OCR
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Monday 23 November 2020 – Morning

GCSE (9–1) Combined Science (Physics) A (Gateway Science)

J250/12 Paper 12 (Higher Tier)

Time allowed: 1 hour 10 minutes

You must have:
- a ruler (cm/mm)
- the Data Sheet for GCSE (9–1) Combined Science (Physics) A (inside this document)

You can use:
- a scientific or graphical calculator
- an HB pencil

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **20** pages.

ADVICE
- Read each question carefully before you start your answer.

SECTION A

Answer **all** the questions.

You should spend a maximum of 20 minutes on this section.

Write your answer to each question in the box provided.

1 Brakes are used to decelerate a car safely in order to reduce the risk of injuries to the passengers.

Which row in the table is correct when the brakes are used safely?

	Deceleration	Size of force on passengers
A	Large	Large
B	Large	Small
C	Small	Large
D	Small	Small

Your answer ☐ **[1]**

2 Electromagnetic waves have many uses.

Which row in the table is correct?

	Electromagnetic wave	Use
A	Gamma rays	Tanning beds
B	Microwaves	Mobile phones
C	Radio waves	Killing bacteria
D	X-rays	Optical fibres

Your answer ☐ **[1]**

3 What is the typical value for human reaction time?

A 0.01 s

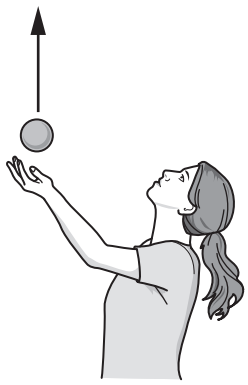
B 0.2 s

C 0.7 s

D 1.0 s

Your answer ☐ **[1]**

4 A ball is thrown vertically into the air.



Energy is transferred from a chemical store in the girl.

Which store is the useful energy transferred to?

A A chemical store only.

B A gravitational store only.

C A gravitational store and a chemical store only.

D A thermal store and a chemical store only.

Your answer ☐ **[1]**

5 A student measures the energy transferred by an electrical heater.

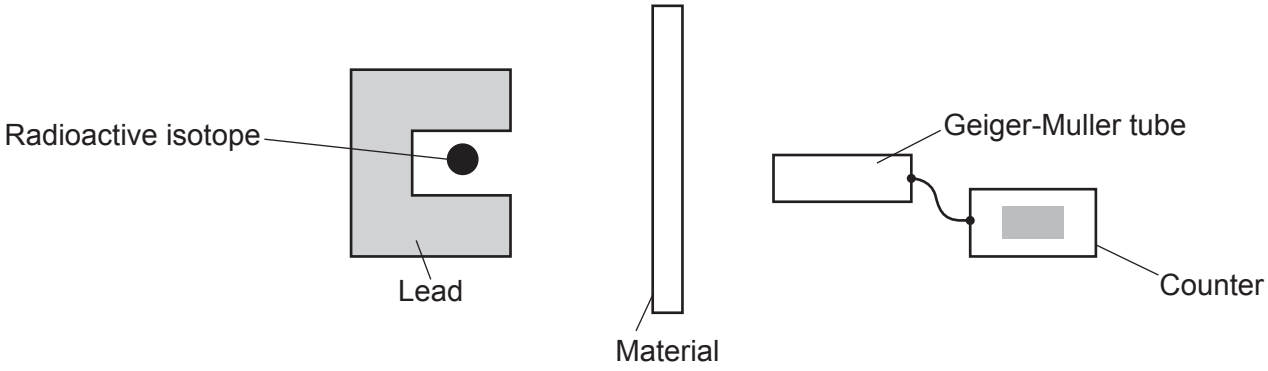
Which row in the table shows the correct apparatus he used?

	To measure potential difference	To measure current	To measure time
A	Ammeter	Voltmeter	Thermometer
B	Joulemeter	Ammeter	Thermometer
C	Voltmeter	Ammeter	Stopwatch
D	Voltmeter	Joulemeter	Stopwatch

Your answer ☐ **[1]**

6 A radioactive isotope emits **only** gamma rays.

A teacher places different materials in front of the isotope. She measures the reading on a Geiger-Muller tube connected to a counter.



