GCSE (9-1)

Exemplar Candidate Work

GATEWAY SCIENCE
COMBINED SCIENCE A

J250
For first teaching in 2016

J250/06 Summer 2018 examination series

Version 1
<table>
<thead>
<tr>
<th>Contents</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>3</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Question 2</td>
<td>4</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>Question 6</td>
<td>5</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>Question 7</td>
<td>6</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Question 8</td>
<td>7</td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>Question 9</td>
<td>8</td>
<td></td>
<td>27</td>
</tr>
<tr>
<td>Question 11 (a)</td>
<td>9</td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>Question 11 (b) (i)</td>
<td>9</td>
<td></td>
<td>31</td>
</tr>
<tr>
<td>Question 11 (b) (ii)</td>
<td>10</td>
<td></td>
<td>32</td>
</tr>
<tr>
<td>Question 12 (a)</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 12 (b)</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 12 (c) (i)</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 12 (c) (ii)</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 12 (d)</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 13 (a)</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 13 (b)</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 13 (c)</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 14 (a)</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 14 (b) (i)</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 14 (b) (ii)</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question 14 (c)</td>
<td>19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Introduction

These exemplar answers have been chosen from the summer 2018 examination series.

OCR is open to a wide variety of approaches and all answers are considered on their merits. These exemplars, therefore, should not be seen as the only way to answer questions but do illustrate how the mark scheme has been applied.

Please always refer to the specification https://www.ocr.org.uk/qualifications/gcse/gateway-science-suite-combined-science-a-j250-from-2016/ for full details of the assessment for this qualification. These exemplar answers should also be read in conjunction with the sample assessment materials and the June 2018 Examiners’ report or Report to Centres available from Interchange https://interchange.ocr.org.uk/Home.mvc/Index

The question paper, mark scheme and any resource booklet(s) will be available on the OCR website from summer 2019. Until then, they are available on OCR Interchange (school exams officers will have a login for this and are able to set up teachers with specific logins – see the following link for further information http://www.ocr.org.uk/administration/support-and-tools/interchange/managing-user-accounts/).

It is important to note that approaches to question setting and marking will remain consistent. At the same time OCR reviews all its qualifications annually and may make small adjustments to improve the performance of its assessments. We will let you know of any substantive changes.
Question 2

Exemplar 1

2. Which of these electromagnetic waves has the smallest wavelength?

A. Gamma-ray
B. Micro-wave
C. Radio wave
D. X-ray

Your answer [ ] [1]

Examiner commentary

It is important to be clear which response that you intend to be your answer. Here the candidate has changed their mind five times, finally choosing an incorrect answer. The only option they did not consider was the correct response A. A better approach would be to sketch out what you know. Most candidates should be able to put the familiar X-ray, micro-wave and radio wave in an order and they would then only have to remember whether gamma-ray has a smaller or larger wavelength than X-ray. Alternatively they could eliminate micro-wave and radio wave and then chose from the 50:50 options left. Only 3:10 candidates chose the correct response A.
Question 6

Exemplar 1

6 An electric kettle is plugged into a socket. The kettle is switched on. A qualified electrician uses three voltmeters, $V_1$, $V_2$, and $V_3$.

Use the relationship: $V_3 = V_1 + V_2$

Which row in the table, A, B, C or D, shows the correct readings for the three voltmeters?

<table>
<thead>
<tr>
<th></th>
<th>$V_1$ (V)</th>
<th>$V_2$ (V)</th>
<th>$V_3$ (V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
<td>230</td>
<td>230</td>
</tr>
<tr>
<td>B</td>
<td>230</td>
<td>0</td>
<td>230</td>
</tr>
<tr>
<td>C</td>
<td>230</td>
<td>230</td>
<td>0</td>
</tr>
<tr>
<td>D</td>
<td>0</td>
<td>0</td>
<td>230</td>
</tr>
</tbody>
</table>

Your answer [B] 

Examiner commentary

The candidate shows a good approach to answering multiple choice questions. You can see that they eliminated options A and C, as the potential difference between the neutral and earth wire ($V_2$) should be 0 V. This makes seeing the correct answer easier as the choice is now just one out of two, and option D cannot be correct as $0 + 0 \neq 230$ V.
Exemplar Candidate Work

Question 7

Exemplar 1

7. An element gives out a beta (β) particle.

The table shows how the atomic number and mass number of the element change.

