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OCR
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GCSE (9-1)

Examiners' report

GATEWAY SCIENCE COMBINED SCIENCE A

J250
For first teaching in 2017

J250/05 Summer 2018 series

Version 1

Contents

Introduction

Our examiners' reports are produced to offer constructive feedback on candidates' performance in the examinations. They provide useful guidance for future candidates. The reports will include a general commentary on candidates' performance, identify technical aspects examined in the questions and highlight good performance and where performance could be improved. The reports will also explain aspects which caused difficulty and why the difficulties arose, whether through a lack of knowledge, poor examination technique, or any other identifiable and explainable reason.

Where overall performance on a question/question part was considered good, with no particular areas to highlight, these questions have not been included in the report. A full copy of the question paper can be downloaded from OCR.

Paper J250/05 series overview

J250/05 is one of the two Foundation Physics papers for the new GCSE 9-1 Combined Science A (Gateway Science). It covers the topics:

- P1 Matter
- P2 Forces
- P3 Electricity and Matter
- CS7 Practical Skills

To do well on this paper, candidates needed to able to recall and / or manipulate equations and be comfortable applying their knowledge and understanding to both familiar and unfamiliar contexts and practical procedures.

Candidate performance overview

Candidates who did well on this paper generally did the following.

- Recalled and applied or manipulated equations.
- Demonstrated knowledge of scientific ideas (eg circuit components and circuit arrangements).
- Analysed information to improve experimental techniques and procedures.
- Analysed and interpreted graphs to draw conclusions.

Candidates who did less well on this paper generally did the following.

- Found it difficult to recall and apply or manipulate equations.
- Struggled to interpret graphs and produced responses that lacked depth and detail.
- Lacked the necessary knowledge to respond to questions about circuit diagrams and density.

There was no evidence that any time constraints has led to candidates underperforming.

Section A overview

Section A is a new addition to the GCSE Combined Science examination and consists of 10 Multiple Choice Questions, concentrating on Assessment Objectives 1 and 2 (AO1 and AO2).

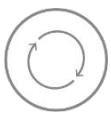
Almost all candidates attempted all of the questions.

Most successful questions	*Least successful questions*
• Current in a series circuit Question 2 • Gravitational field strength Question 3 • Strength of the magnetic field produced by a solenoid Question 5 • Change in thermal energy Question 8	• Force – extension graph Question 1 • Identifying a scalar quantity Question 4 • Transferring energy Question 6 • Strength of the magnetic field produced by a current-carrying wire Question 10

Candidates who did well on this section generally did the following.

- Underlined keywords.
- Wrote equations and / or calculations next to the relevant questions.
- Worked through the distractors methodically eg by crossing out obviously incorrect answers.

Key:



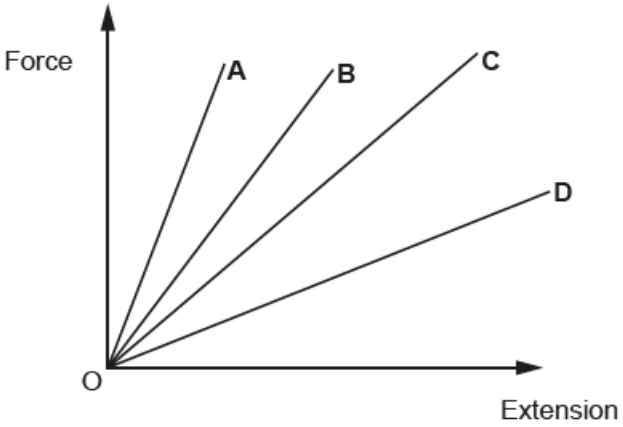
AfL Guidance for future teaching and learning practice.

