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GCSE (9-1)

Examiners' report

# GATEWAY SCIENCE COMBINED SCIENCE A

J250

For first teaching in 2016

## J250/06 Summer 2022 series

Version 2

ocr.org.uk/science

# 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. A selection of candidate answers are also provided. 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 and the mark scheme can be downloaded from OCR.

**Advance Information for Summer 2022 assessments**

To support student revision, advance information was published about the focus of exams for Summer 2022 assessments. Advance information was available for most GCSE, AS and A Level subjects, Core Maths, FSMQ, and Cambridge Nationals Information Technologies. You can find more information on our website.

# Paper 6 series overview

J250/06 is the second Physics Foundation Tier paper in the Gateway GCSE Combined Science suite. The 60 mark paper assesses content from specification topics P4-P6. It also assumes knowledge of the topics in P1-P3.

Section A of the paper has 10 multiple choice questions, each worth 1 mark.

Section B has mainly short answer response questions and includes one six-mark Level of Response question.

To perform well on this paper, candidates need to have a sound knowledge of the theory covered in topics P4-P6 and be able to apply this to novel situations. They also need to apply the skills and understanding that they have developed in the practical activities covered in topic CS7. This paper also contains questions that have elements of synopticity, drawing on material covered by topics P1-P3. There are also questions that involve the assessment of key mathematical requirements and working scientifically from the appendices of the specification.

| Candidates who did well on this paper generally did the following: | Candidates who did less well on this paper generally did the following: |
|---|---|
| • were able to manipulate equations and apply them to different situations, e.g. Question 15, Question 16(d)(iii)<br>• were able to relate graphical data to the use of renewable resources and interpret changes to the effect of different resources on the environment, e.g. Question 14<br>• understood the difference between mode and mean, e.g. Question 6<br>• knew the meanings of wavelength and frequency and how they were related, e.g. Question 5 and Question 13(c)<br>• could write a balanced radioactive decay equation, e.g. Question 2. | • could not identify light as an electromagnetic wave, e.g. Question 1<br>• appeared to be unfamiliar with practical science activities, e.g. Question 13(a), Question 17<br>• exhibited limited knowledge of electrical circuits, e.g. Question 3, Question 9, and Question 17(b)<br>• had difficulty reading from and interpreting graphical data, e.g. Question 16(d) Question 18(b)<br>• showed little knowledge of energy stores, e.g. Questions 16(b) and (c). |

# Section A overview

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

## Question 1

**1** Which type of wave is light?

**A** Electromagnetic

**B** Longitudinal

**C** Sound

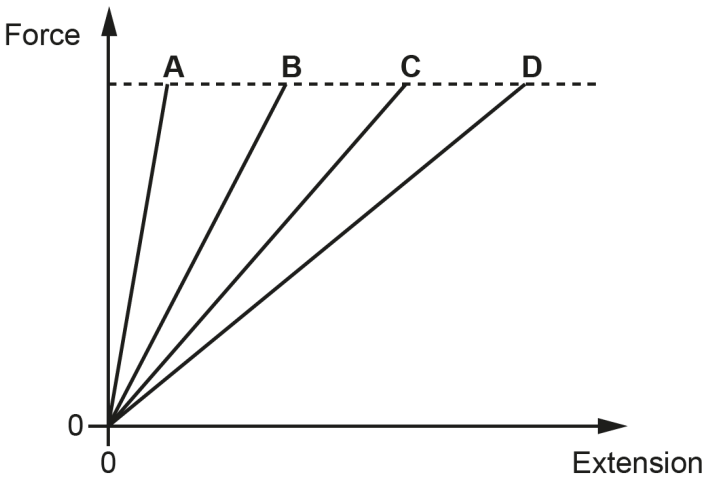
**D** Water

Your answer ☐ **[1]**

Approximately half the candidates gave the correct answer of A but a similar number of candidates answered B

## Question 2

**2** The graph shows the extension of four different springs, **A**, **B**, **C** and **D**.




Which spring stores the most energy?

Your answer ☐ **[1]**

This question was well answered with A the most common incorrect answer.

## Question 3

**3** What is the function of the neutral wire?

**A** To bring current into an appliance

**B** To carry current if there is a fault

**C** To complete the circuit

**D** To melt if the current is too large

Your answer ☐ **[1]**

Many candidates confused the function of the neutral wire with the earth wire and gave B as an incorrect answer.

## Question 4

**4** Some radioactive elements give out beta radiation.

What is beta radiation stopped by?

**A** Aluminium

**B** Thin cardboard

**C** Thin paper

**D** Skin

Your answer ☐ **[1]**

This was generally answered correctly but mistaking Beta for Alpha for was a common mistake.

## Question 5

**5** The wavelength of a water wave is 10 cm. The frequency of the wave is 5 Hz.

What is the **speed** of the water wave?

Use the equation: wave speed = frequency × wavelength

**A** 0.5 cm/s

**B** 2.0 cm/s

**C** 10 cm/s

**D** 50 cm/s

Your answer ☐ **[1]**

Most answered this question correctly.

## Question 6

**6** A teacher measures their reaction time in an experiment.

Their results are shown in the table.

| | **Try 1** | **Try 2** | **Try 3** | **Try 4** | **Try 5** |
|---|---|---|---|---|---|
| **Reaction time (s)** | 0.7 | 0.4 | 0.2 | 0.5 | 0.2 |

What is the **mode** of their reaction time?

**A** 0.2 s

**B** 0.3 s

**C** 0.4 s

**D** 0.5 s

Your answer ☐ **[1]**

This question was well answered the common mistake was to answer C where the candidate had worked out the mean.

## Question 7

**7** In an experiment, 80 waves are produced in 20 s.

What is the frequency of the waves?

