

**GCSE (9–1)**

*Sample SAM Taster Booklet*

# **TWENTY FIRST CENTURY SCIENCE SUITE**

J257, J258, J259, J260

For first teaching in 2016



GCSE (9-1)

# TWENTY FIRST CENTURY SCIENCE SUITE

Our new GCSE (9-1) Twenty First Century Science Suite specifications provide a dynamic, contemporary and exciting opportunity for students to engage with the world around them.

Our Sample Assessment Material (SAM) taster booklet introduces you to the style of assessment for our new qualifications.

The booklet features the questions and mark schemes for the assessments that make up these qualifications. The complete set of sample assessment materials is available on the OCR website  
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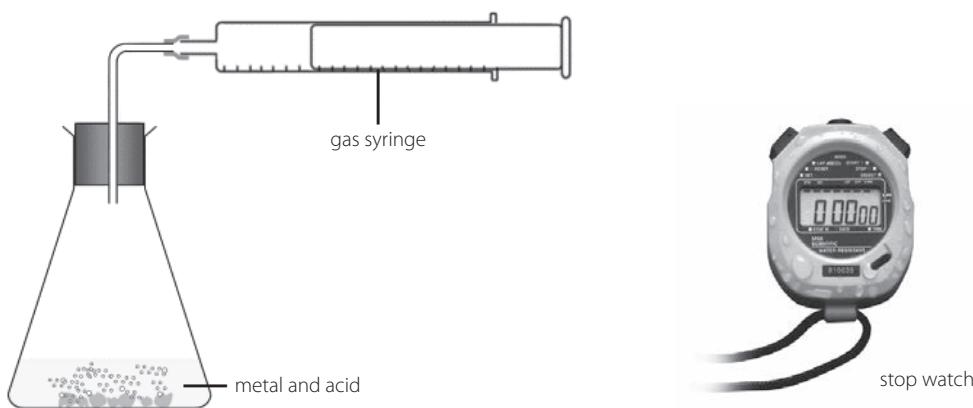


# CHEMISTRY

## HIGHER/FOUNDATION PRACTICAL AND LEVEL OF RESPONSE

2 Joe investigates the rate of reaction between a metal and an acid.

He uses this apparatus.



(a) Joe investigates how changing the concentration of the acid affects the volume of gas collected in 10s.

What factors should Joe control to make sure that his results are repeatable?

Justify your answer.

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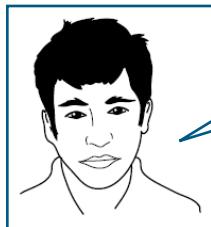
[5]

**(b)** Joe repeats his experiment three times for four different concentrations of acid.

The table shows his results.

Concentration of acid in mol/dm <sup>3</sup>	Volume of gas collected after 10 seconds in cm <sup>3</sup>			Mean volume of gas in cm <sup>3</sup>
	Repeat 1	Repeat 2	Repeat 3	
0.50	3	2	4	3
1.00	4	5	4	4
1.50	5	6	6	
2.00	6	7	6	

Joe makes this comment on his results.



*If I show the mean volumes for the last two concentrations to one significant figure, they are the same.  
I need to show the mean volumes to at least two significant figures to see a difference.*

**(i)** Use calculations to show that Joe is right.

[3]

**(ii)** Evaluate Joe's results and explain how he could change his method to improve the quality of his data.

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[6]

