# Oxford Cambridge and RSA Examinations

RECOGNISING ACHIEVEMENT

## GCSE IN APPLIED SCIENCE: DOUBLE AWARD

**1497/H**
**1497/F**

## SPECIMEN ASSESSMENT MATERIALS

These specimen assessment materials are designed to accompany the OCR GCSE in Science (Double Award) Specification for teaching from September 2002.

Centres are permitted to copy material from this booklet for their own internal use.

OCR has prepared specifications to incorporate the range of features required by GCSEs (Double Awards) and subject criteria. The specimen assessment material accompanying the new specification is provided to give Centres a reasonable idea of the general shape and character of the planned question papers in advance of the first operational examination.

QAN 100/1974/1

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RECOGNISING ACHIEVEMENT

**Oxford Cambridge and RSA Examinations**

**General Certificate of Secondary Education**

# APPLIED SCIENCE: DOUBLE AWARD

UNIT 2: Science for the needs of society

**1497/H**

HIGHER TIER

**Specimen Paper**

Additional materials: Pencil, Ruler (cm/mm), Electronic Calculator

**TIME** 1 hour 30 minutes

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

**INSTRUCTIONS TO CANDIDATES**

- Write your name, Centre number and candidate number in the spaces above.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Answer **all** the questions.
- Read each question carefully and make sure you know what you have to do before starting your answer.

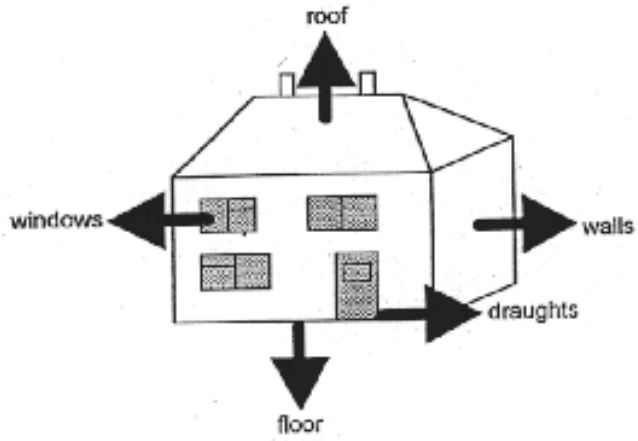
**INFORMATION FOR CANDIDATES**

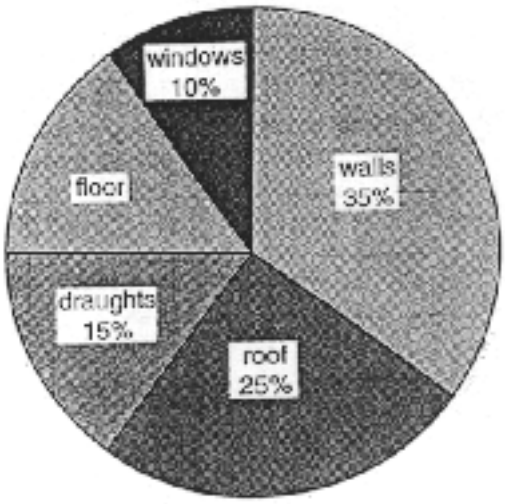
- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **70.**

| Question number | For examiner's use only |
|---|---|
| **1** | |
| **2** | |
| **3** | |
| **4** | |
| **5** | |
| **6** | |
| **7** | |
| **8** | |
| **9** | |
| **10** | |
| **TOTAL** | |

**1** John works as an adviser on home insulation. He explains to Mary where energy is lost from her house.

He uses these diagrams to help.




**(a)** Mary uses carpets and underlay to reduce the energy loss.

Explain how this reduces energy loss.

_____

_____

_____ **[2]**

**1** **(b)** John shows Mary information about **four** methods of reducing energy loss.
He explains that it costs £1000 to install double-glazing. This saves £25 each year so it will take 40 years to recover the cost.

Finish the last column of the table. *There are **two** spaces*.

| method | cost | saving each year | payback time |
|---|---|---|---|
| double glazing | £1000 | £25 | 40 years |
| draught proofing | £30 | £30 | 1 year |
| roof insulation | £300 | £100 | _____ years |
| wall insulation | £250 | £50 | _____ years |

**[1]**

**(c)** Mary's father suggests fitting double-glazing. John explains that this is *not* the best way to reduce energy loss.