<table>
<thead>
<tr>
<th></th>
<th>Atomic number</th>
<th>Mass number</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Decreases by 2</td>
<td>Decreases by 4</td>
</tr>
<tr>
<td>B</td>
<td>Decreases by 4</td>
<td>Decreases by 2</td>
</tr>
<tr>
<td>C</td>
<td>Increases by 1</td>
<td>Stays the same</td>
</tr>
<tr>
<td>D</td>
<td>Stays the same</td>
<td>Increases by 1</td>
</tr>
</tbody>
</table>

Which row of the table is correct?

Your answer: C [1]

Examiner commentary

Candidates found this to be the hardest question and this exemplar was one of the 27% who gave the correct answer. Many candidates get confused between how information is presented for individual isotopes (in physics) against the information for elements in the periodic table (in chemistry). In physics candidates will be asked about individual isotopes and the information is presented in standard notation as:

mass number, atomic number, chemical symbol

and for a beta particle it looks like $^0\text{e}$

By sketching out what they know it can help the candidate to find the correct answer.
Question 8

Exemplar 1

8 A moving car crashes into a wall.

Which row in the table describes one of the energy transfers?

<table>
<thead>
<tr>
<th>Energy store before crash</th>
<th>Energy store after crash</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Chemical</td>
</tr>
<tr>
<td>B</td>
<td>Gravitational</td>
</tr>
<tr>
<td>C</td>
<td>Kinetic</td>
</tr>
<tr>
<td>D</td>
<td>Kinetic</td>
</tr>
</tbody>
</table>

Option A describes the energy transfer in a gas power station while option B describes the energy transfer in a hydroelectric power station. Option D describes the energy transfer when a ball is thrown onto the roof of a building.

Examiner commentary

The diagram should help candidates to visualise the stores and transfer model of energy that has now replaced the abandoned nine types of energy model. In a parked car the fuel tank is a chemical energy store. In a car moving at a constant velocity, energy is transferred through the combustion of fuel to the kinetic energy store. As the car brakes and the crumple zone gets squashed energy is transferred to the thermal energy store. The candidate has clearly thought through their response, made a mark beside the correct answer, and then written D in the box.

Option A describes the energy transfer in a gas power station while option B describes the energy transfer in a hydroelectric power station. Option D describes the energy transfer when a ball is thrown onto the roof of a building.
Question 9

Exemplar 1

9 The graph shows how speed in miles per hour (mph) is related to speed in metres per second (m/s).

A car travels at 20 mph.

What is the speed of this car in m/s?

A 8 m/s
B 9 m/s
C 43 m/s
D 46 m/s

Your answer [5] [1]

Examiner commentary

The candidate has written 8 in the answer box rather than A (an incorrect answer). If the candidate had written 9 in the answer box rather than B they would have been given the mark for a correct answer.

Whenever there is a calculation in a physics question it is always best to write out your calculation, even if you are using a calculator. Sketching out the calculations helps the candidate to spot simple errors, and if there is more than 1 mark they will probably get some marks for a correct method even if the final answer is wrong. Not writing out any calculations is a high risk technique where the candidate chooses to lose some marks to save the small amount of time it will take them to write down a few workings.
**Question 11 (a)**

**Exemplar 1**  

2 marks

11  This question is about radioactivity.

(a) Two isotopes of nitrogen are shown below.

\[
\begin{array}{c}
\text{Neutrons} \\
\text{Protons}
\end{array}
\begin{array}{c}
14^7\text{N} \\
15^7\text{N}
\end{array}
\]

Explain what is meant by the term isotopes.

...when an element has the same number of protons... 
...but different numbers of neutrons...  
...atomic number is the same...  
...but has a different mass...  

Examiner commentary

An excellent answer where the candidate has clearly explained that isotopes have same number of protons (atomic number) but different numbers of neutrons (mass number). Annotating the standard nuclear notation symbols is a very good exam technique to help candidates recall scientific concepts. Many candidates get confused between how information is presented for individual isotopes (in physics) against the information for elements in the periodic table (in chemistry). Visualising the information by sketching and annotating text can be very helpful in developing understanding of these concepts.

---

**Question 11 (b) (i)**

**Exemplar 1**  

1 mark

(b) A teacher shows his class an experiment. The teacher wants to identify the type of radiation given out by a radioactive isotope.

He uses a Geiger-Muller tube connected to a counter to measure the count rate.

He places different materials between the radioactive isotope and the Geiger-Muller tube.

The table shows the count rate for different materials.