Question	Answer	Marks	AO element	Guidance
2 (a)	Volume of acid ✓ Temperature of acid ✓ Mass of magnesium ✓ Surface area of magnesium ✓ Correct link between increase in rate of reaction and factor (e.g. if surface area is greater, rate increase) ✓	5	1.2	
2 (b) (i)	(1.50) $5 + 6 + 6 / 3 = 5.7$ (to two sig figs) ✓ (2.00) $6 + 7 + 6 / 3 = 6.3$ (to two sig figs) ✓ Both values rounded to 6 (to one sig fig) ✓	3	2.2	<b>ALLOW</b> 5.67 etc if correctly rounded (last number must be 7)
2 (b) (ii)	<p><b>Level 3 (5–6 marks)</b> Correctly evaluates the quality of the data as being poor with valid reasons. <b>AND</b> Makes several correct suggestions for the development of the method with correct explanation of how the data will be improved. <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated</i></p> <p><b>Level 2 (3–4 marks)</b> Correctly evaluates the quality of the data as being poor with valid reasons. <b>AND</b> Makes several correct suggestions for the development of the method or makes one suggestion with a correct explanation of how the data will be improved. <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b> Correctly evaluates the quality of the data as being poor with a valid reason. <b>AND</b> Makes one suggestion for the development of the method with no explanation. <i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i></p> <p><b>0 marks</b> No response or no response worthy of credit.</p>	6	2 × 3.1b 2 × 3.3a 2 × 3.3b	<p><b>Indicative scientific points may include</b></p> <p><b>AO3.1b evaluation of the quality of Joe's results.</b></p> <p>For example:</p> <ul style="list-style-type: none"> <li>no spread of data</li> <li>results too close together</li> <li>volumes measured very small</li> </ul> <p><b>AO3.3a suggestions for the development of Joe's method</b></p> <p>For example:</p> <ul style="list-style-type: none"> <li>increase time before volume measured</li> <li>increase volume of acid</li> <li>increase surface area of magnesium</li> <li>more magnesium</li> </ul> <p><b>AO3.3b explanation of how the data will be improved</b></p> <p>For example:</p> <ul style="list-style-type: none"> <li>volume of gas will be greater</li> <li>more precise measurement of volume</li> <li>larger spread of data</li> <li>less overlap of ranges</li> </ul>

**Teacher Tips**

To enable learners to answer this type of practical question, it is vital that they have experienced the practical technique described first hand. This they will have done by completing the practical activities associated with Chemistry Practical Activity Group 8, Measuring rates of reaction.

# COMBINED SCIENCE

## HIGHER IDEAS ABOUT SCIENCE

2 (a) Autism is a condition that makes it difficult for an affected person to communicate with and relate to other people.

In 1998, following their research, some scientists suggested that autism was linked with children having received the MMR vaccination.

The MMR vaccine is a combined vaccine, giving protection against measles, mumps and rubella.

These are all communicable diseases and to prevent epidemics, a high percentage of the population needs to be vaccinated.

The more easily passed on a communicable disease is the greater percentage of the population that needs to be vaccinated.

Explain why.

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[2]

(b) The table below gives some information about the scientific paper in which the scientists' research was reported.

<b>Year of publication</b>	1998
<b>Research</b>	At The Royal Free Hospital, London, by doctors and researchers.
<b>Authors</b>	Twelve authors. The lead author had a contract with solicitors who were suing the vaccine manufacturers.
<b>Children involved in study</b>	Twelve children.
<b>Publication</b>	In the medical journal, The Lancet.
<b>Other studies</b>	No follow-up studies showed the same correlation.

The study had been accepted for publication in 1998.

In 2010, The Lancet withdrew the paper from the scientific literature.

Two of the statements below are possible reasons for The Lancet withdrawing the paper.

Put a tick (✓) in the box after the two correct statements.

Use the information in the table.

The sample size was too small.

All the authors of the study were biased.

The authors were not professionals in their field.

The paper was not peer-reviewed before publication.

The results could not be repeated by other scientists.

[2]



(ii) Here are some suggestions as to how this type of study could be improved.

Some are not suitable.

Put a tick (✓) in the correct box after each statement.

	Suitable	Not suitable
Select a sample from the population to monitor.	<input type="checkbox"/>	<input type="checkbox"/>
Ensure that all the children have had the MMR vaccination.	<input type="checkbox"/>	<input type="checkbox"/>
Ensure that there is no record of autism in the family.	<input type="checkbox"/>	<input type="checkbox"/>

(d) More recent studies have identified other factors that might be involved in autism.

Some results of these studies are shown below.

Year of publication of study	Country	Number involved in study	Additional information	Conclusion
2014	USA	970	Studied autism cases at different distances from farmland and during different stages of pregnancy	Exposure to several common pesticides during pregnancy increases the risk of autism
2014	Sweden	3000 including control group	Study based on analysis of human genome	52% of autism cases are linked with variations in DNA. New mutations accounted for 3% of cases
2015	UK	258	Based on a study of autism in twins	Genetic influence on autism is 74-98%

How have these studies increased our understanding of autism? Explain your answer.