Use the pie chart and the table to explain why.

_____

_____

_____ **[2]**

**2** Chalton Ltd is a company that extracts rock salt from the ground in Cheshire.

**(a)** The company can sell the rock salt to local councils to use directly on roads in winter. It *cannot* sell the rock salt directly to the local supermarket to use in packets of table salt.

Explain these facts.

_____

_____

_____ **[2]**

**2** **(b)** The sodium chloride in rock salt can be separated out. It has the chemical formula NaC*l*.

**(i)** State whether sodium chloride is called an *inorganic* substance or an *organic* substance.

_____ **[1]**

**(ii)** Explain your answer.

_____ **[1]**

**(iii)** Explain why sodium chloride is described as a compound.

_____

_____

_____ **[2]**

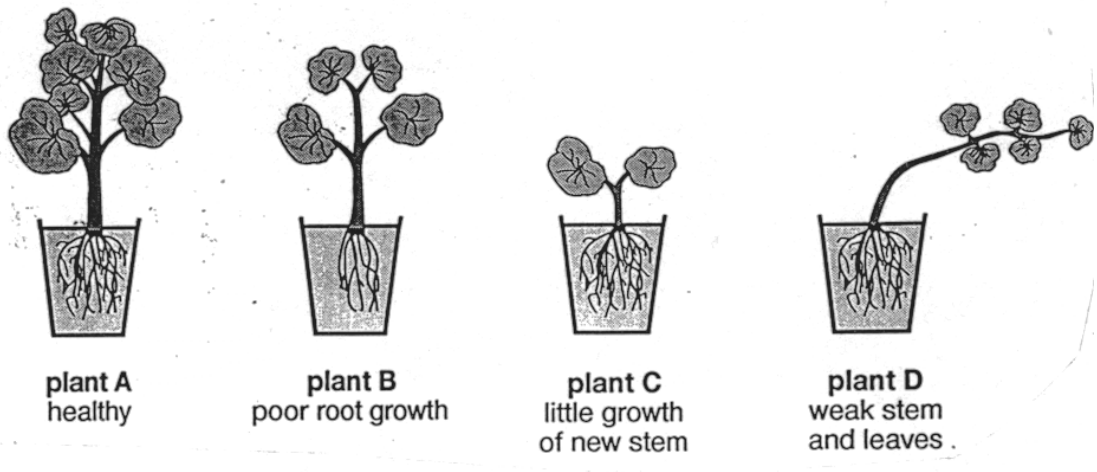
**(c)** Sodium chloride is used in industry to make the gas hydrogen chloride. Hydrogen chloride is called a *bulk chemical*.

State what this means.

