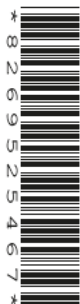**OCR**
Oxford Cambridge and RSA

F

Friday 13 November 2020 – Morning

GCSE (9–1) Physics B
(Twenty First Century Science)

J259/01 Breadth in physics (Foundation Tier)

Time allowed: 1 hour 45 minutes

You must have:
- a ru er (cm/mm)
- the Data Sheet for GCSE (9–1) Phys cs B (ns de th s document)

You can use:
- a sc ent f c or graph ca ca cu ator
- an HB penc

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 answers should be supported with working. Marks might be given for using a correct method, even if the answer is wrong.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- This document has **28** pages.

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

OCR s an exempt Char ty

Turn over

Answer **all** the questions.

1 Jack wants to compare the density of three different foods.
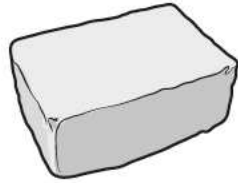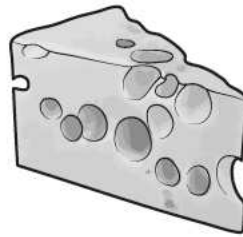
milk   butter   cheese

(a) To calculate density, Jack needs to measure the mass and volume of a sample of each food.

(i) Which measuring instrument should Jack use to measure mass?

Tick (✔) **one** box.

Balance ☐

Measuring cylinder ☐

Metre ruler ☐

Thermometer ☐

[1]

(ii) Which measuring instrument should Jack use to measure the volume of milk?

Tick (✔) **one** box.

Balance ☐

Measuring cylinder ☐

Metre ruler ☐

Thermometer ☐

[1]

(b) Complete the sentences to describe how to measure the volume of the butter.

Use words from the list.

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

add   **measuring cylinder**   **multiply**   **balance**   **divide**   **ruler**

Measure the length, width and height of the butter using a ....

To find the volume, ... these three numbers together.   **[2]**

(c) Jack makes these measurements for the block of butter:

mass = 2.22 kg

volume = 0.0024 m^3

Calculate the density of the butter.

Use the equation: density = mass ÷ volume

Density = ... kg/m^3 **[2]**

(d) The cheese is an irregular solid shape.

Suggest how to measure the volume of the cheese.

....

....

....

.... **[2]**

2 Kareem researches nuclear fission and nuclear fusion.

(a) (i) Complete the sentence to explain what is meant by nuclear fission.

Put a (ring) around the correct answer.

Fission is when nuclei **fuse / grow / shrink / split** to form smaller nuclei. **[1]**

(ii) Complete the sentence to explain what causes nuclear fission.

Put a (ring) around the correct answer.

Fission happens because some nuclei are **negative / positive / unstable / stable**. **[1]**

(b) During nuclear **fission**, energy is released in two main forms.

How is the energy released?

Tick (✓) **two** boxes.

Elastic potential energy of the new particles ☐

Gamma radiation ☐

Gravitational potential energy of the new particles ☐

Kinetic energy of the new particles ☐

Radio waves ☐

Sound waves ☐

[2]

(c) (i) Describe what happens during nuclear **fusion**.

....

....

....

.... **[2]**

(ii) During nuclear **fusion** some of the mass is lost.

What is this mass converted into?

.... **[1]**

5

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

**3** Jane uses a ripple tank to measure the speed of water waves.

(a) The ripples on the surface of the water in the ripple tank are an example of transverse waves.

Describe the difference between transverse and longitudinal waves.

....

....

....

.... **[2]**

(b) The diagram shows a view of part of the ripple tank from above. Waves are travelling from right to left.

A ruler has been placed next to the ripple tank.
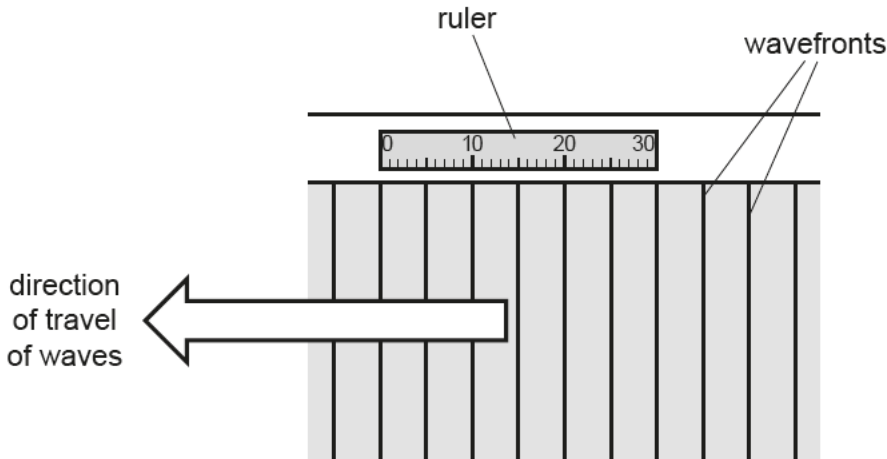
(i) The ruler next to the ripple tank is 0.30 m long.

