if no other mark scored allow for **1** mark<br>heat for longer<br>**or**<br>(heat at a) higher temperature<br><br>**alternative approach**:<br><br>(1) continue heating and pass gas through limewater<br><br>(1) until the (lime)water stops bubbling<br>**or**<br>until the limewater no longer turns cloudy | 1<br><br>1 | AO3<br>4.3.1.3 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



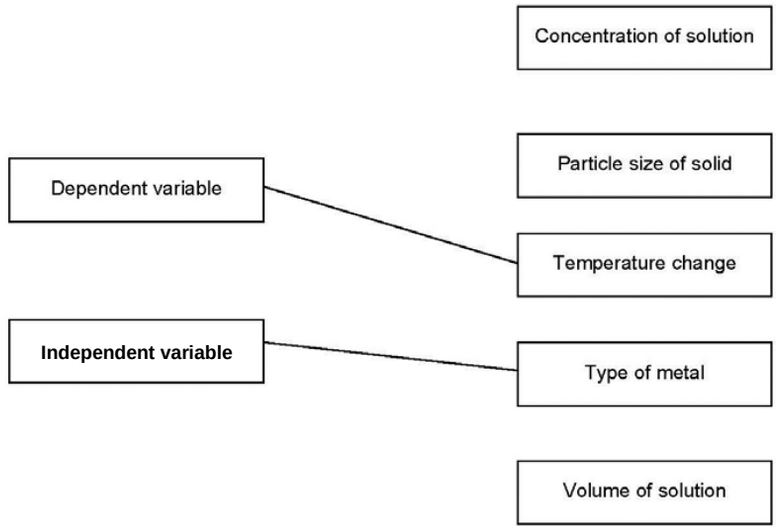
MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **05.6** | straight line of best fit | must touch at least 5 of the 6 plots | 1 | AO2 4.3.1.3 |
| **05.7** | correct value read from line of best fit in Figure 8 | allow tolerance of ± ½ small square | 1 | AO2 4.3.1.3 |
| **05.8** | (mass =) $168 \times \frac{\text{answer from question } \mathbf{05.7}}{8.4}$ | a correctly calculated value from their answer to question **05.7** scores **2** marks<br>allow (mass =) answer from question **05.7** × 20 | 1 | AO2 4.3.1.3 |
| | correctly calculated value (g) | | 1 | |
| **Total** | | | **10** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.1 | <br>allow **one** mark if answers are reversed | | 1<br>1 | AO1<br>4.5.1.1 |
| 06.2 | polystyrene is a better insulator | | 1 | AO3<br>4.5.1.1 |
| 06.3 | both bars labelled<br>both bars correctly plotted | <br>allow tolerance of ± ½ small square<br>ignore width and spacing of bars<br>if no other mark scored, allow **1** mark for any one bar correctly plotted and labelled | 1<br>1 | AO2<br>4.5.1.1 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **06.4** | temperature increases<br><br>**or**<br><br>temperature does not decrease | ignore because it is exothermic<br><br>allow (because) energy / 'heat' is transferred to the surroundings<br><br>energy / 'heat' is not taken in from the surroundings<br><br>allow the energy of the products is less than the energy of the reactants | 1 | AO3<br>4.5.1.1 |
| **06.5** | (most reactive)<br>magnesium<br>(zinc)<br>nickel | this order only | 1 | AO3<br>4.5.1.1<br>4.4.1.2 |
| **06.6** | suitable method described<br><br>the observations / measurements required to place in order<br><br>an indication of how results would be used to place the unknown metal in the reactivity series<br><br>**approaches that could be used:**<br><br>**approach 1:**<br>add the unknown metal to copper sulfate solution (1)<br><br>measure temperature change (1)<br><br>place the metals in order of temperature change (1) | | 1<br><br>1<br><br>1 | AO3<br>4.4.1.2<br>4.5.1.1 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| 06.6 cont. | **approach 2:**<br>add the metal to salt solutions of the other metals<br>**or**<br>heat the metal with oxides of the other metals (1)<br><br>measure temperature change (only if salt solutions used)<br>**or**<br>observe whether a chemical change occurs (1)<br><br>compare temperature change or whether there is a reaction to place in correct order (1)<br><br>**approach 3:**<br>add all of the metals to an acid (1)<br><br>measure temperature change or means of comparing rate of reaction (1)<br><br>place the metals in order of temperature change or rate of reaction (1)<br><br>**approach 4:**<br>set up electrochemical cells with the unknown metal as one electrode and each of the other metals as the other electrode (1)<br><br>measure the voltage of the cell (1)<br><br>place the metals in order of voltage (1) | | | |
| 06.7 | D | | 1 | AO1<br>4.5.1.2 |
| 06.8 | C | | 1 | AO1<br>4.5.1.2 |
| **Total** | | | **12** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.1** | sodium oxide | allow $Na_2O$ | 1 | AO2<br>4.1.1.1<br>4.1.2.5<br>4.4.1.1 |
| **07.2** | oxidation | | 1 | AO1<br>4.4.1.1 |
| **07.3** | 13 | | 1 | AO1<br>4.4.2.4 |
| **07.4** | sodium hydroxide | | 1 | AO2<br>4.1.1.1 |
| **07.5** | $OH^-$ | | 1 | AO1<br>4.4.2.4 |