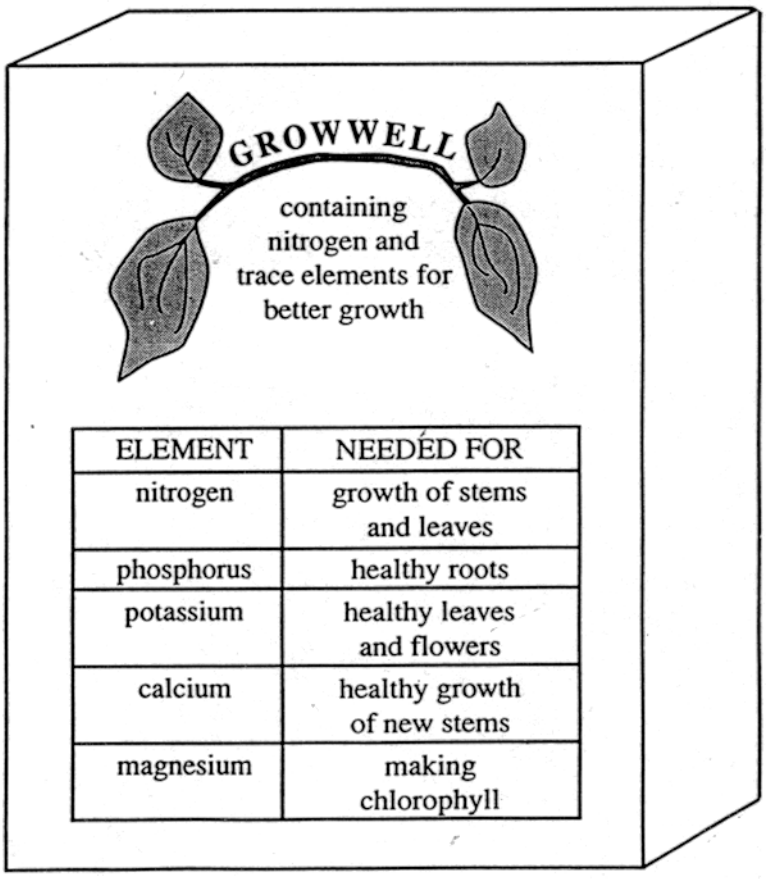
_____ **[1]**

**3** Jody is a plant scientist. She explains to some gardeners about what is needed for plants to grow well. She uses some plants and a packet of fertiliser to help explain.

The diagrams show the plants. Some are showing signs of poor growth.




Here is the packet of fertiliser.




| ELEMENT | NEEDED FOR |
|---|---|
| nitrogen | growth of stems and leaves |
| phosphorus | healthy roots |
| potassium | healthy leaves and flowers |
| calcium | healthy growth of new stems |
| magnesium | making chlorophyll |

**3** **(a)** Plants B, C and D each seem to be lacking a different element.

Finish the table by writing down the name of the element that each plant needs for healthy growth.

Use the information shown on the packet to help you.

| plant | element needed |
|---|---|
| **B** | |
| **C** | |
| **D** | |

**[3]**

**(b)** Explain why magnesium is needed to produce strong healthy plants.

_____

_____

_____

_____

_____ **[3]**

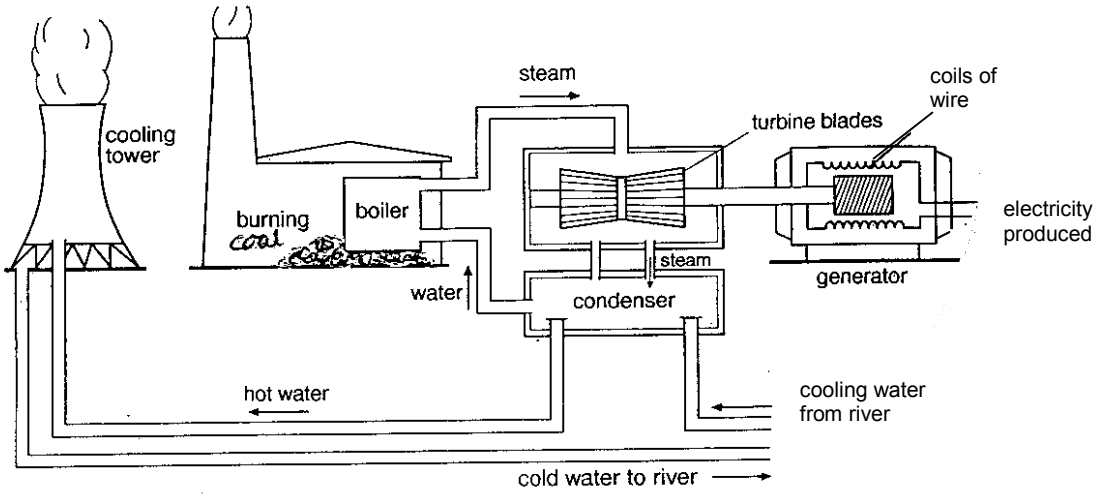
**(c)** State whether adding Growwell to the plants is an example of using an *artificial* fertiliser or a *natural* fertiliser and explain your answer.

_____

_____ **[1]**

**4** Marcus visits a coal burning power station. He has to present a summary of his visit to say how electricity is generated.

He uses this diagram to help him.




The first **two** parts of his summary are shown below.