The ruler is the same length as **6** of the waves.

Calculate the wavelength of the waves.

Wavelength = ... m **[2]**

(ii) Suggest how Jane could use a stopwatch to measure the frequency of the waves in the ripple tank.

....

.... **[1]**

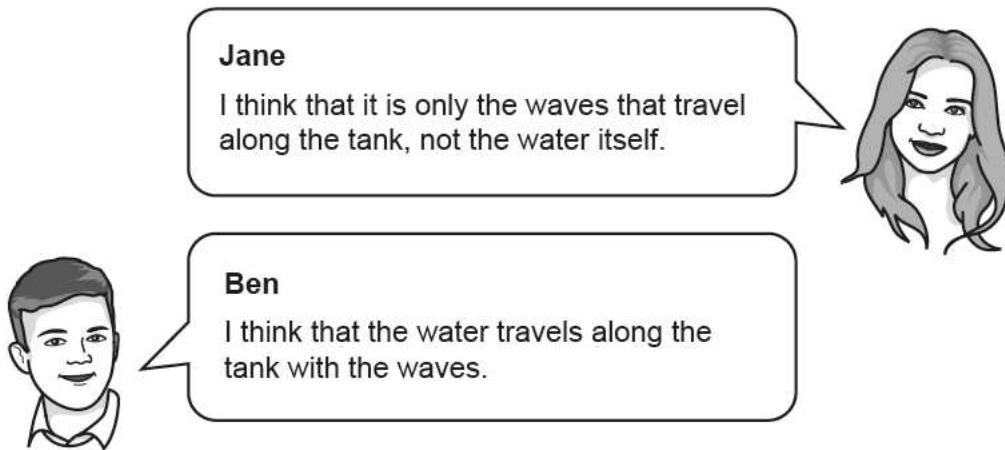**(c)** Ben measures the wavelength of the waves to be 0.08 m.

The frequency of the waves is 3.0 Hz.

Calculate the speed of the waves that Ben measures.

Use the equation: wave speed = frequency × wavelength

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

(d) Jane and Ben talk about the experiment.

Jane

I think that it is only the waves that travel along the tank, not the water itself.

Ben

I think that the water travels along the tank with the waves.

Jane places a small cork on the water to show Ben that she is correct.
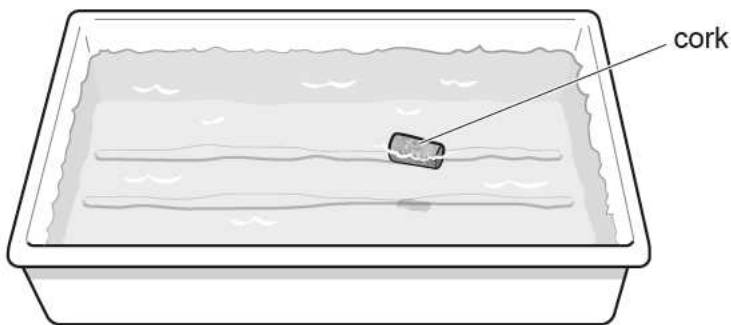
cork

Describe the motion of the cork.

....

....

....

.... **[2]**

4   Eve needs to buy a vacuum cleaner. She compares two vacuum cleaners.

Vacuum cleaner **A** runs using mains electricity. It is connected to the mains using a cable.

Vacuum cleaner **B** does not have a cable. It runs from energy stored in a battery.

(a) Both vacuum cleaners transfer energy from an energy store.

   (i) Name the form of stored energy that is used by wind turbines to generate mains electricity.

   .... [1]

   (ii) Name the form of stored energy in a battery.

   .... [1]

(b) Vacuum cleaner **B** runs out of battery after two hours.

   Describe what has happened to the energy which was stored in the battery.

