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# GCSE (9–1) in Combined Science B (Twenty First Century Science)

**F**

**J260/03 Physics (Foundation Tier)**

Sample Question Paper

# Date – Morning/Afternoon

Time allowed: 1 hour 45 minutes

**You must have:**
- a ruler (cm/mm)
- the Data Sheet

**You may use:**
- a scientific or graphical calculator

*SPECIMEN*

\* ○ ○ ○ ○ ○ \*

| First name | |
|---|---|
| **Last name** | |

| **Centre number** | | | | | | **Candidate number** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

## INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

## INFORMATION
- The total mark for this paper is **95**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in the question marked with an asterisk (*).
- This document consists of **20** pages.

Answer **all** the questions.

1   A refrigerator uses mains electricity to compress a gas into a liquid.
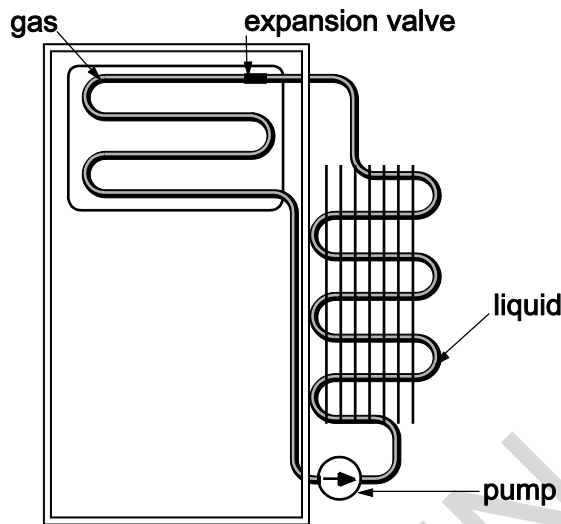


   **(a)**   The density of the gas is different to the density of the liquid.

   Explain the difference in density between the gas and the liquid.

   Use ideas about the arrangement of molecules in your answer.

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**(b) (i)** When the liquid expands and turns back into a gas the temperature of the fridge changes.

Complete the following sentences about the liquid becoming a gas.

Use terms from the list.

> **apart     heat capacity     higher     latent heat     lower     together**

When the liquid changes to a gas, energy is needed to move the molecules

………………….....

This energy is the ……………………………………..

The energy is taken from the air inside the fridge, which makes the temperature inside

the fridge become ………………………………

**[3]**

**(ii)** After the gas has all been compressed into a liquid, the temperature of the liquid begins to rise.

Write down the **three** equations that can be used to link the electrical energy used by the pump and the internal energy of the liquid.

**1** …………………………………………………………………………………………………..

**2** …………………………………………………………………………………………………..

**3** …………………………………………………………………………………………………..

**[3]**

**(iii)** The pump is connected to the mains at 230 V and uses a current of 3 A.

Calculate the power of the pump.

…………………..W     **[3]**

**(iv)** A charge of 2160 C flows through the refrigerator.

Calculate the time in minutes that the fridge was on for.

Use the equation below in your answer:

Charge flow = current x time

………………… minutes    **[4]**

**2** On his car driving test, Amiri has to do an emergency stop.

When the driving test examiner makes a loud noise, Amiri has to stop the car as soon as he can.

Amiri reacts as quickly as he can and pushes down on the car brake pedal.

**(a)** **(i)** It takes 0.1 minutes for the car to stop, after Amiri pushes on the brake. The car travels 58m in that time.

What is the average speed of the car?