**(a)** Finish his summary about how the power station produces electricity.

| | | |
|---|---|---|
| 1. The coal burns. | 2. The energy from this boils the water in the boiler. | 3. |
| 4. | 5. | 6. |

**[4]**

**4** **(b)** The water that enters the river is warmer than the cooling water that comes in from the river.

Explain how this occurs.

Use ideas about energy transfer and efficiency in your answer.

_____

_____

_____

_____

_____ **[3]**

**(c)** Nuclear power stations also produce electricity.

Write down **one** advantage and **one** disadvantage of a nuclear power station compared to a coal burning one.

**(i)** Advantage: _____

_____ **[1]**

**(ii)** Disadvantage: _____

_____ **[1]**

**5** It is the job of a materials scientist to select the best material for a particular purpose.

The table gives information about **five** polymers:

| **Polymer** | **Density in kg/m$^3$** | **Tensile strength in MPa** | **Maximum operating temperature in $^{O}$C** | **Dissolves in organic solvents?** | |
|---|---|---|---|---|---|
| | | | | **below 80 $^{O}$C** | **above 80 $^{O}$C** |
| Low density poly(ethene) | 920 | 15 | 85 | no | yes |
| high density poly(ethene) | 960 | 29 | 120 | no | yes |
| poly(styrene) | 1 050 | 40 | 65 | yes | yes |
| poly(chloroethene) | 1 390 | 60 | 60 | yes | yes |
| poly(propene) | 900 | 35 | 150 | no | no |

**(a)** Why is high density poly(ethene) more suitable than low density poly(ethene) for making milk crates?

_____ **[1]**

**(b)** **(i)** Which polymer would be best for making a pipe to carry oil at 100$^{O}$C?

_____ **[1]**

**(ii)** Give **two** reasons for your choice.

**1** _____ **[1]**

**2** _____ **[1]**

**(c)** Suggest **two** *structural* features which could affect the softening temperature of a particular polymer.

**(i)** _____ **[1]**

**(ii)** _____ **[1]**

**6** Ted is a fuel scientist. He finds some data about the products from UK oil refineries in 1997.

| Product | Thousands of tonnes produced |
|---|---|
| liquid petroleum gases, propane and butane | 2 000 |
| naphtha | 3 000 |
| motor fuel | 30 000 |
| kerosene | 12 000 |
| diesel | 30 000 |
| fuel oil | 12 000 |
| bitumen | 2 000 |
| other products | 9 000 |

**(a)** Name the method used to split up crude oil into more useful parts.

_____ **[1]**

**(b)** All of the products, except for 'bitumen' and 'other products', are burned as fuels.

**(i)** Calculate the percentage of oil products burned as fuels in the UK.

_____

_____ **[2]**

**(ii)** Explain why this causes concern to fuel scientists such as Ted.

_____

_____

_____

_____

_____

_____ **[3]**

**7** James is starting an electrician's course. He is finding out about the cost of using different electrical appliances.

He writes down information about the appliances used in his home between 6 pm and 7 pm.

**(a)** This is what he wrote:

| appliance | power rating in kW | time switched on in hours | energy used in kWh |
|---|---|---|---|
| fan heater | 1.0 | 1.0 | 1.0 |
| TV and video | 0.1 | 1.0 | |
| kettle | 2.0 | 0.1 | |
| water heater | 3.5 | 0.2 | |
| all lights | 0.5 | 1.0 | |

Complete the table by using the formula *Power = energy / time* to calculate the energy used by each appliance. *The first one has been done for you.* **[2]**

**(b)** Which appliance has cost *the most* to use between 6 pm and 7 pm?

_____ **[1]**

**(c)** Electricity costs 7p per kWh.

What is the cost of the electricity used between 6 pm and 7 pm?

_____ **[2]**

**(d)** James finds the following information on the back of the toaster:

**AC 50 Hz 230 V 6 amps**

Calculate the power of the toaster. *You must show your working.*

**[3]**

**8** Mr Smith works for a charity that teaches about first aid and how our bodies work. He is teaching an athlete about respiration.

The athlete starts to run a race.

Aerobic respiration is taking place in his cells.