   ....

   ....

   .... [2]

(c) The table shows some information about the two vacuum cleaners.

Vacuum cleaner	A	B
Input power (W)	700	65
Potential difference (V)	230	11

Calculate the current in vacuum cleaner **B**.

Use the equation: current = power ÷ potential difference

Give your answer to **3** significant figures.

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

(d) (i) Calculate the energy transferred by vacuum cleaner **A** when it is operated for 600 seconds.

Energy transferred = ... J **[3]**

(ii) When both vacuum cleaners are operated for 600 seconds, vacuum cleaner **A** transfers more energy.

Explain why.

....

....

....

.... **[2]**

5 Kai sees this information in an advert for a plane ticket.

> **Weight limit for bags = 20 kg**

Kai thinks this information is wrong.

> The advert does not show weight limits.
> It shows mass limits.

(a) Define **weight**.

....

.... [1]

(b) Kai wants to know if his bag is too heavy to take on the plane. He needs to find its weight.

(i) Name a measuring instrument he could use to find its weight.

.... [1]

(ii) Describe how he can use your answer to (b)(i) to find the weight of the bag.

.... [1]

(c) Kai finds that the weight of his bag is 240 N.

Calculate the mass of the bag.

Gravitational field strength = 10 N/kg

Mass = ... kg **[3]**

6 A Sankey diagram can be used to show how a device transfers energy.

The Sankey diagram below is for a car speeding up.
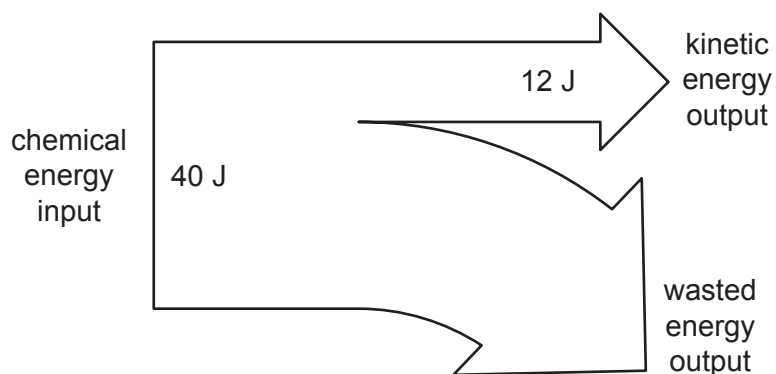
(a) Calculate the wasted energy output.

Wasted energy output = ... J **[1]**

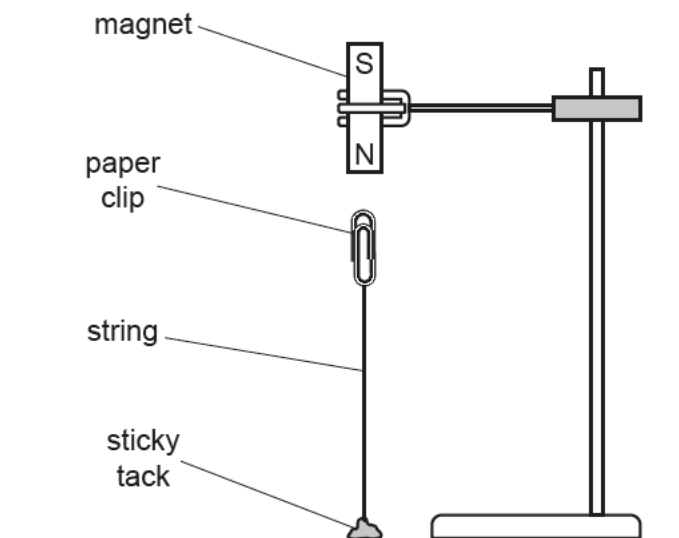**(b)** Calculate the efficiency of the car.

Use values from the Sankey diagram.

Use the equation: efficiency = useful energy transferred ÷ total energy transferred

Give your answer as a **percentage**.

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

7   Sarah's teacher demonstrates some examples of forces.

She sets up the equipment shown below.

(a) One of the forces acting on the paper clip is the attractive force of the magnet.

Name **two** other forces acting on the paper clip.

1 ....

2 ....

[2]

(b) Sarah's teacher says that forces always act in pairs.

The magnet provides a force of attraction which acts upwards on the paper clip.

Describe the other force in this pair.

....

.... **[2]**

(c) The teacher cuts the thread.

