Radiation and waves – 2021/20 GCSE 21st Physics Combined Science B

1. Nov 2021/Paper_J260/03/No.1

Jane wants to know if different types of radiation are absorbed, reflected or transmitted by different materials.

(a) Complete the sentences to describe if electromagnetic radiation is absorbed, reflected, or transmitted by the materials.

Put a (ring) around the correct answers.

Wood warms up when it **absorbs** / **reflects** / **transmits** infrared radiation.

Some metals are shiny because they **absorb** / **reflect** / **transmit** visible light.

Windows are made out of glass because glass **absorbs** / **reflects** / **transmits** visible light.

An X-ray scan can be hazardous because human bodily tissue **absorbs** / **reflects** / **transmits** X-rays.

[4]

(b) Complete the sentences about wavelength.

Use the words.

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

a shorter **a longer** **the same**

(i) X-rays have ..... wavelength compared to visible light. **[1]**

(ii) Infrared radiation has ..... wavelength compared to visible light. **[1]**

(iii) Radio waves have ..... wavelength compared to infrared radiation. **[1]**

2. Nov 2021/Paper_J260/03/No.5

The different types of electromagnetic radiation are absorbed and emitted in different ways.

(a) Complete the table to show the type of electromagnetic radiation absorbed or emitted in each case.

Tick (✓) **one** box in each row.

	Type of electromagnetic radiation		
	Gamma rays	**Infrared**	**Ultraviolet**
Absorbed and re-emitted by carbon dioxide			
Absorbed by oxygen to produce ozone			
Emitted from nuclei			

[3]

(b) Which **two** statements are correct?

Tick (✓) **two** boxes.

All electrons in an atom are at the same distance away from the nucleus. ☐

All electromagnetic radiation has the same frequency. ☐

All electromagnetic radiation is transmitted through space at the same speed. ☐

Atoms can become ions by losing their outer electrons. ☐

Visible light and gamma rays travel through space at different speeds. ☐

[2]

(c) This hazard sign is found on gamma ray sources, X-ray machines and some ultraviolet lamps.

Describe the risk of using equipment labelled with this hazard sign.

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.....

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

3. Nov 2021/Paper_J260/04/No.1

(a) (i) Which statements about waves are **true** and which are **false**?

Tick (✓) **one** box in each row.

	True	False
All electromagnetic waves are transverse.	☐	☐
Light is an electromagnetic wave.	☐	☐
Sound is a transverse wave.	☐	☐

[2]

(ii) **Fig. 1.1** shows a transverse wave.

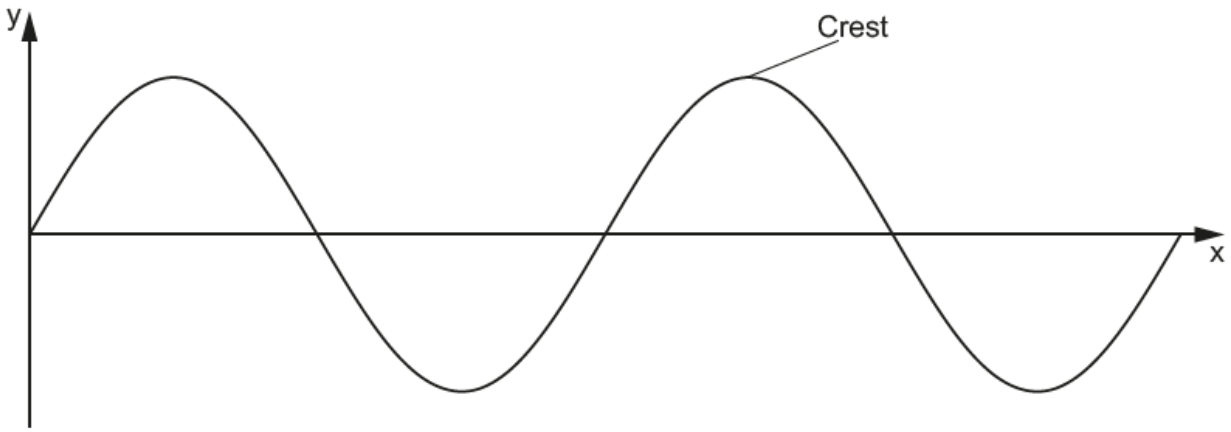


Fig. 1.1

Complete each sentence about the transverse wave in **Fig. 1.1**.

Use the words.

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

amplitude **frequency** **period** **speed** **wavelength**

The maximum height of the wave above the x-axis is called the .....

The distance from one crest to another is called the .....

The number of waves passing a point each second is called the .....

[2]

(b) Sundip is investigating the reflection of light off a plane mirror.