**A** 0.25 Hz

**B** 4 Hz

**C** 16 Hz

**D** 1600 Hz

Your answer ☐ **[1]**

Many candidates did not divide the number of waves by the time. It was common to see answers A and D

## Question 8

**8** A student stands near a wall and claps their hands.

The sound echo takes 0.2 s to return to the student. The speed of sound is 330 m / s.

What is the **distance** between the student and the wall?

Use the equation: distance travelled = speed × time

**A** 33 m

**B** 66 m

**C** 1650 m

**D** 3300 m

Your answer ☐ **[1]**

Very few candidates scored this mark. Answer B was generally seen where the candidate simply substituted into the given equation without taking the echo into account and halving the time.

## Question 9

**9** A remote control can be used to operate a television.

**Remote control** **Television**

Which row in the table describes how energy is transferred?

| | Remote control | Television |
|---|---|---|
| **A** | 3 V a.c. from batteries | 230 V d.c. from domestic mains supply |
| **B** | 3 V d.c. from batteries | 230 V a.c. from domestic mains supply |
| **C** | 230 V a.c. from domestic mains supply | 3 V d.c. from batteries |
| **D** | 230 V d.c. from domestic mains supply | 3 V a.c. from batteries |

Your answer ☐ **[1]**

The majority of candidates answered A incorrectly. Candidates understood that batteries were at a lower voltage than mains but showed little understanding of the difference between a.c. and d.c.

## Question 10

**10** What is a typical acceleration of a car driving along a road?

**A** $3\,m/s^2$

**B** $10\,m/s^2$

**C** $60\,m/s^2$

**D** $80\,m/s^2$

Your answer ☐ **[1]**

Only a few candidates got this correct; no pattern to incorrect answers suggested many candidates did not know this and could not estimate it as being lower than $10 m/s^2$ the acceleration due to gravity.

# Section B overview

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

## Question 11 (a)

**11 (a)** Uranium-238 is a radioactive isotope.

When uranium decays, it gives out an alpha particle forming thorium-234.

Complete the radioactive decay equation using the symbols below:

$^{4}_{2}\alpha$ $^{234}_{90}Th$ $^{238}_{92}U$

You must write **one** symbol in **each** box.

**[2]**

Generally this was well answered by candidates but a full variety of answers was seen here, including no response, letters with no numbers and numbers with no letters.

## Question 11 (b)

**(b)** Atoms can give out different types of electromagnetic radiation.

Draw lines to connect each **question** with its correct **answer**.

| Question | Answer |
| --- | --- |
| Which radiation is given out by atoms? | Radiation with a large range of frequencies |
| | Radiation with a small range of frequencies |
| Which radiation is detected by our eyes? | Only gamma radiation |
| | Only infra-red radiation |

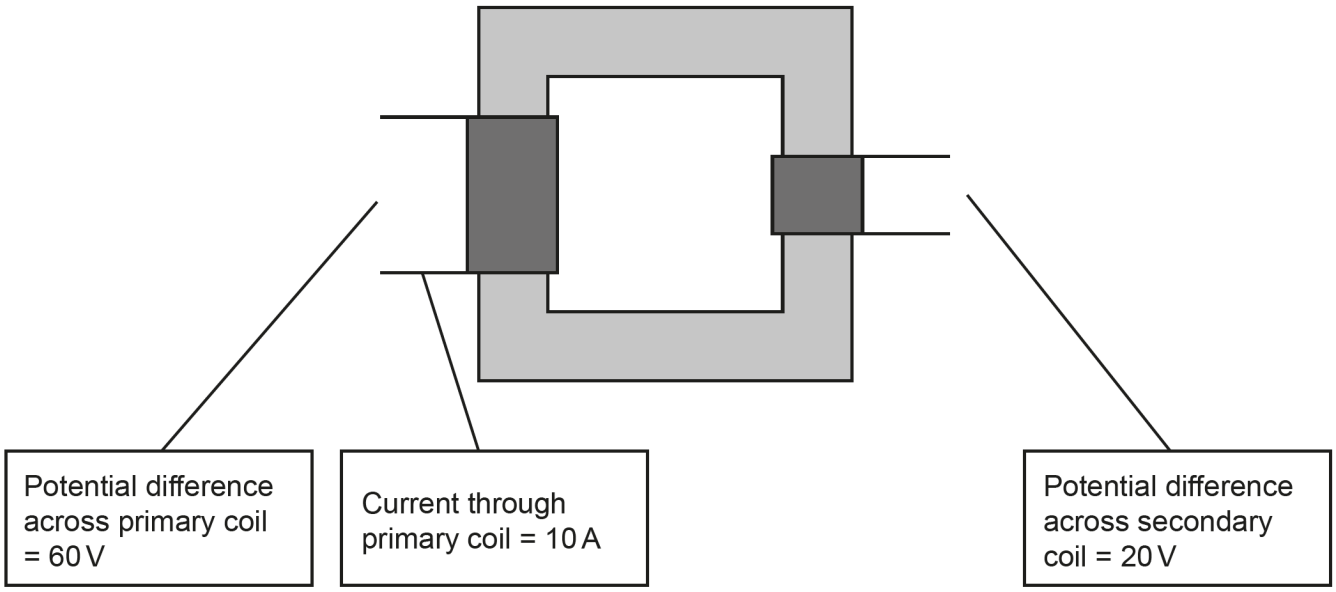
**[2]**

Very few candidates scored both marks. Top LHS box connected correctly was the most commonly seen correct answer, but a lot of candidates drew two lines from each box and did not score.

## Question 12 (a)

**12 (a)** Transformers are used to transfer energy efficiently.

This is a diagram of a transformer:




Calculate the current through the secondary coil.