**(a)** **(i)** Complete the *symbol* equation for aerobic respiration.

$C_6H_{12}O_6$ + _____ → _____ + $6H_2O$ + energy **[2]**

**(ii)** Explain why the athlete's breathing rate *increases* during the race.

_____

_____

_____ **[2]**

**(b)** Towards the end of the race anaerobic respiration is taking place in the athlete's muscle cells.

**(i)** Complete the *word* equation for anaerobic respiration.

_____ → _____ + energy **[1]**

**(ii)** Explain why muscle cells are unable to continue anaerobic respiration for a long period of time.

_____

_____ **[1]**

**(c)** When the athlete has finished the race his breathing rate remains high.
Why does his breathing rate need to remain high?

_____

_____ **[1]**

**9** **(a)** Atoms are joined together by chemical bonds.

It is important that scientists know how atoms join together because the type of bond affects the properties of a substance.

Magnesium oxide has a high melting point and is used as a refractory lining.

**(i)** Name the type of bonding in magnesium oxide.

_____ **[1]**

**(ii)** Explain in terms of electrons how this bond is formed

_____ **[1]**

**(b)** Hydrogen chloride is a gas and is used to make hydrochloric acid.

**(i)** Name the type of bonding in hydrogen chloride.

_____ **[1]**

**(ii)** Explain in terms of electrons how this bond is formed

_____ **[1]**

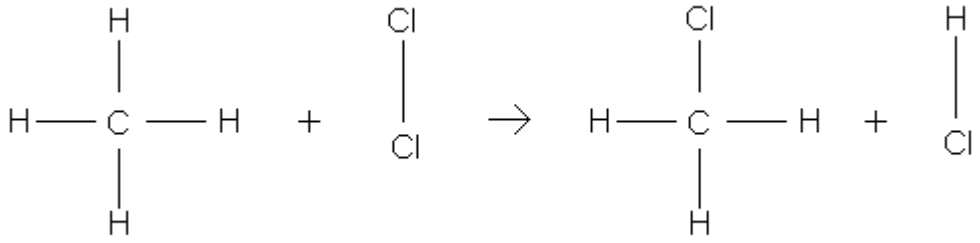
**9** **(c)** Chemical bonds require energy to break them.

The table gives the energy required to break some bonds. The number of bonds broken is the same in each case.

| bond | energy required in kJ |
|---|---|
| C-H | 435 |
| C*l*-C*l* | 243 |
| H-C*l* | 432 |
| C-*Cl* | 346 |

The energy required to break a bond is the same as the energy given out when the bond forms.

In the presence of sunlight, methane, $CH_4$, will react with chlorine, $Cl_2$, as in the equation:



**(i)** Calculate the energy transfer in this reaction. You must show your working.

energy _____ kJ **[3]**

**(ii)** Explain how your answer shows that this is an e*xothermic* reaction.

_____

_____ **[1]**

**10** Food scientists are concerned about the rising world population. It is expected to increase from its present 6 billion to over 7 billion in 25 years time.

In order to provide enough food some farmers use *intensive farming* methods. Other farmers use *organic farming* methods.

Explain what is meant by the terms *intensive farming* and *organic farming*.

Compare the *advantages* and *disadvantages* of each method in helping to cope with the need to feed a rising world population.

**[7]**

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# APPLIED SCIENCE: DOUBLE AWARD

UNIT 2: Science for the needs of society

**1497/H**

HIGHER TIER

MARK SCHEME

## Advice to examiners on marking scripts

1 Please ensure that you use the *final* version of the marking scheme. *You are advised to destroy all draft versions*.

2 Please mark all post standardisation scripts in red ink. A tick should be used for each answer judged worthy of a mark. The tick should be placed at the point in the answer where the mark has been awarded. The number of ticks should be the same as the number of marks awarded. If two (or more) responses are required for one mark, use only one tick. Half marks should never be used.

3 No comments should be written on scripts. Remember that scripts may be returned to Centres.

4 The marks awarded for each part question should be indicated in the margin provided on the right hand side of the page. The mark total for each question should be ringed at the end of the question, on the right hand side. These totals should be added up to give the final total on the front of the paper.

5 Correct answers to calculations should gain full credit even if no working is shown unless otherwise indicated in the mark scheme. (An instruction on the paper to 'Show your working' is to help candidates who may then gain partial credit even if their final answer is not correct.)