Misconception

Question 1

1 Four springs **A**, **B**, **C** and **D** are made of four different materials.

Use the equation: Force = Extension × Spring constant



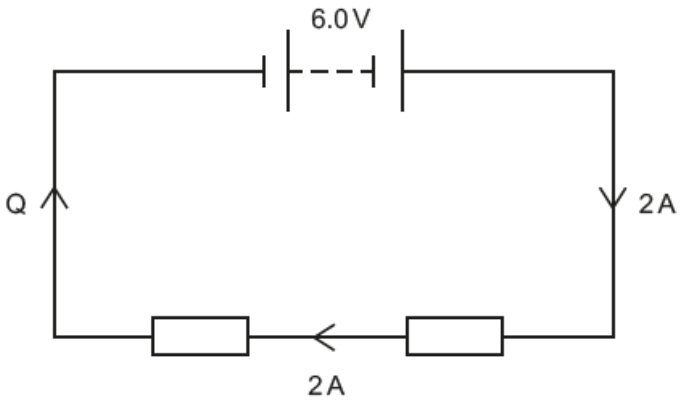
Which of the springs has the **greatest** spring constant?

Your answer ☐ **[1]**

This question assessed candidates' knowledge of force-extension graphs. Most candidates were unable to link the gradient of the graph to the magnitude of the spring constant.

Question 2

2 What is the current at point Q in the circuit?



A 0A

B 2A

C 4A

D 6A

Your answer ☐ **[1]**

Most candidates successfully applied their knowledge of series circuits to work out the current at Q.

Question 4

4 Which of the following is a scalar quantity?

A Displacement

B Distance

C Force

D Velocity

Your answer ☐ **[1]**

Most candidates could not identify the scalar quantity.

Question 5

5 A solenoid can be used to produce a magnetic field.

Which of the following **increases** the magnetic field strength produced?

A Decreasing the current

B Decreasing the number of turns

C Increasing the current

D Removing magnetic material from the core

Your answer ☐ **[1]**

Candidates were mainly able to identify how to increase the strength of the magnetic field produced by a solenoid.

Question 6

6 Which of the following transfers the **most** energy?

A 1.0 kW over one hour

B 2.0 kW over two hours

C 3.0 kW over one hour

D 500 W over four hours

Your answer ☐ **[1]**

Many candidates had difficulty applying the equation: energy transferred = power x time

Question 8

8 Which row, **A**, **B**, **C** or **D** shows the **largest** change in thermal energy?

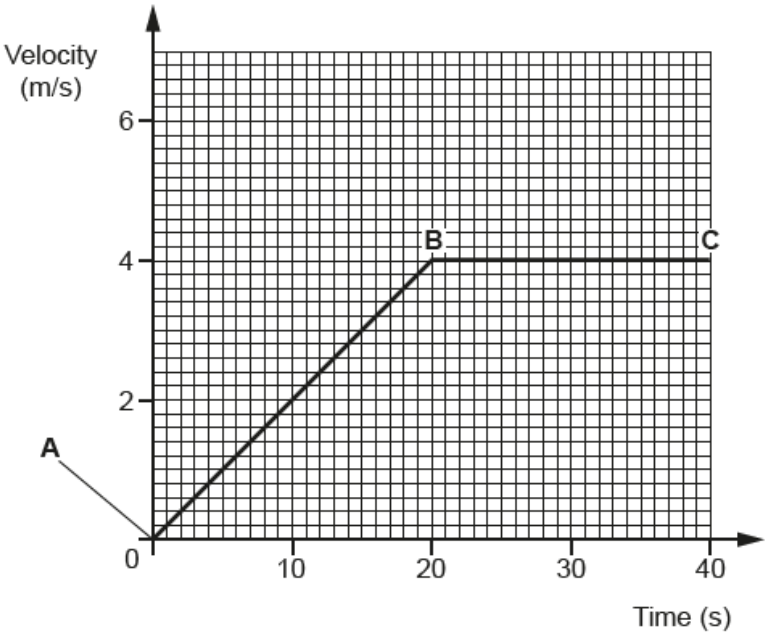
	Mass (kg)	Specific heat capacity (J/kg °C)	Temperature change (°C)
A	1	4200	40
B	1	4200	20
C	2	4200	10
D	2	4200	5

Your answer ☐ **[1]**

This question required candidates to select (from the Data Sheet) and apply the equation:
change in thermal energy = mass x specific heat capacity x change in temperature
Most candidates were able to do this correctly.

