OCR
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Wednesday 1 December 2021 – Afternoon
GCSE (9–1) Combined Science (Physics) A (Gateway Science)

J250/06 Paper 6 (Foundation Tier)

Time allowed: 1 hour 10 minutes

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.
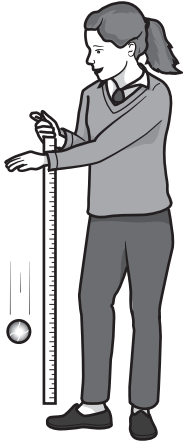
Turn over

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   A student drops a ball from a height of 1 m. They measure the bounce height.

One of their results in the table is an outlier.

Attempt	1	2	3	4
Bounce height (cm)	54	56	52	38

Which result is the outlier?

A   38 cm

B   52 cm

C   54 cm

D   56 cm

Your answer [   ]   **[1]**

2   Which sentence describes a feature of the **live** wire in a plug?

A   It carries current to earth if there is a fault.

B   It completes the circuit.

C   It is at a potential difference of 230 V compared to earth.

D   It melts if the current is too small.

Your answer [   ]   **[1]**

3 A 2.5 kW electric radiator is used for 2 hours.

Calculate the energy transferred.

Use the equation: energy transferred = power × time

A 1.25 kWh

B 5 kWh

C 1250 kWh

D 5000 kWh

Your answer [ ] **[1]**

4 The braking distance for a car is 25 m. The braking force is 4000 N.

Calculate the work done by the brakes.

Use the equation: work done = force × distance

A 1.6 J

B 100 J

C 160 J

D 100 000 J

Your answer [ ] **[1]**

5 A student investigates how **hot** water in an insulated beaker cools.
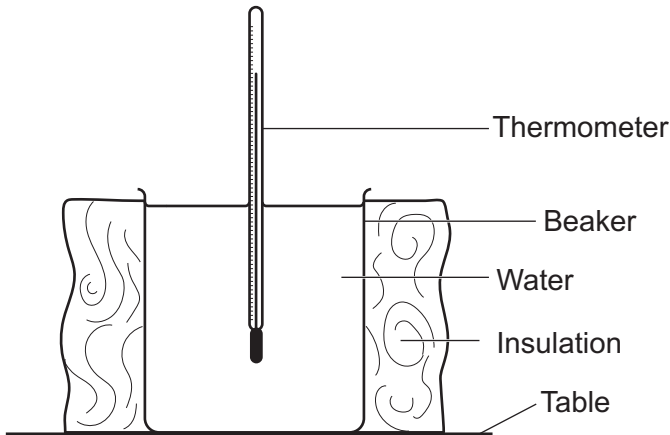
They test how the thickness of insulation affects the rate of cooling.

Which row in the table describes a suitable method for this investigation?

	What the student changes	What the student measures
A	temperature drop of water	thickness of insulation
B	temperature rise of water	thickness of insulation
C	thickness of insulation	temperature drop of water
D	thickness of insulation	temperature rise of water

Your answer [1]

6 Why are step-up transformers used in the national grid?

A To generate alternating currents.

B To increase the current from power stations.

C To increase the voltage from power stations.

D To reduce pollution from power stations.

Your answer [1]

7 P, Q, R and S are isotopes.

^4_2P ^6_3Q ^3_2R ^2_1S

Which **two** atoms are isotopes of the **same** element?

A ^4_2P and ^3_2R

B ^6_3Q and ^3_2R

C ^3_2R and ^2_1S

D ^4_2P and ^2_1S
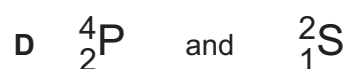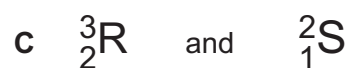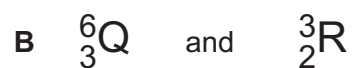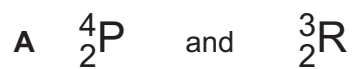
Your answer [ ] **[1]**

8 A car of mass 1000 kg is travelling at 5 m/s.

Calculate the kinetic energy of the car.