| **07.6** | (volume =) $\frac{250}{1000}$ or ¼<br>or 0.25 ($dm^3$)<br>**or**<br>(mass per $cm^3$ =) $\frac{40}{1000}$ (g)<br>or 0.04 (g)<br><br>($\frac{250}{1000}$ × 40 =) 10 (g) | an answer of 10 (g) scores **2** marks | 1<br><br>1 | AO2<br>4.3.2.5 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **07.7** | all points correct | allow a tolerance of ± ½ a small square<br><br>allow **1** mark for 3 points correct<br><br>ignore any attempt at a line of best fit | 2 | AO2<br>4.1.2.5 |
| **07.8** | 39 (°C) | allow any value from 34 to 46 (°C) | 1 | AO2<br>4.1.2.5 |
| **Total** | | | **10** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **08.1** | any **one** from:<br>• metal<br>• (metal) hydroxide<br>• (metal) carbonate<br>• alkali | allow named example<br>allow correct formula<br>ignore base<br><br>allow ammonium hydroxide<br>allow ammonium carbonate<br>allow soluble base<br>allow ammonia | 1 | AO1<br>4.4.2.1<br>4.4.2.2<br>4.4.2.3 |
| **08.2** | $Ca(NO_3)_2$ | allow $Ca^{2+}(NO_3^-)_2$ | 1 | AO2<br>4.4.2.2 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Mark | AO / Spec. Ref. |
|---|---|---|---|
| 01.3 | **Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced. | 5–6 | AO1 4.4.2.3 |
| | **Level 2:** The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced. | 3–4 | |
| | **Level 1:** The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear. | 1–2 | |
| | **No relevant content** | 0 | |
| | **Indicative content**<br><br>• use magnesium oxide and sulfuric acid<br>• add sulfuric acid to a beaker<br>• warm sulfuric acid<br>• add magnesium oxide<br>• stir<br>• continue adding until magnesium oxide is in excess<br><br>• filter<br>• using a filter paper and funnel<br>• to remove excess magnesium oxide<br><br>• heat solution in an evaporating basin<br>• to crystallisation point<br>• leave to crystallise<br>• pat dry with filter paper<br><br>credit may be given for diagrams | | |
| **Total** | | | **8** |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **09.1** | $FeS_2$ | do **not** accept equations | 1 | AO2<br>4.2.1.3 |
| **09.2** | 26<br>30<br>26 | must be this order | 1<br>1<br>1 | AO2<br>4.1.1.4<br>4.1.1.5 |
| **09.3** | any **two** from:<br>• iron has a high(er) melting / boiling point<br>• iron is dense(r)<br>• iron is hard(er)<br>• iron is strong(er)<br>• iron is less reactive<br>• iron has ions with different charges<br>• iron forms coloured compounds<br>• iron can be a catalyst | allow the converse statements for sodium<br>allow transition metal for iron<br>allow Group 1 metal for sodium<br>ignore references to atomic structure<br>ignore iron rusts<br>allow iron is less malleable / ductile<br>allow specific reactions showing difference in reactivity<br>allow iron is magnetic | 2 | AO1<br>4.1.2.5<br>4.1.3.1<br>4.1.3.2 |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **09.4** | carbon is more reactive (than nickel) | allow converse | 1 | AO1<br>4.4.1.2<br>4.4.1.3 |
| | (so) carbon will displace / replace nickel (from nickel oxide)<br>**or**<br>(so) carbon will remove oxygen (from nickel oxide) | allow (so) nickel ions gain electrons<br><br>allow (so) carbon transfers electrons to nickel (ions) | 1 | |
| **09.5** | | an answer of 67.8 (%) scores **3** marks<br><br>an answer of 67.8160919 (%) or correctly rounded answer to 2, 4 or more sig figs scores **2** marks<br><br>an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps | | AO2<br>4.3.3.2 |
| | (total $M_r$ of reactants =) 87 | | 1 | |
| | (percentage atom economy)<br><br>$= \frac{59}{87} \times 100$ | allow (percentage atom economy)<br>$= \frac{59}{\text{incorrectly calculated } M_r} \times 100$ | 1 | |
| | = 67.8 (%) | allow an answer from an incorrect calculation to 3 sig figs | 1 | |
| **Total** | | | **11** | |