Use the information in the diagram **and** the Data Sheet.

Current = ..... A **[3]**

This was not answered well for the most part. Candidates did not pick the correct equation from the equation sheet and simply used P = VI or V = IR. Those that did pick the correct equation struggled to substitute the numbers in properly and then divide. Many full correct answers were seen but incorrect answers usually lacked working, so no marks could be given.

### Assessment for learning

Candidates should be encouraged to always show their workings so that some marks can be obtained even when the final answer is incorrect.

## Question 12 (b) (i)

**(b)** Energy use can be measured in kilojoules (kJ) or kilowatt hours (kWh).

**(i)** An electric shower has a power of 8.5 kW.

1 kW = 1000 W.

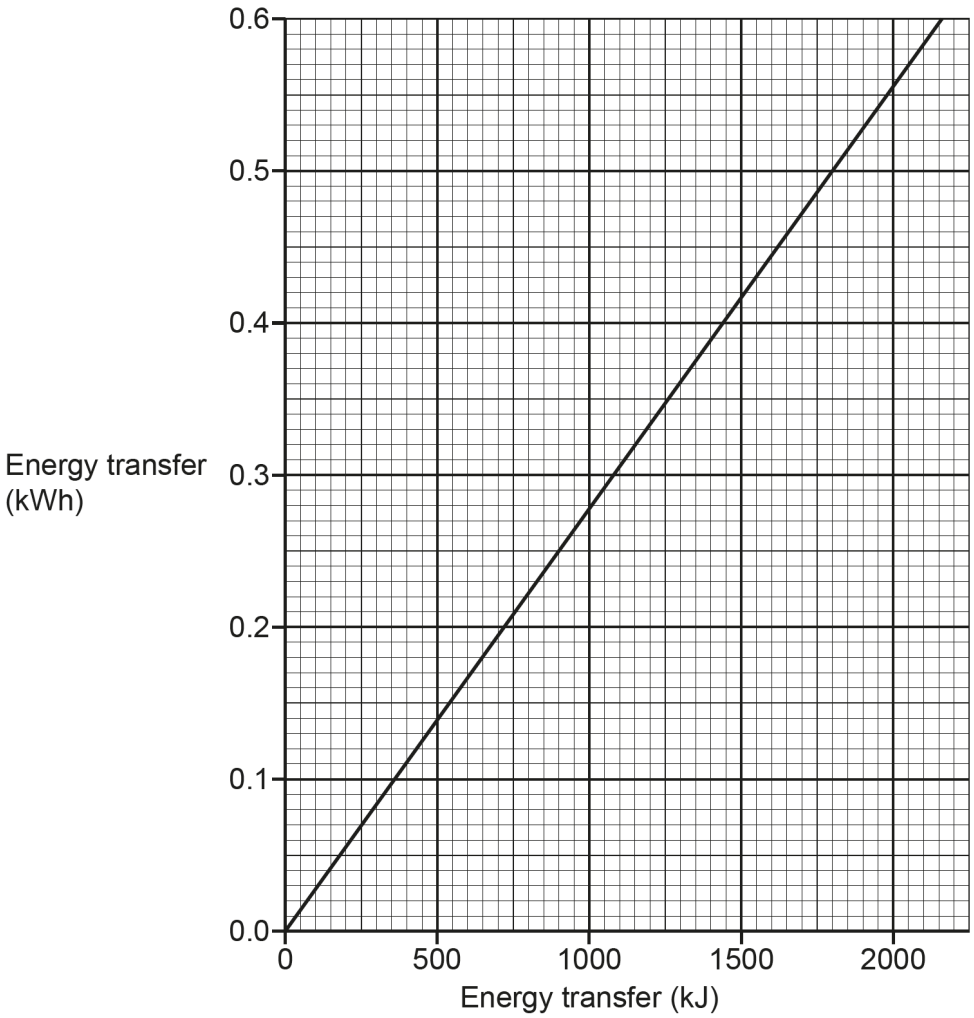
What is the power of the shower in watts (W)?

Power = ..... W **[1]**

A very well answered question. The vast majority of candidates scored this mark, 85 000 and 0.0085 were the most common errors.

## Question 12 (b) (ii)

**(ii)** The graph shows the relationship between energy transfer in kJ and energy transfer in kWh.




A kettle transfers 1800 kJ of energy.

Use the graph to find the energy transfer in kWh.

Energy transfer = ..... kWh **[1]**

This was generally well answered. Common errors included misinterpreting the x-axis and drawing the line from 1800 in the wrong place.

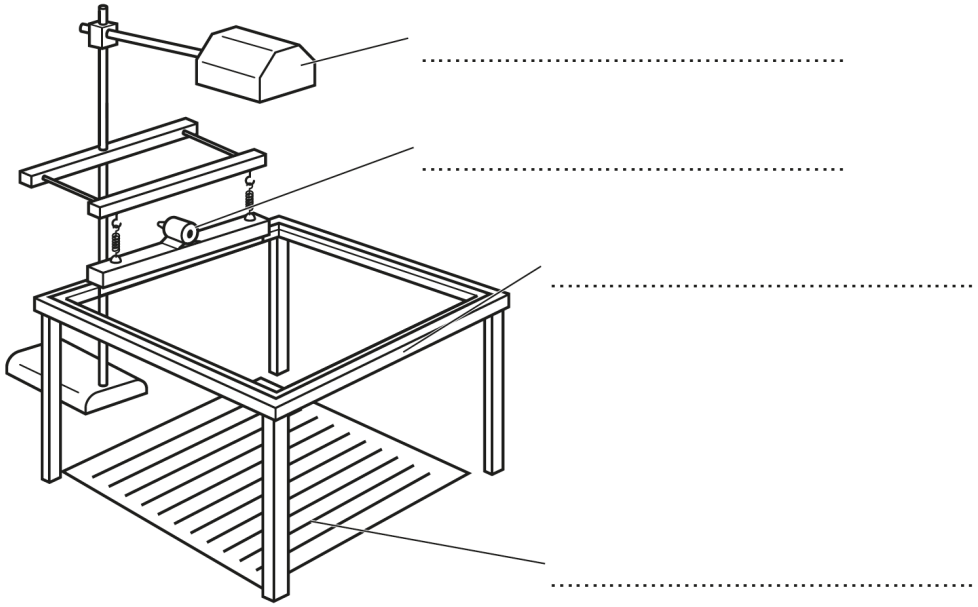
## Question 13 (a)