.....

.....

.....

.....

[3]

Question	Answer	Marks	AO element	Guidance
2 (a)	Less chance of coming into contact with the disease / reference to herd immunity ✓ (more) communicable diseases are more likely to be passed on / spread ✓	2	1.1	
2 (b)	✓ The sample size was too small ✓ The results could not be repeated by other scientists	2	2.2	
2 (c) (i)	<b>Any three from</b> Abdul is correct because after the MMR vaccination is introduced, the number of cases increased ✓ <i>Becky is correct because:</i> We don't know the factors affecting the population / named factor, e.g. birth rate, immigration, death rate, migration ✓ (Numbers affected by) increased awareness of condition / increased diagnosis / better reporting ✓ The data doesn't show / account for any variations in the age of the person at which the condition was diagnosed / developed ✓ The data doesn't take into account the percentage of children vaccinated ✓	3	3.1a	
2 (c) (ii)	Select a sample from the population to monitor. <b>Suitable</b> Ensure that all the children have had the MMR vaccination. <b>Not suitable</b> Ensure that there is no record of autism in the family. <b>Not suitable</b>	3	3.3b	
2 (d)	<b>Any three from</b> If autism develops in one identical twin the probability of it developing in the other is high ✓ A connection with pesticides means there is an environmental link to autism ✓ Human genome analysis suggests genetic component ✓ (But) not all inherited / pass down in families as 3% of cases arise by mutation ✓ Range of genetic contribution revealed ✓	3	3.1a 3.1b x 2	Award 1 mark for studies suggest environmental and genetic links <b>ALLOW</b> further DNA / genomic studies needed

#### Teacher Tips

This is a combined science paper question showing how learner's knowledge of Ideas about Science is tested within a structured question. Learners should be given varied opportunities to research topics to enable them to learn how to interpret data and draw conclusions.

# BIOLOGY

## FOUNDATION MATHS

(d) (i) The nervous system consists of billions of neurons.

The speed an electrical impulse can travel down a neuron can differ.

Neuron	Length (m)	Time taken for impulse to travel (s)	Speed (m/s)
A	1.3	0.027	48.15
B	1.3	0.014	
C	0.8	0.022	

Calculate the speed of the electrical impulse travelling down neuron B and neuron C.

Neuron B speed ..... m/s

Neuron C speed ..... m/s

[2]

(ii) One of these neurons has a fatty substance wrapped around its axon.

Which neuron, **A**, **B** or **C**, has a fatty substance wrapped around its axon?

Use data from the table in (d)(i) to justify your choice.

.....

[2]

Question	Answer	Marks	AO element	Guidance
(d) (i)	<b>B:</b> 36.36 ✓ <b>C:</b> 92.86 ✓	2	2.2	<b>DO NOT ALLOW</b> answers not given to 2d.p.
(d) (ii)	Neuron B ✓ Speeds up the time taken for the impulse to travel ✓	2	3.2a 1.1	<b>IGNORE</b> any reference to insulation

### Teacher Tips

This question demonstrates a maths question at Key Stage 3 level maths. Only the marks from question d (i) will form part of the 10% maths requirement of the biology papers.

# PHYSICS

## FOUNDATION PRACTICAL

1 Two students are investigating springs and forces.

(a) They measure how much a steel spring stretches for a range of different weights hung on it.

State **one** safety precaution the pupils should take when completing this experiment.

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[2]

