Cambridge NATIONALS

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COMBINED FEEDBACK ON THE JUNE 2013 EXAM PAPER

UNIT R072/02: HOW SCIENTIFIC IDEAS HAVE DEVELOPED

SCIENCE

Level 1/2

cambridgenationals.org.uk

OCR
Oxford Cambridge and RSA

CONTENTS

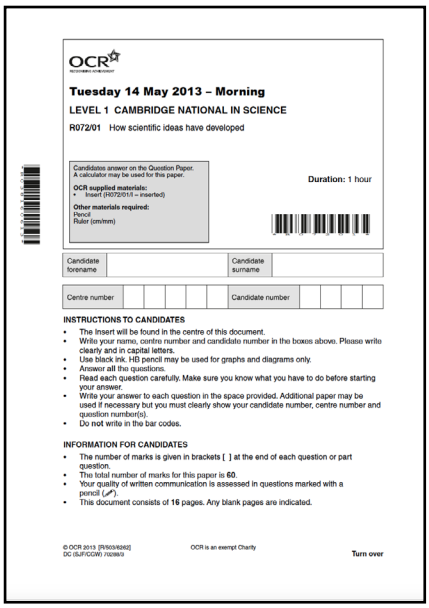
INTRODUCTION

This resource brings together the questions from the June 2013 examined unit (R072/02), the marking guidance, the examiner's comments and the exemplar answers into one place for easy reference.

The marking guidance and the examiner's comments are taken straight from the Report to Centre for this question paper.

The Question Paper, Mark Scheme and the Report to Centre are available from:

http://www.ocr.org.uk/qualifications/cambridge-nationals-science-level-1-2-j815/



OCR

Tuesday 14 May 2013 – Morning

LEVEL 1 CAMBRIDGE NATIONAL IN SCIENCE

R072/01 How scientific ideas have developed

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
- Insert (R072/01/I – inserted)

Other materials required:
Pencil
Ruler (cm/mm)

Duration: 1 hour

Candidate forename | Candidate surname

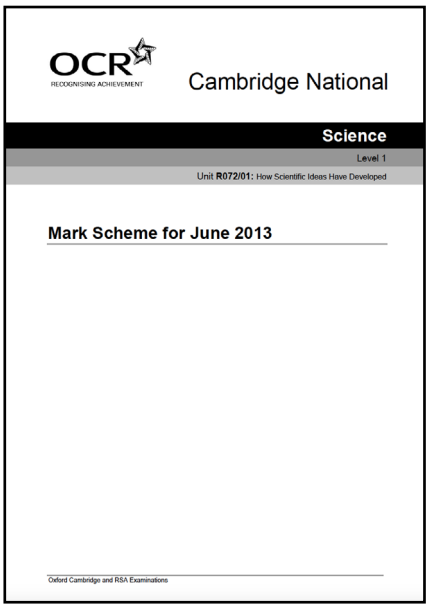
Centre number | Candidate number

INSTRUCTIONS TO CANDIDATES
- The Insert will be found in the centre of this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer all the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do not write in the bar codes.

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 **60**.
- Your quality of written communication is assessed in questions marked with a pencil (✍).
- This document consists of **16** pages. Any blank pages are indicated.