(i) Predict what will happen to the paper clip.

.... **[1]**

(ii) Give **one** reason for your answer to **(c)(i)**.

....

.... **[1]**
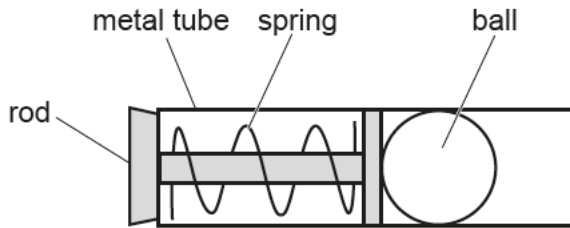
BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

8 In a pinball machine, a spring is used to push out a small metal ball at high speed.

The diagram shows the part of the machine that fires the ball, and the process of firing the ball.

metal tube spring   ball

rod

To fire the ball, the rod is pulled back. When the rod is released, the ball moves off at a high speed.

Stage 1 - rod pulled back

Stage 2 - rod released
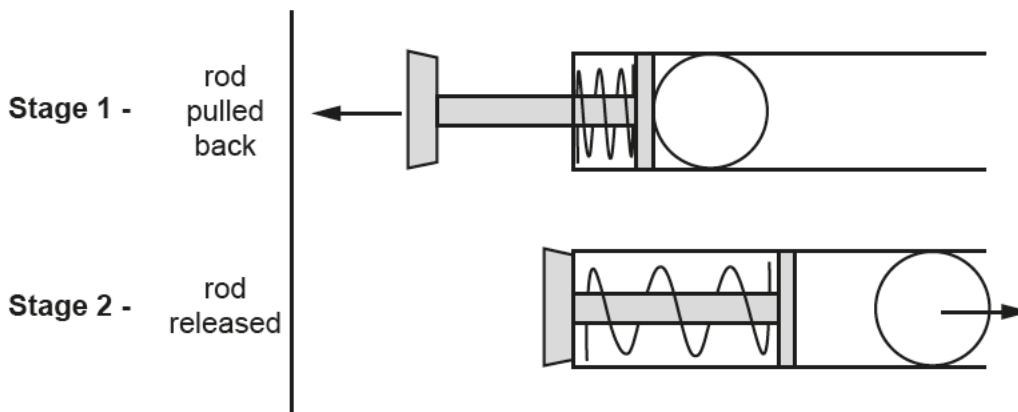
(a) When the spring is compressed, its length changes by 4.6 cm.

Calculate the energy stored in the spring.

Spring constant = 400 N/m.

The change of length of the spring is equivalent to its extension.

Use the equation: energy stored in a stretched spring = $\frac{1}{2}$ × spring constant × (extension)^2

Energy stored in spring = ... J **[3]**

(b) Energy is stored in the spring, the ball and the metal tube.

    (i) Before the spring is released, the spring is a store of elastic energy.

        Describe how this stored elastic energy changes when the spring is released.

        ....

        ....

        ....

        .... **[2]**

    (ii) What happens to the total amount of energy in the spring, the ball and the metal tube when the spring is released?

        ....

        .... **[1]**

9 Amaya and Li measure the speed of sound in air:

- Amaya stands 30 m away from Li;
- Amaya claps her hands;
- Li starts a timer when he sees the clap;
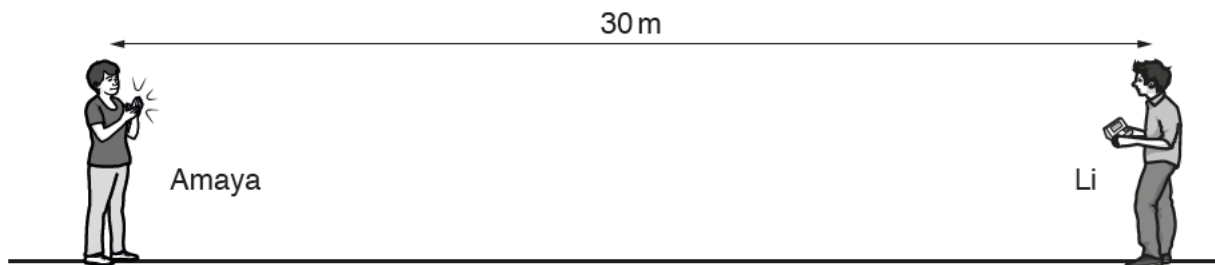- Li stops the timer when he hears the sound.