Which row in the table shows the correct reading on the counter?

	Reading on counter (Bq)			
	No material	**Cardboard**	**5 mm thick aluminium**	**10 cm thick lead**
A	0	20	40	60
B	20	20	19	2
C	20	3	2	2
D	20	20	3	3

Your answer ☐ **[1]**

7 How can the efficiency of an energy transfer be increased?

A Decrease the total energy input.

B Decrease the wasted energy.

C Increase the total energy input.

D Increase the wasted energy.

Your answer ☐ **[1]**

8 A 1500 W heater is used for 1.5 hours.

What is the energy transferred in kWh?

Use the equation: energy transferred = power × time

A 2.25 kWh

B 135 kWh

C 2250 kWh

D 135 000 kWh

Your answer ☐ **[1]**

9 In glass, violet light refracts more than red light as it passes from air into glass.

Which statement explains why?

A Red light has a shorter wavelength.

B Red light slows down more than violet light.

C Violet light has a longer wavelength.

D Violet light slows down more than red light.

Your answer ☐ **[1]**

10 Thinking distance is directly proportional to speed.

The thinking distance at 30 mph is 9 m.

What is the thinking distance at 60 mph?

A 9 m

B 18 m

C 27 m

D 36 m

Your answer ☐ **[1]**

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SECTION B

Answer **all** the questions.

11 A student measures the temperature of a beaker of water as it cools down.

The graph in **Fig. 11.1** shows how the temperature changes with time.

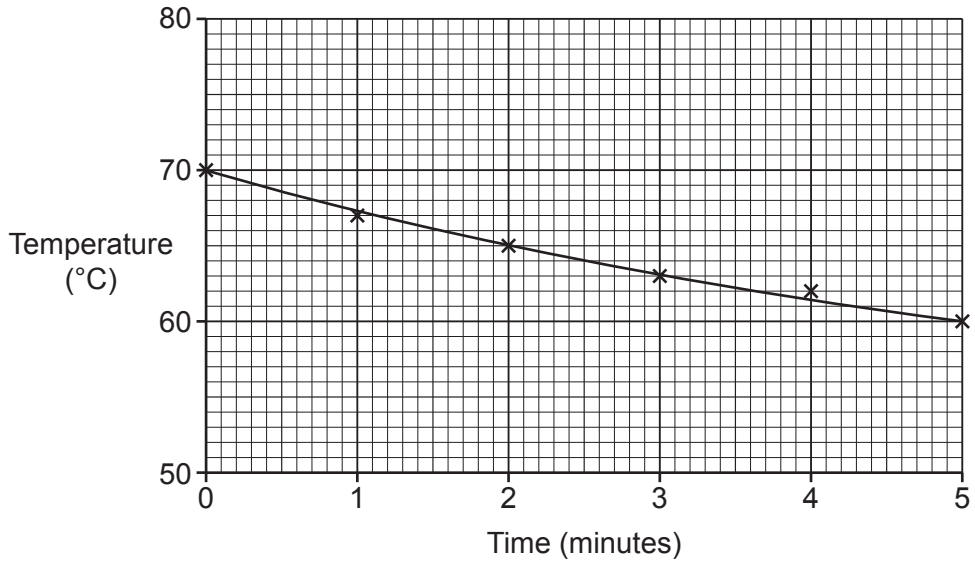

Fig. 11.1

(a) Calculate the rate of temperature change over the 5 minutes.

Rate of temperature change = ... °C / minute **[3]**

(b) (i) Describe, in detail, how the temperature changes over the 5 minutes.

.....

.....

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

(ii) The beaker contains 0.2 kg of water.

The specific heat capacity of water is 4200 J / kg °C.

Calculate the change in thermal energy in the water after 5 minutes.

Give your answer to **1** significant figure.

Use an equation from the Data Sheet to help you.

Change in thermal energy = ... J **[3]**

(c) Describe the change in energy stores as the water cools down.

.....

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

(d) The student is given some insulation. She wraps the insulation around the sides of the beaker and repeats the experiment.