OCR is an exempt Charity

Turn over



OCR RECOGNISING ACHIEVEMENT

Cambridge National

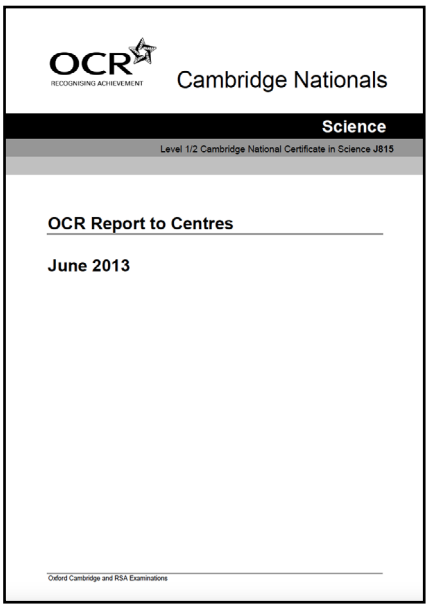
Science

Level 1

Unit **R072/01:** How Scientific Ideas Have Developed

Mark Scheme for June 2013

Oxford Cambridge and RSA Examinations



OCR RECOGNISING ACHIEVEMENT

Cambridge Nationals

Science

Level 1/2 Cambridge National Certificate in Science J815

OCR Report to Centres

June 2013

Oxford Cambridge and RSA Examinations

PRE-RELEASE MATERIAL

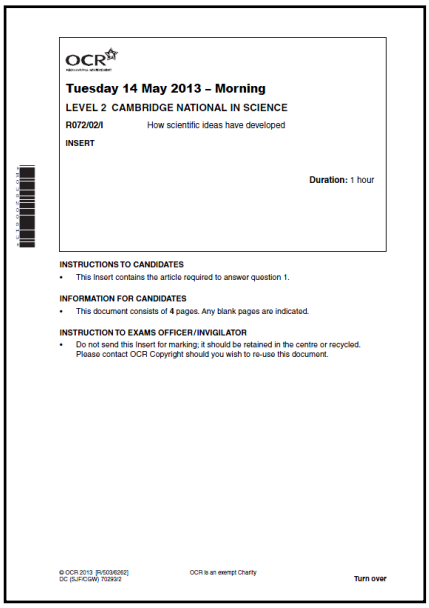
The question paper is based on a pre-release article issued to centres, which is required to answer question 1. This question accounts for 25% of the total marks.

A case study provides the context for the first questions (15 marks) on the paper, targeting Learning objective 2 and Learning objective 3, but using knowledge and understanding from one or more parts of Learning objective 1.

The case study presents information about the work of some modern scientists, including information about their research and some of their results. Pre-release material sent to centres before the examination gives learners an opportunity to become familiar with the case study.

The pre-release material can be found here:

http://www.ocr.org.uk/Images/167837-question-paper-unit-r072-02-how-scientific-ideas-have-developed-pre-release-resource-booklet.pdf



OCR

Tuesday 14 May 2013 – Morning

LEVEL 2 CAMBRIDGE NATIONAL IN SCIENCE

R072/02/I How scientific ideas have developed

INSERT

Duration: 1 hour

INSTRUCTIONS TO CANDIDATES

- This Insert contains the article required to answer question 1.

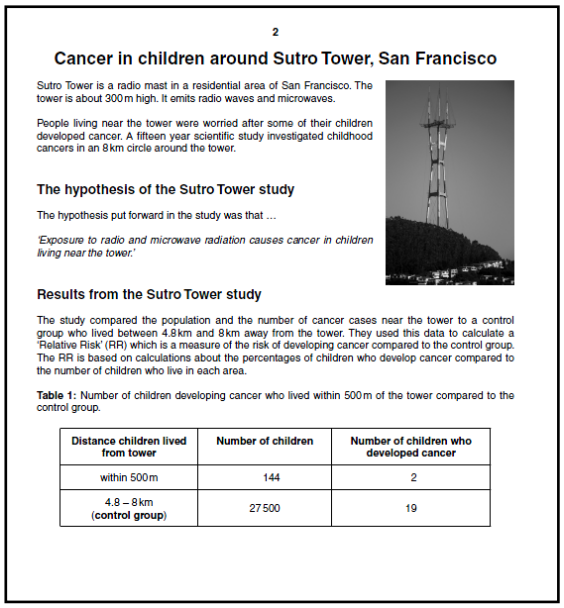
INFORMATION FOR CANDIDATES

- This document consists of 4 pages. Any blank pages are indicated.

INSTRUCTION TO EXAMS OFFICER / INVIGILATOR

- Do not send this Insert for marking; it should be retained in the centre or recycled. Please contact OCR Copyright should you wish to re-use this document.

Turn over



2

Cancer in children around Sutro Tower, San Francisco

Sutro Tower is a radio mast in a residential area of San Francisco. The tower is about 300 m high. It emits radio waves and microwaves.

People living near the tower were worried after some of their children developed cancer. A fifteen year scientific study investigated childhood cancers in an 8 km circle around the tower.

The hypothesis of the Sutro Tower study

The hypothesis put forward in the study was that ...

'Exposure to radio and microwave radiation causes cancer in children living near the tower.'

Results from the Sutro Tower study

The study compared the population and the number of cancer cases near the tower to a control group who lived between 4.8 km and 8 km away from the tower. They used this data to calculate a 'Relative Risk' (RR) which is a measure of the risk of developing cancer compared to the control group. The RR is based on calculations about the percentages of children who develop cancer compared to the number of children who live in each area.

Table 1: Number of children developing cancer who lived within 500 m of the tower compared to the control group.

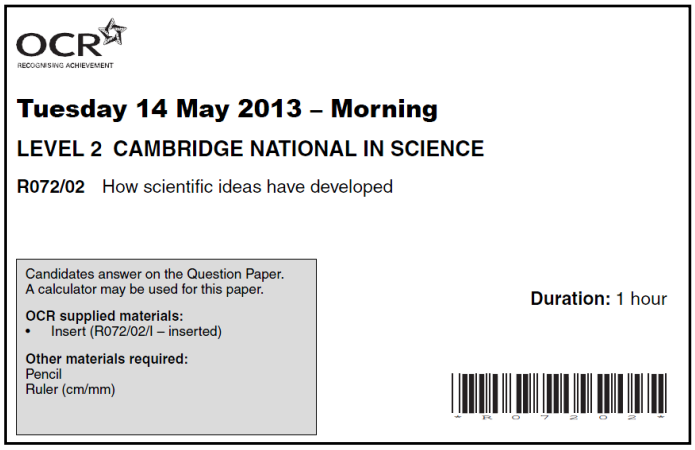
Distance children lived from tower	Number of children	Number of children who developed cancer
within 500 m	144	2
4.8 – 8 km (**control group**)	27 500	19

GENERAL EXAMINER COMMENTS ON THE PAPER

This Level Two examination gives candidates the chance to study the processes by which scientific ideas have developed by considering a number of important steps in modern understanding.

