Qualification Accredited

Oxford Cambridge and RSA

GCSE (9-1)

Examiners' report

GATEWAY SCIENCE COMBINED SCIENCE A

J[redacted]50

For first teaching in 2017

J250/11 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.

3-3 grade

Like all exam boards, we have awarded a 'safety net' grade of 3-3 for higher tier GCSE Combined Science candidates in 2018 where appropriate so that they are not disadvantaged by being the first to sit a new GCSE. To help teachers making difficult decisions about higher versus foundation tiers in 2019, OCR will be providing further guidance and extra webinars during the Autumn term.

Paper J250/11 series overview

J250/11 is one of six Papers for the GCSE (9-1) Gateway Science Combined Science A Higher Tier Qualification. It is the first of the two physics papers covering Topics P1 Matter, P2 Forces, P3 Electricity and magnetism and CS7 Practical skills.

This is the first examination series for J250.

Please note an erratum notice was issued for this paper in relation to the data sheet. You can view this at the end of the report.

Section A overview

This section consists of 10 multiple choice questions testing AO1 and AO2.

Questions answered well by candidates

- question 2 about the definition for specific heat capacity
- question 3 about the electrical circuit symbol for a variable resistor

Questions answered less well by candidates

- question 4 about non-contact forces
- question 6 about the conversion of speed from km/h to m/s
- question 10 about gravitational potential energy.

Candidates who used the data sheet and clearly showed calculations on questions where it was needed performed well e.g. question 10, where it was evident that some candidates had calculated the gravitational potential energy for each row of the table. This can be seen in the following example.

10 A student lifts four different objects onto a set of shelves. m x g x h

Object	Mass (kg)	Height lifted (m)	
A	0.1	2.2	2.2
B	0.3	1.5	4.5
C	0.4	1.7	6.8
D	0.5	2.0	10

Which object gains the **most** gravitational potential energy?

Your answer D **[1]**

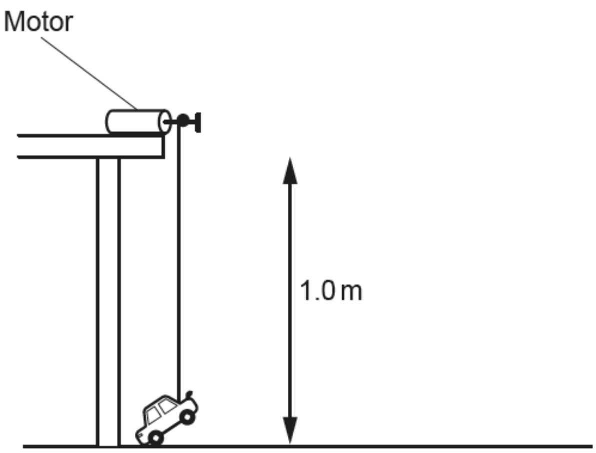
Section B overview

This section consists of six questions testing AO1, AO2 and AO3.

Candidates who were able to manipulate equations and apply them to different situations performed well on this section. Candidates who had experienced the demonstration of the Van de Graaff generator tended to be able to answer this question well and explained the observations using the correct order of events. Other candidates were unable to understand what was being demonstrated and had clearly not experienced the use of a Van de Graaff generator. Candidates that had performed different investigations using simple electrical components and motors tended to understand the experimental procedures, recording of results and interpretation of these results. Candidates who were unfamiliar with such investigations were unable to give answers to questions about incorrect results and improvements to procedures.

Question 11 (a) (i)

11 **(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]**

Candidates who were able to perform this simple calculation to find the work done when lifting the car achieved full marks for this question. The most common incorrect response was '20' where the candidate used an incorrect version of the equation and calculated 1/0.05 as the work done being distance/force rather than work done being force x distance.

Question 11 (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]**

Many candidates recognised power = work done/time and so gained three marks for this calculation. These candidates usually went on to give the correct unit (W) for the power calculated. Candidates were still able to achieve full marks for an incorrect answer to question 11(a)(i) as an error carried forward was applied to this question. Some lower ability candidates scored the mark for the correct unit (W) even if there was no response for the calculation.

Question 11 (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]**

This was well answered by the majority of candidates with the answer '3V'. The most common incorrect answer was '1.5V' where candidates had not added the two potential differences together.