…………………m/s   **[3]**

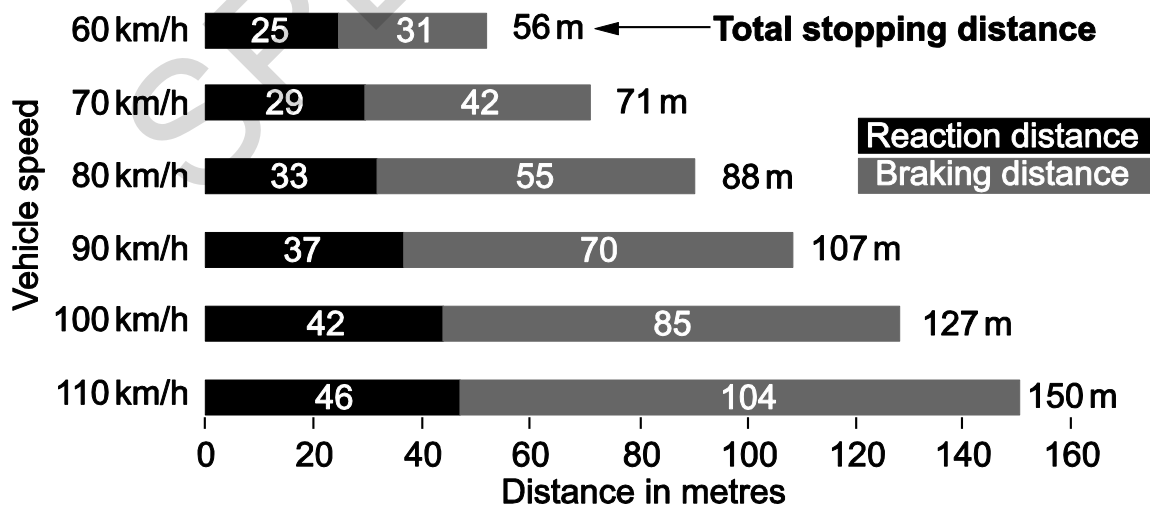**(ii)** The car starts at a speed of 15m/s before breaking and coming to rest in 5 seconds.

Calculate the deceleration of the car in this time.

Use the equation below in your answer.

Deceleration = (final speed – initial speed)
                              time

– (minus) ………………m/s² **[2]**

**(b)** Amiri had to learn about stopping distances for the theory part of his driving test.



**How long it takes to stop (driving an average sized vehicle)**

**(i)** Use the chart to write down an equation linking the braking distance, reaction distance and stopping distance.

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

6

**(ii)** Amiri says:

> **There is a correlation between reaction distance and speed, because the reaction distance gets longer.**

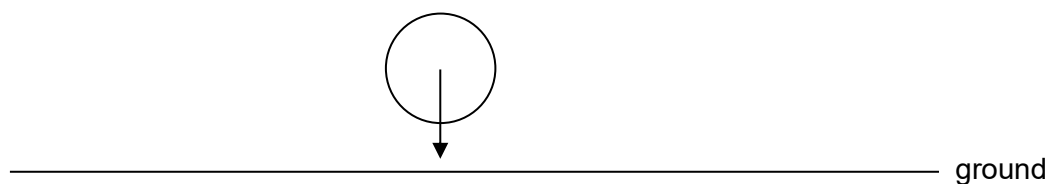Explain why he makes this conclusion.

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. **[2]**

SPECIMEN

**3** **(a)** A ball is falling through the air.



The arrow in the diagram shows the direction of gravity acting down on the ball.

**(i)** **On the diagram** draw an arrow to show the interaction force that is paired with the gravitational force acting on the ball. **[2]**

**(ii)** State Newton's Third Law.

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……………………………………………………………………………………… **[1]**

**(b)** The gravitational force on the ball is called weight.

**(i)** State the equation that shows the relationship between weight and mass.

……………………………………………………………………………………… **[1]**

**(ii)** An object with a mass of 15 kg has a weight of 150 N.

Calculate the weight of an object with a mass of 5 kg.

…………………..N **[2]**

**(c) (i)** The falling ball has a mass of 0.058 kg and falls with an acceleration due to gravity of 10 m/s$^2$.

Calculate the force acting on the ball.

Use the equation below in your answer.

Force = mass x acceleration

………………………..N  **[2]**

**(ii)** Calculate the kinetic energy of the falling ball when its speed is 2.0m/s.
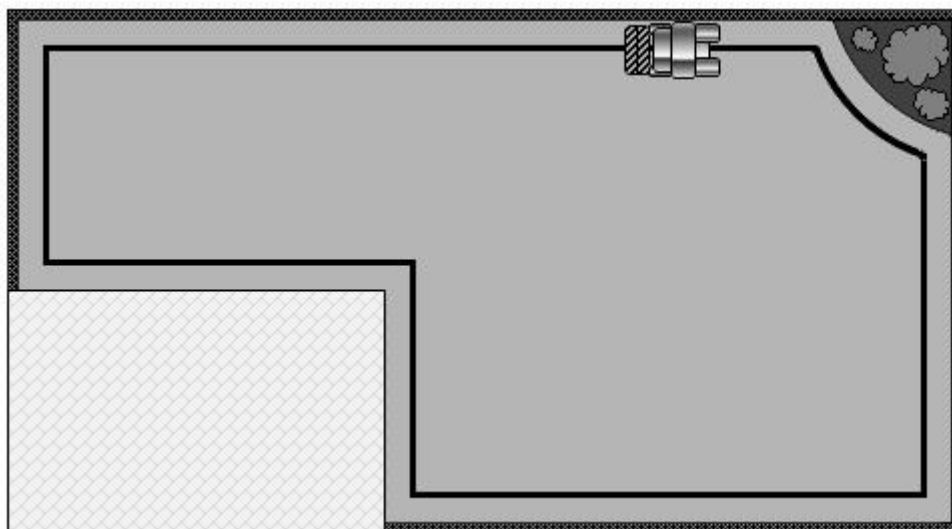
Use the equation below in your answer.