<table>
<thead>
<tr>
<th>Material</th>
<th>Count rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>No material (air)</td>
<td>200</td>
</tr>
<tr>
<td>Thick paper</td>
<td>200</td>
</tr>
<tr>
<td>Thin aluminium</td>
<td>197</td>
</tr>
<tr>
<td>Thick lead</td>
<td>3</td>
</tr>
</tbody>
</table>
Examiner commentary

This response shows a candidate states the correct answer by writing in a straightforward factual way. The lead prevents the radiation reaching the other people in the classroom. Many candidates wrote long story-like explanations, and it was easy for these to become quite confusing. For example many candidates wrote about how lead was a poor conductor that would insulate the teacher from the radioactive isotope and others wrote about how lead 'stops radioactive waves'.

Question 11 (b) (ii)

Exemplar 1 3 marks

(ii) Which type of radiation is given out by the radioactive isotope?

gamma

Explain your answer.

Use the data in the table to help.

The paper has no effect so it can't be alpha and the aluminium has very little effect so it can't be beta so it has to be gamma. [3]

Examiner commentary

The candidate gave a concise straightforward answer that fully explained why the correct answer was gamma rays. They have used the data to show why it cannot be alpha or beta radioactivity, and therefore can only be gamma rays. Many candidates wrote much longer convoluted answers with much irrelevant detail. Other responses just explained that it was gamma because it reached the detector through the materials but without explaining why it could not be beta or alpha radiation. The answer lines available and the marks for a question are there to guide candidates to provide appropriate detail in their answers. In Q11bii there were 3 marks available: 1 mark for the first half answer line, and 1 mark for the four full answer lines. The instruction to 'use the data in the table' is further guidance as to what detail candidates need to provide.
Question 12 (a)

Exemplar 1

12 The table shows some information about electrical appliances in the home.

<table>
<thead>
<tr>
<th>Appliance</th>
<th>Power (W)</th>
<th>Current (A)</th>
<th>Resistance (Ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hairdryer</td>
<td>1800</td>
<td>7.8</td>
<td>29.6</td>
</tr>
<tr>
<td>Heater</td>
<td>800</td>
<td>3.5</td>
<td>66.1</td>
</tr>
<tr>
<td>Iron</td>
<td>2000</td>
<td>8.7</td>
<td>26.4</td>
</tr>
<tr>
<td>Kettle</td>
<td>2500</td>
<td>10.9</td>
<td>21.0</td>
</tr>
</tbody>
</table>

(a) A teacher says: ‘As power increases, resistance increases’

Is this correct? ....NO........

Use data from the table to explain your answer:

because the kettle has a power of 2500 W

and the lowest resistance...so as power increases, resistance decreases. [2]

Examiner commentary

Notice how the candidate in this exemplar uses the data from the table to show that the electrical appliance with the largest power rating (kettle 2500 W) has the smallest resistance (21.0 Ω). They then correctly conclude that power is inversely proportional to resistance, the complete opposite of the teacher’s hypothesis.

Many less able candidates assumed that the teacher must be correct and then tried to force the data to support a false conclusion. It is very helpful for candidates to experience the scientific method at work in the classroom. If they only ever get asked to test hypotheses that the teacher knows will work this creates a false model of how science works. When an experiment does not work as predicted, it creates an opportunity to learn how things really work. It also prepares candidates for assessment questions where an experiment may not work perfectly, or the data needs or be analysed before a conclusion can be reached.
**Question 12 (b)**

**Exemplar 1**

3 marks

(b) The kettle is switched on for 60 seconds.

Calculate the energy transferred:

\[2500 \times 200 = 150'000\]

Answer = \[150'000\] J [3]

**Examiner commentary**

This response is set out in an ideal way. Recalling and writing down the correct equation and substituting the values from the question allows compensatory marks to possibly be awarded even if the candidate’s final answer is incorrect. Most candidates who provide some workings gain some marks in this type of question. Providing no workings is a high risk, all or nothing strategy that disadvantages the candidate.

**Question 12 (c) (i)**

**Exemplar 1**

1 mark

(c) Electricity companies do not use joules (J) in electricity bills. Electricity companies use kilowatt-hours (kWh).

(l) A hairdryer has a power of 1800 W.

What is the power of the hairdryer in kilowatts (kW)?

\[1800 \text{ W} \rightarrow \frac{1800 \text{ W}}{3600 \text{ W/kW}} = \frac{1}{2} \text{ kW}\]

Answer = \[\frac{1}{2}\] kW [1]

**Examiner commentary**

Although candidates learn conversion between standard units in Key Stage 3, many candidates of all abilities will slip up, often making very simple arithmetic errors such as forgetting a zero. The candidate in this exemplar used a simple sketch to make sure the conversion was correct. Visual learning and thinking through drawing reinforces memory and helps candidates to visualise their ideas and process their understanding.
**Question 12 (c) (ii)**

Exemplar 1

0 marks

(ii) Suggest why electricity companies charge for electricity using kWh.