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

A   2500 J

B   5000 J

C   12 500 J

D   25 000 J

Your answer [ ] **[1]**

Turn over

9 Which row in the table explains why a safety belt is a safety feature in a car?

	Deceleration of driver	**Force on driver**
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

Your answer [1]

10 Which factor increases **both** thinking distance **and** braking distance?

A Drinking alcohol

B Icy roads

C Increasing speed

D Worn tyres

Your answer [1]

SECTION B

Answer **all** the questions.

11 This question is about two radioactive isotopes, **X** and **Y**.

(a) Draw lines to connect each **part of the atom** with its correct **description**.

Part of the atom	Description

Electrons

Usually found in the nucleus.

Neutrons

Unstable in radioactive isotopes.

Nucleus

Arranged in shells around the nucleus.

Protons

[3]

(b) Isotope **X** gives out gamma rays.

(i) The charge on the nucleus of isotope **X** stays the same.

What happens to the mass number of the nucleus?

.... **[1]**

(ii) Isotope **X** is stored safely in a container.

Suggest a material for the container.

....

.... **[1]**

(c) Describe how an object can be **irradiated** using isotope **X**.

....

....

....

.... **[2]**

(d) Equal amounts of isotope **Y** are placed in a plastic box and in a cardboard box.

Table 11.1 gives information about both boxes.

	Plastic box	**Cardboard box**
Waterproof	yes	no
Material breaks easily	no	yes
Secure lid	yes	no

Table 11.1

(i) Which box is best for storing isotope **Y**?

Give **one** reason for your answer using the information in **Table 11.1**.

....

....

.... **[1]**

(ii) The plastic box does not let any of the radiation emitted by isotope **Y** pass through it.

Which type of radiation does isotope **Y** emit?

.... **[1]**

(e) The graph shows how the quantity of isotope **Y** changes with time.
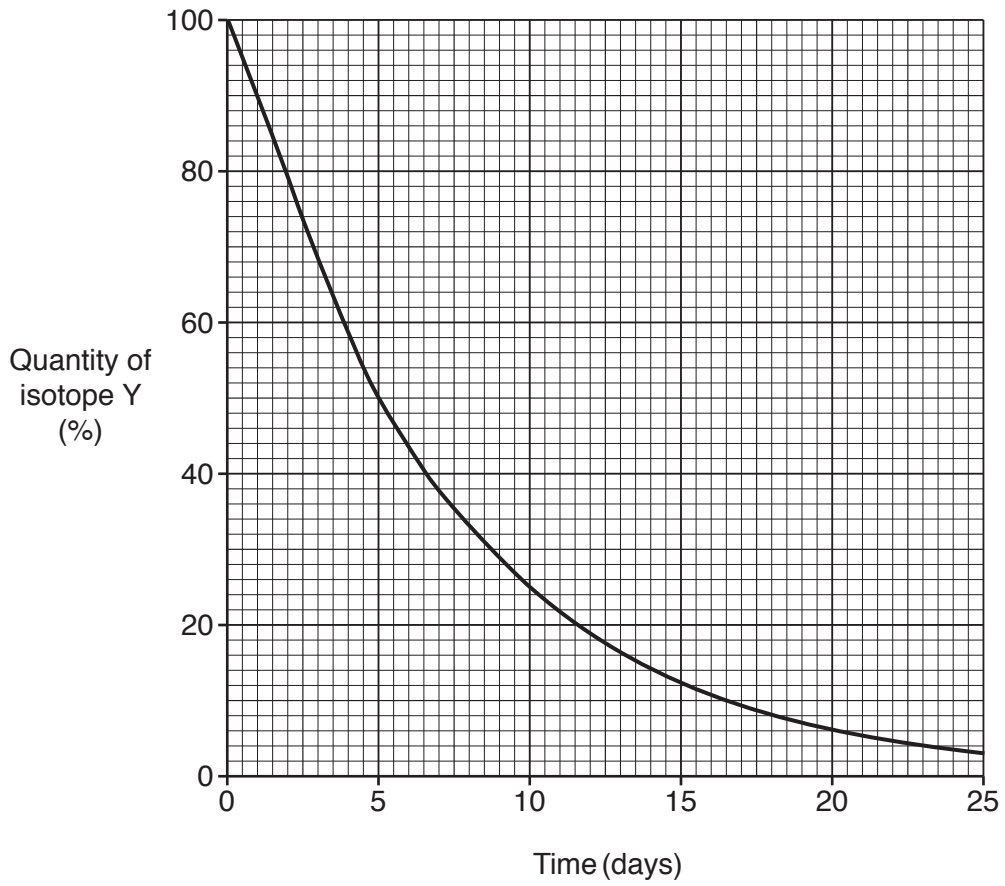
(i) Complete **Table 11.2** using the graph to help you.