Kinetic energy = $\frac{1}{2}$ x mass x (speed)$^2$

………………………..J  **[2]**

**4** Jasmine has a robot lawnmower.



A wire carrying an electric current marks the edge of the lawn.

**(a) (i)** What is an electric current and what causes the electric current to flow in a wire?

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…………………………………………..…………………………………………………………

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

**(ii)** The lawnmower can detect an electric current of 0.5 A or more in the wire. A 50 m long wire has a resistance of 2.5 Ω.

Calculate the potential difference across the wire needed to produce a current of 0.5 A.

Include the units in your answer.

……………………………… units………….. **[4]**

10

**(b)** Jasmine measured how the potential difference changed with the current in the wire. The graph shows the pattern of her results.
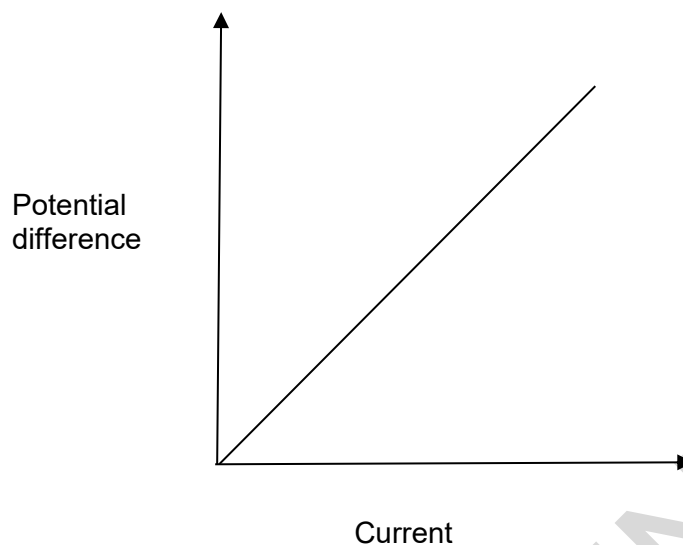


**(i)** Put a tick (✓) in the boxes next to the **two** correct conclusions from the graph.

The wire has no resistance.

The resistance increases with the current.

The resistance increases with the potential difference.
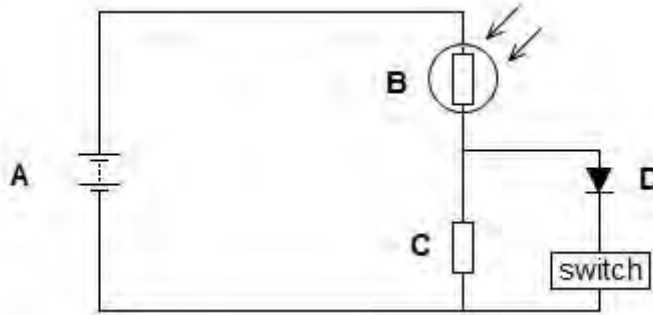
The resistance is fixed.

The wire is a linear part of the circuit.

**[2]**

**(ii)** A longer wire will have a larger resistance.

**On the graph** above draw the line for the longer wire. **[1]**

**(c)** Jasmine thinks the robot lawnmower is too noisy to use at night.

She builds a circuit which uses a Light Dependent Resistor (LDR) to detect the light level and switch the lawnmower off at night.



**(i)** Which component in the circuit is the LDR?

Put a ring around the correct letter.

        **A**        **B**        **C**        **D**

**[1]**

**(ii)** The LDR is sensitive to light.

What property of the LDR changes when the light level changes?

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

**5** The table shows the results of an investigation into some materials used as shielding against gamma radiation.

| Material | Thickness that absorbs half the gamma radiation (cm) | Density (g/cm$^3$) | Mass that absorbs half the gamma radiation (g/cm$^2$) |
|---|---|---|---|
| lead | 1.0 | 11.3 | 12 |
| steel | 2.5 | 7.86 | 20 |
| concrete | 6.1 | 3.33 | 20 |
| packed soil | 11.3 | 1.60 | 18 |
| loose soil | 15.0 | 1.20 | 18 |
| water | 18.0 | 1.00 | 18 |
| wood | 29.0 | 0.56 | 16 |
| air | 15 000 | 0.0012 | 18 |

**(a)** How well the material absorbs gamma radiation is dependent on its density.

**(i)** Describe how the density of the material and the thickness needed to absorb half of the radiation are linked.

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**(ii)** State the equation for density.

