OCR
Oxford Cambridge and RSA

F

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

J260/03 Physics (Foundation Tier)

Wednesday 23 May 2018 – Afternoon

Time allowed: 1 hour 45 minutes

You must have:
- a ruler (cm/mm)
- the Data Sheet (for GCSE Combined Science B (inserted))

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

First name	
Last name	

Centre number						Candidate number				

INSTRUCTIONS
- The Data Sheet will be found inside this document.
- 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. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

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 **28** pages.

Answer **all** the questions.

1 This question is about electromagnetic radiation.

(a) Which of the following is electromagnetic radiation?

Put a (ring) around the correct answer.

radio waves **sound waves** **water waves** **waves on a rope**

[1]

(b) Amaya uses a prism to produce a spectrum of the electromagnetic radiation from the Sun, as shown in **Fig. 1.1**.

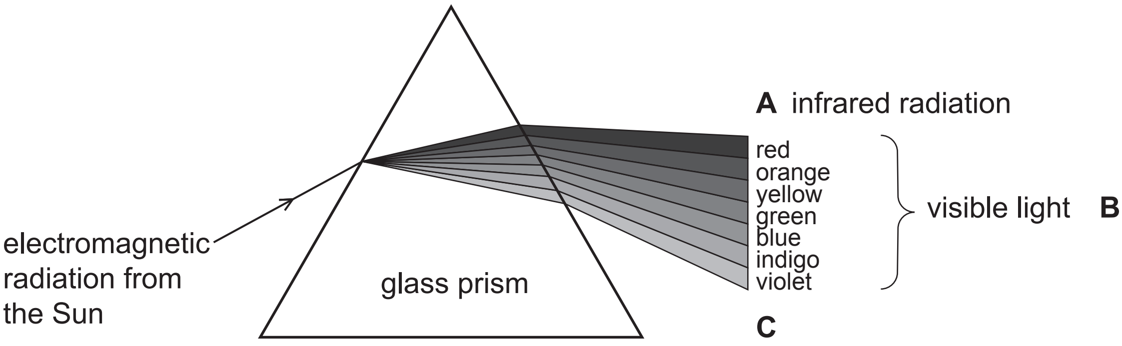


Fig. 1.1

(i) What is the electromagnetic radiation arriving at point **C** in **Fig. 1.1**?

Tick (✓) **one** box.

Microwave ☐

Sound wave ☐

Ultraviolet ☐

X-ray ☐

[1]

(ii) Describe how Amaya could detect the infrared radiation arriving at point **A** in **Fig. 1.1**.

....

.... **[2]**

(c) Give **one** example of how infrared radiation can be used.

....

.... **[1]**

2 The largest egg ever recorded was an ostrich egg.

(a) Complete the following sentences about the weight of the egg.

Use words from the list.

area **attraction** **force** **mass** **pressure** **repulsion**

Weight is the .... on the egg due to the gravitational

.... of the Earth.

The weight of the egg is proportional to its .... **[3]**

(b) The egg had a mass of 2.6 kg.
Gravitational field strength = 10 N / kg

Calculate the weight of the egg.

Use the equation: weight = mass × gravitational field strength

Weight = ... N **[2]**

(c) The weight of an egg can be measured by attaching a pan to a Newton meter, as shown in **Fig. 2.1**.

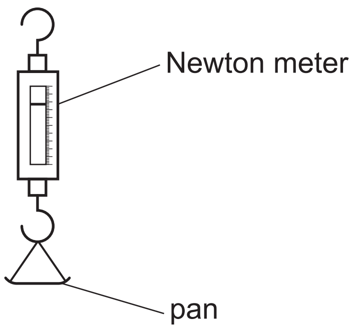


Fig. 2.1

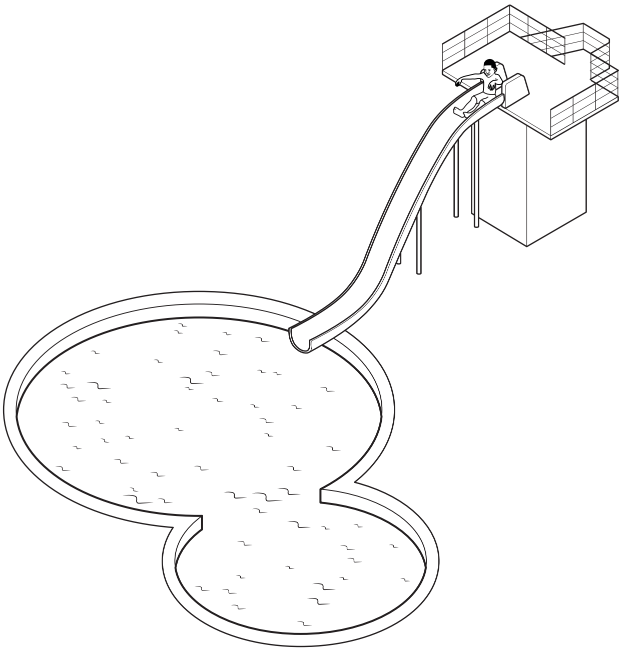
Describe how the weight of an egg can be measured using the apparatus in **Fig. 2.1**.

