Electricity – 2021/20 GCSE Gateway Physics Combined Science A

1. Nov/2021/Paper_J250/06/No.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**.

.....

.....

.....

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2. Nov/2021/Paper_J250/06/No.15

(a) A teacher lifts a weight of 45 N through a height of 1.8 m.

Calculate the work done by the teacher.

Use the equation: work done = force × distance

Work done = ... J **[2]**

(b) Another teacher does 1500 J of work.

They take 5 seconds to do the work.

Calculate their power.

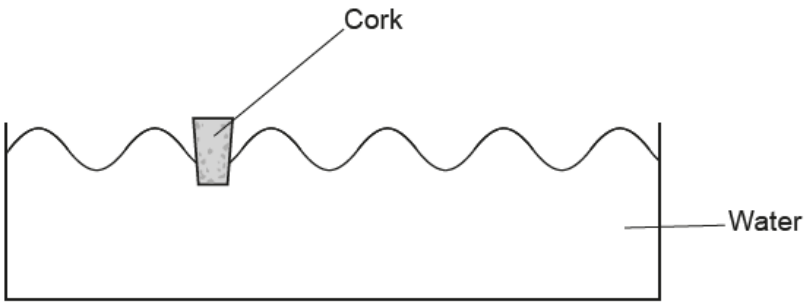
Give the unit in your answer.

Use the equation: power = work done / time

Power = ... Unit ..... **[3]**

3. Nov/2020/Paper_J250/06/No.8

A student makes transverse waves in a tray of water. He places a cork on the surface of the water.



Which row in the table describes the experiment correctly?

	How does the cork vibrate during the experiment?	Where is the water after the experiment?
A	↕	The water stays in its original position.
B	↔	The water moves to one side of the tray.
C	↕	The water moves to one side of the tray.
D	↔	The water stays in its original position.

Your answer ☐ **[1]**

4. Nov/2020/Paper_J250/06/No.10

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]**

5. Nov/2020/Paper_J250/06/No.13

(a) Electromagnetic waves have similar properties.

Use these words to complete the sentences:

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

Acceleration **Frequency** **Longitudinal**

Sound **Speed** **Transverse** **Wavelength**

Electromagnetic waves are ..... waves.

Electromagnetic waves travel with the same ..... in space.

[2]

(b) A student wants to work out the speed of water waves in a ripple tank. **Fig. 13.1** shows the apparatus the student uses.

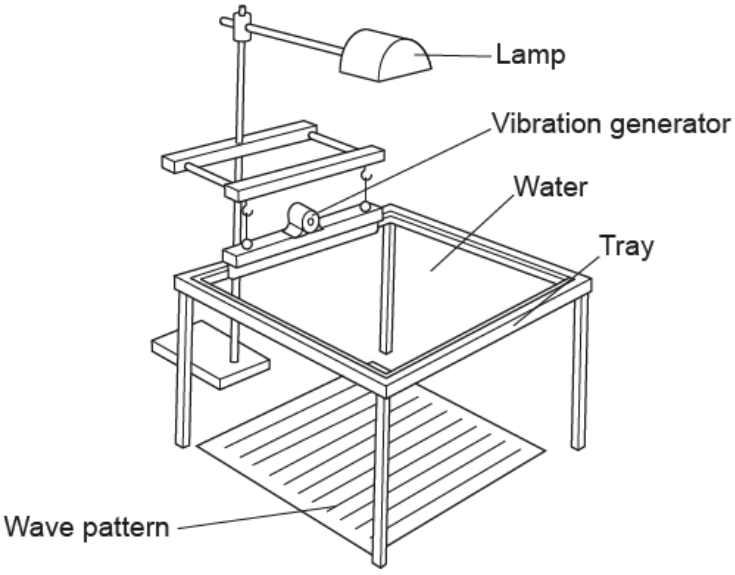


Fig. 13.1

Name the **two** extra pieces of apparatus she will need to work out the speed of the waves.

1 .....

2 .....

[2]

6. Nov/2020/Paper_J250/06/No.15

Fig. 15.1 shows how the height of a water wave changes with distance.