### 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

| Question | Answers | Extra information | Mark | AO / Spec. Ref. |
|---|---|---|---|---|
| **10.1** | copper, zinc, sodium chloride solution | | 1 | AO2<br>4.5.2.1 |
| **10.2** | a reactant is used up | allow the reaction stops<br><br>allow electrolyte / electrode / ions / metal / metal hydroxide / alkali for reactant | 1 | AO1<br>4.5.2.1 |
| **10.3** | the reaction is not reversible | | 1 | AO1<br>4.5.2.1 |
| **10.4** | $2H_2 + O_2 \rightarrow 2H_2O$ | allow fractions / multiples<br><br>allow **1** mark for $O_2$ | 2 | AO1<br>AO2<br>4.1.1.1<br>4.5.2.2 |

## 4.5.1.1 Energy transfer during exothermic and endothermic reactions



MARK SCHEME – GCSE CHEMISTRY – 8462/1F – JUNE 2018

<table>
<tr><th>Question</th><th>Answers</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td rowspan="5">10.5</td><td>Level 3: A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.</td><td>5–6</td><td rowspan="5">AO3<br><br>AO3<br><br>AO2<br><br><br>4.4.3.4<br>4.5.2.1<br>4.5.2.2</td></tr>
<tr><td>Level 2: Some logically linked reasons are given. There may also be a simple judgement.</td><td>3–4</td></tr>
<tr><td>Level 1: Relevant points are made. This is not logically linked.</td><td>1–2</td></tr>
<tr><td>No relevant content</td><td>0</td></tr>
<tr><td colspan="2">Indicative content<br><br>reasons why fuel cells could be judged as better<br><br><table><tr><th>from the table</th><th>from other knowledge</th></tr><tr><td>• time for refuelling a fuel cell is faster than recharging<br>or<br>a fuel cell does not need to be recharged<br>• a fuel cell has a greater range</td><td>• hydrogen can be renewable if made by electrolysis using renewable energy<br>• lithium-ion batteries can catch fire<br>• produces only water<br>or<br>no pollutants produced<br>• lithium-ion batteries may release toxic chemicals on disposal<br>• lithium-ion batteries (eventually cannot be recharged so) have a finite life</td></tr></table><br>reasons why the lithium-ion battery could be judged as better<br><br><table><tr><th>from the table</th><th>from other knowledge</th></tr><tr><td>• lithium-ion uses energy more efficiently<br>• cost of lithium-ion car much less<br>• cost of recharging much less than refuelling with hydrogen</td><td>• hydrogen is often made from fossil fuels so is not renewable<br>• charging points are more widely available than hydrogen filling stations<br>• hydrogen takes up a lot of space<br>or<br>is difficult to store<br>• hydrogen can be highly flammable / explosive<br>• no emissions produced<br>• (catalyst in the hydrogen fuel-cell eventually becomes poisoned so) have a finite life</td></tr></table></td><td></td></tr>
<tr><td>Total</td><td colspan="2"></td><td>11</td></tr>
</table>

Answer 45 · Examiner comments

June 2018 | 8462/1F | Original Q6

## Question 6 (low and standard demand)

**06.1** 25% of students could identify both variables, with 41% identifying one. This was usually the independent variable.