**13 (a)** A teacher uses the ripple tank in **Fig. 13.1** to show refraction of water waves.

Label **Fig. 13.1** using words from the list.

| | | | |
|---|---|---|---|
| **Lamp** | **Pattern of waves** | **Tray of water** | **Vibration generator** |

**Fig. 13.1**



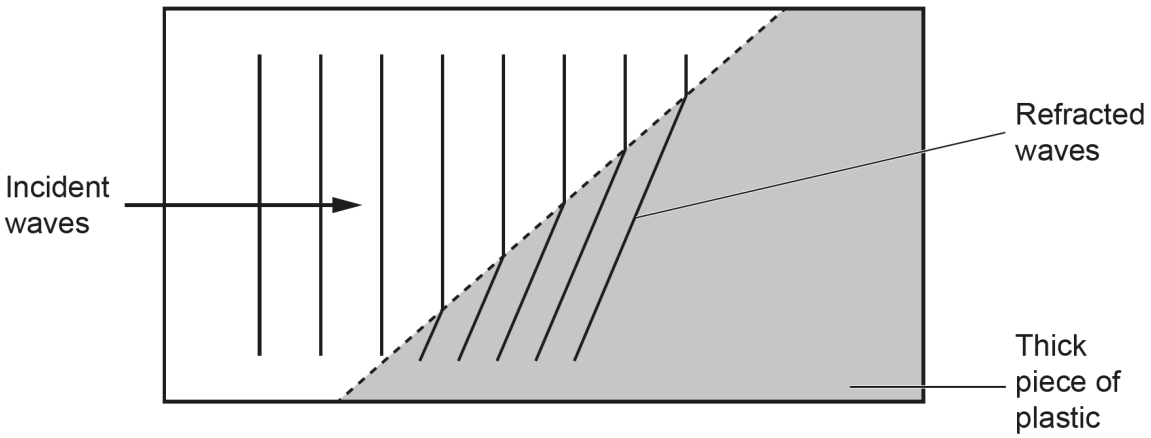

**[2]**

The majority of candidates scored at least 1 mark on this question it was common to see the bottom two labels the wrong way around.

## Question 13 (b)

**(b)** **Fig. 13.2** shows the pattern of the water waves when the teacher places a thick piece of plastic into the ripple tank.

**Fig. 13.2**




Explain why placing the plastic into the ripple tank causes refraction.

.....

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

A very small minority of candidates obtained this mark. Many candidates either talking about a reflection from the plastic or just stating that a change in direction has occurred see exemplar below.

### Exemplar 1

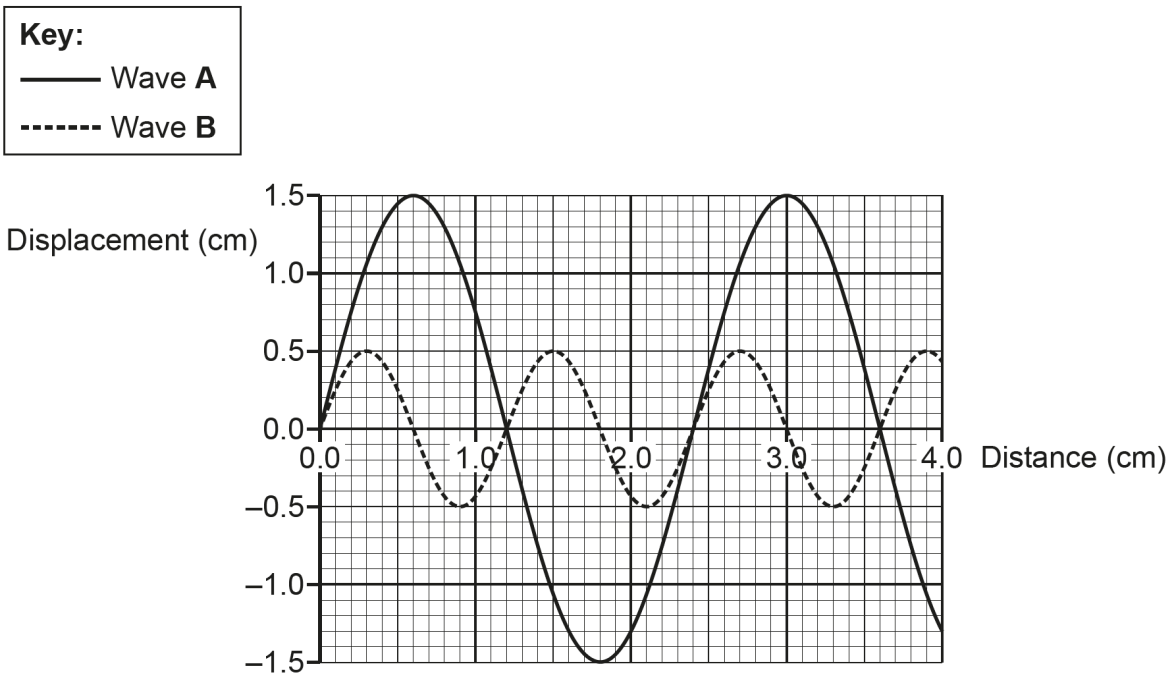
The wave will ~~a~~ refract ~~to~~ from the ~~direct~~ old direction to a new one, the plastic changes ~~it~~ to ~~the~~ wave direction.