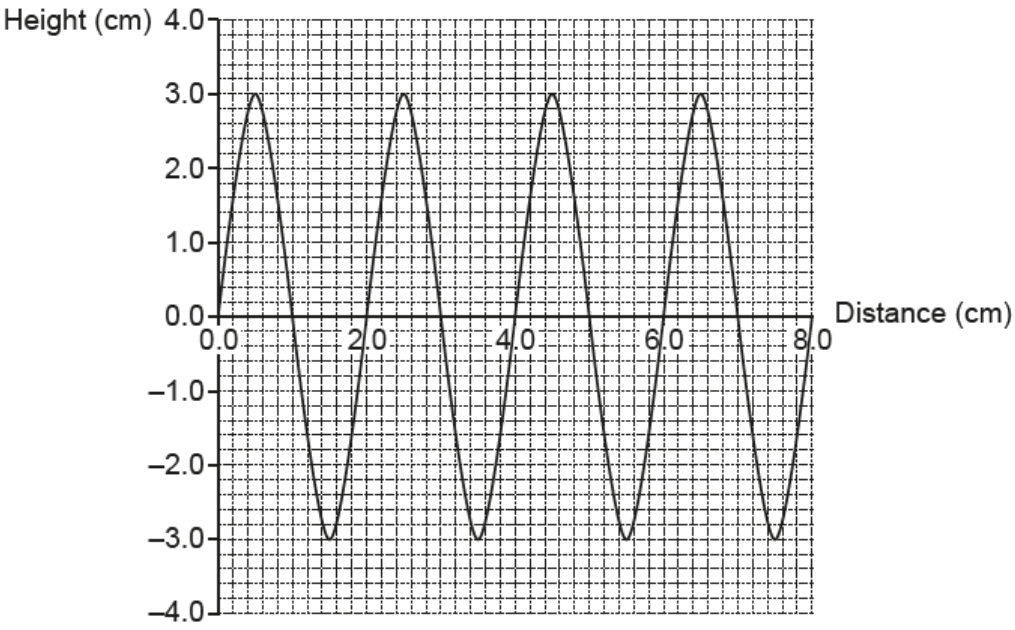


Fig. 15.1

Fig. 15.2 shows how the height of the **same** wave changes with time.

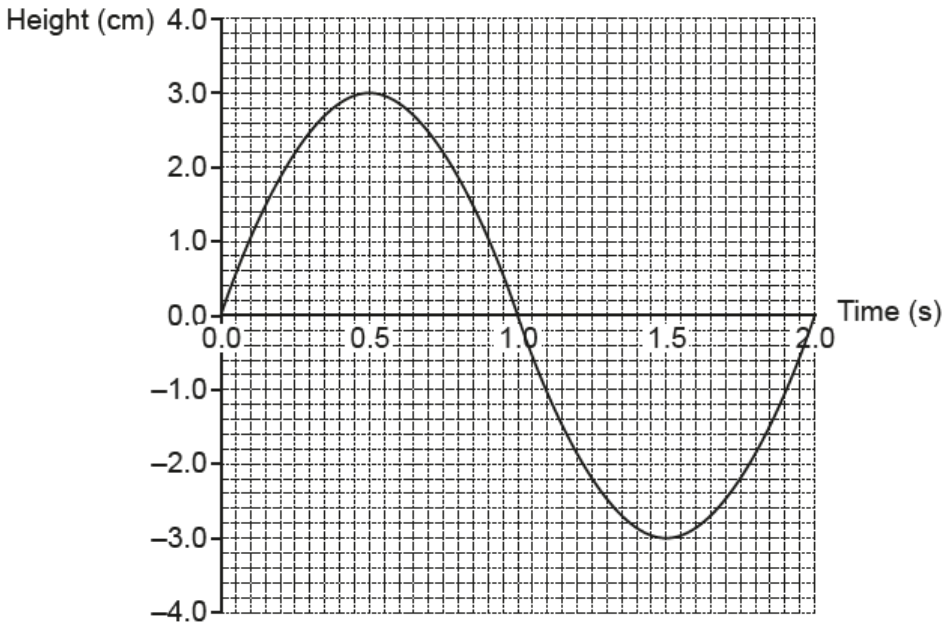


Fig. 15.2

Waves can be described using these words:

- amplitude
- wavelength
- frequency
- wave speed.