(i) Sundip writes a series of steps for her investigation.

They are **not** in the correct order.

A Measure the angle of the incident ray.

B Measure the angle of the reflected ray.

C Repeat the measurements for different angles.

D Use a ray box to shine a light at the plane mirror.

Write the **letters** in the boxes to show the correct order of the steps.

[3]

(ii) The table shows Sundip's results.

Angle of incidence (°)	Angle of reflection (°)
20	21
30	29
40	40
50	51
60	55
70	69

Sundip thinks one of her results is an outlier.

Put a (ring) around the **outlier** in the table. **[1]**

(iii) Complete the sentence to make Sundip's conclusion correct.

Put a (ring) around the correct answer.

The angle of the incident ray is **approximately equal to / greater than / less than / unrelated to** the angle of the reflected ray. **[1]**

(c) **Fig. 1.2** shows a pencil in a glass of water.

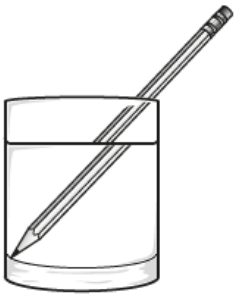


Fig. 1.2

Complete each sentence about why the pencil looks broken in **Fig. 1.2**.

Use the words.

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

colour **direction** **energy** **slows down** **speeds up**

The pencil appears broken because the light changes .....

when it moves from the air in the glass into the water.

The light ..... as it enters the water.

[2]

4. Nov 2020/Paper_J260/04/No.1

Nina studies radiation and waves.

(a) Which **one** statement about electromagnetic radiation is **true**?

Tick (✓) one box.

Infrared radiation has enough energy to cause ionisation. ☐

Microwaves have a longer wavelength than visible light. ☐

Radio waves have a higher frequency than microwaves. ☐

[1]

(b) A sound wave travelling through a copper wire has a wavelength of 15 m and a frequency of 248 Hz.

Calculate the wave speed of the sound wave through the copper wire.

Use the equation: wave speed = wavelength × frequency

Wave speed = ... m/s **[2]**

5. Nov 2020/Paper_J260/04/No.4

There are 2 types of waves.

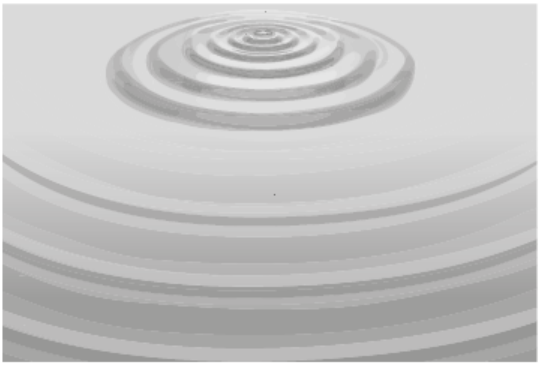
(a) Complete the sentences to describe each type of wave.

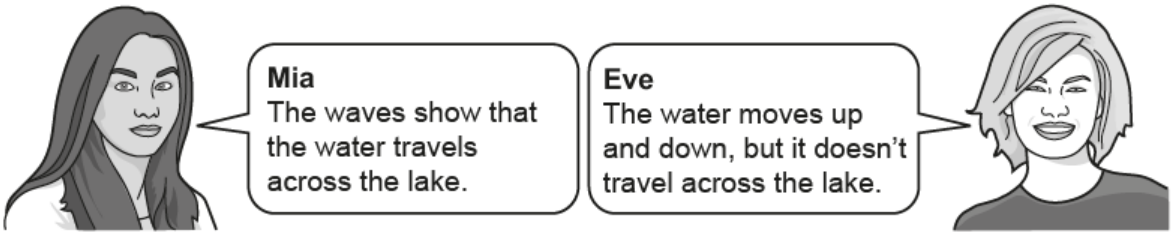
Waves on a rope are an example of ..... waves.

Sound waves in air are an example of ..... waves.

[2]

(b) Mia and Eve are discussing waves on the surface of a lake.





Eve places a plastic duck on the surface of the lake to show that she is correct.

Describe the motion of the plastic duck.