....

....

.... **[2]**

3 This question is about a water slide.



(a) Ben sits at the top of the slide. The water is **not** flowing and he is **not** moving.

Name the **two** forces acting on Ben and give the direction they act in.

Force 1 ....

Direction ....

Force 2 ....

Direction ....
[4]

(b) The water is switched on and flows past Ben. He can feel the water pushing him, but it does not move him forward.

(i) What force stops him moving forward?

.... **[1]**

(ii) Ben moves himself to the start of the slope. He slides down.

His mass is 40 kg and he accelerates at $5\,m/s^2$.

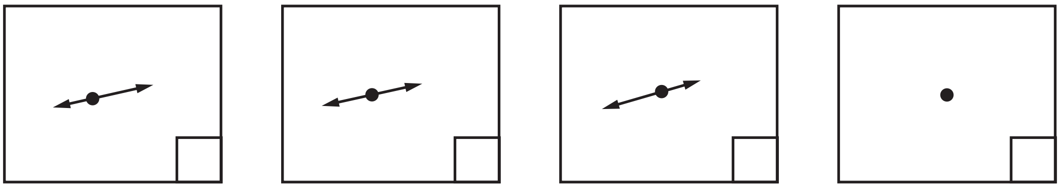
Calculate the force accelerating him.

Use the equation: force = mass × acceleration

Force = ... N **[2]**

(c) Ben reaches the shallow slope at the bottom of the slide. Now he slides at a steady speed.

Put a tick in the box by the diagram that shows the forces on Ben as he slides parallel to the shallow slope.



[1]

4 A portable electric heater can be used with a 12 V car battery to heat a car. **Fig. 4.1** shows the electric circuit for the heater.

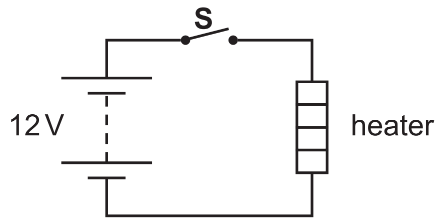


Fig. 4.1

When the switch, **S**, is closed there is a current in the heating element.

(a) Calculate the current in the heater. The power is 165 W.

Use the equation: current = power ÷ voltage

Give the units in your answer.

Current = ... units .... **[3]**

(b) The statements below about the circuit in **Fig. 4.1** are either **true** or **false**.

Put a tick (✓) in the correct box after each statement.

	True	**False**
If the current changes the resistance of the heating element remains constant.		
The size of the current depends on the potential difference across the heating element.		
The size of the current depends on the resistance of the heating element.		

[3]

(c) Energy is transferred from the car battery, by the electric current and the heater, to the air in the car.

(i) What is the energy store at the start?

Tick (✓) **one** box.

Chemical ☐

Elastic ☐

Gravitational ☐

Thermal ☐

[1]

(ii) Complete these sentences to describe how the energy is transferred in the circuit in **Fig. 4.1**.

Put a (ring) around the correct answer.

The electric current transfers energy by **doing work / storing energy / convection** on the heater.

The heater transfers energy by **electricity to / storing energy for / heating** the air in the room.

[2]

(iii) What is the energy store at the end?

Tick (✓) **one** box.

Chemical ☐

Elastic ☐

Gravitational ☐

Thermal ☐

[1]

(d) The energy transferred depends on the length of time that the heater is switched on.

(i) Write down an equation that links the energy transferred with the power of the heater and the time it is switched on.

.... **[1]**

(ii) The power of the heater is 165 W.

Calculate the energy transferred in 60 s.

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

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

5 Sound waves can be used to measure distances.

(a) (i) Sound is a longitudinal wave.

Describe the difference between a longitudinal wave and a transverse wave.

You may draw labelled diagrams to help you describe the waves.