Many thought that the concentration of the solution was the dependent variable. A compensatory mark was awarded to those who identified the two correct variables but had them the wrong way round.

**06.2** 86% of students understood the reason for using a polystyrene cup in this required practical activity.

**06.3** This question was very well done, with 83% of students able to draw a bar chart correctly. Of those who achieved a single mark, forgetting to label the bars was more common than mis-use of the scale.

**06.4** 50% of students answered correctly. Of the unsuccessful attempts, many failed to express their ideas coherently. Some confused endothermic with exothermic, eg saying the temperature decreased, ignoring the evidence in front of them.

There was confusion between heat and temperature: heat is not increasing, and temperature is not given out. Some students thought ‘taking in heat’ means the temperature would rise. This shows a common misunderstanding of endothermic reactions: students think that heat energy is moving, rather than being converted from heat energy to chemical energy.

**06.5** 81% of students were able to give the correct order of reactivity.

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 45 · Examiner comments

June 2018 | 8462/1F | Original Q6

**06.6** Students found this question difficult to answer. 19% of students achieved all three marks, although47% achieved at least one mark. 14% of students did not attempt the question.

Students answer in terms of repeating the experiment using the unknown metal, and reorder the four elements according to the temperature change. However, many decided to use a different method, with varying degrees of success.

Alternative approaches that were accepted were:

- reacting all four metals with an acid and assessing the rate of reaction or temperature change
- carrying out a series of displacement reactions, either by adding the unknown metal to salt solutions of the other three metals, or by heating the unknown metal with oxides of the others
- using the unknown as the test electrode in a series of electrochemical cells and measuring the voltage.

Approaches that were not accepted included:

- trying to react the metal with the other metals
- measuring melting or boiling point
- looking at the periodic table.

**06.7** 53% of students could identify line D as the correct answer. A decent number of students confused products with reactants.

**06.8** This was well done, with 75% of students able to identify the activation energy on the reaction profile.

Answer 46 · Examiner comments



# Question 10 (standard demand)

**10.1** 27% of students realised that the other gas used in the Haber process is hydrogen.

**10.2** Few knew the temperature and pressure used in the process. This was made even more challenging as they had to give the correct units as well. 12% of students achieved any marks for this question.

**10.3** 7% of students could explain why only the ammonia, and not the other gases, turn into a liquid because its boiling point is higher.

**10.4** This was another 'extended response', 'level marked' question. This time there were three levels and the command word was 'explain'. Again, the question was marked holistically. Students were given information about the current atmosphere of Venus, believed to be similar to that on the early Earth, and the Earth's atmosphere today. Generally, a level 1 response used the percentages given to say in which direction the amounts of these gases had moved. Level 2 moved beyond this, giving an explanation in terms of one process, such as photosynthesis or dissolving in oceans. Level 3 responses usually gave more than one process, for example both of the processes mentioned above. Many students talked only about the changes in the last few centuries, which was not what the question was asking. 47% of students were able to reach level 2 or 3.

**10.5** Few students seemed aware of the timescale under consideration here, namely the atmosphere of billions of years ago. A lack of evidence or proof was also accepted.

## Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account on how students have performed for each question.

## Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 47 · Examiner comments

June 2019 | 8462/1F | Original Q7

**Question 7 (low and standard demand)**

**07.1** Only approximately 40% of students correctly identified a hand warmer as the piece of equipment that uses an endothermic change.

**07.2** Almost 90% of students identified the correct thermometer to use to measure temperature to a particular resolution.

**07.3** Approximately 50% of students identified the correct type of error represented by the loss of energy.

**07.4** Only approximately a third of students scored this mark.

Plastic beaker and polystyrene cup were the most common correct responses, others knew that insulation was needed but didn't name the type of container.

**07.5** This graph question was answered well.

Approximately two-thirds of students scored all 4 marks for plotting the points and then drawing and extending a line of best fit.

The most common errors were the line of best fit being drawn to go through the 'origin' or incorrect extrapolation through the 'origin'.

**07.6** Approximately 70% of students correctly read the intercept on the y-axis.

**07.7** Approximately 80% of students identified at least 1 of the 2 correct responses for the cause of the anomalous result.