Question 9

9 What is the acceleration between points **A** and **B** on the graph?



A $0.1\,m/s^2$

B $0.2\,m/s^2$

C $0.3\,m/s^2$

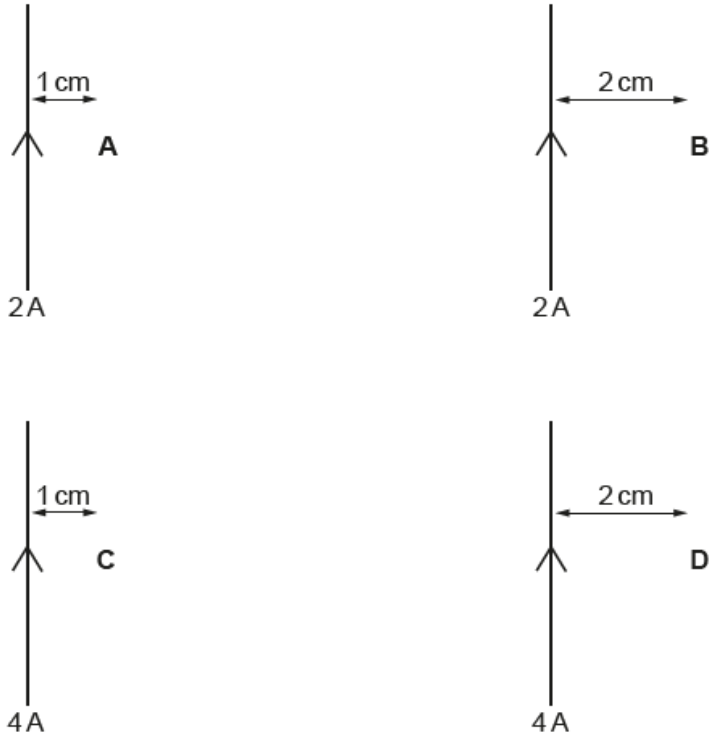
D $0.4\,m/s^2$

Your answer ☐ **[1]**

Many candidates were able to recall and apply the equation: acceleration = change in velocity / time using data from the graph.

Question 10

10 Four compasses are each placed near to a wire at points **A**, **B**, **C** and **D**. Each wire has a current flowing through it. The distance of each compass from its wire is shown.



Which compass experiences the **greatest** magnetic field strength?

Your answer ☐ **[1]**

Although many candidates were able to identify that a larger current increased the size of the magnetic field strength, a significant number of these candidates had the misconception that a larger distance from the wire resulted in a larger field strength. These candidates therefore incorrectly chose distractor D.

?

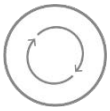
Section B overview

Section B consisted of short, 1 mark, questions as well as questions requiring longer answers and the Level of Response question. It covered all of the AOs and many questions needed candidates to use mathematical skills.

Most successful questions	*Least successful questions*
• Plotting a graph Question 11bi • Calculating resistance (equation provided) Question 11bii • Identifying measuring instruments Question 12ai • Calculating average speed Question 12bi • Drawing particle diagrams Question 14b	• Drawing a circuit diagram Question 11a • Improving experimental technique Question 12c • Interpreting a graph Question 13 (Level of Response) • Recalling and applying the equation power = work done / time Question 16aii • Improving experimental technique Question 16c

Candidates who did well on this section generally did the following.

- Underlined key words.
- Recalled equations and wrote down all of their calculations.
- Worked methodically in order to describe and explain each section of the graph in the Level of Response question.
- Applied their knowledge to evaluate and improve experimental techniques and procedures.



Candidates who did less well on this section generally did the following.

- Struggled with the mathematical skills required.
- Only wrote the answers to questions involving equations, no calculations were shown.
- Gave answers that lacked depth when analysing graphs and experimental techniques.

Question 11(a)

11 A student has one cell and two lamps. She wishes to connect them so that both lamps have maximum brightness.

(a) Draw a **complete** circuit diagram to show how she can achieve this.

[3]

This question, which covered AO1 and AO2, differentiated well between abilities as it required candidates to use their knowledge of circuits to draw a circuit diagram with one cell and two lamps in parallel. Some candidates could recall and draw the symbols for the components in series but only the more able correctly drew the lamps in parallel.