....

....

.... **[2]**

(ii) Put a (ring) around the correct word to complete the following sentence:

An echo is heard when sound waves are **absorbed / amplified / reflected / refracted**.

[1]

(b) **Table 5.1** shows the speed of sound in different materials.

Material	Speed of sound (m/s)
air	340
bone	4100
iron	
rock	6000
seawater	1500

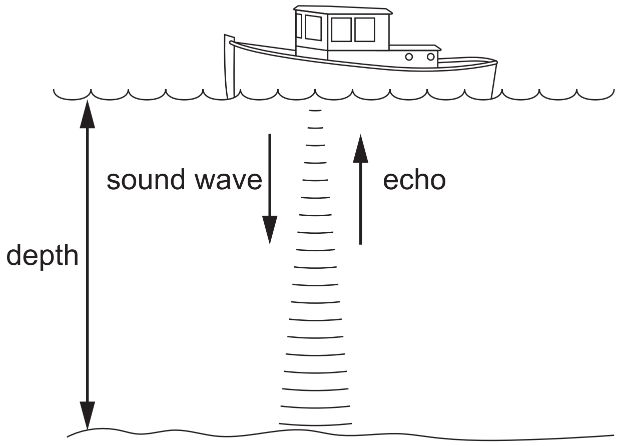
Table 5.1

(i) The speed of sound in iron is 18 000 **kilometres per hour (km/h)**.

Calculate the speed of sound in **iron** in **metres per second (m/s)**.

Speed of sound = ...m/s **[2]**

(ii) A boat uses the echo of sound waves from the sea-bed to measure the depth of the sea.



A sound wave is sent towards the sea-bed. The echo returns to the boat after 1.8 s.

Use data from **Table 5.1** to help calculate the distance travelled by the wave.

Use the equation: distance = speed × time

Distance travelled = ... m **[3]**

(iii) What is the depth of the sea?

Depth of sea = ... m **[1]**

(c) Sound waves with a frequency of 20 kHz are called ultrasound. They are used to produce images of inside the body.

Calculate the wavelength of these ultrasound waves in **bone**.

Use data from **Table 5.1** and the equation: wavelength = wave speed ÷ frequency

Give your answer to **2** decimal places.

Wavelength = ... m **[4]**

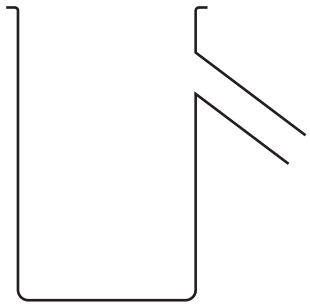
BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

6 Mia is investigating the density of different materials.

(a) Mia has a stone with a mass of 220.0 g. She wants to measure its volume.

She pours water into the can shown in this diagram.



(i) What other equipment does she need to measure the volume of the stone?

.... **[1]**

(ii) State **two** steps Mia must follow when using the can to get an accurate measurement of the volume of the stone.

1 ....

....

2 ....

.... **[2]**

(b) Complete this sentence to define density.

Density is .... **[1]**

(c) **(i)** Mia repeats the volume measurement five times.

These are her results.

Measurements	**1**	**2**	**3**	**4**	**5**
Volume of the stone (cm^3)	43.0	44.5	43.0	45.0	44.5

Calculate the mean volume of the stone.

Mean volume = ... cm^3 **[2]**

(ii) Calculate the density of Mia's 220.0 g stone.

Use your answer to part **(c)(i)**.

Density = ... g / cm^3 **[3]**

(d) **Table 6.1** gives the densities of some materials.

Material	Density (g/cm^3)
chalk	2.3
sandstone	2.3
granite	2.7
malachite	3.9
haematite	5.1

Table 6.1

(i) Which of the materials in **Table 6.1** could Mia's stone be made of?

Tick (✓) **one** box.

Chalk ☐

Sandstone ☐

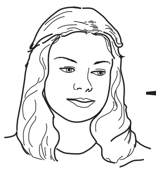
Granite ☐

Malachite ☐

Haematite ☐

[1]

(ii) Mia discusses her experiment with Sundip.



Mia
Measuring the density is a useful way to identify any type of rock.

Sundip
I don't think you can identify rocks by their density alone.

Use the data in **Table 6.1** to help you decide whether Mia or Sundip is correct.

Explain your reasoning.

....

....

....