...It is easier to charge in kWh because...whats... doesn't exactly divide into money.

Examiner commentary

Many candidates found it difficult to say simply that using kWh gives smaller numbers than joule and so makes it easier for customers to use/understand how much electricity they have consumed. This response is typical of many where the candidate may be trying to say this but their convoluted language is ambiguous and unclear. A common misconception was that using kWh was a way for electricity companies to charge more, or improve the quality of the electricity (for example, higher voltage or gets to homes faster or there is more of it).

**Question 12 (d)**

Exemplar 1

2 marks

(d) The average electricity consumption per household changes every year.

The graph shows how this changes from the year 2008 to the year 2015.

![Graph showing average electricity consumption from 2008 to 2015](image)

Describe and explain the trend shown by the graph.

In 2008, electricity consumption has decreased from over 4,600 kWh to in 2015 using near 4,000 kWh. This may be due to more electric saving inventions over the year which prevents wastage of electricity.

Examiner commentary

Like most candidates, this response gained the first mark for identifying the downward trend in household consumption. It is a particularly good response where the candidate used data from the graph to show the decrease and suggests an explanation for the reduction in average household consumption.
**Question 13 (a)**

**Exemplar 1**

2 marks

13. A student draws a diagram to show the national grid.

Examiner commentary

Here the candidate has clearly identified the two mistakes in the student’s diagram and concisely stated them:
- power lines are high voltage not low voltage
- there is a step down transformer between the national grid and houses not a step up transformer.

Many candidates appeared to be confused by being asked to identify mistakes and suggested random missing item ‘mistakes’. Most candidates who gained 1 mark knew that the power lines were the wrong voltage. Only a small number correctly spotting that the final transformer should have been a step down, and many suggested that there should be a step down transformer between the coal power station and the national grid.
**Question 13 (b)**

**Exemplar 1**

2 marks

(b) The national grid uses transformers.

Explain how using transformers makes the national grid more efficient.

- The step up transformer increases
- the voltage so the current is low to
- reduce energy being lost by heat

[2]

**Examiner commentary**

This shows a good answer where the first marking point is clear (step up transformer increases the voltage resulting in a lower current). The second mark was awarded for explaining that energy losses would be reduced even that is was not clear that it was through heat loss in the wire. This exemplar could be useful broken down in a classroom activity to help future candidates understand what a good scientific response looks like:

- the step up transformer increases voltage so the current is low – the science is clear and unambiguous
- the current is low to reduce energy being lost to heat – how clear is the science with and without the diagram? Is it clear where the heat loss taking place?

**Exemplar 2**

0 marks

(b) The national grid uses transformers.

Explain how using transformers makes the national grid more efficient.

...It takes less time and is easier, meaning...

...the process better and can be done...

...more frequently. [2]

**Examiner commentary**

Twenty First Science candidates are in general much better at understanding the links between the science they experience in the classroom and the science they experience in the world around them. However power generation, the national grid and domestic supply is an area with many misconceptions and some candidates do seem to think of domestic electricity supply as a mysterious process.

This exemplar is typical of many candidates and shows one of the common misconceptions about transformers and the national grid; that they speed up the flow of electricity to homes. Many candidates believe that the national grid is there to improve the quality of the electricity supplied to homes (for example, makes the voltage better or it gets to homes faster or there is more of it for homes to use).
Question 13 (c)

Exemplar 1

Examiner commentary
This candidate had a sound understanding of what the differences are between direct voltage and alternating voltage. When considered in isolation these are difficult ideas for candidates to conceptualise and this is clear even in this response answer which gained both marks. Taking a more holistic approach linking how power stations work, d.c. and a.c. and \( V = IR \), can help candidates to be clearer in their understanding. Direct current is constant in size and direction therefore the potential difference will be constant in size and direction but alternating current constantly changes in size and switches direction during each cycle therefore the voltage will constantly change in size and direction.

Exemplar 2

Examiner commentary
This response shows a common misconception: that direct voltage goes straight to a place whereas alternating voltage goes to several places. The candidate also appears to be suggesting that electricity is being lost.
Question 14 (a)

Exemplar 1

14 A scientist does an experiment to measure the energy transferred to water.

She uses an immersion heater to increase the temperature of the water.