This is a typical response of a candidate that has used the diagram and realised that a change of direction has occurred and realised this is due to refraction. The candidate did not respond to the question that asks for the cause of this change of direction, that is, the change of speed of the wave as it enters shallower water.

## Question 13 (c) (i)

**(c)** **Fig. 13.3** shows two water waves.

**Fig. 13.3**




**(i)** The amplitude of wave **A** is bigger than the amplitude of wave **B**.

Calculate how many times bigger.

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

This was a well answered question. Many candidates obtained 2 marks with the others obtaining 1 mark from taking the numbers 1.5 and 0.5 from the graph. These candidates often subtracted or added these numbers instead of dividing them.

## Question 13 (c) (ii)

**(ii)** A student says, 'A wave with a high frequency has a long wavelength.'

Explain why the student is **incorrect**.

Use **Fig. 13.3** to explain your answer.

.....

.....

.....

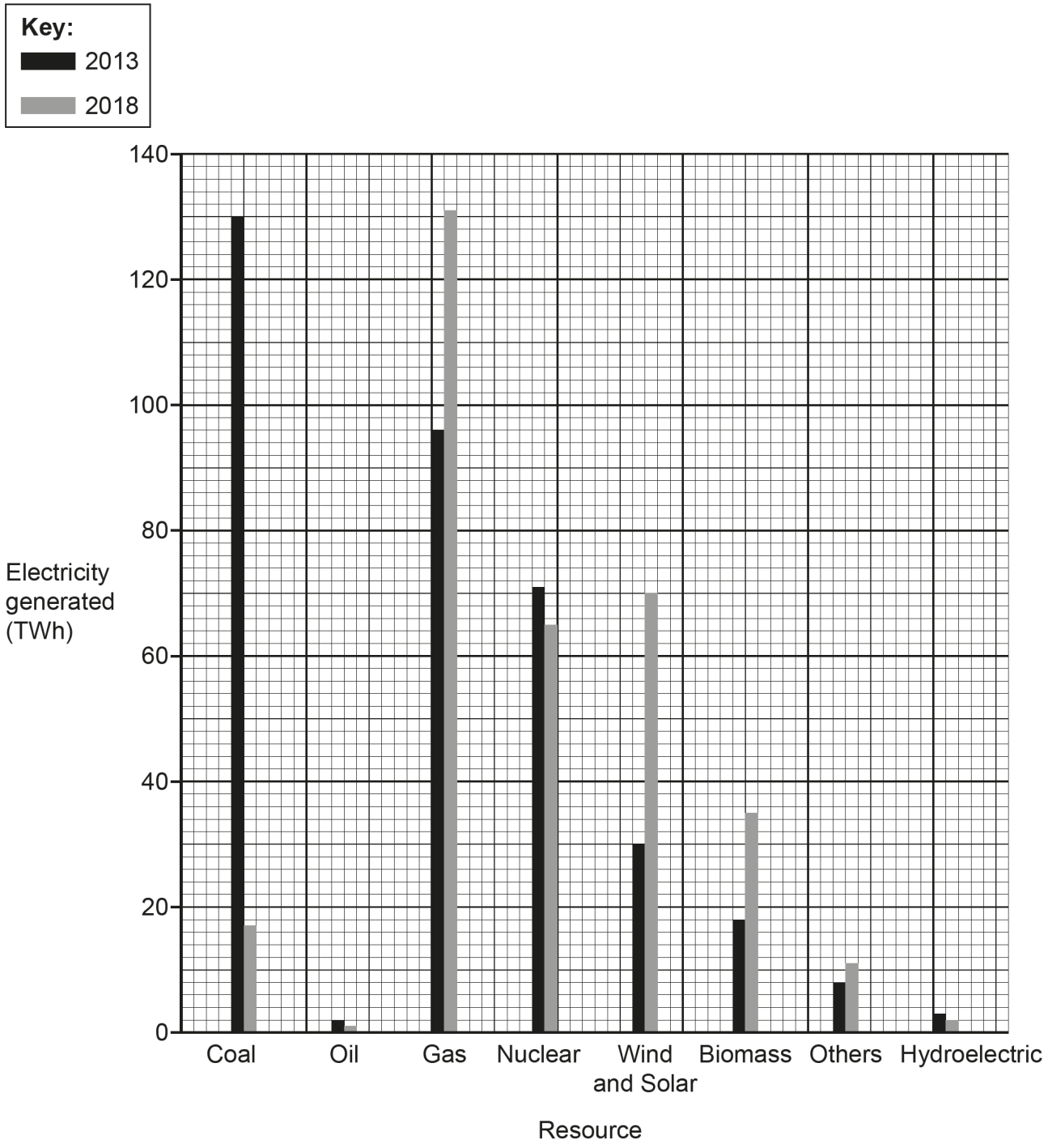
..... **[2]**

A good number of candidates recognised that high frequency = short wavelength and scored 1 out of 2 for the question.

## Question 14*

***14** Electricity in the UK is generated using renewable and non-renewable resources.

The graph shows how electricity was generated in 2013 and 2018.



Explain how and why electricity generation changed between 2013 and 2018.

Write about renewable and non-renewable resources.

.....

.....

.....

.....

.....