.... **[3]**

7 This question is about radioactive decay.

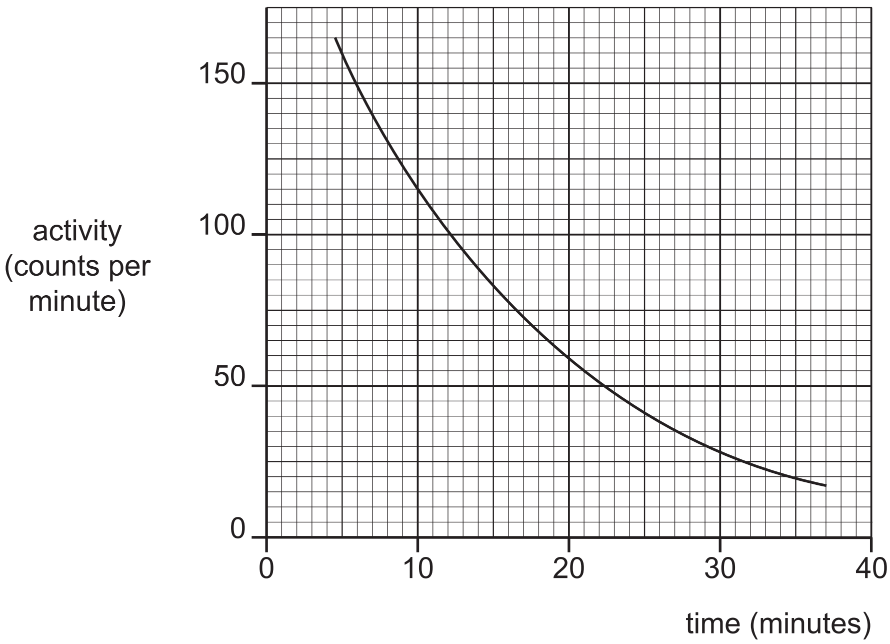
(a) Explain what the half-life of a radioactive isotope means.

....

....

.... **[2]**

(b) This graph shows how the activity of a cerium-131 source changes over time.



Use the graph to find the half-life of cerium-131.

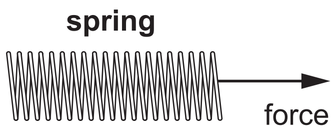
Show your working on the graph.

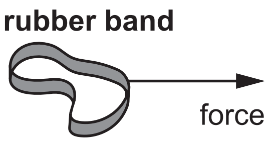
Half-life = ... minutes **[2]**

8 Alex and Jack are talking about stretching objects.

Alex
The diagrams below show how a spring and a rubber band can be stretched.

Jack
I don't agree. The force will just move the rubber band or the spring.





(a) Is Alex or Jack correct?
Give a reason for your answer.

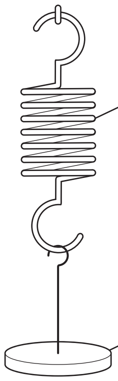
Alex ☐

Jack ☐

Reason ....

.... **[1]**

(b) Alex wants to know how much a spring will extend when he hangs different masses from the end of it.



He attaches a mass to the end of the spring and records its weight, in N, and the extension of the spring. He repeats this for different masses.

(i) State **two** safety precautions he should take while doing the experiment.

1 ....

....

2 ....

.... **[2]**

(ii) Alex did not know how to work out the extension of the spring.

What measurements should Alex record and how should he use them to find the extension?

....

....

....

.... **[3]**

Alex plots the results of his experiment on the graph shown in **Fig. 7.1**.