The scientist uses this apparatus:

- A beaker
- An immersion heater
- A stirring rod
- A 12V battery and wires.

(a) What two other pieces of apparatus does the scientist need for this experiment?

1. [Error spotted and replaced with a thermometer.]

2. Thermometer

[2 marks]

Examiner commentary

This style of question is where candidates have to consider specific details about apparatus or techniques used in a practical activity. Some candidates find it difficult to apply their own experience of practical work to a new situation. For example some candidates want to replace some of the existing equipment with what they used in their classroom (for example replacing the battery with a power pack or the immersion heater with a gas burner). In this exemplar the candidate has named two appropriate pieces of equipment that would allow a valid measurement of energy transfer to be measured. Other correct responses seen included a joulemeter.

The candidate has also checked their answer, spotted an error and neatly replaced it with an appropriate piece of equipment. Some candidates waste time trying to completely scribble over their previous answer. The advantages of a single line through what the candidates believes to be a wrong answer is that, it is quick, it is clear to the marker; if no other response is provided then it can still be read and may gain some marks if it is correct.
Question 14 (b) (i)

Exemplar 1 1 mark

(b) (i) Explain how the scientist could reduce energy transfer to the surroundings.

Examiner commentary

Correct candidate responses like this one are deceptively simple. However it is clear that this candidate has been well prepared and has practised scientific writing: it reports the facts clearly, uses technical language, and is concisely written, avoiding unnecessary creative language.

Exemplar 2 1 mark

(b) (i) Explain how the scientist could reduce energy transfer to the surroundings.

Examiner commentary

Some candidates wrote four or five line answers often using a storytelling style (I would take the beaker and then I would …). Exemplar 2 has made the question much more complicated than it actually was. They may have experienced that their smartphone gets warm when used continuously, however they have not specified whether the material used should be a conductor or insulator. Their answer also contains a lot of additional detail that is not relevant. The answer lines and marks available are indicative of the answer required.

Question 14 (b) (ii)

Exemplar 1 1 mark

(ii) The immersion heater is placed at the bottom of the beaker.

Examiner commentary

Here the candidate has given an excellent clear and concise response that explains that only be heating the bottom will the energy be transferred evenly to the water in the beaker.
Question 14 (c)

Exemplar 1 2 marks

(c) The heater is connected to a battery. When the heater is turned on, energy is transferred.

Describe this energy transfer.

Use ideas about energy stores.

the energy has transferred chemically
from the battery through to the heater
where it is stored as heat to the
be transferred to thermal energy. [2]

Examiner commentary

Very few candidates achieved 2 marks. This candidate correctly identified both stores, chemical and thermal, and that energy is transferred between them. Compared to Exemplar 1 for question 14b(i), this candidate has had less experience of scientific writing. It can help future candidates to develop an appropriate writing style to take a response like this and see if they could improve the scientific communication with better phrasing.

Exemplar 2 0 marks

(c) The heater is connected to a battery. When the heater is turned on, energy is transferred.

Describe this energy transfer.

Use ideas about energy stores.

The energy is stored in the battery, but when the heater is turned on, energy is transferred as it is no longer being stored. [2]

Examiner commentary

Almost all the candidates attempted to use the stores and transfer model (in contrast to the superseded ‘nine types of energy’ model). A common error that is seen in this exemplar is to reword the stem of the question to look like a reasonable answer but without providing any additional scientific detail. Here the candidate has not stated how the energy is transferred (electrically through the wires of the circuit) nor have they described the type of energy stores (battery = chemical, hot water = thermal).
**Question 14 (d) (i)**

**Exemplar 1**

**2 marks**

\[(d) \quad (i) \quad \text{The current through the heater is 3.8 A. The potential difference across the heater is 9.0 V.} \]

Use the equation: Power = Potential difference × Current

Calculate the power of the immersion heater.

\[P = V \times I\]

Answer: \[\text{[value]} \text{ W} \]

**Examiner commentary**

This response is set out in an ideal way. Writing down and substituting the correct values from the question allow compensatory marks to possibly be awarded even if the candidate’s final answer is incorrect. Most candidates who provide some workings gain some marks in this type of question. Providing no workings is a high risk, all or nothing, strategy that disadvantages the candidate.

**Question 14 (d) (ii)**

**Exemplar 1**

**3 marks**

\[(i) \quad \text{The scientist writes down more information about her experiment.} \]

- Mass of water = 150 g
- Specific heat capacity of water = 4200 J/kg°C
- Temperature increase of water = 10 °C

Calculate the change in thermal energy of the water.