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

This was a very well answered accessible LOR question with the full range of marks given. Most candidates had a good grasp of renewable/non-renewable resources and trends (especially decline of coal) were identified from the graph. The idea of harm to the environment from burning fossil fuels was common but often lacked detail.

**Misconception**

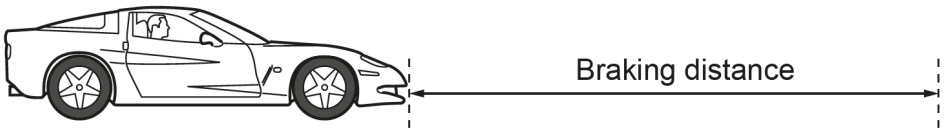
Common misconceptions – gas is renewable (because it has increased in 2018), hydro is non-renewable (because it decreased in 2018).

Reusable was often seen in place of renewable or used as a definition 'hydroelectric can be used again and again, but oil can only be used once.'

## Question 15 (a)

**15** This question is about stopping a car.

**(a)** A driver presses the brakes to stop a car.




- The braking force is 6000 N.
- The work done stopping the car is 84 000 J.

Calculate the braking distance.

Use the equation: work done = force × distance

Braking distance = ..... m **[3]**

This was well answered by most candidates but a common issue was to multiply work done by the braking force leading many candidates to calculate that a car would take over 500 million metres to stop. Again the lack of working stopped candidates from obtaining partial marks.

## Question 15 (b)

**(b)** Braking efficiency can be measured using this equation:

$$\text{braking efficiency} = \frac{\text{braking force}}{\text{weight of car}}$$

- The weight of the car is 8000 N.
- The braking force is 6000 N.

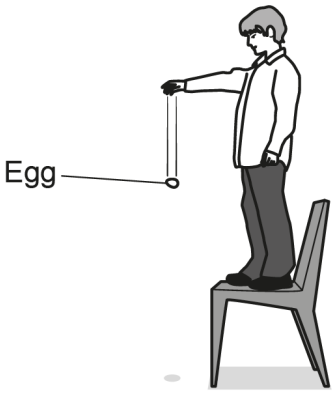
Use the equation to calculate the braking efficiency of this car.

Braking efficiency = ..... **[2]**

The majority of candidates scored both marks. Inverting the division was a common issue.

## Question 16 (a)

**16** A student drops an egg onto a hard floor. The mass of the egg is 0.05 kg.




**(a)** The egg is dropped from a height of 1.5 m.

Calculate the potential energy of the egg before it is dropped. Use the Data Sheet.

Gravitational field strength = 10 N / kg.

Potential energy = ..... J **[3]**

The majority of the candidates scored well on this question, mostly without working. Candidates who had the incorrect answer often picked up a mark for selecting or using the correct equation. A common error was for candidates to try converting the units of one of the quantities.

## Question 16 (b)

**(b)** Which energy store is at its maximum value just before the egg hits the ground?

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

Many wrong responses were seen for this question. The most common wrong answer was gravitational (potential) but plenty of random words seen here, such as force, mass, and velocity.

## Question 16 (c)

**(c)** The egg stops moving when it hits the floor.

Describe the energy transfer when the egg hits the floor.

Name of the energy store that increases .....

Where the energy is transferred to .....

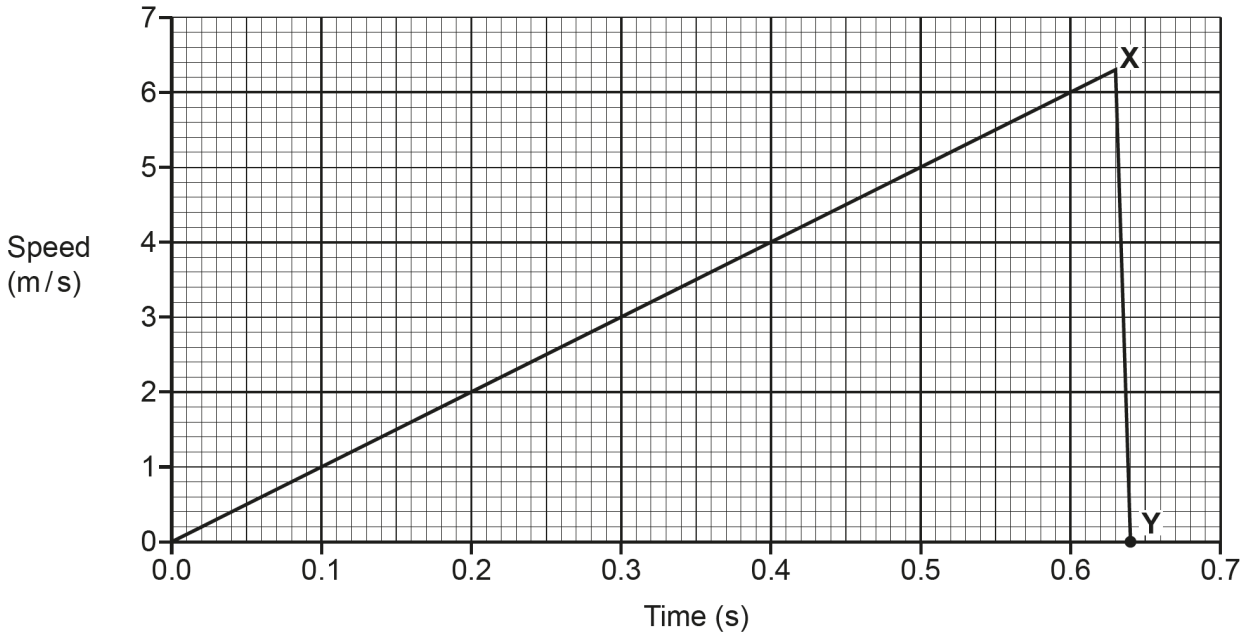
.....