The first question relating to the pre-release material provides 25% of the marks for the whole paper. Candidates who did well had clearly worked on this pre-release material with their teachers in advance of the examination. Very few marks are obtained by simply copying something from the document but many marks were accessible to those who have considered and discussed the pre-release material with their teachers.

The language of the examination was inclusive and there was no evidence that any candidates were disadvantaged by this or cultural issues. There was no indication of time pressure or other constraints for candidates.



OCR

RECOGNISING ACHIEVEMENT

Tuesday 14 May 2013 – Morning

LEVEL 2 CAMBRIDGE NATIONAL IN SCIENCE

R072/02 How scientific ideas have developed

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
- Insert (R072/02/I – inserted)

Other materials required:
Pencil
Ruler (cm/mm)

Duration: 1 hour

Question 1 (a) and (b)

This question is based on the case study 'Cancer in children around Sutro Tower, San Francisco'.

Answer **all** questions.

1 (a) Look at the data in Table 1.

'A higher percentage of children living within 500m of the mast developed cancer compared to the children in the control group'.

Use calculations to show that this statement is true.

2 / 144 x 100 = 1.38 / 1.39%

19 / 27500 x 100 = 0.06(9) / 0.07%

[2]

(b) Before the study, the scientists discussed how to choose the control group of people to make sure that their test was fair.

(i) The scientists decided that they needed to choose a control group of people who did not live near the tower.

Explain why this was a good choice.

Not affected by radiation (from the tower) idea

Other example answer:

• Idea of comparing/comparison/difference

[2]

(ii) Some scientists suggested choosing a control group of people who lived 100km away.

After discussion, the scientists chose a control group who lived between 4.8km and 8km away from the tower.

Explain why this is a better choice than a group that lived much further away.

Other factors may affect people who live further away / too different

[1]

(iii) Why is it a good idea that several scientists work together to choose a control group, instead of one scientist making the decision alone?

Idea of sharing ideas / joint decision

[1]

Mark Scheme Guidance

1(a) Allow two correct ratios for 1 mark.
Allow: 1 in 72 (chance); 1 in 1447 (chance).

Examiner comments

The pre-release material contained a lot of data and it was hoped that candidates would have been helped to understand how this data could be used. It appeared that some candidates had not worked on the pre-release material in advance of the examination. The first question required candidates to compare data. Most candidates were able to identify the correct data to be used, but it was clear that many candidates did not have access to a calculator. Some candidates understood the idea that a control group provided a chance to compare, but few went on to explain that the control needed to be unaffected by the tower in part (bi) but close enough to be similar in other respects (bii).

Question 1 (c)

(c) (i) Look at the original hypothesis for the study.

What evidence is there in the case study to support this hypothesis?

Lower rate of cancers further from mast

(more) cancers occur near the mast / gives examples

More relative risk of cancers nearer the mast

Other example answers:

- Less relative risk of cancer further away from the mast
- Pattern of exposure matches relative risk
- Correlation between exposure and incidence of cancer

[3]

(ii) Look at the opinions in the article which **do not support** the hypothesis.

What further research is needed to make the hypothesis more secure?

Do the same study for other places (with masts)

Larger study

Other example answers:

- More people in the study
- Study over a longer time
- Idea of collecting more data

[3]

Mark Scheme Guidance

1 (ci) Allow: UK study supports hypothesis.
Reject: lower **number** of cancers further from the mast.
Allow: exposure largest near the tower / falls with distance.
Allow: None, as correlation does not prove causation (1 mark).

1 (cii) Allow: compare radiation from other sources / appliances eg collecting genetic / ethnic data.

Examiner comments

The concept of working in teams was better understood but often in terms of splitting the workload rather than sharing ideas. Many different approaches were possible to answer part (c). A few candidates were able to identify the way that Relative Risk or Exposure changed with distance, but not many candidates linked the two of these together. It was also rare to find candidates who confidently identified the extra evidence which would have made the conclusion secure. As the pre-release material covered contentious ground, it was hoped that teachers would have undertaken exercises such as this in preparing with their candidates for the examination.

Question 1 (d) and (e)

(d) A newspaper uses Graph 2 in a story.