Answer: \[\text{[value]} \text{ J} \]

**Examiner commentary**

In this response the candidate has demonstrated good practice by underlining the units that need to be converted to a common unit (in this case kg). Although they have not shown their workings had they not correctly carried out the conversions their final answer would not be correct. Failing to convert all the observations to a common set of units is a simple error that candidates commonly make. Writing down workings allows a candidate to check their answer, spot errors and minimise any marks lost through accidental errors.
Question 15

Exemplar 1 6 marks

15a Person A and person B drive their cars along the same road on different days. Both cars travel at 25 m/s.

The traffic lights along the road change to red. Person A and person B see the red light and press the brakes in their car.

The graphs show the speed of each car after person A and person B see the red light.
The graphs are drawn using the same scale.

Describe the different ways the cars come to a stop.

In your answer:

- Suggest reasons why the cars take different times to stop
- Write about thinking and braking.

When car A was driving they might have been texting while driving which was causing a longer reaction time to the lights so their thinking distance is longer. Car B they had a more delayed thinking time but made a shorter braking distance. This could've been because their wheels were not as worn and the brakes are newer.

The road conditions weren't as good as person A or person B could've been fired or drunk causing them. [6] to panic once they had seen the lights change. Meaning they would've hit their brakes harder.

Examiner commentary

This response is a Level 3 answer that was awarded 3 marks and uses 116 words. This response is at Level 3 because the candidate has correctly linked the graphs to both the braking distances and the thinking distances for both cars, explained factors that could affect the different times to stop and drawn conclusions about their response to the red light.

This response has gained full marks because of the quality of the science in the candidate's answer, not because it was longer than the two exemplars for this question that follow. The green ticks do not indicate marks awarded but content of scientific merit from the mark scheme. The candidate has used quite a lengthy story-telling writing style, compared to the style of Exemplar 2 which reads more like a scientific report. A useful classroom exercise would be to let candidates write out an answer in their usual fashion, show them some guidelines for writing a clear concise scientific answer and then get them to rework their original answer. For example this response is only 78 words and much clearer:

• A – took longer to slow and halt, but they had a shorter reaction time so their thinking distance is shorter.
• B – had a more delayed thinking time but a shorter braking distance.
• A – could have been driving in the rain or their tyres and brakes might be worn.
• B's tyres or brakes could be newer or the road conditions were better. Also B could have been distracted and panicked when they saw the red light so braked harder.
The graphs are drawn using the same scale.

Describe the different ways the cars come to a stop.

In your answer:

- Suggest reasons why the cars take different times to stop
- Write about thinking and braking

Person A takes longer to stop after the lights change to red, suggesting they were only braking lightly, with little force, or they had bad brakes. Person B brake for quicker than the first car once the lights had changed to red. This suggests person B braked straight away, slamming on the brakes, or he had better brakes than person A.

Examiner commentary

This response is a Level 2 answer that was awarded 3 marks and uses 61 words. The candidate has annotated some key details in the stem of the question (25 m/s and braking), even this basic analysis has allowed them to write a clear concise answer that covers the rate at which the cars braked, identified that A's overall stopping distance is longer and suggests some plausible reasons the differences. This has allowed the candidate to move into Level 2. Had they mentioned that the thinking time/distance for A and B were different this would have been a 4 mark response. To move up to Level 3 the response would need to describe the different factor that affect the way a car comes to a stop and also write a third bullet with detailing their conclusions about why the two cars take different times to stop, rather than just suggesting individual reasons in isolation.
Examiner commentary

Describing and interpreting the patterns and trends shown on different types of graph is a skill that candidates can only learn through practice. The practical activities in Topic CS7: Practical skills provides many opportunities for candidates to gather primary data and analyse their results. It is also important for candidates to have experience of the different types of graph such as bar graphs, histograms, line graphs, pictograms and scatter graphs.

Exemplar 3 is a Level 0 answer that was awarded 0 marks and uses 51 words. The candidate has dived in and written an answer without making any plan. They have missed critical details (such as both cars are initially moving at 25 m/s). By not using any technical language (such as gradient, reaction time, braking distance) they have had to write a much longer answer than was necessary and also their answer is not very clear. To achieve Level 1, the candidate needed to either interpret the graph correctly or suggest some of the factors that affect reaction time or stopping distances. Annotating the graph before starting to write an answer can help candidates to plan a clear concise scientific answer. Exemplar 3 shows how a lack of a clear plan to answer a level of response question will inevitably lead to weak answers with poor quality of written communication.
**Question 16 (a)**

**Exemplar 1**

1 mark

16 The graph shows how the height of a water wave changes with distance.

![Graph showing the height of a water wave changes with distance.](image)

(a) The water wave has a wavelength of 8 m.