**[2]**

The second marking point was obtained more often with candidates stating energy is transferred to the floor/ground for a marking point. Fewer students obtained a mark for thermal, with most suggesting the energy store was kinetic.

## Question 16 (d) (i)

**(d)** The graph shows the speed of the same egg as it falls.




**(i)** At which time does the egg have **maximum** kinetic energy?

Time = ..... s **[1]**

Many candidates did not achieve this mark, either picking 0.64 which is the end point, or picking the maximum velocity of 6.2 instead of the time.

## Question 16 (d) (ii)

**(ii)** Suggest what happens to the egg between points **X** and **Y**.
Explain your answer by writing about force and acceleration.

.....

.....

.....

..... **[2]**

This question proved challenging for many candidates. Many candidates believed the egg was continuing to accelerate downwards from X, only hitting the floor at Y. Some thought that X was when the egg was first dropped. At Y, many recognised that the egg had stopped, but often said stopped accelerating rather than stopped moving.

### Exemplar 2

The egg cracks when it hits the floor as it couldn't cope with the force when hitting the floor **[2]**

The candidate has recognised that the egg has hit the floor and has broken thus obtaining 1 mark.

## Question 16 (d) (iii)

**(iii)** Calculate the kinetic energy of the egg when it moves at 4 m / s.

Use the equation: kinetic energy = 0.5 × mass × (speed)$^2$

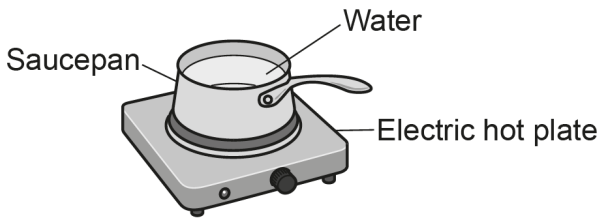
Kinetic energy = ..... J **[2]**

This was answered correctly by most candidates. A common error was not squaring the speed.

## Question 17 (a) (i)

**17 (a)** Student **A** uses the electric hot plate in **Fig. 17.1** to increase the temperature of water in a saucepan.

**Fig. 17.1**




**(i)** Student **A** wants to calculate the thermal energy transferred to the saucepan of water.

These are the steps in their method:

**1** Measure the volume of water with a balance.
**2** Measure the starting temperature of the water with a thermometer.
**3** Use the equation:

change in thermal energy = mass × specific heat capacity × change in temperature

Student **A**'s method is **incorrect**.

Identify the **two** mistakes the student has made and write down the correction for each mistake.

Mistake **1** .....

.....

Correction **1** .....

.....

Mistake **2** .....

.....

Correction **2** .....

.....

**[3]**

A wide range of answers was seen with very few scoring all 3 marks. Although many students spotted the 'measure volume with balance' issue, relatively few recognised that it was the 'volume' part, not the use of a balance that was the issue, so 'use a measuring cylinder' was seen frequently. The most obtained marking point was the second correction mark for noting that the temperature at end/temperature change was needed.

## Question 17 (a) (ii)

**(ii)** Student **A** suggests wrapping insulation around the saucepan in **Fig. 17.1**.

Suggest **another** way student **A** can improve their experiment.

.....

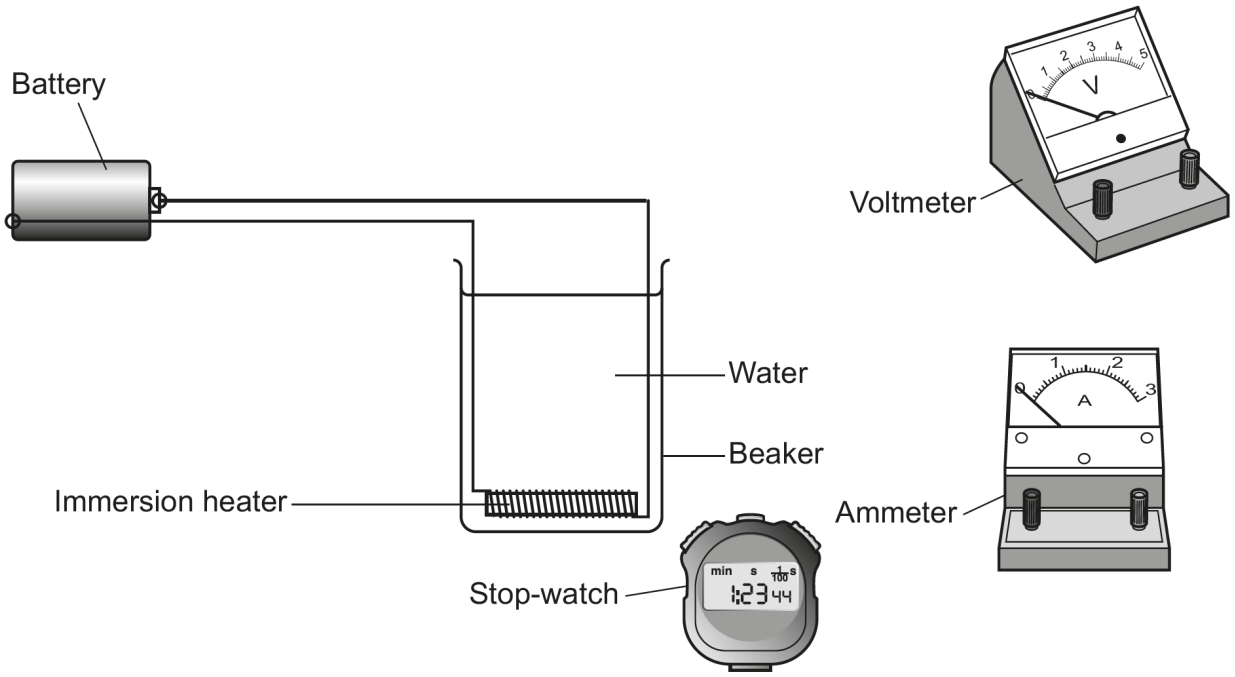
..... **[1]**

Many candidates scored this mark. Many scored a mark for adding a lid or repeating the readings. Carrying out the experiment in a temperature controlled room, adding more/different insulation or a water bath were common incorrect answers.