Table 9.1 shows their results.

Attempt	Time (s)	Calculated speed (m/s)
1	0.32	94
2	0.44	68
3	0.37	81
4	0.49	61
5	0.40	

Table 9.1

(a) Calculate the speed of sound for Attempt **5**.

Use the equation: speed = distance ÷ time

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

(b) The expected value for the speed of sound in air is about 300 m/s.

(i) State why the data in **Table 9.1** is inaccurate.

....

.... **[1]**

(ii) State why the data in **Table 9.1** is imprecise.

....

.... **[1]**

(c) (i) Describe **one** improvement to the method.

....

.... **[1]**

(ii) State how your improvement in **(c)(i)** will produce better data.

....

.... **[1]**

10 Mia investigates Hooke's law using the equipment shown in **Fig. 10.1**.
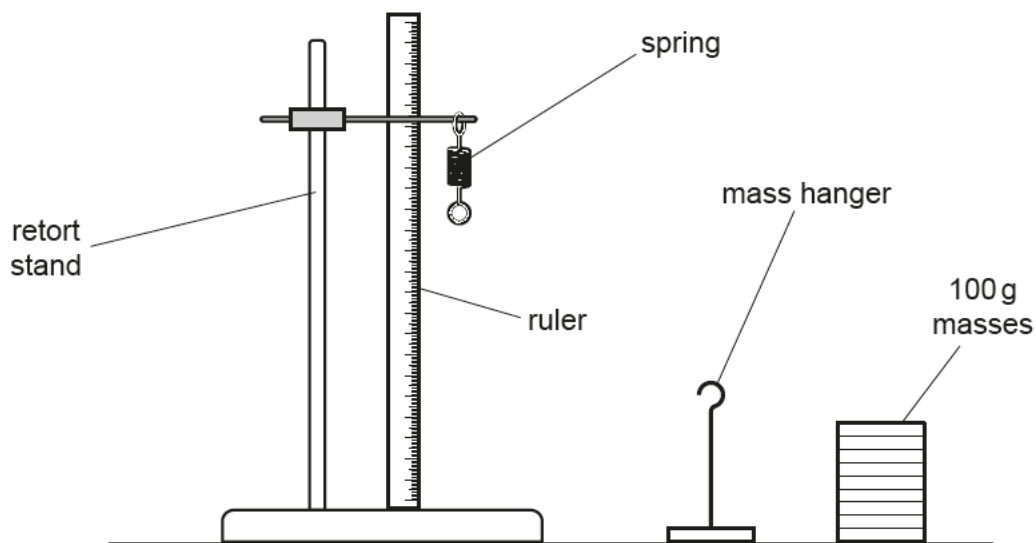

Fig. 10.1

(a) Describe how to use the equipment in **Fig. 10.1** to investigate how the **extension** of the spring depends on the **force** applied to the spring.

....

....

....

....

....

.... **[3]**

(b) When Mia applies a force of 8.0 N, the spring has an extension of 0.20 m.

Calculate the spring constant of the spring.

Spring constant = ... N/m **[3]**

(c) A group of students in Mia's class measures the spring constant of another spring.

Table 10.1 shows each student's results.

Student	Spring constant (N/m)
Alex	28
James	24
Layla	30
Mia	29
Sundip	25

Table 10.1

(i) Using **Table 10.1**, find the median value of the spring constant.

Median = ...N/m **[1]**

(ii) Using **Table 10.1**, calculate the mean value of the spring constant.

Mean = ...N/m **[1]**

Turn over

11 Amir investigates how insulation affects the rate of cooling.

He writes down his method.

1. Fill a metal tin with water at 80 °C.
2. Wait for 10 minutes.
3. Measure the new temperature and write it down.
4. Repeat the experiment for each of these types of insulation:

Experiment	Insulation
A	None
B	1 layer of aluminium foil
C	1 layer of bubble wrap
D	3 layers of bubble wrap
E	1 layer of bubble wrap **and** 1 layer of aluminium foil

(a) Predict which experiment will cool down the slowest. Explain your answer.

Experiment: ....

Explanation: ....

....

....

[2]

(b) Amir's teacher reads his method. The teacher says that the method is not detailed enough to make the experiment **reproducible**.

(i) Explain the meaning of the word **reproducible**.

....

....

.... **[2]**

(ii) Give **one** piece of additional information that you would need to **reproduce** Amir's experiment.

....