Question 11 (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]**

The majority of candidates gained all three marks for this calculation involving a rearrangement of a given equation to calculate the current in the circuit. Candidates were still able to achieve full marks for an incorrect answer to question 11(b)(i) as an error carried forward was applied to this question.

Question 11 (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.

....

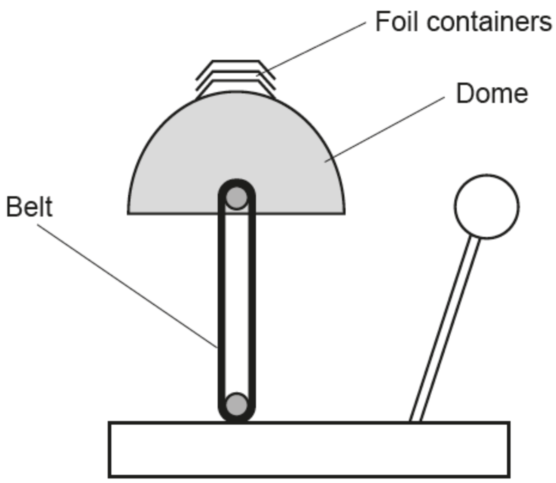
.... **[1]**

Higher ability candidates gave one of many different correct responses with adding more mass to the car and removing one of the cells being the most common answers. Lower ability candidates and those candidates who had not read the question carefully thought they were being asked about how the car could be lifted quicker. They had misinterpreted the 'increase the time taken' and gave answers that reflected this misinterpretation e.g. decrease the distance of the lift and use a more powerful motor.

Question 12 (a)

12 A teacher demonstrates static electricity using a Van de Graaff generator.

She places 3 metal foil containers on top of the dome of the Van de Graaff generator. When the Van de Graaff generator is turned on, the foil containers fly off the dome one by one.



(a) Explain why this happens.

Use ideas about charge in your answer.

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....

....

.... **[4]**

A full range of marks were credited for this question. Higher ability candidates were able to describe why the foil containers fly off the dome one by one using ideas about charge and electron movement. Most candidates gained a mark for explaining that electrons are transferred but these candidates rarely discussed the idea that charge was distributed over the dome. The majority of candidates gained two marks for linking the like charges to being repelled from the dome and then the containers below. Lower ability candidates incorrectly gave answers about the foil being repelled because they were oppositely charged or that there was the movement of positive electrons.

Question 12 (b)

(b) Calculate how long it would take for a charge of 5.0 C to flow with a current of 25 mA.