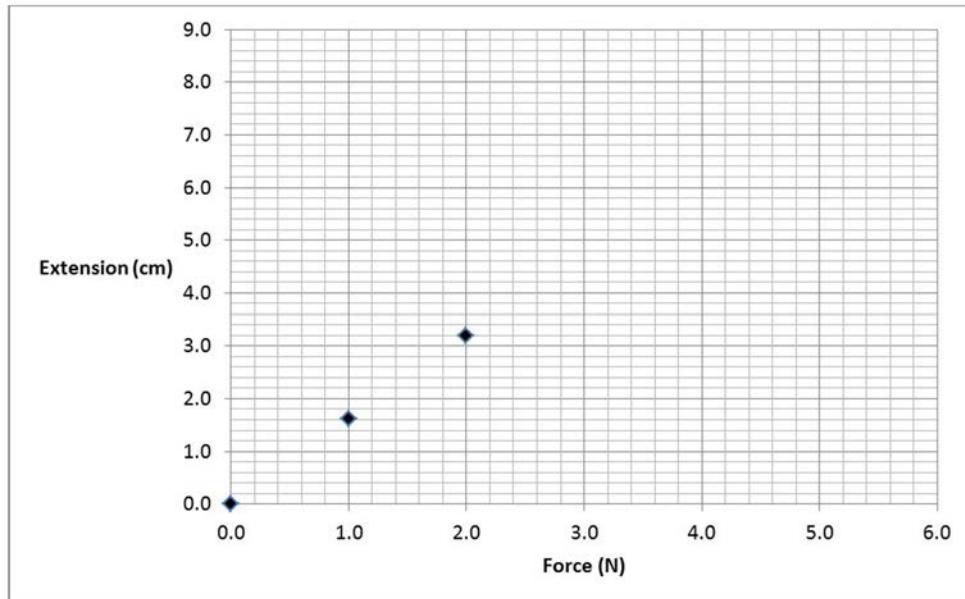
(b) They collect the following results.

Force (N)	Extension (cm)
0.0	0.0
1.0	1.6
2.0	3.2
3.0	6.0
4.0	6.4
5.0	8.0

Circle the outlier in the results for extension.

[1]

(c) They start to plot a graph of their results.



Plot the remaining points, ignoring the outlier, and draw a line of best fit.

[3]

(d) Using the data calculate the spring constant of the spring when the force is 4.0N.

Force exerted = extension  $\times$  spring constant

..... N/m [3]

Question	Answer	Marks	AO element	Guidance
1 (a)	Not to hang too much weight so not to break spring / careful with dropping masses ✓	1	3.3a	<b>ALLOW</b> any sensible suggestion for safety precaution
1 (b)	6.0 (cm) circled ✓	1	3.1a	
1 (c)	Marks correctly plotted ✓ Correct best fit line ✓  	3	2 s x 2.2 1.2	If outlier plotted give 2 marks only. <b>ALLOW</b> ECF from (b)
1 (d)	<b>FIRST CHECK THE ANSWER ON ANSWER LINE</b> <b>If answer = 62.5 N/m award 4 marks</b> Re-arrange equation to give spring constant = force ÷ extension ✓ Use the table to find extension at 4N = 6.4 cm ✓ Convert cm to m 6.4cm = 0.064m ✓ $4N \div 0.064 = 62.5 \text{ (N/m)}$ ✓	4	2 x 1.2 2.1 x 2	<b>ALLOW</b> any other pair of numbers from table / graph that gives same answer

**Teacher Tips**

This question demonstrates how practical skills experienced in the classroom can be applied by learners in the examination. Learners can be prepared for this type of question by completing the practical activities required in the practical activity groups in Chapter P8.

# COMBINED SCIENCE – PHYSICS

## HIGHER MATHS

4 (c) Another kettle heats 1 kg of water from 20 °C to 100 °C and continues heating until half of the water has turned to steam.

Calculate the total increase in internal energy of the water and state the units.

Specific heat capacity of water = 4200 J/kg/°C

Specific latent heat of water vaporisation = 2260 kJ/kg

Total increase in internal energy = ..... units ..... [5]

Question	Answer	Marks	AO element	Guidance
4 (c)	<p><b>FIRST CHECK THE ANSWER ON THE ANSWER LINE.</b>  <b>If answer = 1466,000 J or 1466 kJ award 5 marks</b></p> <p>Temperature rise: Select and apply: <math>\Delta E = m \times c \times \Delta T</math>  <math>= 1 \times 4200 \times 80 = 336,000 \text{ J or } 336 \text{ kJ } \checkmark</math></p> <p>Select and apply <math>\Delta E = m \times L</math>  Boiling tray water turns to steam therefore <math>m = 0.5 \times 1 \text{ kg} \checkmark</math>  <math>= 0.5 \times 2260,000 = 1130,000 \text{ J or } 1130 \text{ kJ } \checkmark</math>  Total energy change = <math>336,000 + 1130,000 \text{ (J)}</math>  <math>= 1466,000 \text{ (J) or } 1466 \text{ (kJ) } \checkmark</math>  Units: joules or kilojoules <math>\checkmark</math></p>	5	2.1 2.1 2.1 1.2 1.1	If units not given award 4 marks for an answer of 1466,000 or 1466

### Teacher Tips

Learners have an understanding and should have practiced using the equations in the Equations in physics list in Appendix 5h of the specification to enable them to apply the appropriate equations.