Describe the wave represented by both **Fig. 15.1** and **Fig. 15.2** in detail.

Use calculations and definitions in your answer.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[6]**

7. Nov/2021/Paper_J250/12/No.3

Some waves are transverse. Some waves are longitudinal.

Which row in the table is correct?

	Transverse	Longitudinal
A	light	sound
B	sound	light
C	sound	water ripples
D	water ripples	light

Your answer ☐ **[1]**

8. Nov/2021/Paper_J250/12/No.6

Which property is the same for all electromagnetic waves in space?

A Frequency

B Time period

C Velocity

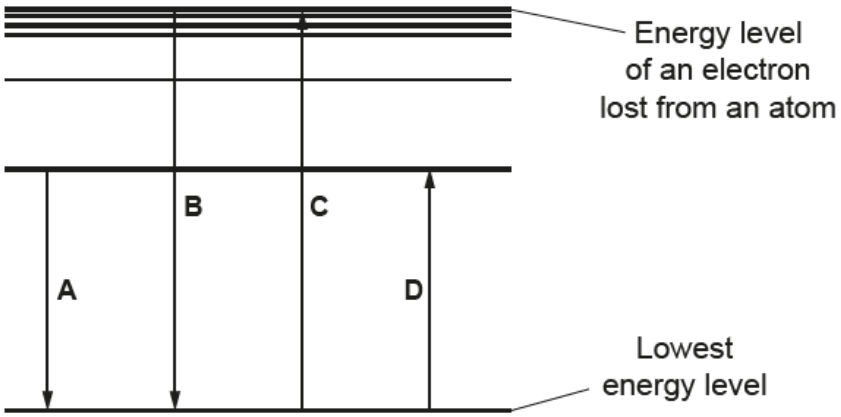
D Wavelength

Your answer ☐ **[1]**

9. Nov/2021/Paper_J250/12/No.9

This is a model of energy levels inside a hydrogen atom.

The arrows shown as ↑ and ↓ represent an electron moving between energy levels.



Which electron movement, **A**, **B**, **C** or **D**, shows ionisation?

Your answer ☐ **[1]**

10. Nov/2021/Paper_J250/12/No.11

(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 11.1 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 11.1

(i) Using data from **Table 11.1** describe the relationship between **frequency** and **wavelength**.

.....

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

(ii) How many significant figures are used in each value in **Table 11.1**?

..... **[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]**

11. Nov/2021/Paper_J250/12/No.15

Two students are making waves using a dripping tap.

The water droplets create waves in the water in a bowl.

(a) Describe the change in energy stores as a water droplet

- falls from the tap: .....
- lands in the water in the bowl: .....

[2]

(b) The students count the number of droplets hitting the water in the bowl.

In 20 seconds, 5 droplets hit the water in the bowl.

Calculate the frequency of the waves produced.

Frequency = ...Hz **[2]**

(c) How can the students tell that the water waves travel but the water does not?

.....

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

(d) (i) One of the students says, 'the temperature of the water in the bowl increases when the water drips into it'.

- 1 droplet of water transfers 5.04×10^{-4} J of energy as it lands in the bowl.
- The bowl contains 3 kg of water.
- The specific heat capacity of water is 4200 J / kg °C.

Calculate the temperature rise of the water in the bowl when 1 droplet of water lands in it.

Use an equation from the Data Sheet to help you.

Temperature rise = ... °C **[3]**

(ii) In 1847, James Joule did experiments at the bottom of a waterfall.

He was unable to measure the temperature rise of the water.

Suggest **two** reasons why.

1 .....

.....

2 .....

.....

[2]

12. Nov/2020/Paper_J250/12/No.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]**

13. Nov/2020/Paper_J250/12/No.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]**

14. Nov/2020/Paper_J250/12/No.13

This question is about sound, light and water waves.

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

.....