Of these correct responses, 'too little sulfuric acid was added' was identified more often than 'the mixture was not stirred'.

Answer 48 · Examiner comments

June 2019 | 8462/1F | Original Q8

**Question 8 (standard demand)**

**08.1** Less than 10% of students scored this mark which required an appropriate reference to the properties of tellurium and/or iodine.

Many referred to atomic number or electron arrangement rather than properties.

**08.2** Students found this question difficult. In many cases, they simply repeated the information in the question that Mendeleev thought there were undiscovered elements.

Less than 20% of students gained any marks. The most commonly scored mark was for the idea that these elements were eventually discovered.

**08.3** Approximately 70% of students correctly identified relative atomic mass as the modern name for atomic weight.

**08.4** Approximately 40% of students scored this mark.

The most common correct response was 'atomic number'.

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 48 · Examiner comments



Common responses seen that were not credited included:

- reactivity
- relative atomic mass
- mass
- number of electrons in the outer shell.

**08.5** Approximately 60% of students scored 0 marks on this question, with approximately 10% not attempting it.

More students scored the mark for the state of astatine than for its formula. For the formula, $At_2$, the correct casing for the letters needed to be used; also, a subscript for the number.

**08.6** Students appeared to be unfamiliar with the reaction in this question.

Many students described the reaction of sodium with water rather than chlorine, referring to the sodium floating, dissolving, fizzing, etc.

The observation of a flame was the most common correct response.

## Question 10 (Standard demand)

**10.1** Many students found planning this practical challenging; less than 5% of answers reached Level 3. Of those who did realise they simply had to add measured masses of sodium carbonate to a measured volume of hydrochloric acid and measure the highest temperature, many compromised their response by heating the mixture with a Bunsen burner. Incorrect approaches included heating the sodium carbonate powder alone to melt it or measuring the loss in mass during the reaction. A significant minority answered in terms of one of the Required Practical Activities, usually the preparation of a salt.

**10.2** The calculation was done well, with over 60% of students scoring 3 or more marks. Many students determined the gradient correctly, with most using the coordinates of the points at the limits of the printed line. However, many appeared to misread the scale on the *y*-axis, reading 28.6 as 28.3 and 22.2 as 22.1. Many did not annotate their graph, making it very difficult for examiners to judge whether the *x*-coordinates corresponded to the given *y*-coordinates. Students should always show their working in full, including annotating the graph to enable working marks to be awarded. A sizeable minority of students took a single point on the line and divided the temperature by the mass. Very few correct units were seen; many students did not obtain the unit by dividing the units on the *y*-axis by those on the *x*-axis.

**10.3** Most students extrapolated the line to the *y*-axis correctly to read off the value of initial temperature. Some misread the intercept as 20.3 °C. Some students appeared to ignore the information in the question and gave the value of temperature at one end or the other of the printed line. Others attempted to give a value without extrapolating the line.

**10.4** Two-thirds of students chose the correct graph, **C**.

**10.5** This was poorly answered, with many students appearing to think the vertical axis involved temperature and/or time. Of those who did mention energy, many gave activation energy as one, or even both, of the answers. Only a quarter of students scored one mark and less than 10% scored both.

**10.6** Only one third of students scored the mark. Most students did not refer to the relative energies of the reactants and products. Some students appear to believe that an exothermic reaction is one where substances are lost to the surroundings, rather than energy.

### Use of statistics

Statistics used in this report may be taken from incomplete processing data. However, this data still gives a true account of how students have performed for each question.

### Mark Ranges and Award of Grades

Grade boundaries and cumulative percentage grades are available on the Results Statistics page of the AQA Website.

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 56 · Examiner comments

June 2022 | 8462/2F | Original Q6

**Question 6 (Low and standard demand)**

**06.1** The equation was correctly balanced by about three-quarters of the students.

**06.2** Over 80% of the students knew that (s) represents a solid reactant.

**06.3** The use of a cross on paper to monitor the turbidity of the sulfur produced was known by over 70% of the students, although use of a gas syringe was a common incorrect response.

**06.4** Over 80% of the students gained the mark, by associating a drop in gradient on the graph with a fall in the rate of reaction.