Candidates need to be aware that pictures of the circuit components will not gain credit. Circuit component symbols must be drawn.

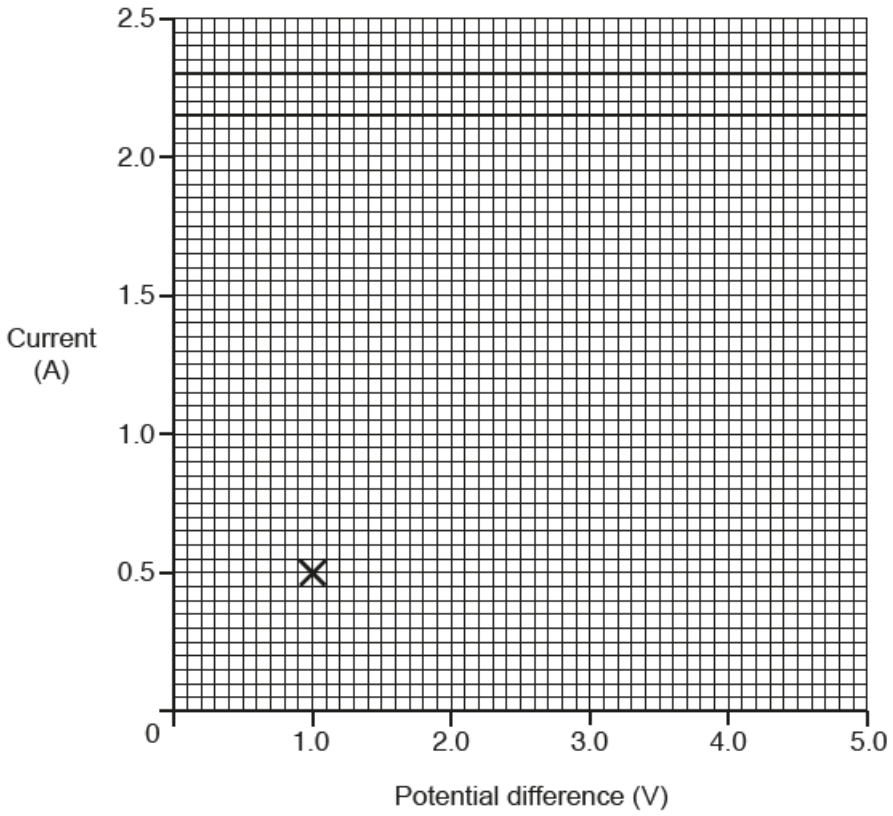
Question 11(b)(i)

(b) The student then investigates an unknown component. She records values for current through the component and the potential difference across the component.

Potential difference (V)	Current (A)
1.0	0.5
2.0	1.0
3.0	1.5
4.0	2.0
5.0	2.5

(i) Plot a graph of the data and draw a line of best fit.

One of the points has already been completed for you.



[3]

Many excellent responses with the majority of the candidates gaining full credit. However a few did not draw the line of best fit.

Question 11(b)(ii)

(ii) Describe what these results show.

.....

.....

..... **[1]**

This AO3 question required candidates to describe that as the potential difference increased, the current also increased (or higher level answers). Most candidates correctly described the relationship. Some less able candidates merely wrote 'a positive correlation' with no description of what the graph showed so could not gain credit.

Question 11(b)(iii)

(iii) Calculate the resistance of the unknown component.

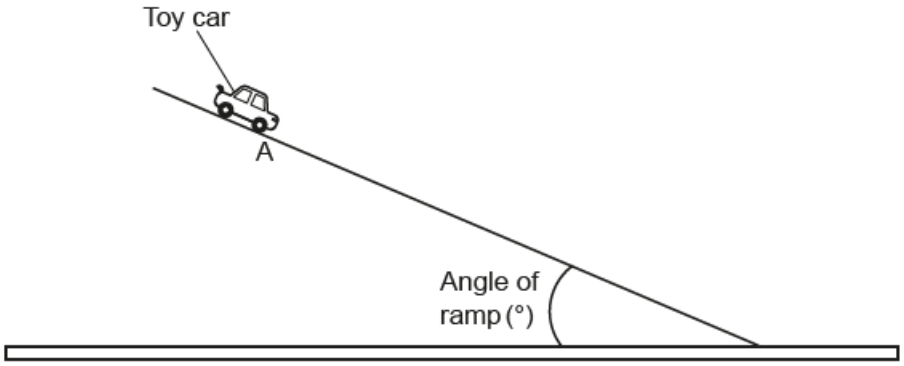
Use the equation: Resistance = Potential difference ÷ Current