.... **[1]**

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

12 A low-carbon source causes very little carbon dioxide to be given off into the atmosphere.

Some of the energy supplied to the UK comes from low carbon sources.

Fig. 12.1 shows how the percentage of UK energy supplied from low carbon sources has changed over time.

© Edie Newsroom. www.edie.net. Item removed due to third party copyright restrictions.

Fig. 12.1

(a) (i) Describe the trend in the percentage of UK energy supplied by **biofuels**.

....

.... **[1]**

(ii) Suggest **one** reason for this trend.

....

.... **[1]**

(b) Ali and Ling discuss the trends shown in the data.

Ali

I think that, in the future, we will get more energy from the wind than from nuclear power.

(i) Evaluate whether the evidence shown in **Fig. 12.1** supports Ali's statement.

....

....

....

.... **[2]**

Ling

The data shows that in 2016, over 16% of energy was supplied by renewable energy sources.

(ii) State why Ling is **incorrect**.

....

.... **[1]**

(iii) Using **Fig. 12.1**, estimate the correct percentage of energy that was supplied by renewable energy sources in 2016.

Percentage = ... % **[1]**

13 Ultraviolet radiation can be used to disinfect water.

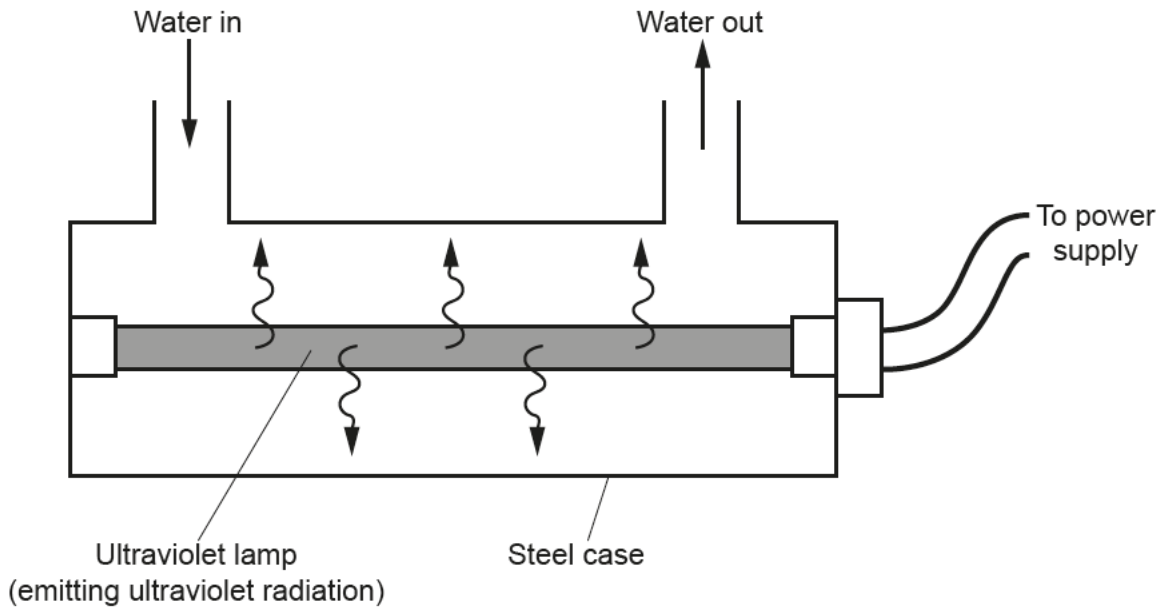Fig. 13.1 shows an ultraviolet disinfection unit.

Fig. 13.1

(a) Ultraviolet radiation is emitted by the atoms in the ultraviolet lamp.

Describe how changes in atoms can generate ultraviolet radiation.

....

....

....

.... **[2]**

(b) Ultraviolet disinfection works because ultraviolet radiation harms micro-organisms in the water.

   (i) Explain why ultraviolet radiation is also harmful to living organisms, including humans.

   ....

   ....

   .... **[2]**

   (ii) Suggest how the design of the disinfection unit in **Fig. 13.1** prevents it from harming humans.

   ....

   .... **[1]**

(c) Alpha radiation is also harmful to living organisms.

   Give **two** reasons why alpha radiation would not be suitable for disinfecting water.

   1 ....

   ....

   2 ....

   ....
   [2]

END OF QUESTION PAPER

26

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).

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

....

OCR
Oxford Cambridge and RSA