**06.5** Many deduced that one of the reactants was used up, with over 60% of the students gaining a mark. A sizeable number asserted that no light was reaching the sensor, even though the graph did not reach $y = 0$.

**06.6** Over 60% of the students gained a mark, but most of the remainder thought that the line would be less steep at the start.

**06.7** Over 50% of the students gained two marks. However, there was a wide range of incorrect response combinations, the most common of which used the two responses which were linked to a higher temperature rather than a lower one.

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 57 · Examiner comments — June 2023 | 8462/1F | Original Q10

**Question 10 (standard demand)**

**10.1** Nearly half of students scored at least one mark. Many realised that the two required variables were those in the table headings or in the description of the investigation. However, some had these the wrong way round. 'Amount' is not synonymous with 'mass' and is not an acceptable alternative. Some just mentioned the name of the substance rather than its mass.

**10.2** This question discriminated well, with a third of students scoring all three marks and two thirds scoring at least one. Many excellent graphs were seen, with correctly plotted points and a straight line of best fit, with an even scatter of points about the line. Some students had difficulty in handling the different scales on the two axes, and some drew a 'point to point' line instead of a line of best fit. A line of best fit where the points do not all lie on the line should have an even scatter of points about the line. This was often not the case, with a line skimming the bottom of some points and most of the others above it.

Students should use a pencil for plotting points as well as for drawing the line. It is very difficult to 'cross out' points or lines drawn in ink if the student changes their mind. Where two points are given, the examiner will not choose which one to mark for the student.

**10.3** Fewer than a half of students extended their line to the axis and read off the intercept value correctly. Many did extend their line to the axis, but then gave a value that was merely to the nearest major gridline, or was the temperature of the highest or lowest data point.

**10.4** Nearly a half of students gave an acceptable answer. Many gave a definition of an endothermic change in terms of energy transfer, rather than referring to the results as required. Reference to the temperature decrease was all that was needed. Some contradicted a correct reference to temperature decrease with an incorrect reference to heat being released.

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Answer 57 · Examiner comments — June 2023 | 8462/1F | Original Q10

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**10.5** This was very poorly answered. Only a handful of students scored both marks, with just over one in ten scoring one. Students are unfamiliar with the idea of uncertainty as the range about the mean, as stated in the specification. There were some good descriptions of the highest value being 0.3 °C above the mean and the lowest being 0.3 °C below the mean, but very few used the word uncertainty.

**10.6** This question did not discriminate well, with roughly equal numbers of students choosing each response. The correct answer, random error, was the least popular.

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 58 · Examiner comments

June 2023 | 8462/2F | Original Q1

**Question 1 (Low demand)**

**01.1** Just over three quarters of students identified the correct planet, with the other distractors being roughly equally selected.

**01.2** Just over half of the students correctly identified the percentage of oxygen in the atmosphere. 80% was the most common incorrect response.

**01.3** Around half of the students gained two marks. 'Carbonate sediments formed in oceans' was the most common distractor. Some students did not read the rubric correctly and only ticked one box.

**01.4** More than a half of the students gained 2 marks for correctly completing the scale on the *y*- axis and drawing a correct bar. The most common incorrect response was to omit the scale on the *y*-axis. A minority of students achieved no marks for the bar chart as they had included a non-linear scale.

Answer 58 · Examiner comments

June 2023 | 8462/2F | Original Q1

**01.5** This question was answered very well with more than 90% of students correctly identifying which test tube was at the highest temperature. A small minority chose test tube B, which produced the fewest bubbles.

**01.6** This was also very well answered, with more than two thirds of students correctly identifying the test for oxygen. 'Bromine water' was the most common distractor.

**01.7** Just over 50% of students recognised that a catalyst does not appear in a chemical reaction. 'Manganese dioxide is used up during this reaction' was a powerful distractor.

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 59 · Examiner comments

June 2023 | 8462/2F | Original Q4

**Question 4 (Low and standard demand)**

**04.1** Students found this question challenging, with fewer than 50% of students being able to interpret the information provided in the table and achieve marks. Incorrect responses often failed to identify that the colourless gas was water vapour or confused reactants and products. Less than 20% of students achieved 2 marks for this question.