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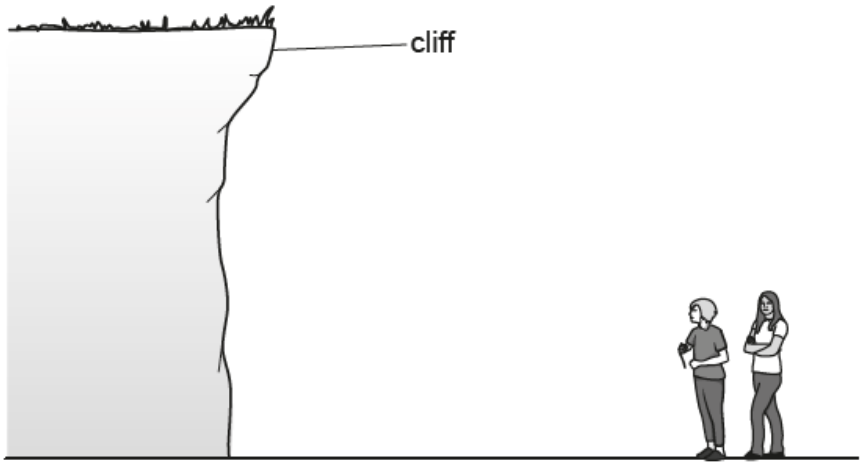
.....

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

(c) Sound waves in air travel at a speed of approximately 340 m/s.

Mia and Eve do an experiment to measure the speed of sound waves in air.

They use the echo from a cliff to measure the distance travelled by the sound waves, and the time taken for the sound waves to travel that distance.



(i) Describe how to take **accurate** measurements of the time taken and distance travelled, for the sound waves.

Include in your answer how the sound is produced, and any equipment needed.

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

(ii) How can they calculate the speed of sound waves in air from their measurements?

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

6. Nov 2021/Paper_J260/07/No.5(c)

Two tug boats, tug **A** and tug **B**, are pulling a ship as shown in **Fig. 5.1**.

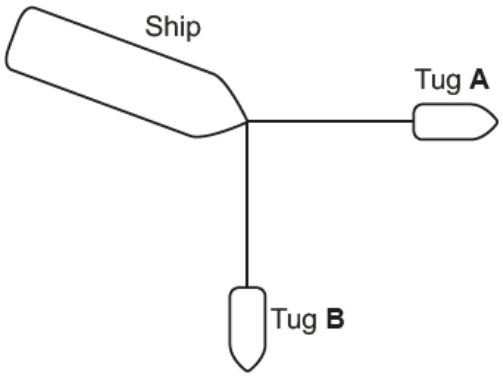


Fig. 5.1

The force of tug **A** on the ship is shown on the vector diagram in **Fig. 5.2**.

Scale: 1 cm = 100 kN.

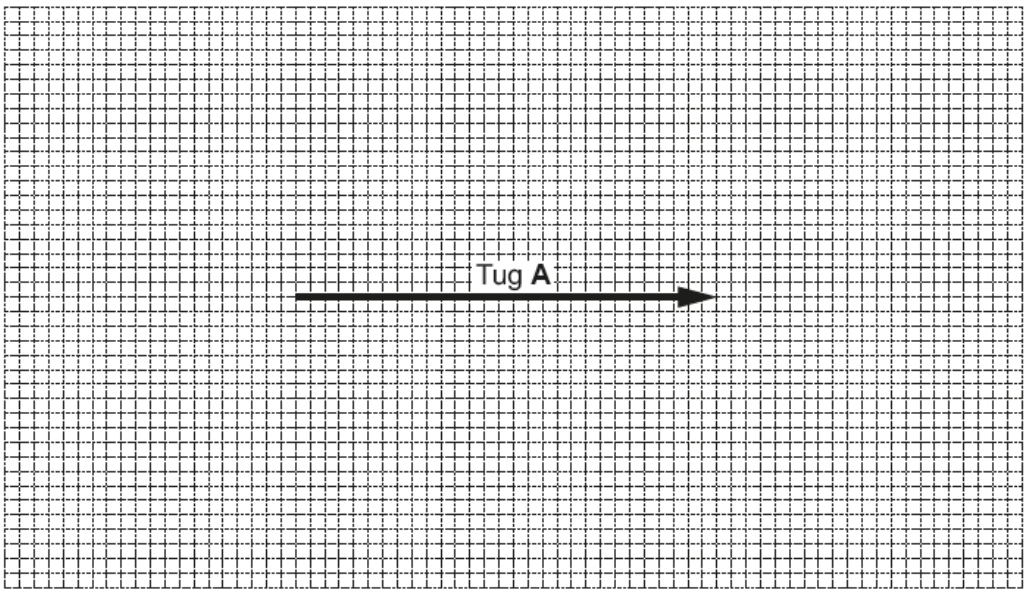


Fig. 5.2

(c) The water waves in the sea are moving at 3.2 m/s and 10 waves pass a stationary boat in 16 s.

Calculate the wavelength of the water waves.

Use the equation: wave speed = frequency × wavelength

Wavelength = ... m **[3]**

7. Nov 2021/Paper_J260/07/No.7(a)

Jamal is setting up the lights for a disco. He hangs a rotating mirror ball from the ceiling, as shown in **Fig. 7.1**.