6 Strike through all blank spaces and/or pages in order to give a clear indication that the whole of the script has been considered.

7 An element of professional judgement is required in the marking of any written paper and candidates may not use the exact words that appear in the mark scheme. If the essence is correct *and* answers the question, contact your Team Leader/Principal Examiner for guidance.

| Question | Answer | Mark | Grade | AO |
|---|---|---|---|---|
| 1(a) | • trapped air<br>• reduces draughts/is an insulator/reduces conduction | 1<br>1 | 1D<br>1D | AO1 |
| 1(b) | 3 and 5 (*both needed*) | 1 | 1D | AO2 |
| 1(c) | • least energy loss<br>• longest payback period/saves least amount of money/only saves 10% | 1<br>1 | 1D<br>1D | AO2 |
| 2(a) | • idea that rock salt is not pure sodium chloride (salt)<br>• idea that this is not a problem for salting roads but is when a high degree of purity is required | 2x1 | 2D | AO1 |
| 2(b)(i) | Inorganic | 1 | 1C | AO1 |
| 2(b)(ii) | it does not contain carbon atoms *OR* it was formed from non-living things | 1 | 1C | AO1 |
| 2(b)(iii) | • it contains more than one element<br>• (chemically) combined/joined bonded | 2x1 | 2C | AO1 |
| 2(c) | it is manufactured on a large scale | 1 | 1C | AO1 |
| 3(a) | • phosphorus<br>• calcium<br>• nitrogen | 3x1 | 3D | AO2 |
| 3(b) | • magnesium helps to make chlorophyll<br>• which is needed for photosynthesis/chlorophyll traps light<br>• so that plants can produce their own food/make sugar/make new cells/make new leaves | 1<br>1<br>1 | 1D<br>1C<br>1C | AO1 |
| 3(c) | (it is artificial) because it has been made by people/it is not found naturally like this | 1 | 1C | AO2 |
| 4(a) | • steam turns blades of the turbine<br>• turbine is connected to a shaft which turns a magnet inside the generator<br>• magnet (in generator) turns inside coils of wire<br>• an electric current is induced in the coils.<br>*[if more than one answer is in a single box, give credit]* | 4x1 | 1D<br>3C | AO1 |
| 4(b) | • generating electricity from a primary source such as coal is not an efficient process owtte<br>• not all energy is transferred form the burning fuel to the steam to the turning of the turbine owtte<br>• some of the wasted energy is in the form of heat and this is in the water that enters the cooling tower and then the river owtte | 1<br>1<br>1 | 1A<br>1A<br>1A* | AO1 |

| Question | Answer | Mark | Grade | AO |
|---|---|---|---|---|
| **4(c)(i)** | *One advantage from:*<br>• saves reserves of fossil fuels<br>• no acid rain pollution<br>• no need to use FGD<br>• no carbon dioxide emissions | **1** | 1B | AO1 |
| **4(c)(ii)** | *One disadvantage from:*<br>• disposal of radioactive waste<br>• transport of radioactive material<br>• danger of radioactive emissions<br>• 'dangerous' must be qualified | **1** | 1B | AO1 |
| **5(a)** | higher (tensile) strength/higher MPa | **1** | 1B | AO2 |
| **5(b)(i)** | poly(propene) | **1** | 1B | AO2 |
| **5(b)(ii)** | not soluble in organic solvents<br>higher maximum operating temperature | **1**<br>**1** | 1B<br>1B | |
| **5(c)** | *Two from:*<br>• chain length<br>• cross linking<br>• chain branching<br>• packing of chains<br>• attraction between chains<br>• chain shape<br>• side chains | **2x1** | 2A* | AO1 |
| **6(a)** | fractional distillation | **1** | D | AO1 |
| **6(b)(i)** | masses = 89 000 / 100 000<br>=89% | **1**<br>**1** | C<br>C | AO2<br>AO2 |
| **6(b)(ii)** | • idea of $CO_2$ produced<br>• causing global warming *[allow max of one for 'pollution']*<br>• idea of limited reserves | **1**<br>**1**<br>**1** | C<br>C<br>C | AO1<br>AO1<br>AO1 |
| **7(a)** | 0.1 0.2 0.7 0.5 *[all correct 2 marks, two or three correct 1 mark]* | **2x1** | 2B | AO2 |
| **7(b)** | fan heater (ecf form energy column) | **1** | 1B | AO2 |
| **7(c)** | Total energy used = 2.5 kwh<br>cost is 2.5 x 7p = 17.5p | **1**<br>**1** | 1D<br>1C | AO2 |
| **7(d)** | power = voltage x current *(allow volts x amps)*<br>230 x 6 = 1380<br>watts<br>*[allow 1.38 kW for the last two marks]* | <br>**1**<br>**1**<br>**1** | 1A<br>1A<br>1A | AO2 |