PROOF THAT RADIO MASTS CAUSE CANCER

Does the graph prove that radio masts cause cancer?

Explain your reasoning.

Correlation (between RR & exposure)

(correlation) does not prove a cause

Other example answer:

• Other risk factors may exist

[2]

(e) The case study says that some types of radiation are **genotoxic** and may disrupt protein synthesis.

Explain why a 'genotoxic' substance may disrupt protein synthesis.

Changes / mutations to the DNA

DNA is responsible for protein synthesis

Other example answer:

• Changed DNA may produce different proteins

[2]

[Total: 15]

Mark Scheme Guidance

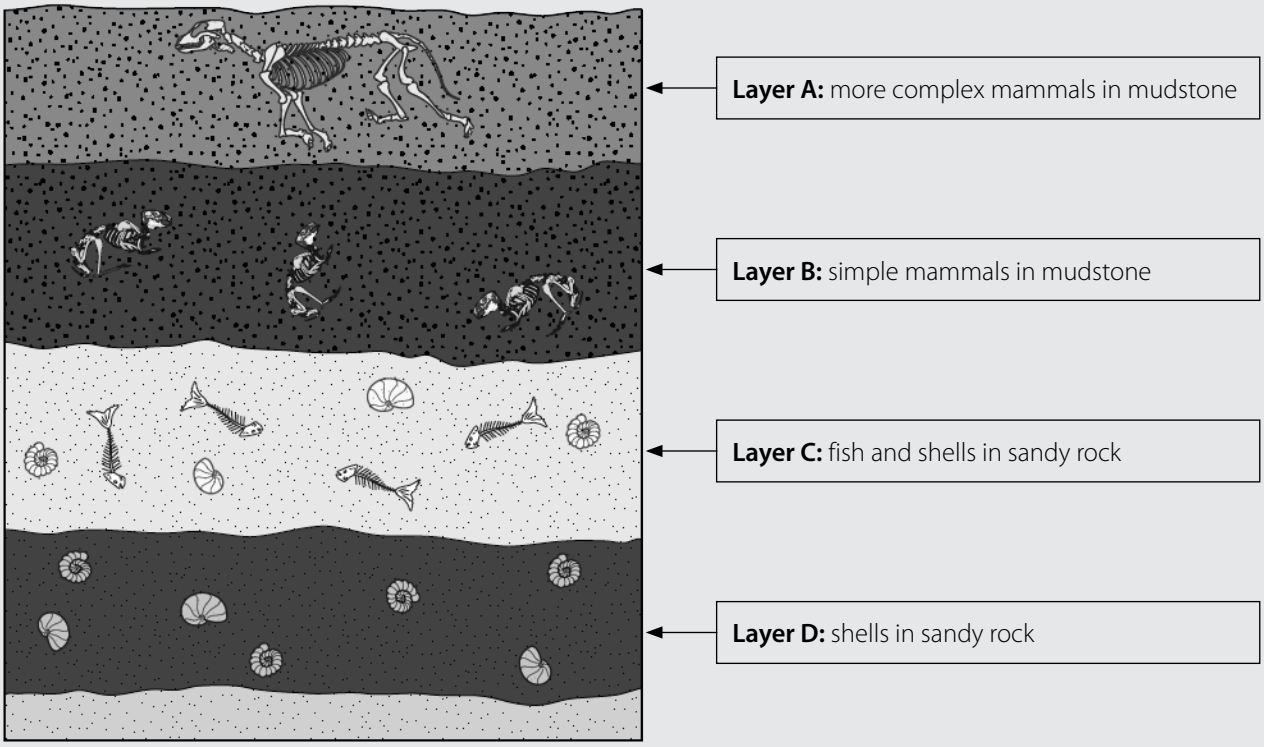
1 (d) Allow: Correlation (between RR/exposure & distance).
Allow: only one source of data.

Examiner comments

Part (d) was better understood by candidates (presumably because such headlines are used). Many responses correctly identified the apparent correlation between relative risk and exposure to radiation but the idea that such a correlation did not prove causation was rarely seen. The number of candidates who did not attempt to answer the final part of the question again suggests that a significant number of candidates had not considered the implications of the pre-release material in advance of the examination. Although a minority of candidates appreciated that DNA might be damaged, few went on to link this to protein synthesis.

Question 2 (a) and (b)

2 Scientists collect evidence from rock layers.



(a) Rock layer **C** is 250 million years old.

Suggest the age of rock Layer **B**.

Up to 250 **million years old**

[1]

(b) Darwin used fossils as evidence for his theory of evolution.

How do the fossils in these rock layers support Darwin's theory?

Fossils different in each layer

Fossils change over time

(more recent fossils are) more complex

Other example answers:

- Specific example: fish after shells
- Mammals after fish

[3]

Mark Scheme Guidance

2 (b) Allow: Animals have developed.