Time (days)	Quantity of isotope Y (%)
5	....
10	....

Table 11.2

[1]

(ii) Explain why the half-life of isotope **Y** is 5 days.

....

.... [1]

Turn over

12 This question is about energy changes in different situations.

(a) A car moving at a constant speed has 60 000 J of energy in its kinetic energy store. **Fig. 12.1** shows the change in the kinetic energy store and the thermal energy store as the car brakes, and after the car stops.

Car braking   After car stops

Kinetic energy store decreases   Kinetic energy store = 0 J
Thermal energy store increases   Thermal energy store = 60 000 J

Fig. 12.1

(i) Define **braking distance**.

....

.... **[1]**

(ii) • The braking distance is 6 m.

 • The thinking distance is 6 m.

Calculate the **stopping distance.**

Stopping distance = ... m **[1]**

(b) Explain how **Fig. 12.1** shows the law of conservation of energy.

....

....

....

.... **[2]**

(c) Complete these sentences about energy stores.

You can use each word once, more than once, or not at all.

chemical   gravitational   kinetic   magnetic   nuclear   thermal

- A student rolls a ball up a hill. The ball stops at the top of the hill.

  A kinetic store decreases. A .... store increases.

- A car accelerates.

  A chemical store decreases. A .... store increases.

- Uranium fuel rods are used in a power station to produce electricity.

  An electric kettle boils water.

  A nuclear store decreases. A .... store increases.

[3]

Turn over

(d) A student measures the increase in the temperature of a metal block when it is heated.

Fig. 12.2 shows the apparatus that the student uses.
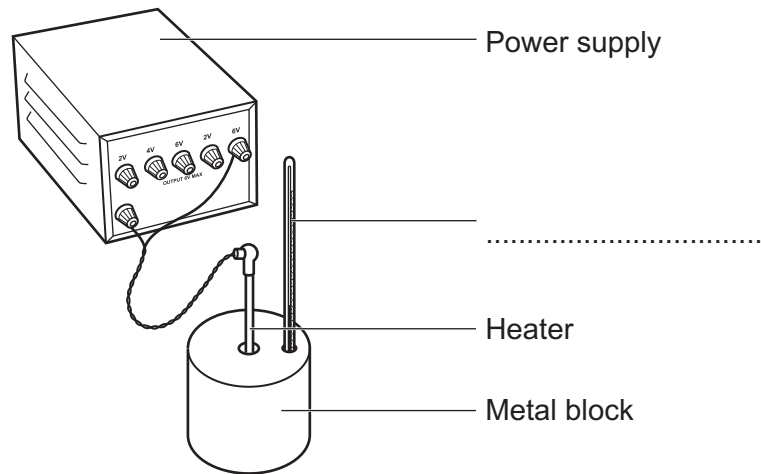
Fig. 12.2

(i) Complete the missing label on the diagram. **[1]**

(ii) • The specific heat capacity of the block is 500 J/kg °C.

• The mass of the block is 0.5 kg.

• Its temperature increases by 20 °C.

Calculate the energy transferred to the block.

Use an equation from the Data Sheet to help you.

Energy transferred = ... J **[2]**

13 This question is about waves.

(a) Two students are watching a tap dripping water into a bowl. As the water drips, it makes waves in the bowl, as shown in **Fig 13.1**.

Fig. 13.1

(i) The students want to calculate the frequency of the waves in the bowl.

Define frequency.

....

.... **[1]**

(ii) In 10 seconds, 10 waves are made in the bowl.

State the frequency of the waves.

Frequency = ... Hz **[1]**

(iii) The students want to measure the wavelength of the water's waves.

Describe a way for them to do this **accurately**.

....

....

....

.... **[2]**

(b) Sound is a longitudinal wave.

Fig. 13.2 shows one particle in a sound wave travelling in air.

Show how the air particle moves by adding **two** arrows to **Fig. 13.2**.

○   ⟶
                                    Direction of
                                    energy transfer

Fig. 13.2

[1]

(c) Storms can produce thunder and lightning.