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**(b)** What would be the best material to use in a hospital radiography department where the shielding must be portable?

Justify your answer.

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**(c)** Use values from the table above. Calculate the volume of concrete used.

…………………….cm$^3$ **[4]**

**6** Earthquakes cause waves that travel through rocks. These are called seismic waves.

Three types of seismic waves are produced.

**S – waves:** particles in the rock move from side to side, at right angles to the direction of the wave.

**P – waves:** particles in the rock move backwards and forwards in the direction of the wave.

**L – waves:** move along the surface of the Earth making the ground move up and down.

**(a)** A wave has a wavelength of 500 m and a frequency of 15 Hz.

Calculate the wave's speed and state the units.

…………………………. units ………… **[4]**

**(b)** Scientists can use seismic waves to find out about the structure of the earth.

**(i)** Scientists can tell when the rocks change by the refraction and reflection of waves.

What is the effect of reflection on a wave?

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………………………………………………………………………………………… **[2]**

**(ii)** What is the effect of refraction on a wave?

…………………………………………………………………………………………………

………………………………………………………………………………………… **[2]**

**(iii)** The scientists have discovered that the core of the Earth is liquid. This is because one of the waves cannot pass through a liquid.

Which wave cannot pass through the liquid at the Earth's core?

Justify your answer.

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………………………………………………………………………………………… **[2]**

**7** Here is part of a leaflet given to patients of a local hospital.

> **Safe and Painless Diagnosis for Kidney Patients**
>
> You can obtain images of your kidneys by using a radioisotope.
>
> The radioisotope quickly passes into your kidneys and then into your bladder and is then excreted.
>
> The radioisotope emits gamma radiation.

**(a) (i)** It is important that this radioisotope should have a short half-life.

Suggest why.

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

**(ii)** The hospital uses technetium-99 as the radioisotope.

The half-life of technetium-99 is 6 hours.

How long will it take for the activity of a sample of technetium-99 to fall to one eighth of its starting value?

…………………..hrs **[2]**

**(b)** Alpha and beta radiation are not suitable for obtaining images of inside the body.

Explain why.

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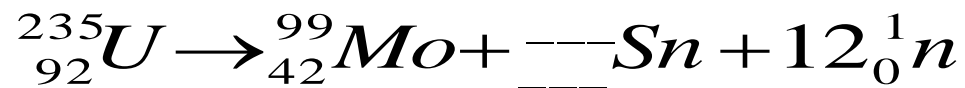……………………………………………………………………………………………………

………………………………………………………………………………………………… **[3]**

15

**(c)** Technetium-99 is produced by the radioactive decay of molybdenum (Mo).

Molybdenum is produced in nuclear reactors by the fission of uranium.

Tin (Sn) and some neutrons (n) are also produced.

$$^{235}_{92}U \longrightarrow {}^{99}_{42}Mo + {}^{\_\_\_}_{\_\_\_}Sn + 12{}^{1}_{0}n$$

Write the mass number and atomic number of the tin (Sn) in the **spaces in the equation.**

**[2]**

SPECIMEN

**8\*** An island is struggling with the energy demand of its inhabitants and will need to produce more electricity in the future.

Information about the islands electricity production is given below.

| Predicted electricity consumption | 18,880,000 kWh |
|---|---|
| Current electricity production | 16,000,000 kWh |
| Produced by burning oil and peat | 100% |
| Produced by hydroelectricity | 0% |
| Produced by nuclear | 0% |
| Produced by wind | 0% |
| Produced by waves/tides | 0% |
| Oil imported | 248.9 barrels/day |
| Peat used for fuel | 13,000 ton/year |

The island is keen not to import any more oil.

What might the environmental minster advise as a plan for the island's future production of electricity?

Use the data in the table in your answer.