(i) Add **another line** to the graph in **Fig. 11.1** to show how the temperature may change when the beaker is wrapped with insulation. **[1]**

(ii) State **one** thing the student can do to reduce the rate of cooling further.

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

12 Carbon-12 is a stable isotope. Carbon-14 is an unstable radioactive isotope.

(a) Describe what is meant by the term **isotope**.

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.....

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

(b) This is the equation for the radioactive decay of carbon-14:

$$^{14}_{6}C \longrightarrow {}^{14}_{7}N + {}^{0}_{-1}e$$

(i) Which type of radiation is emitted by carbon-14?

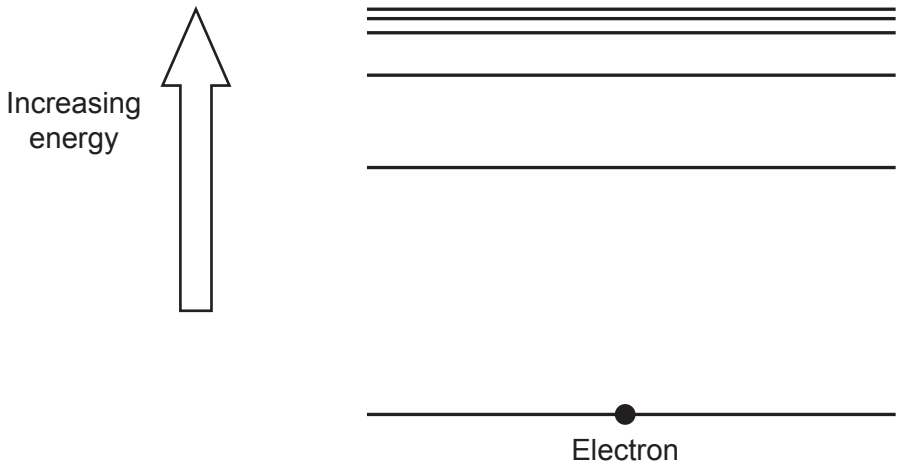
..... **[1]**

(ii) Describe how the mass and charge of the nucleus changes when the carbon-14 decays.

Mass .....

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

(c) This is a diagram of energy levels inside a hydrogen atom.



Electromagnetic radiation can cause ionisation.

Explain what is meant by the term **ionisation**.

You may add to the diagram to help explain your answer.

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

(d) Carbon-14 can be used to date ancient objects.

An ancient object is 17 100 years old. The half-life of carbon-14 is 5700 years.

For the ancient object, what is the ratio of the original amount of carbon-14 to the amount of carbon-14 left?

Ratio = ... **[3]**

13 This question is about sound, light and water waves.

(a) State **one** difference between sound waves and light waves.

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

(b) In **Fig. 13.1**, a student makes waves in a tray of water. He places a cork at position **A**.

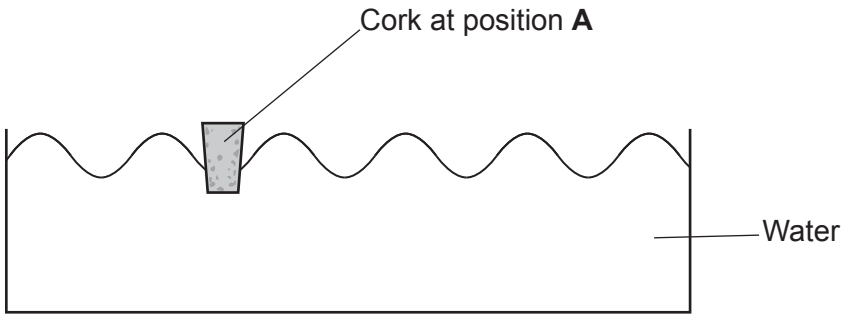

Fig. 13.1

(i) **Fig. 13.2** shows a free-body force diagram for the cork.

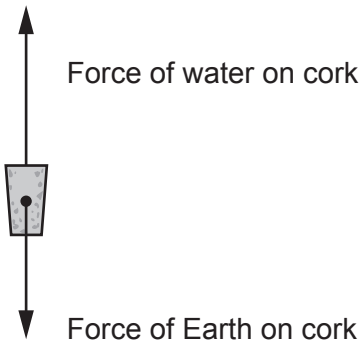

Fig. 13.2

At position **A** in **Fig. 13.1**, the cork starts to move up.