Use the equation: Charge flow = Current × Time

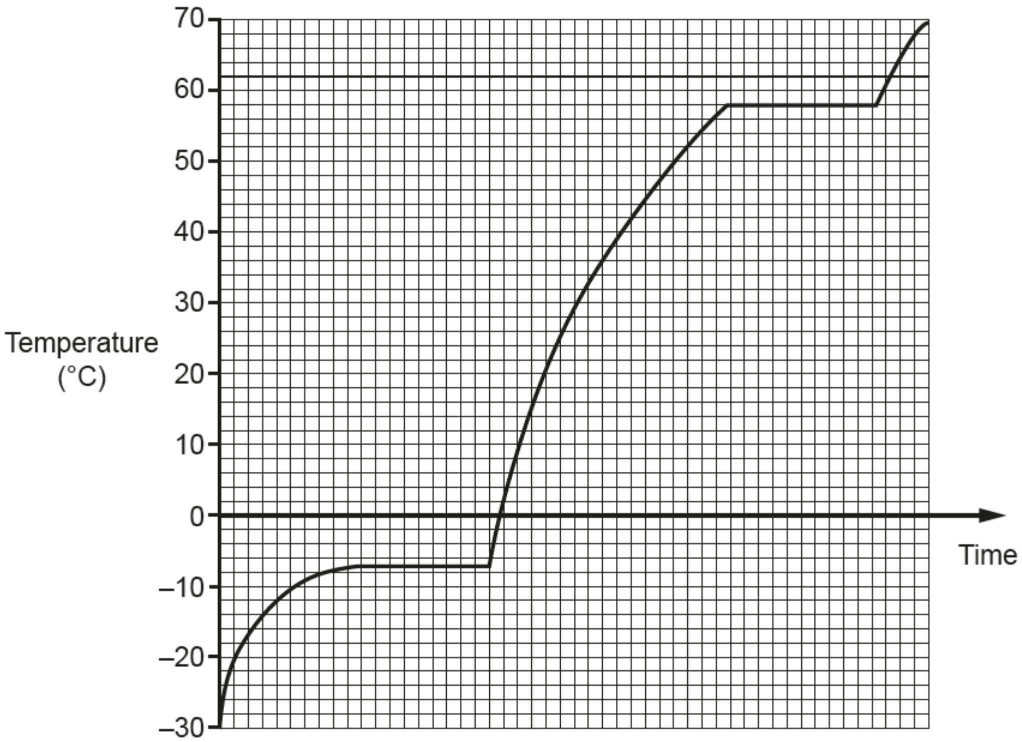
Answer = ... s **[4]**

The majority of candidates gained three marks for the calculation to determine the time. These candidates usually did not convert the 25mA to A correctly. Lower ability candidates tended to use the incorrect rearranged equation of 'time = current/charge' and so gave their answer as 25/5 = 5s.

Question 13

13* A student removes a material from a freezer and heats it up.

He uses a heater with a constant power output. He then plots a heating curve of the material as its temperature rises.



Describe and explain what the graph tells us about the material being heated.

....

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....

....

.... **[6]**

This is the Level of Response question. This question was well answered by candidates and a full range of the marks available were credited. Many candidates gained credit for AO3.2a were they recognised that there had been a change of state or that the three states of matter (solid, liquid, gas) were present during the heating of the material. Higher ability candidates gained credit for AO3.2b where they correctly identifying the melting point and boiling point as being -7°C and 58°C respectively. Fewer candidates gained credit for AO3.1a by linking the melting point and boiling point to regions on the graph where the gradient was zero and describing the different rates of heating of the material to the changing gradients of the graph.

Question 14 (a)

14 (a) Objects in freefall eventually reach terminal velocity.

Draw a labelled diagram to show the forces acting on an object when it is falling at terminal velocity.

[3]

The quality of the diagrams drawn by candidates varied considerably. Candidates that had carefully drawn the forces using a ruler and annotations gained the mark for the arrows being the same length indicating that the forces were equal and opposite. Lower ability candidates gave the answer as just 'gravity' for 'weight' and so only tended to gain the one mark for air resistance or drag for the vertically upwards arrow.

Question 14 (b)

(b) A student measures two forces.

The forces are 5.0 N and 3.0 N. The forces act at 90° to each other.

Draw a scale drawing to determine the resultant force.

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

Again the quality of diagrams drawn by the candidates varied considerably. Many of the poorly drawn diagrams failed to score any marks. These diagrams tended to be drawn freehand without the use of a ruler. Only the higher ability candidates gained all three marks from a carefully drawn scaled diagram showing the forces acting at right angles to each other. A number of these higher ability candidates also calculated the resultant force from the diagram and from a calculation.

Question 14 (c)

(c) An object travelling in a circle at a constant speed has a changing velocity.

State why.

....

.... **[1]**

The higher ability candidates explained clearly that the object is changing direction because velocity depends on size and direction as velocity is a vector quantity.

Question 15 (a) (i)

15 (a) (i) Fleming's left-hand rule is used to show the direction of the force produced when a current flows in a magnetic field.

Explain how.

....

....

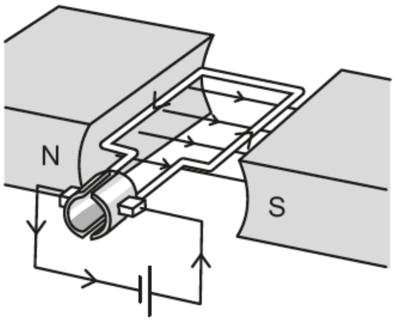
....

.... **[3]**

The majority of candidates were able to link the first finger to the direction of the magnetic field, the second finger to the direction of the current and the thumb to the direction of the force. Only the higher ability candidates gained the third mark for explaining or drawing a diagram to show that the position of the fingers and thumb need to be perpendicular to each other.

Question 15 (a) (ii)

(ii) A simple motor is shown in the diagram.