# CHEMISTRY

## FOUNDATION

8 Salts are made by reacting an acid with a metal or a metal compound.

(a) Draw straight lines to connect the reactants to the correct salt formed.

**Reactants**

- zinc hydroxide and nitric acid
- magnesium and hydrochloric acid

**Salt formed**

- zinc sulfate
- magnesium sulfate
- zinc nitrate
- magnesium chloride

[2]

(b) When magnesium reacts with hydrochloric acid, a gas is also made.

What is the name of the gas?

Put a **ring** around the correct answer.

hydrogen      nitrogen      oxygen      chlorine

[1]

(c) Kate makes a solution of zinc chloride by reacting solid zinc carbonate with dilute hydrochloric acid.

She adds too much solid zinc carbonate to the reaction mixture.

She needs to remove the excess solid.

What separation technique should she use?

Put a **ring** around the correct answer.

crystallisation      filtration      distillation      evaporation

[1]

Question	Answer	Marks	AO element	Guidance
8 (a)	zinc hydroxide and nitric acid > zinc nitrate magnesium and hydrochloric acid > magnesium chloride	2	1.1	
8 (b)	hydrogen ✓	1	1.1	
8 (c)	filtration ✓	1	1.2	

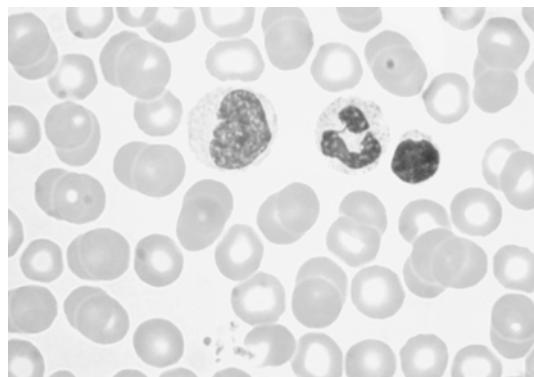
### Teacher Tips

This question demonstrates the objective style questions used mainly in the foundation tier paper. Practice for these types of question can be achieved using past papers from the legacy specification where there are many examples.

# BIOLOGY

## FOUNDATION/HIGHER PRACTICAL

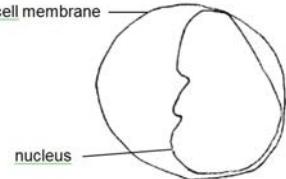
**3 (a)** Blood is made up of cells, plasma and platelets. The picture below is of blood cells as seen down a microscope.



Draw a labelled scientific drawing of a white blood cell in the space below.

Label the nucleus and cell membrane.

[4]

Question	Answer	Marks	AO element	Guidance
3(a)	Correct cell drawn ✓ Continuous, unfeathery lines, no shading ✓ Label lines drawn with a ruler ✓ Nucleus AND cell membrane correctly labelled ✓	4	1.2 x 3 1.1	<p>Drawing should take up approximately 50% of space e.g.</p> 

### Teacher Tips

This question again demonstrates the importance of learners experiencing practical work first hand. In this case, if learners have drawn labelled scientific drawings, they will be in a better position to succeed at this type of question.