Describe how the graph shows this.

The wavelength can be shown when the wave rises up to repeat itself and .

Examiner commentary

In this exemplar, the annotation on the graph clarifies what the candidate has written. Although this candidate has a sound understand of physics (at the top of the foundation tier) many of their answers use this storytelling style that can be confusing in scientific writing. The written answer on its own is ambiguous and it is difficult to understand what the candidate means. However because they annotated the graph in detail it clarifies their written answer and so they have gained the mark.

It can be very helpful in a physics exam to annotate diagrams/graphs or for the candidate to draw a quick clear diagram. A well annotated drawing can save time, make the candidate’s answer clearer (like in this exemplar) and reduce the amount of writing needed in an answer. Candidates need to remember that you only need to say it once and so should avoid repeating their annotations/drawing content in their written answer.
Question 16 (b)

Exemplar 1

(b) The frequency of the water wave is 0.5 Hz.

Calculate the speed of this water wave.

\[
\text{Wave speed} = \text{frequency} \times \text{wavelength}.
\]

\[
0.5 \times 6 \quad \checkmark \checkmark \checkmark
\]

Answer = \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots m/s [3]

Examiner commentary

This response is set out in an ideal way. The candidate has recalled the correct equation (1 mark), substituted the values from the question (1 mark) and calculated the correct value for wave speed (1 mark). Many less able candidates think that they are saving time by not providing candidates, for this straightforward question two thirds of candidates gave no workings and got no marks because the final answer was wrong. However the small number of less able candidates who wrote down some workings were able to gain one or two compensatory marks even if their final answer was incorrect.
Question 16 (c)

Exemplar 1

2 marks

(c) A group of students use a ripple tank, a metre ruler and a stopwatch.

They draw a diagram of this equipment.

Explain how this equipment is used to measure the frequency of water waves.

The vibration generator causes the waves to appear. The ruler measures the length of the waves, and the stopwatch times how fast it takes the waves to go from one end of the tank to the other.

Examiner commentary

This response shows a clear succinct answer and could be used by someone as a basic set of instructions to carry out the experiment. Note how the candidate has picked out the two factors needed to calculate the frequency. One improvement would be to quote the wave equation:

- use the ruler measure the wavelength
- use the stopwatch to time how fast the waves move from one end of the tank to the other
- frequency = wave speed ÷ wavelength.
Exemplar 2

Explain how this equipment is used to measure the frequency of water waves.

- The ruler is used to measure the height of the waves to record their amplitude as the waves move by the vibration generator.
- The waves start to appear, then you time it and find out how many waves there are in a second and the height of the waves using the ruler and then from that you can work out the frequency.
- When the generator is switched on it causes the water to make waves and you can then record the wave pattern using a ruler to measure how fast the waves are and find the frequency.

Examiner commentary

Many candidates wrote too much for a 2 mark question (94 words). They tended to read like legacy controlled assessment write ups, often using a narrative approach. In this response, the candidate achieved the marks, but wasted time and effort describing the experiment rather than answering the question. When answering this type of question it would be better to use bullet points to write procedures rather than long descriptions. For example, it could be rewritten as:

- switch on the generator
- when waves start to appear time how many waves are made in a second
- from that you can work out the frequency (26 words).
Question 17 (a)

Exemplar 1

17 A student measures the extension of a spring when it is stretched.

He hangs different cubes from the spring. He measures the extension of the spring for each cube.

Look at his results.

<table>
<thead>
<tr>
<th>Weight of cube (N)</th>
<th>Extension of spring (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>2.9</td>
</tr>
<tr>
<td>3.0</td>
<td>8.4</td>
</tr>
<tr>
<td>4.0</td>
<td>11.4</td>
</tr>
<tr>
<td>5.0</td>
<td>14.4</td>
</tr>
<tr>
<td>7.0</td>
<td>20.0</td>
</tr>
</tbody>
</table>
Examiner commentary
The candidate here has plotted the data points neatly and precisely (within ±0.5 small square). Because the line of best fit it was appropriate to draw it as a continuous straight line using a ruler. The candidate could have improved the quality of their response by not extending the line of best fit beyond the plotted data.
**Question 17 (b)**