Answer = ... ohms **[2]**

Most candidates correctly substituted values of potential difference and current from the table into the equation and calculated the resistance to gain full credit. Some candidates struggled to use the equation even though it was provided, instead dividing the current by potential difference or multiplying current by potential difference.

Question 12(a)(i)

12 A student wishes to calculate the average speed of a toy car travelling down a ramp. He releases the car without pushing it from the start point A.



He takes measurements of distance and time.

(a) **(i)** Write down the instruments the student could use to measure distance and time.

Distance .....

Time .....

[2]

The vast majority of candidates were able to identify measuring instruments and gained full credit.

Question 12(a)(ii)

(ii) State how he can calculate the average speed using these measurements.

.....

..... **[1]**

This question required candidates to state that the average speed could be calculated by dividing the distance by the time. A significant proportion misinterpreted the words 'average speed' and instead described how to calculate the mean of a set of speed measurements.

Question 12(b)(i)

(b) The student has an idea about this experiment. He thinks that the greater the angle of the ramp, the greater the average speed of the car.

Look at his results.

Angle (°)	Distance (m)	Time (s)	Average speed (m/s)
10	1.2	1.9	0.63
20	1.2	2.0	
30	1.2	1.3	0.92

(i) Calculate the average speed for the 20° angle.

Write your answer to **2** significant figures.

Answer = ... **[3]**

Candidates who gained full credit were able to recall and apply the equation: speed = distance / time. Some candidates did not read the question carefully enough and only gave their answer to 1 significant figure.

Question 12(b)(ii)

(ii) Do these results support the student's idea?

Explain your answer.

.....

.....

..... **[1]**

This AO3 question required candidates to analyse the results from the table in 12(b) and draw a conclusion. Their answer to 12(b)(i) was not necessary as candidates could either answer:

YES - based on the idea that the 30^{o} angle had the fastest speed
or
NO – based on the idea that the 20^{o} angle had a speed slower than the 10^{o} angle / the slowest speed

Candidates' poor quality of communication prevented the less able from gaining credit as they merely repeated the student's idea about the experiment.

Question 12(c)

(c) Another student thinks that this experiment could be improved.

Suggest **one** problem with this experiment and explain how the experiment could be improved.

Problem: .....

Improvement: .....

.....

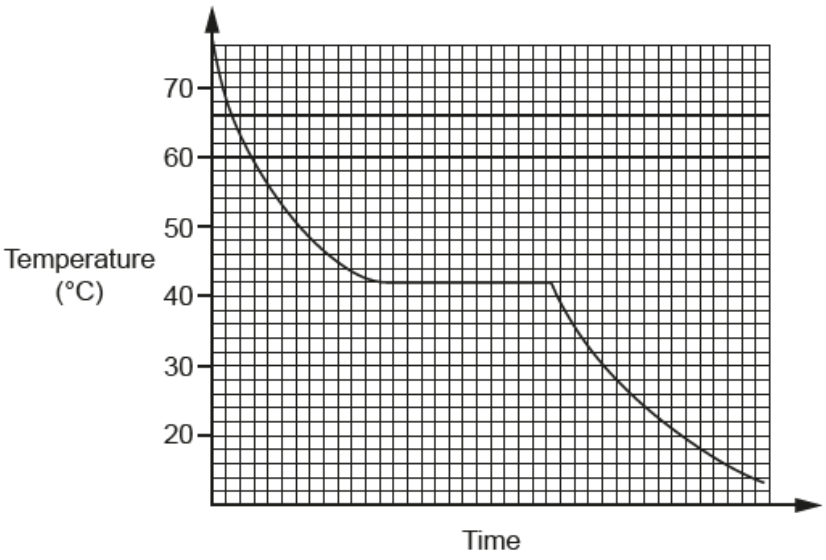
..... **[3]**

This question assessed AO3 and the majority of candidates found it very challenging, with few gaining full credit. Many answers included vague statements and candidates appeared to be unfamiliar with how to improve experiments. Some candidates gained 1 mark by identifying a problem but then struggled to suggest an improvement.