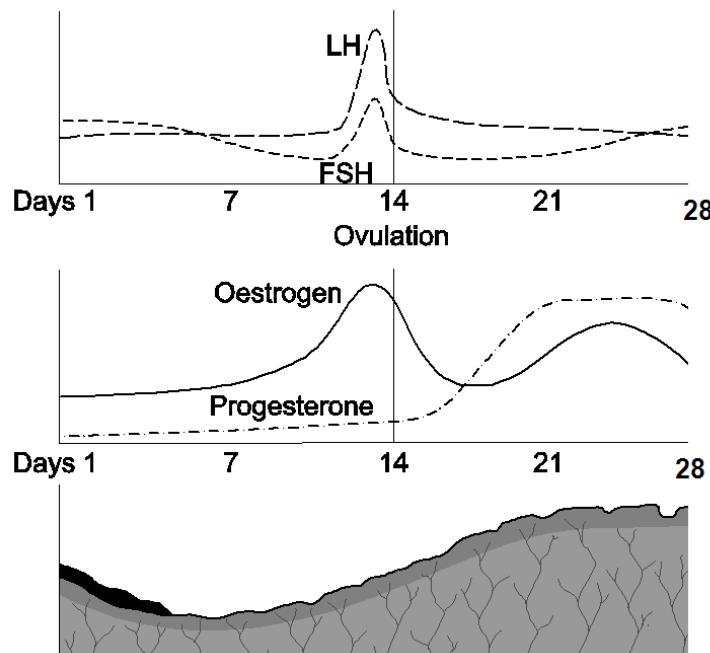
# BIOLOGY

## HIGHER LEVEL OF RESPONSE

4 The menstrual cycle is controlled by four hormones.

These hormones have an effect on target organs such as the ovaries and the uterus.

The graphs and diagram below show the hormone levels of the four hormones and the relative thickness of the uterus lining during a typical 28 day menstrual cycle.



Use the graphs and diagram above and your own knowledge to explain the changes that occur to prepare a woman's body to receive a fertilised egg and then allow it to grow and develop.

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Question	Answer	Marks	AO element	Guidance
4 (a)	<p><b>Level 3 (5–6 marks)</b> Explains fully the physical changes that occur during the menstrual cycle <b>AND</b> Links them correctly to evidence from the diagram and graphs <i>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</i></p> <p><b>Level 2 (3–4 marks)</b> Explains two physical changes that occur during the menstrual cycle <b>AND</b> Links them correctly to evidence from the diagram and graphs <i>There is a line of reasoning presented with some structure. The information presented is relevant and supported by some evidence.</i></p> <p><b>Level 1 (1–2 marks)</b> Explains one physical change that occurs during the menstrual cycle <b>AND</b> links it correctly to evidence from the diagram and graphs <i>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</i></p> <p><b>0 marks</b> No response or no response worthy of credit.</p>	6	1.1 x 3 3.1a x 3	<p><b>AO1.1 Physical and hormonal menstrual cycle changes</b></p> <p>For example:</p> <ul style="list-style-type: none"> <li>Uterus becomes thicker because it becomes more vascular</li> <li>Ovulation is when an egg is released from an ovary</li> <li>Ovulation occurs when a follicle ruptures / bursts</li> <li>Has to be an egg present in the oviduct / Fallopian tube for fertilisation could occur</li> <li>High progesterone and thick uterus lining required for successful implantation.</li> </ul> <p><b>AO3.1a Interpretation of graphs and diagram</b></p> <p>For example:</p> <ul style="list-style-type: none"> <li>Days 7–14 uterus lining thickens / develops</li> <li>Thickening of uterus occurs under the influence of a rise in oestrogen</li> <li>Day 14 is when ovulation occurs / an egg is released</li> <li>Follicle bursts due to a peak of LH</li> <li>Days 15–28, fertilisation could occur</li> <li>Uterus lining stays thick from days 21–28.</li> </ul>

### Teacher Tips

This question requires the learner to combine their scientific knowledge and understanding with the skill of using graphs and diagrams. This question is marked using a Level of Response (LOR) mark scheme similar to the LOR mark schemes used in the legacy specifications. These are high tariff questions (6 marks) and learners need to practice answering these types of question in a logical coherent way and with a sustained line of reasoning. Learners need to be familiar with the way that these questions are marked in order to realise that the structure of their answer will be considered along with the scientific content.

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## OCR customer contact centre

General qualifications

Telephone 01223 553998

Facsimile 01223 552627

Email [general.qualifications@ocr.org.uk](mailto:general.qualifications@ocr.org.uk)