Use the free-body force diagram to explain why.

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

(ii) Explain how this experiment shows that the wave travels but **not** the water.

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

(c) A teacher uses a signal generator to produce a sound wave.

Fig. 13.3 shows the sound wave on the oscilloscope screen.

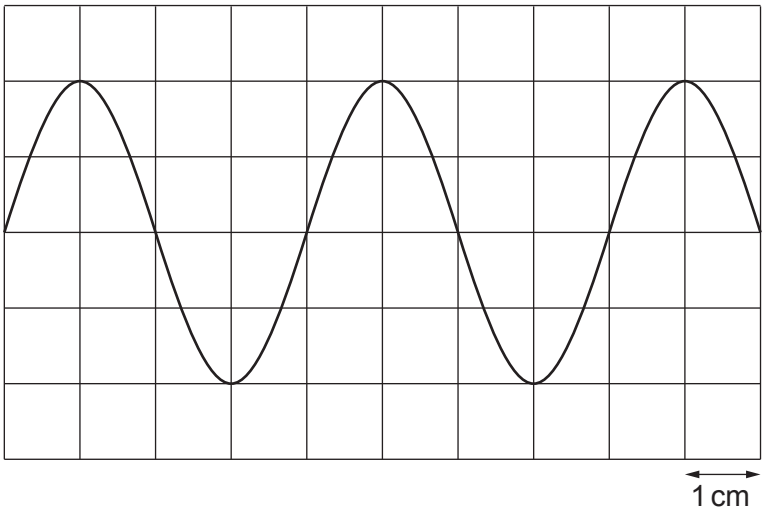

Fig. 13.3

1 cm represents 0.005 s on the horizontal scale.

(i) Calculate the period of the sound wave.

Period = ... s **[1]**

(ii) Calculate the frequency of the sound wave.

Frequency = ... Hz **[3]**

(d) **Fig. 13.4** shows the experiment a teacher does to measure the speed of sound.

She uses two microphones and a speaker.

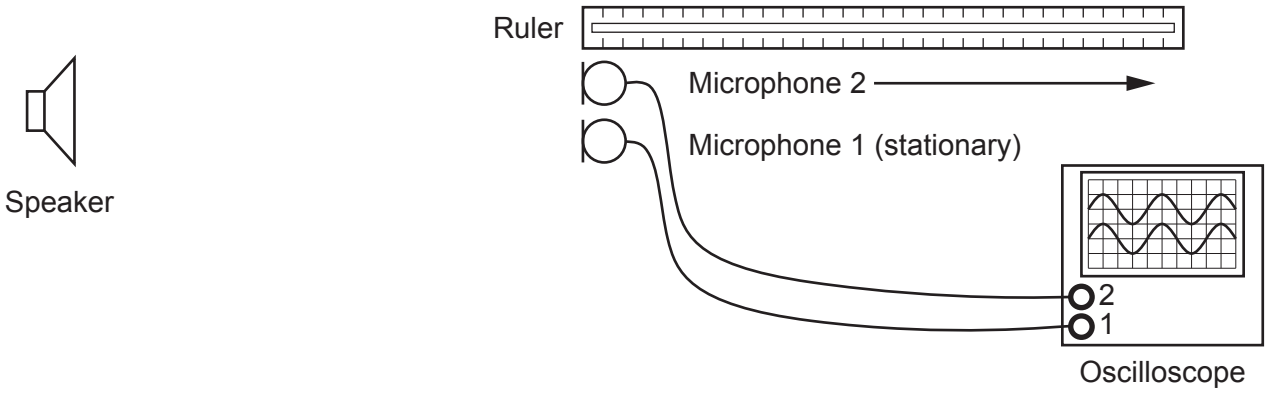

Fig. 13.4

- The speaker is connected to a signal generator.
- The speaker emits sound with a frequency of 1200 Hz.
- Microphone 2 is moved 0.29 m to the right of microphone 1.
- The traces on the oscilloscope screen are **one wavelength** apart.