Examiner comments

A wide range of answers were acceptable for part (a) which simply sought to confirm that the upper layers of rock were younger than the lower ones – and most candidates found this accessible. However, the link between this and the idea that species have changed over time was not well explained in part (b).

Question 2 (c) and (d)

(c) Other scientists used the rock layers as evidence of changing conditions over time.

What conclusions could be made from looking at these rock layers?

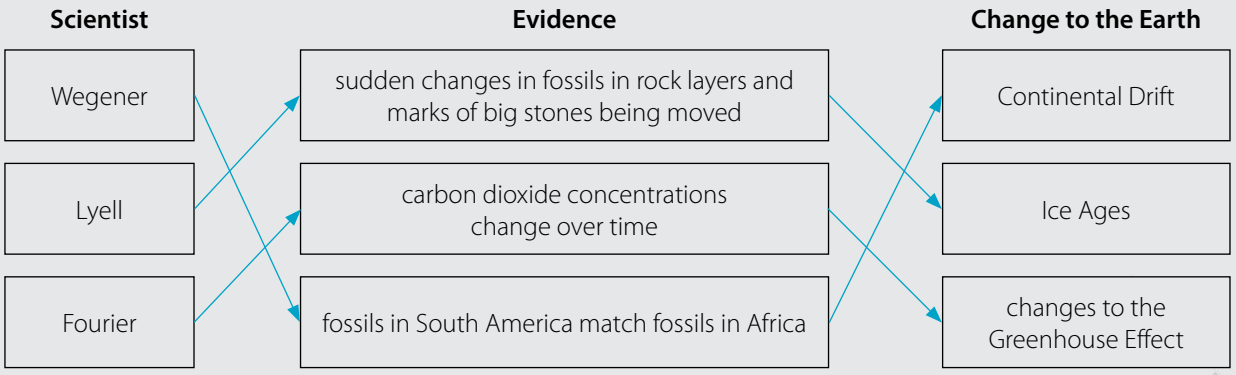
Put ticks (✓) in the boxes next to the **two** correct conclusions.

The area used to be under water	✓
The area was flooded after a long time of dry land	
There has always been a deep sea in the area	
The area was a desert for a short time	
The area had some dry land for millions of years	✓

[2]

(d) Different scientists have put forward ideas about changes to the Earth.

Draw lines to connect each **scientist** with the **evidence** he collected and the **change to the Earth** he investigated.



[2]

[Total: 8]

Mark Scheme Guidance

2 (c) -1mark for each additional tick.

2 (d) Left hand side correct = 1 mark.
Right hand side correct = 1 mark.

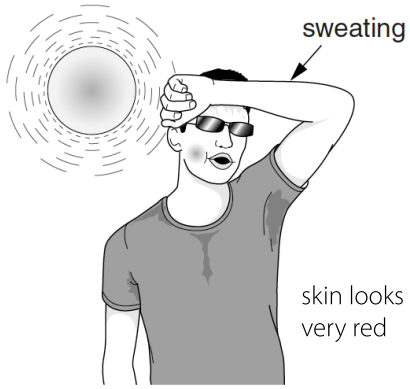
Examiner comments

All the conclusions offered in part (c) were chosen by some candidates, although some did not recognise that they were being asked which were available from the rock evidence. A pleasing number of candidates were able to link the named scientists to their evidence and even more could link the evidence to the changes in the earth that they indicated. It was disappointing that this question (and a few other objective items) were ignored even by some strong candidates.

Question 3 (a)

3 Alex goes on holiday to a very hot place. Ben goes on holiday to somewhere very cold.

Alex



outside temperature	40°C
skin temperature	39°C
core temperature	37°C

Ben

outside temperature	2°C
skin temperature	31°C
core temperature	37°C

(a) Temperature control in Alex and Ben uses a **negative feedback** system involving **receptors** and **effectors**.

Use ideas about negative feedback to explain what is happening to Alex and Ben.

The quality of written communication will be assessed in your answer to this question.

Receptors & Effectors • Receptors detect temperature

Negative feedback • Idea of negative feedback returning / reversing a change to a normal level

Comparison of temperature • Alex skin/air temperature is above core temperature

Other example answers:

Receptors & Effectors

- Receptors detect skin temperature
- Receptors detect blood temperature
- Processed by the brain
- Messages sent to effectors
- Effectors cause response
- Operates by vasoconstriction/vasodilation
- Operation of shivering/sweating

Negative feedback

- By losing / gaining heat (eg by shivering / sweating)
- Keeps core temperature constant (when skin temperature varies).