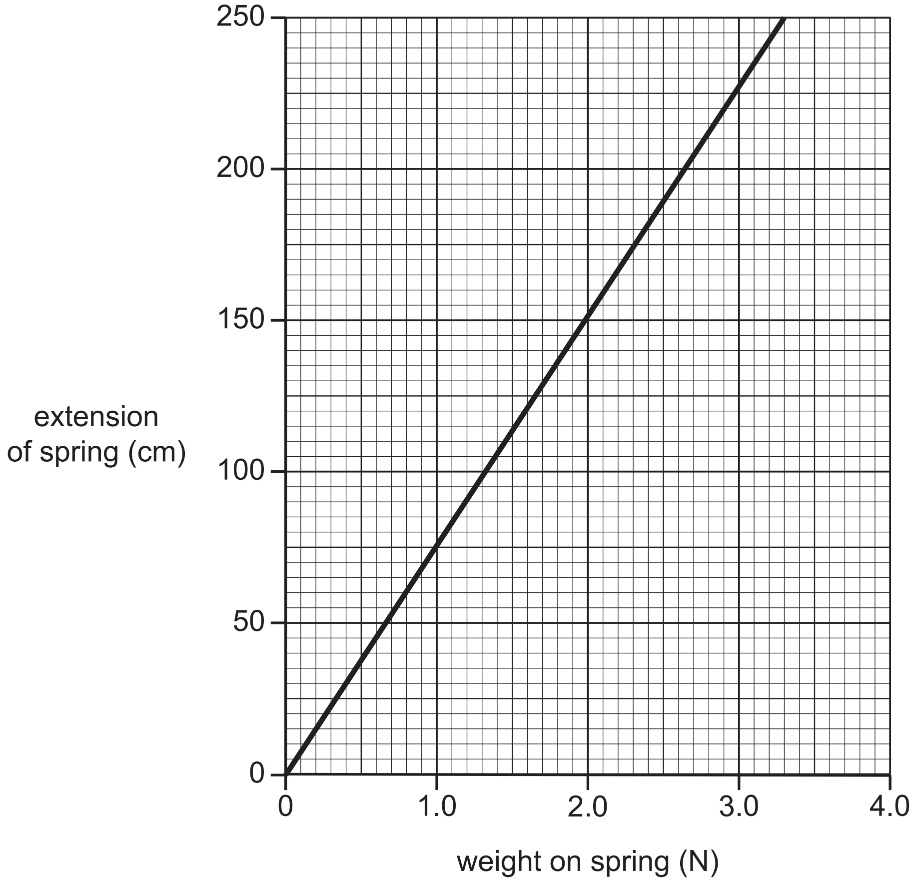


Fig. 7.1

(iii) Alex removes all the masses from the spring. He hangs a toy with a weight 1.2 N on the spring.

Use the graph in **Fig. 7.1** to find the extension of the spring.

Extension = ...cm **[1]**

(c) Alex has a second spring. It has a spring constant = 8.0 N / m.

He hangs a bigger toy on this spring and the extension of the spring is 35 cm.

Calculate the weight of this toy.

Weight = ...N **[4]**

(d) The masses are now hung from a rubber band.

Describe how the force - extension relationships for a rubber band and a spring are different.
You may include sketch graphs in your answer.

....

....

.... **[2]**

9 This question is about the structure of the atom.

(a) Describe the structure of the atom.
Include information about particles that make up the atom.
You may include a diagram.

....

....

....

....

....

.... **[5]**

(b) **(i)** What is the size of a typical atom?

Draw a (ring) around the correct answer.

10^{-15} m **10^{-10} m** **10^{-5} m** **10^{-1} m** **10^{5} m** **10^{10} m**

[1]

(ii) How does the size of the nucleus compare to the size of an atom?

.... **[1]**

(c) The development of our modern model of the atom started with the discoveries of J.J. Thomson in 1897.

(i) What did J.J. Thomson discover, that appeared to come from the atom?

.... **[1]**

(ii) The model changed because of J.J. Thomson's discovery. Describe the new model J.J. Thomson suggested.

....

....

....

.... **[3]**

(d) The element carbon has two isotopes, carbon-12 and carbon-14.

What is the difference between these two isotopes?

....

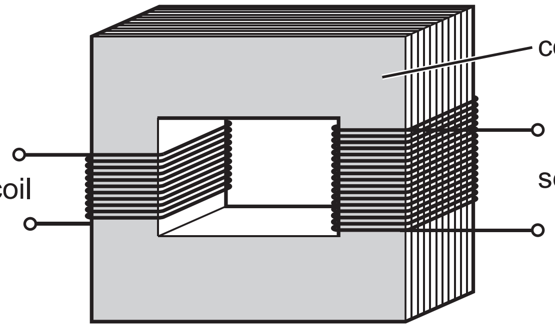
.... **[2]**

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

10* Eve wants to connect an electric pump to the mains electricity supply.

She needs a transformer which can supply enough power for an **output** potential difference of **12 V** and an **output** current of **3 A**.



input power		**output power**
potential difference across primary coil × current in primary coil	=	potential difference across secondary coil × current in secondary coil

She has three transformers to choose from:

	Transformer A	**Transformer B**	**Transformer C**
Maximum input power (W)	30	60	60
Output potential difference (V)	12	12	15

Eve
I want the lowest power transformer that can supply enough output power.

Which transformer should Eve choose?
Justify your answer and use calculations to support your decision.

....

....

....

....

....

....

....

....

....

....

....

.... [6]

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).