(i) Calculate the wave speed of sound.

Wave speed = ... m/s **[3]**

(ii) Suggest how this experiment can be improved.

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

(iii) The speed of sound can also be calculated using echoes and a large wall.

Explain how.

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

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14 This question is about the way electricity is used in the home.

(a) The national grid transfers electrical power from power stations.

The table shows information for different types of power line.

	Power line 1	**Power line 2**	**Power line 3**
Voltage (V)	400 000	200 000	100 000
Current (A)	125	250	
Power loss (W)	46 875	187 500	750 000

(i) The resistance of each power line is 3 Ω.

Calculate the current in **power line 3**.

Use the equation: power = current^2 × resistance

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

(ii) Explain how power loss is reduced in the national grid.

Use the values for **power line 1** and **power line 2** to help you.

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

(b) In **Fig. 14.1**, an electrician wires an electrical socket next to a sink.

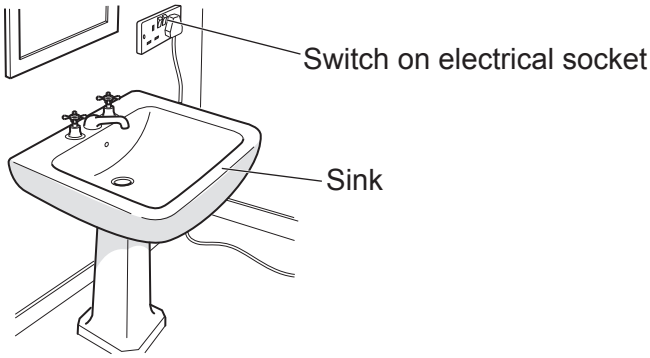

Fig. 14.1

The switch on the socket is open. Explain why this situation is dangerous if water enters the socket.

Write about the live wire and earth wire in your answer.

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

15* A turbine contains a rotating blade.

Fig. 15.1 is a diagram of a wind turbine and **Fig. 15.2** is a diagram of a water (tidal) turbine.

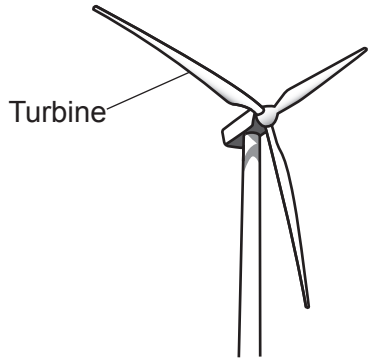

Fig. 15.1

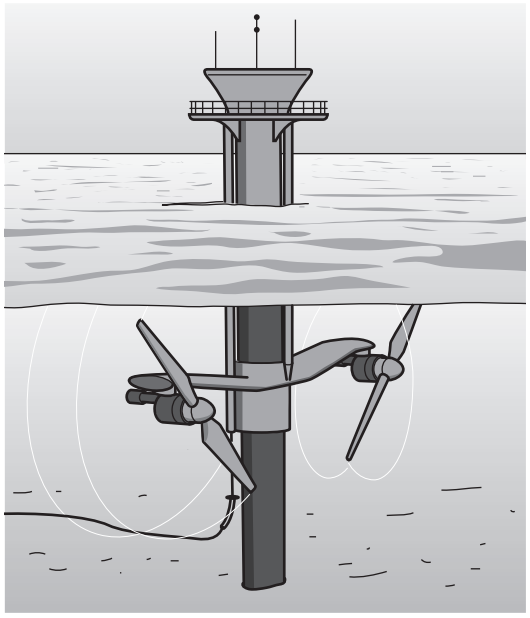

Fig. 15.2

A volume of air (wind) or water (tidal) flows through the turbine every second.

Some of the **kinetic energy** of the air or water is transferred.

This table gives information about wind and tidal turbines:

	Wind energy	**Tidal energy**
Density of air or water (kg / m^3)	1.2	1020.0
Typical air or water speed (m / s)	5	5
Volume of air or water through turbine in 1 second (m^3)	38 000	8
Efficiency	0.60	0.75

Compare the advantages and disadvantages of using each type of turbine.

Use kinetic energy calculations to support your answer.

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END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).