Comparison of temperature

- Ben skin /air temperature is below core temperature
- Idea that temperature of skin is affected by surroundings

[6]

Mark Scheme Guidance

This question is targeted at grades up to D*

Level 3 (5–6 marks)
Gives points to address all aspects of answer; **receptors and effectors** AND **negative feedback** AND **a comparison of temperature**. Quality of written communication does not impede communication of the science at this level.

Level 2 (3–4 marks)
Compares temperatures AND describes **negative feedback** or describes the role of **receptors and/or effectors**. Quality of written communication partly impedes communication of the science at this level.

Level 1 (1–2 marks)
Compares temperatures or indicates a need to control core/body temperature (but not skin temperature). Quality of written communication impedes communication of the science at this level.

Level 0 (0 marks)
Insufficient or irrelevant science. Answer not worthy of credit.

Examiner comments

Part (a) is superficially similar to the six-mark extended-writing question which was on the Level One paper. However this question required that candidates use the idea of negative feedback to explain and not just describe the processes involved. It is understood that there will be relatively few candidates likely to achieve the Distinction Grade on this Level Two examination paper, but there must be questions to identify these candidates. A good number of responses indicated some knowledge of thermoregulation, but very few candidates addressed the idea of negative feedback.

Question 3 (bi)

(b) Another control system in the body is involved in the control of glucose concentration in the blood.

Amir is a doctor. He uses a glucose monitor to test the glucose concentration in blood.

He tests the blood of a patient every half hour after the patient has eaten.

He repeats his test several times.

The table shows his results.

Time after eating in hours		0.0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
Glucose concentration in blood in mmol/l	**Test 1**	5.1	5.6	6.1	6.6	7.1	6.7	6.3	5.9	5.4
	Test 2	4.5	4.9	5.3	5.7	6.1	5.8	5.4	4.9	4.6
	Test 3	4.8	5.2	5.6	6.0	6.4	5.9	5.6	5.3	4.9

(i) Amir suggests some explanations for the results in the table above.

Explanation 1: Our bodies immediately release all of the glucose from a meal into our blood.

Explanation 2: Digestion takes time to convert food into glucose in our body.

Explanation 3: Our bodies use glucose from our blood for energy.

Explanation 4: Eating keeps the level of glucose in our blood constant.

Explanation 5: The glucose concentration falls from when we eat until we eat again.

Which **two** explanations give the best fit for the results in the table?

Explain your reasons.

Explanations 2 and 3

Reasons Glucose level rises after eating the meal

Falls because we use glucose for energy

[3]

Mark Scheme Guidance

Allow 'rises and falls' / 'highest after two hours' if no 'reason' marks (1)

Examiner comments

Part (b) gave candidates the opportunity to interpret unfamiliar data in a relatively familiar context. It should have been clear that the level of blood glucose went up for some time and then went down again. Candidates seemed able to recognise this, but many did not link it successfully to the relevant explanations in part (bi).

Question 3 (bii) and (c)

(ii) Amir thinks that the data from the tests is good quality because it is reliable.

Why does he think this?

Put a tick (✓) in the box next to the correct answer.

The results for all of the tests show a similar pattern	✓
All of the measurements are to one decimal place	
He took all of the measurements carefully	
The values do not change very much over time	

[1]

(c) To make the tests fair, Amir told the patient that he was **not** allowed to ...

- eat snacks
- exercise

Explain why it is important that the patient **did not** eat snacks or exercise during tests.

Eating provides more glucose

Exercise uses glucose

Idea that results or data would be changed

Other example answers:

- Eating increases glucose levels
- Exercise decreases glucose levels
- Idea that results or data would be less reliable
- Idea that results or data could not be compared

[3]

Examiner comments

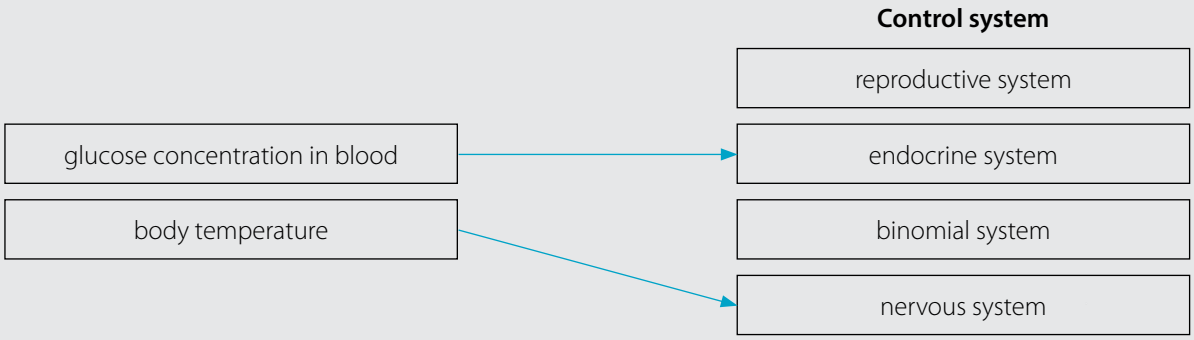
Most candidates identified the similarities in the results as an argument for reliability in part (bii).