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

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

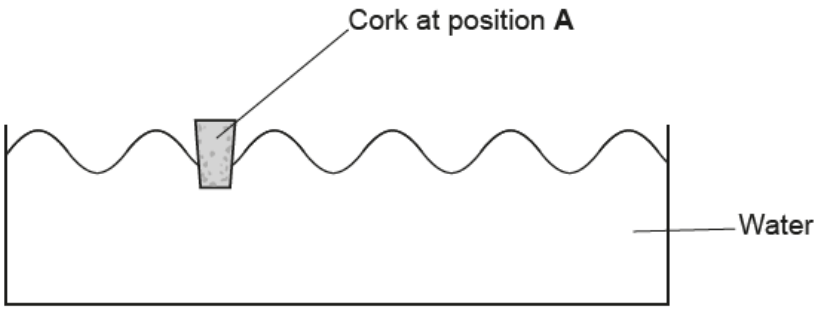


Fig. 13.1

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

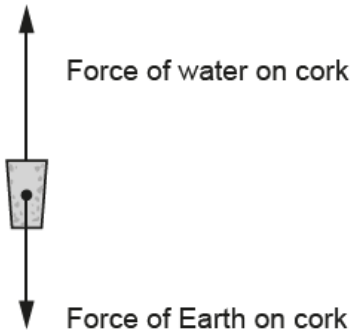


Fig. 13.2

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

Use the free-body force diagram to explain why.

.....

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

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

.....

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

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

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

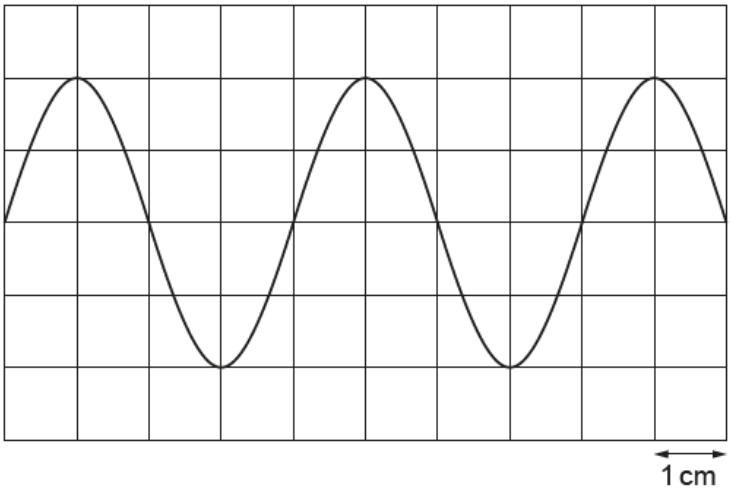


Fig. 13.3

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.

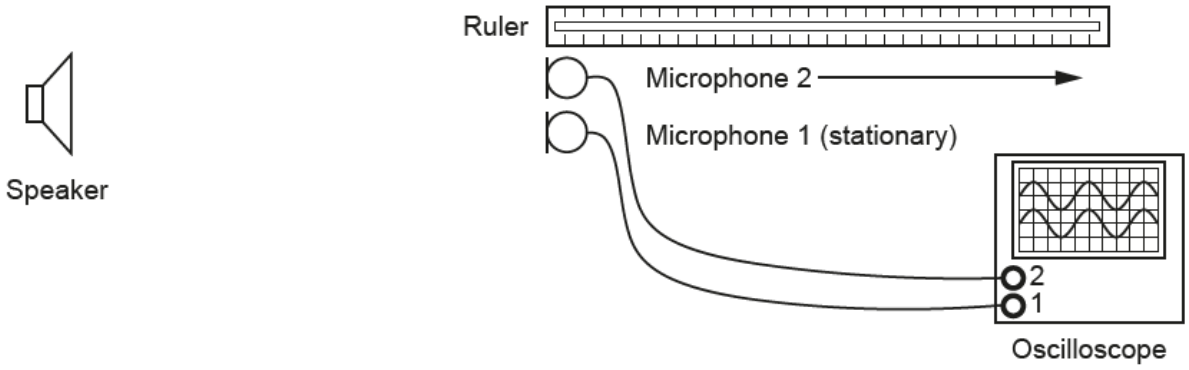


Fig. 13.4

- 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.

.....

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

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

Explain how.

.....

.....

.....

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