(i) The speed of light is 3×10^8 m/s.

Estimate how many times **greater** the speed of light is than the speed of sound.

....

.... [1]

(ii) A storm is 1340 m away.

A student sees the lightning and then hears the thunder 4 s later.

Calculate the speed of sound.

Use the equation: distance travelled = speed × time

Speed of sound = ... m/s [3]

(d) The speed of sound can be worked out using two different methods.

Method 1: Clapping your hands and timing the echo from a wall.

Method 2: Measuring the time to hear the thunder after seeing the lightning.

Which method is better?

Explain your answer.

....

....

....

.... **[2]**

14* Student **A** does an experiment to measure the reaction time of student **B**.
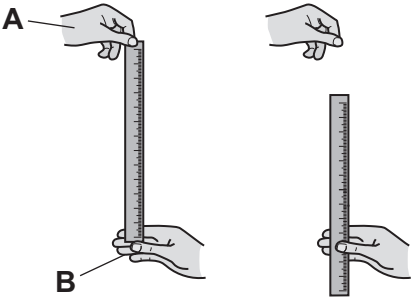
They use a 30 cm ruler. **Table 14.1** shows their method.
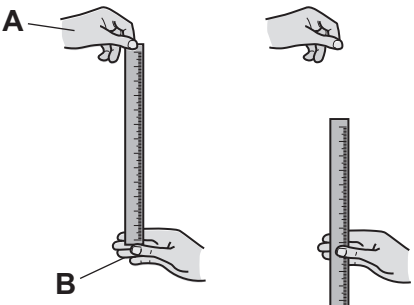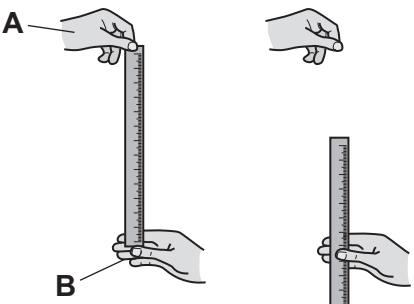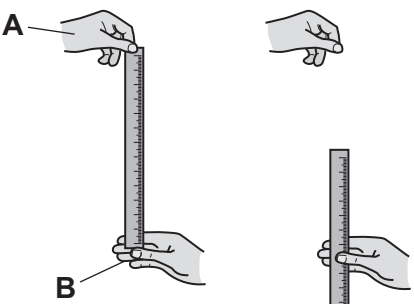
Test	Time before dropping ruler (s)	Starting height of ruler above thumb of student B (cm)	How ruler was dropped
1	2	0.0	
2	20	0.0	
3	5	0.0	
4	8	0.0	

Table 14.1

Describe how student **A** measures the reaction time of student **B**, **and** how the students obtain accurate and precise results.

Use the method shown in **Table 14.1** to support your answer.

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....

.... **[6]**

Turn over

15 (a) Radio waves are electromagnetic waves and are used for communications.

(i) Suggest why gamma rays are **not** used for communications.

....

.... **[1]**

(ii) Name **one** other electromagnetic wave that is used for communications.

.... **[1]**

(iii) State **one** use of this electromagnetic wave in communications.

.... **[1]**

(b) A TV transmitter emits electromagnetic waves with different frequencies.

Table 15.1 gives information about the waves emitted.

Name of wave	Frequency (MHz)	Wavelength (m)	Energy (10^{-18} J)
BBC A	562	0.533	3.72
ARQ A	571	0.526	3.78
D3&4	578	0.519	3.83
BBC B	586	0.511	3.88
ARQ B	594	0.505	3.94
SDN	691	0.435	4.57

Table 15.1

(i) Using data from **Table 15.1** describe the relationship between **frequency** and **wavelength**.

....

.... **[2]**

(ii) How many significant figures are used in each value in **Table 15.1**?

.... **[1]**

(iii) Calculate the speed of the wave **ARQ B**.

Use the equation: wave speed = frequency × wavelength

Speed = ... m / s **[3]**

(c) A TV transmitter has a useful output energy transfer of 100 kJ in 1 second.

The input energy is 250 kJ in 1 second.

Calculate the efficiency of the TV transmitter.

Efficiency = ... **[3]**

END OF QUESTION PAPER

20

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).

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