**Exemplar 1**

3 marks

Examiner commentary

Only a very small number of the most able candidates correctly answered this question, although a few less able candidates correctly recalled the spring constant equation and so gained a compensatory mark. This exemplar is one of the few responses that gained all 3 marks. The candidate has correctly recalled the formula for the spring constant and used a complicated alternative route to show that the spring constant is 35 N/m:

- \[ \text{extension (cm)} \div \text{force (N)} = 100 \div \text{spring constant} \]
- \[ 20 \div 7 = 2.857142 \]
- \[ 2.857142 \times 35 = \frac{100}{\text{spring constant}} \times \text{spring constant} = 100 \]

The candidate here made a medium demand overlap question (with the higher tier) into a very high demand question because of the alternative method that they used.

The straightforward method that candidates were expected to use was:

- \[ \text{force (N)} = \text{extension (m)} \times \text{spring constant (N/m)} \]
- \[ 7 \div 0.2 = 35 \text{ N/m} \]

**Exemplar 2**

0 marks

Examiner commentary

Several more able candidates showed a different misconception where they attempted to rearrange the equation for energy transfer rather than the spring constant. One check that the candidate here could have made when deciding which of the two spring equations to use was what information do I have?

- \[ \text{weight/force (N)} \]
- \[ \text{extension (cm)} \]
- \[ \text{spring constant} = 35 \text{ N/m} \]

It should then have been clear that the equation required was:

- \[ \text{force (N)} = \text{extension (m)} \times \text{spring constant (N/m)} \]
Exemplar 3

(b) Use the results and the graph to show the spring constant is 35 N/m.

Examiner commentary
A very common misconception for this question was adding two numbers together to make 35; others multiplied 3.5 N and 10 cm to reach their product 35. Nearly half of all candidates did not even attempt this question and of those that did most showed little understanding of what the spring constant is.

Question 17 (c)

Exemplar 1

(c) The spring constant is 35 N/m.
Calculate the energy transferred to this spring when the extension is 0.2 m.

\[ \text{Energy transferred} = \frac{1}{2} \times 35 \times 0.2^2 \]

Answer = \(0.7\) J

Examiner commentary
This response is set out in an ideal way. The candidate has selected and written down the correct equation from the data sheet and then substituted the values from the question to calculate the correct answer. By writing down what they are doing, the candidate has minimised the risk of losing marks unnecessarily because compensatory marks could still be awarded even if their final answer had been incorrect.
We'd like to know your view on the resources we produce. By clicking on the 'Like' or 'Dislike' button you can help us to ensure that our resources work for you. When the email template pops up please add additional comments if you wish and then just click 'Send'. Thank you.

Whether you already offer OCR qualifications, are new to OCR, or are considering switching from your current provider/awarding organisation, you can request more information by completing the Expression of Interest form which can be found here:

www.ocr.org.uk/expression-of-interest

OCR Resources: the small print
OCR's resources are provided to support the delivery of OCR qualifications, but in no way constitute an endorsed teaching method that is required by OCR. Whilst every effort is made to ensure the accuracy of the content, OCR cannot be held responsible for any errors or omissions within these resources. We update our resources on a regular basis, so please check the OCR website to ensure you have the most up to date version.

This resource may be freely copied and distributed, as long as the OCR logo and this small print remain intact and OCR is acknowledged as the originator of this work.

Our documents are updated over time. Whilst every effort is made to check all documents, there may be contradictions between published support and the specification, therefore please use the information on the latest specification at all times. Where changes are made to specifications these will be indicated within the document, there will be a new version number indicated, and a summary of the changes. If you do notice a discrepancy between the specification and a resource please contact us at:

resources.feedback@ocr.org.uk.

OCR acknowledges the use of the following content:
Square down and Square up: alexwhite/Shutterstock.com
Section B, Q12d

Please get in touch if you want to discuss the accessibility of resources we offer to support delivery of our qualifications:

resources.feedback@ocr.org.uk.

www.ocr.org.uk
OCR Customer Contact Centre

General qualifications
Telephone 01223 553998
Facsimile 01223 552627
Email general.qualifications@ocr.org.uk

OCR is part of Cambridge Assessment, a department of the University of Cambridge. For staff training purposes and as part of our quality assurance programme your call may be recorded or monitored.

© OCR 2018 Oxford Cambridge and RSA Examinations is a Company Limited by Guarantee. Registered in England. Registered office The Triangle Building, Shaftesbury Road, Cambridge, CB2 8EA. Registered company number 3484466. OCR is an exempt charity.