**04.2** Students found this question challenging with less than 20% of students achieving this mark. From the responses it appears that many students are unfamiliar with the term 'stopper'.

The most common incorrect responses were those that suggested that the solid would still be able to escape the tube or that the reaction in some way required oxygen. Others correctly suggested that the pressure in the tube would increase but failed to include a possible consequence of this.

**04.3** Less than half of students were able to identify the other measurement needed to calculate the mass of the contents in the test tube. 'The mass of the contents of the test tube at the start' was a very common incorrect response.

**04.4** More than two thirds of students correctly identified the minimum heating time for the calcium hydroxide. '6 minutes' was often seen.

**04.5** Less than 50% of the students gained two marks. The most common incorrect response was to total all the individual mass readings.

**04.6** Around 40% of students correctly identified that in this reversible reaction the energy taken in from the surrounding would equal that released in the reverse reaction.

**04.7** Over two thirds of students correctly identified the forward reaction as endothermic. Very few selected 'combustion'.

Answer 60 · Examiner comments

June 2024 | 8462/1F | Original Q3

**Question 3 (low and standard demand)**

**03.1** Two thirds of students recognised this as a displacement reaction. Combustion proved surprisingly popular.

**03.2** Nearly a half of students scored 2 or 3 marks on this calculation. A common error was to give the answer to three decimal places instead of three significant figures. A few students thought that 39.81 should be rounded up to 39.9, and some left a recurring dot on the $\dot{8}$ of 39.$\dot{8}$ (so an infinite number of significant figures). Many students operated on the data provided seemingly at random, with addition, subtraction and multiplication seen as well as the division the wrong way round. It was common to leave the ' × 100' out of the expression, so that marking point 1 could not be awarded if the answer was incorrect.

**03.3** Two thirds of students identified the volume of copper sulfate solution as the control variable.

**03.4** Two thirds of students gave the correct answer. Some students gave the minimum or maximum temperature as their answer, rather than reading the mass at the turning point of the graph.

**03.5** Most students realised that they needed to subtract the minimum temperature from the maximum, and three fifths of students scored at least one mark. Some, however, misread those values from the graph, with 45.4 – 20.4 being frequently seen. Although this gave the correct answer, it was as the result of incorrect working so did not score both marks. A minority of students were unable to start the calculation, and various multiplications of random values were seen.

**03.6** Over a half of students gave a fully correct answer. Many students could not convert their volume to $dm^3$ even given the conversion factor, with many trying to do a calculation involving the mass of copper sulfate. However, partial credit was then awarded for those who substituted their value of volume into the given equation and calculated the results correctly. Many students do not seem to understand the terms volume and concentration, and that they mean different things.

**03.7** Just over a half of students were able to draw two sharp straight lines, with a ruler, which passed through all the points. Some did not use a ruler, and a few drew an extra line joining the first and last points, meaning that full marks could not be awarded.

**03.8** Students struggled with this standard demand question, with only a quarter gaining a mark. More than a half of students selected the second distractor, in which both parts of the statement are the opposite of the correct version. When temperature decreases, heat energy is being taken in from the surroundings and converted to chemical energy, so the reaction is endothermic. It is this reduction in heat energy that causes the temperature decrease. A misconception for many students is thinking that when heat energy is taken in from the surroundings it remains as heat energy in the system, causing the confusion with the direction of temperature change.

Answer 61 · Examiner comments



## Question 2 (low and standard demand)

**02.1** More than four fifths chose the correct name. Magnesium nitrate was a more popular distractor than magnesium sulfate.

**02.2** Fewer than three fifths chose hydrogen as the correct gas. Chlorine was by far the most popular distractor, and oxygen the least.

**02.3** Fewer than two fifths of students could identify both variables, but another third could identify one. More students could identify the independent variable correctly than the dependent variable, with the volume of hydrochloric acid being a popular wrong choice for the dependent variable. Some students identified the correct two variables but had them the wrong way round, and a few drew multiple lines from the same box, which automatically negated any marks.

**02.4** More than three fifths gave the correct answer, with the two distractors being approximately equal in popularity.

**02.5** Just over a third of students gave 2 °C as the resolution of the thermometer, with the majority incorrectly opting for 20 °C. Many appear to think that the resolution of an instrument is the gap between numbered values on the scale rather than the size of the smallest scale division.