## Question 17 (b)

**(b)** Student **B** uses the immersion heater in **Fig. 17.2** to increase the temperature of water in a beaker.

**Fig. 17.2**




Describe an experiment to measure the **energy** transferred to the immersion heater, using the equipment in **Fig. 17.2**.

In your answer include:

- a method
- a circuit diagram
- an equation from the Data Sheet
- the symbol for a resistor to represent the immersion heater in your circuit.

.....

.....

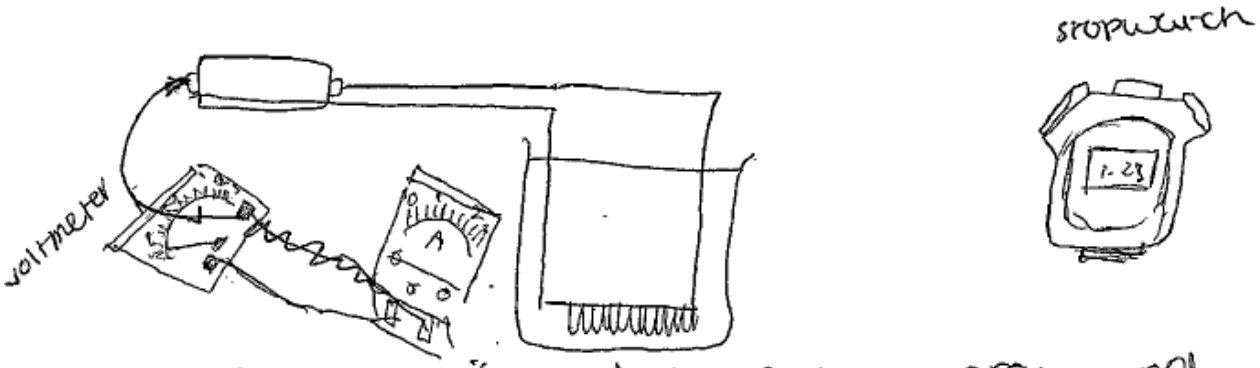
.....

.....

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

While very few answers scored 4 marks, 2 and 3 mark answers were often seen. An appropriate equation was usually seen, although the equation form Question 17(a)(i) was sometimes given here. The idea of timing was the most common mark given. Not all candidates attempted circuit diagrams, when a circuit diagram was attempted not many correct resistor symbols were seen, many of the attempted resistors were in fact thermistors. The voltmeter was commonly seen in series or in a strange parallel to nothing arrangement, but the ammeter (if present) usually scored a mark.

## Exemplar 3




The battery is used to power energy and increase the temperature of water in a beaker. The stopwatch is used to time how long it takes. The ammeter and voltmeter both connect to ~~the~~ each other and the battery to show the current.

The circuit diagram shows an ammeter and voltmeter (incorrectly) in series. There is not a complete working circuit so a mark is not awarded for either the voltmeter or ammeter.

The only mark obtained in the method is for the stopwatch recording (watching) the time.

## Question 18 (a)

**18** This question is about radioactivity.

**(a)** Which statements about the nucleus of an atom are correct?
Tick (✓) **two** boxes.

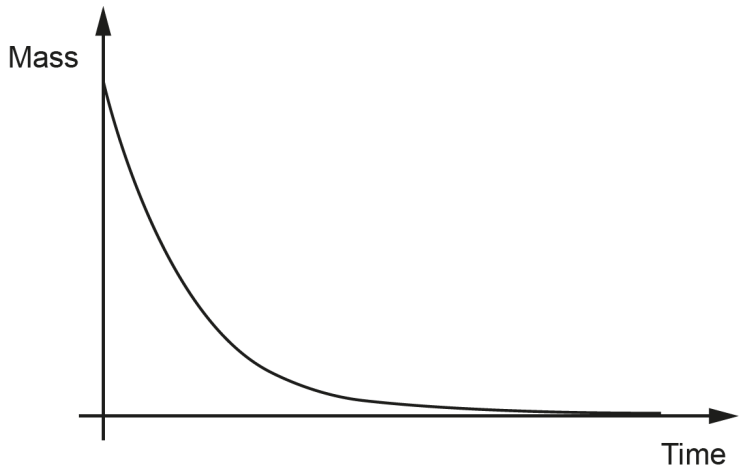
- In radioactive atoms, the nucleus is stable. ☐
- Most of the nucleus contains empty space. ☐
- Scientists can say exactly when a nucleus will emit radiation. ☐
- The diameter of a nucleus is approximately 1 nm. ☐
- The mass of a nucleus is much less than the mass of an atom. ☐
- The nucleus contains protons and electrons. ☐
- The nucleus contains protons and neutrons. ☐
- The nucleus has a positive charge. ☐

**[2]**

This was mostly well answered with many candidates scoring at least 1 mark. Rarely candidates ticked more than two boxes.

## Question 18 (b)

**(b)** The graph shows how the mass of a radioactive element changes with time.




Describe the trend shown by the graph.

.....

.....

.....

..... **[2]**

Many candidates scored the first mark for the basic trend, but most answers were a single sentence 'As time goes on, mass decreases'. Mark 2 was rarely given.

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