| Question | Answer | Mark | Grade | AO |
|---|---|---|---|---|
| **8(a)(i)** | $6O_2$ $6CO_2$<br>*[one mark for symbols $O_2$ and $CO_2$*<br>*one mark for balanced equation $6O_2$ and $6CO_2$]* | **2x1** | 2A* | AO2 |
| **8(a)(ii)** | *Two from:*<br>• more energy is needed<br>• more energy is released; respiration takes place at a faster rate<br>• more respiration; so more oxygen is taken in; increase in CO2<br>• lactic acid; detected by the brain | **2** | 1A<br>1A* | AO2 |
| **8(b)(i)** | glucose *and* lactic acid | **1** | 1A | AO2 |
| **8(b)(ii)** | *One from:*<br>• muscle fatigue<br>• less energy released<br>• cramp presence of lactic acid | **1** | 1A | AO1 |
| **8(c)** | *One from:*<br>• repay 'oxygen debt'<br>• to break down or remove lactic acid<br>• removal of excess $CO_2$ | **1** | 1A* | AO1 |
| **9(a)(i)** | magnesium oxide has ionic bonding | **1** | 1A | AO1 |
| **9(a)(ii)** | this involves the loss and gain of electrons between sodium and chlorine atoms | **1** | 1A | |
| **9(b)(i)** | hydrogen chloride has covalent bonding | **1** | 1A | AO1 |
| **9(b)(ii)** | this involves the sharing of electrons between hydrogen and chlorine atoms | **1** | 1A | |
| **9(c)(i)** | energy required for bond breaking<br>= (4 x 435) + 243 = 1983 kJ OR 435 + 243 = 678 kJ | **1** | 1A* | AO2 |
| | energy released on bond making<br>= (3 X 435) + 346 + 432 = 2083 kJ OR 346 + 432 = 778 kJ | **1** | 1A* | |
| | energy transfer = (-) 100 kJ | **1** | 1A* | |
| **9(c)(ii)** | *One from:*<br>• the sign is negative<br>• more energy given out in bond making than used up in bond breaking. | **1** | 1A* | AO2 |

| Question | Answer | Mark | Grade | AO |
|---|---|---|---|---|
| **10** | Intensive farming increases yields by:<br>• use of artificial fertilisers<br>• pesticides<br>• herbicides<br>• fungicides<br>• controlled environments for meat.<br>*[Any 4 points or more for 2 marks*<br>*2 or 3 points for 1 mark]*<br><br>Organic farming relies on:<br>• natural fertilisers<br>• natural pesticides<br>• mechanical elimination of weeds<br>• animals in more natural conditions.<br>*[Any 3 points for 2 marks*<br>*1 or 2 points for 1 mark]*<br><br>Advantage of intensive:<br>• bigger yields<br>• mechanisation possible.<br><br>Disadvantage of intensive:<br>• destruction of habitats<br>• risk of traces of pesticides etc.<br><br>Advantages of organic:<br>• habitats preserved<br>• no risk of pesticides etc.<br><br>Disadvantages of organic:<br>• smaller yields<br>• labour intensive.<br>*[One mark for each contrasting advantage/ disadvantage. Maximum 2 marks]*<br><br>An overall summarising statement of balance of viewpoints. Ideally we use organic methods but demand may present this. *[One Mark*] | **7** | 2B<br>3A<br>2A* | AO1 |

**Total mark available: 70**