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J260/03

**9** Here is a picture of a mountain bike. The rider makes the pedal turn in a circle, which results in the bike moving.



suspension with spring

**(a)** **On the diagram** draw labelled arrows to show:

1 The force that does work to make the bike move.

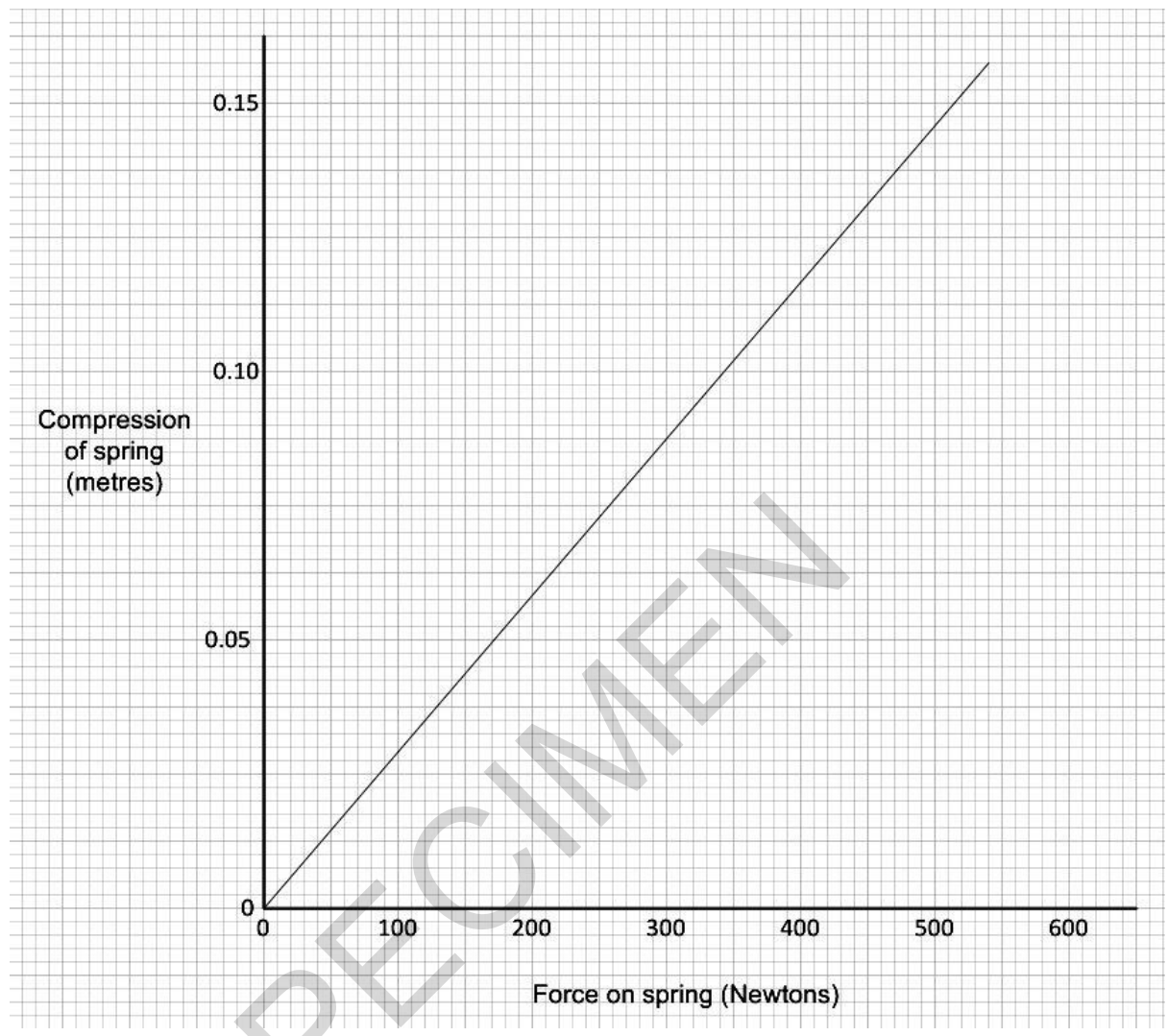2 The friction force that moves the bike forwards.

**[2]**

**(b)** There is a spring in the front wheel suspension fork. Each time the rider pushes down on the pedal, the spring is compressed.

When the bike hits a tree stump, a force of 510 N compresses the spring by 15 cm.

Calculate the spring constant of the spring.

………………..N/m  **[4]**

18

**(c)** The graph shows the force and compression for the spring.



**(i)** Use the graph to find how much energy is stored in the spring each time the pedal is pushed down.

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

**(ii)** Explain how you found your answer.

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**(d)** Explain why the spring will result in the bicycle not going as fast as it would without the spring.

Use ideas about energy in your answer.

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**END OF QUESTION PAPER**