**02.6** Fewer than half of responses gave the correct answer, with more than half believing that temperature decreases in an exothermic reaction.

**02.7** Nearly three quarters of students were able to identify **A** as the reactants. **C** was the most popular distractor, followed by **B** and **D**.

**02.8** More than four fifths could identify **C** as the activation energy, with **A** being the most popular distractor.

**02.9** Only a quarter of students were able to identify **B** as the overall energy change, with **E** being by far the most popular response.

4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 62 · Examiner comments** June 2025 | 8462/2F | Original Q2

## Question 2

02.1 Half of the students correctly identified the alkene as propene. Both butene and ethene were commonly seen.

02.2 Over 80% of students were able to give the number of atoms in the molecule as 9.

02.3 Over two thirds of students correctly identified the use of alkenes.

02.4 Nearly 80% of students scored all three marks for plotting the bar chart. Of the remaining students, most scored two marks, the most common error was to plot the bar at 92, rather than 86.

02.5 The test for alkenes is not well known. Slightly more than 1 in 10 students scored either mark on this question. A full range of tests was seen, with nearly 30% of students did not attempt this item.

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**Answer 62 · Examiner comments** June 2025 | 8462/2F | Original Q2

02.6 Nearly two thirds of students correctly completed the formula in the equation. Many students recognised that the number should be 7, but did not follow the conventions of writing formulas, so did not gain the mark because the 7 was too large. When writing formulas, it is expected that the tops of numbers are discernibly below the tops of upper-case letters.

02.7 Over half of students correctly identified the use of alkanes as fuels. Both distractors were frequently seen.

02.8 Nearly 90 % of students correctly answered this item.

02.9 Three quarters of students correctly compared the rates, with many explaining why the rate changes using the ideas from the previous item.

4.5.1.1 Energy transfer during exothermic and endothermic reactions

**Answer 63 · Examiner comments** June 2025 | 8462/2F | Original Q3

03.1 The reversible symbol was identified or correctly described by three quarters of students. Those that did not gain the mark talked about the 'equals sign' or the 'reversible sign' without a description.

03.2 Nearly 9 in 10 students correctly identified the type of reaction as 'endothermic'.

03.3 Well in excess of half of students correctly calculated the energy change. The methods employed were varied, with none being more common.

03.4 Around half of students correctly identified both materials. Many students completely reversed the responses. If 1 mark was awarded it was most likely for correctly identifying the reinforcement.

03.5 Over half of all students

## Question 3

03.1 The reversible symbol was identified or correctly described by three quarters of students. Those that did not gain the mark talked about the 'equals sign' or the 'reversible sign' without a description.

03.2 Nearly 9 in 10 students correctly identified the type of reaction as 'endothermic'.

03.3 Well in excess of half of students correctly calculated the energy change. The methods employed were varied, with none being more common.

03.4 Around half of students correctly identified both materials. Many students completely reversed the responses. If 1 mark was awarded it was most likely for correctly identifying the reinforcement.

03.5 Over half of all students were able to identify iron. Aluminium and copper were the most frequently seen incorrect answers.

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**Answer 63 · Examiner comments** June 2025 | 8462/2F | Original Q3

03.6 Three quarters of students correctly identified clay. Poly(ethene) was the most common incorrect response.

4.5.1.1 Energy transfer during exothermic and endothermic reactions

Answer 64 · Examiner comments

June 2025 | 8462/2F | Original Q4

## Question 4

04.1 Around 40% of students correctly identified both sources of the gases. There is a strongly held misconception that hydrogen comes from the air.

04.2 Nearly half of students understood that cooling occurs at point X in the diagram. The two distractors were both equally commonly seen.

04.3 Around half of students knew that iron was used as a catalyst in the Haber process.

04.4 Over 90% of students correctly identified the trend from the given data.

04.5 Nearly three fifths of students achieved all four marks on this scaffolded calculation. Taking the correct numbers from the table was the most common step where students did not gain credit.

04.6 About half of students scored the mark for this item. Change in amount of acid rain was the more common distractor seen.

04.7 Nearly 4 in 5 students correctly identified both compounds that contain nitrogen. Most of the remainder gained one of the two marks.