Use the diagram to explain how rotation is caused in the motor.

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....

....

.... **[3]**

This proved to be the most difficult question on the paper with only the higher ability candidates gaining any marks. These candidates usually gained marks for stating that the commutator changed the direction of the current every half turn. Many candidates that tried to explain this relationship incorrectly stated that the direction of the current changed every turn. Those that recognised that the current flowing through the coil produced a magnetic field then went on to explain that the field produced and the magnetic field between the magnets interacted with each other therefore achieving the other two marks available.

Question 15 (b)

(b) Calculate the magnetic flux density on a 0.5 m long conductor when a current of 0.8 A flows.

The force produced is 0.6 N.

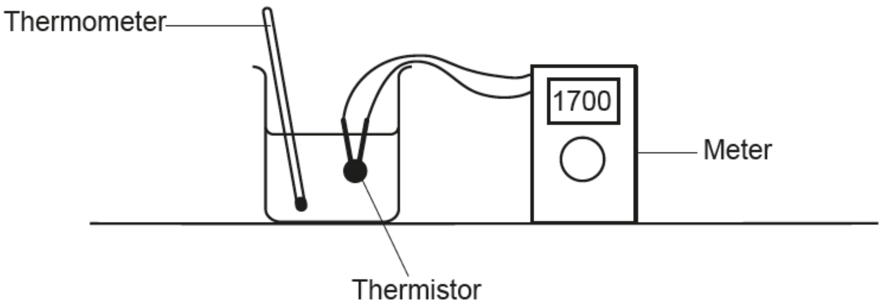
Answer = ... T **[3]**

The majority of candidates were able to calculate the magnetic flux density as being 1.5T. The most common error by lower ability candidates was that they did not put brackets around (current x length) and so ended up calculating force/current x length resulting in (0.6/0.8) x 0.5 = 0.34 instead of force/(current x length).

Question 16 (a) (i)

16 Two students investigate how the resistance of a thermistor varies with temperature.

The students place the thermistor in a beaker of water and measure the resistance of the thermistor for 5 different temperatures. They repeat the experiment three times at each temperature in order to calculate a mean.



Temperature (°C)	Resistance (Ω)			
	1	2	3	Mean
10	1900	1870	1930	1900
15	980	1000	990	990
20	770	760	760	763.3
25	610	720	610	647
30	540	540	530	536

(a) **(i)** Describe the pattern shown by these results.

....

....

.... **[2]**

The majority of candidates achieved one mark for describing the pattern as being the temperature increases as the resistance decreases. Few candidates then went on to describe that the change in resistance is larger at lower temperatures.

Question 16 (a) (ii)

(ii) The students have made mistakes when recording their results.

Identify **two** mistakes **and** explain what they should have done.

....

....

....

.... **[2]**

Only the candidates that clearly identified the mistake and then linked this mistake to what they should have done achieved marks for this question. Many candidates pointed out the mistakes but gave no idea about what should have been done. A number of candidates did not realise the question was about the mistake in the recording of the results rather than problems with the experimental procedure.

Question 16 (b)

(b) Suggest **one** way the experiment could be improved.

....

.... **[1]**

Lower ability candidates gave general answers about making it more accurate by doing repeats and then insulating the beakers by putting lids on to reduce any heat loss. Higher ability candidates gave more detailed answers about repeating anomalous readings and decreasing the intervals between temperature readings.

Question 16 (c)

(c) At 10 °C the thermistor had a resistance of 1900 Ω. The thermistor has a power rating of 75×10^{-3} W.

Calculate the maximum current in this thermistor at 10 °C.

Use the equation: Power = Current^2 × Resistance

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

Higher ability candidates achieved three marks for this calculation by carefully rearranging the equation to calculate the maximum current. Lower ability candidates were unable to correctly rearrange the equation and incorrectly used current as square root of resistance/power instead of current as square root of power/resistance. Some candidates altered the square root value from 3.95×10^{-5} to 3.9×10^{-5}.

Erratum notice

Turn to **page 2** of the **data sheet** and look at the **equation** under the title **'Higher Tier Only'**.

Cross out the words 'field strength' and replace them with 'flux density'.

The equation should now read:

'force on a conductor (at right angles to a magnetic field) carrying a current = magnetic flux density × current × length'

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