Good responses highlighted problems, for example no repeats were taken, only 3 angles were used, and improvements linked to these problems.

Question 13

13* The graph below shows the change in temperature of a material as it cools.



Describe the graph and explain what it tells us.

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..... **[6]**

This was the Level of Response question, targeted up to Grade 5. It assessed AO3 and candidates' ability to analyse a cooling curve which showed a change of state.

The question proved challenging to most candidates, with very few making clear, detailed judgements about what the graph showed. Most responses achieved Level 1 as they only gave a simple description of what was happening to the temperature during the 3 main sections of the graph. The more able candidates were able to link the constant temperature section of the graph with a change of state taking place for Level 2.

A more complete response for Level 3 would also have included either a description of how the rate of temperature decrease varied throughout the graph or a conclusion about the properties of the material. Candidates could benefit from being given graphs of familiar and unfamiliar contexts and then describing and explaining what the graph is showing.

Exemplar 1

From the graph we can see a material changing it's present state. This is proved when the temperature decreases to 42°C and there is a horizontal line. The line tells us that the material is taking time without changing the temperature as it needs a substantial amount of energy needed, in this case to turn the liquid into the solid. We can see that after time has passed, the material continues to decrease in temperature with its new state. The graph shows a pattern of the same shape decreasing. [6]

L1 L2 L2 L1

Exemplar 1 illustrates a Level 2 response, 4 marks. There is a clear description of the graph levelling out at 42°C which is then linked to an explanation of a change of state occurring at this temperature.

To progress to Level 3, the candidate would also need to include a description of how the rate of temperature decrease varied or suggest a property of the material e.g. it is not water.

Question 14(a)

14 (a) A student has a wooden cube.

Explain how she could find the density of the wooden cube.

Include the measurements needed.

.....

.....

.....

.....

.....

..... **[3]**

Most candidates attempted this question but a significant proportion did not gain any credit. The question assessed AO1 and AO2 and required candidates to identify the measurements required and recall the equation: density = mass / volume.

Some candidates gained credit for identifying a measurement or stating the equation but only the higher ability candidates gained full credit.

Question 14(b)

(b) When a material changes state, its density changes.

Explain how.

Use ideas about particles.

You may draw diagrams of solids, liquids and gases to help.

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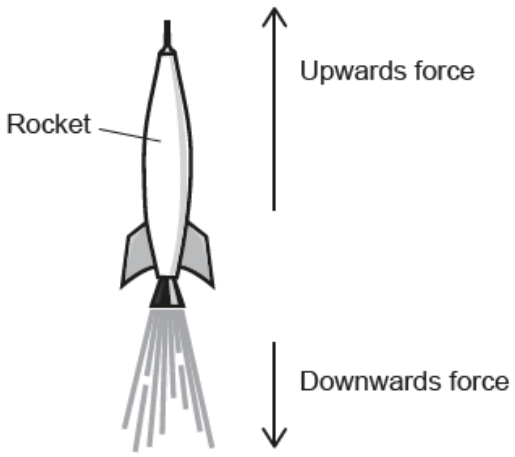
..... **[4]**

This question assessed AO1 and required candidates to demonstrate their knowledge and understanding of particle arrangement and density. The majority of candidates gained 3 marks by correctly drawing particle diagrams for solid, liquid and gas. It was rare to see responses gaining full credit as few candidates explained how the density varied between the three states of matter.

Question 15(a)(i)

15 During launch, a rocket accelerates when the upwards force is greater than the downwards force.



(a) (i) Name the upwards and downwards forces on the rocket during launch.

Upwards force: .....

Downwards force: .....

[2]

Most candidates were able to identify a correct downwards force but often confused thrust with upthrust for the upwards force so could not gain full credit.

Question 15(a)(ii)

(ii) At launch, the upwards force is 10 000 N and the downwards force is 8 000 N.