Stronger candidates were able to score some marks on part (c) for describing the effects that either snacking or exercise would have had on the results.

Question 3 (d)

(d) Glucose concentration in the blood and body temperature are controlled by different systems in the body.

Draw straight lines to link the correct **control system** for glucose concentration in the blood and body temperature.



[2]

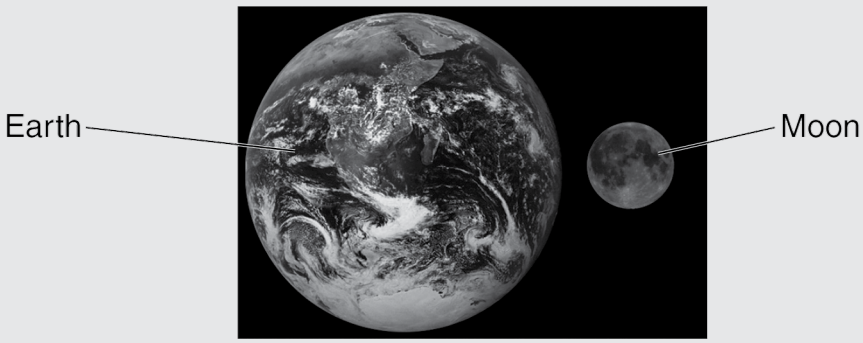
[Total: 15]

Examiner comments

The control systems in part (d) were not well known, but Examiners were concerned that a large number of candidates drew far more lines than was appropriate on this question.

Question 4 (a) and (b)

4 Scientists have studied the movement of moons, planets and stars for thousands of years.



(a) The ancient Greeks believed that the planets moved in orbits.

In the sixteenth century, Galileo put forward new ideas about the orbits of the planets.

How were Galileo's ideas different to the ideas of the ancient Greeks?

The quality of written communication will be assessed in your answer to this question.

Ancient Greeks believed Earth was centre

Galileo believed Sun was the centre

Other example answers:

- Ancient Greeks believed planets moved around Earth
- Ancient Greeks believed planets moved on crystal spheres
- Galileo believed that planets moved around Sun

[3]

(b) Isaac Newton agreed with Galileo.

Newton proposed an explanation for the movement of the planets.

How did Newton explain the movement of the planets?

Put ticks (✓) in the boxes next to the **two** correct answers.

The planets travel across the Universe in regular patterns	
The movement of the planets follow mathematical laws of motion	✓
The planets are kept in orbit by gravity	✓
Cosmic radiation causes planets to travel in circular paths	
All planets follow an identical path through the night sky	

[2]

Mark Scheme Guidance

Quality of written communication: Response addresses the question and is easily understood.

Examiner comments

Many candidates scored well in part (a) with strongest candidates confidently comparing the heliocentric and geocentric views of the solar system and also usually identifying the key aspects of Newton's theories in part (b). It was again noted that the question stem specifically required two responses to be chosen, but many candidates selected the wrong number (including no response at all).

Question 4 (c) and (d)

(c) In the last century, scientists put forward theories that the Universe started with the Big Bang and that the Universe is still expanding.

Which statements give evidence for this theory?

Put ticks (✓) in the boxes next to the **two** correct answers.

'Red shift' means that light from stars appears more red than expected	✓
Tectonic plates move apart every year	
Background radiation shows that the Universe is still cooling	✓
The diameter of the Earth is expanding	
The temperature of the atmosphere of the Earth may be increasing	

[2]

(d) Telescopes that observe objects in the Universe rely on different types of electromagnetic waves.

Visible light, microwaves and infra-red waves are all collected and processed by telescopes.

Which of the following statements are true for all three types of radiation, and which are true for one type of radiation?

Put a tick (✓) in one box in each row.

Statement	True for all three (✓)	True for visible light only (✓)	True for microwaves only (✓)	True for infra-red only (✓)
travels at 300,000 km/s	✓			
used to transmit calls to mobile phones			✓	
used to transmit data via optical fibre				✓
has the shortest wavelength		✓		

[3]

[Total: 10]

Mark Scheme Guidance

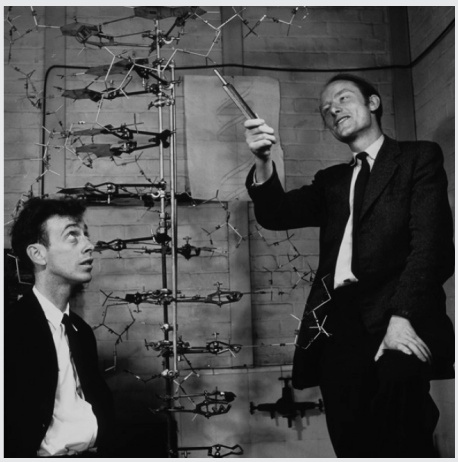
4 (d) All correct = 3 marks
3 correct = 2 marks
2 correct = 1 mark
Any row with more than one tick does not score.