Write down the size of the resultant force in Newtons.

Answer = ... N **[1]**

The more able candidates were able to calculate the size of the resultant force. Less able candidates attempted the question but carried out a variety of incorrect calculations with the number provided.

Question 15(a)(iii)

(iii) The rocket has a mass of 800 kg.

Calculate its acceleration.

Use the equation: Force = Mass × Acceleration

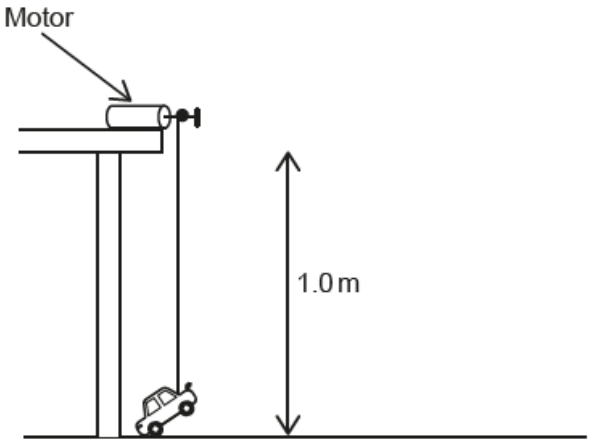
Answer = ... m/s^2 **[3]**

This question required candidates to rearrange the equation provided. The majority of candidates found this very challenging and did not gain any credit. Those candidates who could manipulate the equation correctly, almost always gained full credit.

Candidates could benefit from practising how to rearrange equations.

Question 16(a)(i)

16 (a) A student uses a small motor to lift a toy car through a vertical distance of 1.0 m.



The car has a weight of 0.05 N.

(i) Calculate the work done when lifting the car through this distance.

Answer = ... J **[3]**

This question required candidates to recall and apply the equation: work done = force x distance. Nearly all of the candidates attempted the question but the majority did not gain any credit. Out of the candidates who gained credit, most scored all 3 marks. Very few candidates gained 1 or 2 marks. This was because they only wrote their final answer and did not write down the equation or their calculations, so could not be credited any compensatory marks.

Question 16(a)(ii)

(ii) Calculate the power of the motor if the car takes 5.0 seconds to travel the 1.0 m distance.

State the unit.

Answer = ... Unit ..... **[4]**

This question required candidates to use their answer for the work done from 16(a)(i) to calculate power using: power = work done / time. The majority of candidates did not gain any credit with only a few higher ability candidates achieving 3 or 4 marks. It was evident that the equation and unit for power were not well known. Again, candidates mostly wrote only their final answer and no equation or calculations.

Candidates could again benefit from writing down the equation and calculations rather than only their final answer so that compensatory marks may be credited.

Question 16(b)(i)

(b) The motor uses 2 cells in series.

Each cell has a potential difference of 1.5 V.

(i) Write down the total potential difference of the cells.

Answer = ... V **[1]**

The majority of candidates were able to work out the potential difference of the two cells.

Question 16(b)(ii)

(ii) The motor has a resistance of 6.0 Ω.

Calculate the current in the circuit when the motor is in use.

Use the equation: Potential difference = Current × Resistance

Answer = ... A **[3]**

This question required candidates to rearrange the equation provided and use their answer to 16(b)(i). The majority of candidates found this very challenging and did not gain any credit. Those candidates who could manipulate the equation correctly, almost always gained full credit.

Question 16(c)

(c) The student wishes to increase the time taken to lift this toy car vertically through the 1.0 m distance shown.

Suggest a change he could make to this experiment to achieve this.

.....

..... **[1]**

This question assessed AO3 and required candidates to analyse the information in order to suggest ways to develop the experimental procedure. The majority of candidates found this question very challenging.

Some candidates misinterpreted the question and made suggestions linked to increasing the speed of the car. Others appeared to have misread the question as they suggested using a different (heavier) car although the question referred to 'this car' so credit could not be gained. Some candidates were aware that less power or potential difference was required but did not explain how this could be achieved in the experiment.

Good responses suggested specific changes to the experiment such as adding mass to the car or removing a cell.

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