Examiner comments

In part (d) few candidates realised that all three radiation types travel at the same speed.

Question 5

5 In 1953, Watson and Crick published ideas about the structure of DNA.



Watson and Crick

The information shows a timeline for some stages in the development of ideas about DNA.

Peer review comments for some of the ideas are also shown.

Developments of ideas	Peer review comments
1951 Franklin gives a lecture showing her X-ray crystallography photographs of DNA.	Scientists believed that the photographs could help work out the structure of DNA.
1953 Watson and Crick publish their first ideas that DNA ... • is a triple chain helix of sugar and phosphate • has bases on the outside • is held together by magnesium atoms	Scientists rejected the model because the magnesium atoms could not hold the structure together. Scientists agreed that DNA was made of sugar, phosphate and four bases.
1953 Linus Pauling publishes his ideas that DNA ... • is a triple chain helix of sugar and phosphate • has phosphate groups with hydrogens on them • has bases on the outside	X-ray crystallography showed that the bases should be on the inside and other scientists pointed out that the hydrogen atoms were wrong.
Later in 1953 Watson and Crick published new ideas that DNA ... • is a double helix of sugar and phosphate • has bases on the inside, holding the structure together	Scientists accepted the new model because it explained how DNA could copy itself by splitting down the middle.

Question 5 (a)

(a) Explain how the **peer review comments** influenced the development of ideas about the structure of DNA.

The quality of written communication will be assessed in your answer to this question.

Support from peer review

- X-ray crystallography /photographs can be used to work out structure
- DNA contains sugar

Models rejected by peer review

- Watson and Crick's model rejected because of magnesium atoms
- Both early models rejected because bases on outside

Effect of peer review

- Meant scientists refined model

Other example answers:

Support from peer review

- DNA contains phosphate
- DNA contains (4) bases

Models rejected by peer review

- Pauling model rejected because hydrogen atoms wrong

Effect of peer review

- Scientists came up with new ideas
- Final model accepted because it shows how DNA can copy itself

[6]

Mark Scheme Guidance

This question is targeted at grades up to D*

Level 3 (5–6 marks)
Describes development of models including examples of both **support** and **rejection** from peer review.
Quality of written communication does not impede communication of the science at this level.

Level 2 (3–4 marks)
Describes development of models including example(s) of refinements from peer review.
Quality of written communication partly impedes communication of the science at this level.

Level 1 (1–2 marks)
Describes development of models including effect of peer review.
Quality of written communication impedes communication of the science at this level.

Level 0 (0 marks)
Insufficient or irrelevant science. Answer not worthy of credit.

Examiner comments

This question included the second of the six-mark extended-writing questions. Candidates were provided with a lot of information about a process with which they should have been familiar (the discovery of the structure of DNA). A competent response could be produced from judicious use of this information, but most candidates were content to copy out chunks of the information in the flow-chart in the hope that these answers would contain something worthy of credit.

Question 5 (b)

(b) Two separate teams of scientists each worked out the structure of DNA at a similar time.

(i) Watson and Crick published their ideas very quickly.

Suggest reasons why some scientists want to publish their ideas very quickly.

To make sure other scientists don't publish first

Other example answer:

• Keen to make their discoveries known

[1]

(ii) Franklin worked out the structure of DNA at about the same time as Watson and Crick.

She took much longer to publish her ideas.

Suggest a reason why some scientists take a long time to publish their ideas.

Checking the data

Other example answers:

• Checking explanations
• Making sure they are right
• Discussing (within the team)

[1]

Mark Scheme Guidance

Ignore peer review / allow others to comment.

Examiner comments

Responses to part (b) suggest that the story of the competition was well understood.

Question 5 (c) and (d)

(c) One of the features of the structure of DNA is how the four bases fit together.

Describe how the bases fit together.

In pairs

A to T

Other example answer:

- C to G

[2]

(d) William Bragg developed the technique of X-ray crystallography in 1912.

Explain why this was important to the development of ideas about DNA.

Examine DNA structure

Shows where bases/chains are

Other example answers:

- Evidence against (Pauling's) structure
- Evidence for double helix

[2]

[Total: 12]

Examiner comments

Part (c) was less well answered – reflecting the tendency for candidates to be familiar with ideas but lacking in their recall of factual details.

The reference to X-ray crystallography in part (d) showed up that most candidates were familiar only with the medical use of X-rays and so assumed that Bragg or Franklin had used X-rays to "take a photograph" of DNA analogous to "pictures" of a broken bone.

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