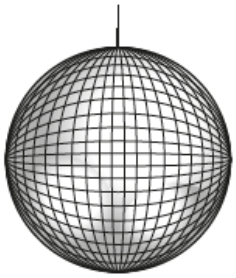


Fig. 7.1

(a) (i) The mirror ball reflects visible light. Visible light is a type of electromagnetic radiation with a small range of wavelengths.

Describe how the wavelength of **two** other types of electromagnetic radiation is different from the wavelength of visible light.

1. .....

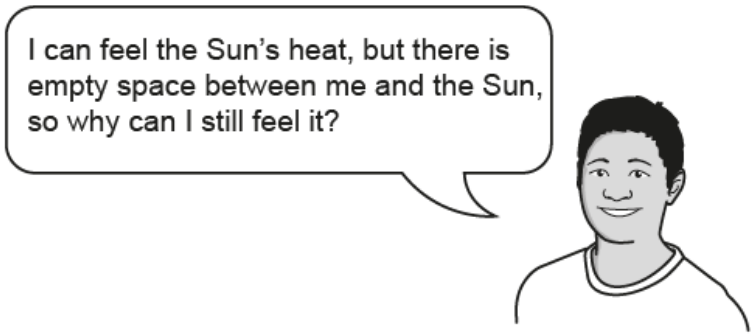
.....

2. .....

.....

[2]

Jamal closes the curtains in the room to keep out the sunlight.



(ii) Explain why Jamal feels the heat from the Sun.

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

8. Nov 2020/Paper_J260/07/No.3

(a) This sign is used to mark sources of ionising radiation.

(i) Name **two** types of ionising radiation.

1. .....

2. .....

[2]

(ii) Describe how ionising radiation is a hazard to humans.

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

(b) Carbon dioxide in the atmosphere absorbs infrared radiation from the Earth.

Complete the following sentences to describe what happens when molecules of carbon dioxide absorb infrared radiation.

Use words from the list.

Each word can be used once, more than once or not at all.

decreases **density** **faster** **increases** **mass**

slower **temperature**

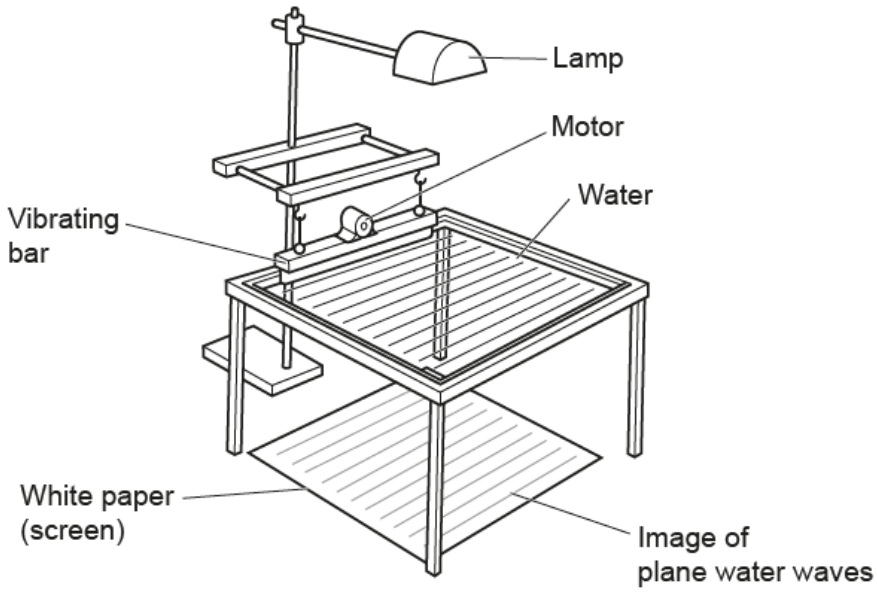
When molecules of carbon dioxide absorb infrared radiation, their internal store of energy ..... .

They move ..... and the ..... of the carbon dioxide increases. If the carbon dioxide is in a container with a constant volume the pressure ..... .

[3]

9. Nov 2020/Paper_J260/07/No.5

This diagram shows a ripple tank.



(a) (i) The image of the plane water waves does not show up very clearly on the paper.

Suggest how you could improve the quality of the image on the white paper (screen).

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

(ii) Describe how to use the ripple tank to **accurately** measure the wavelength of a plane water wave.

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

(iii) Alex wants to find out if the temperature of the water affects the wavelength of the plane water waves in the ripple tank.

Suggest how he could change the experiment in **(a)(ii)** to see if the temperature of the water affects the wavelength of the plane water waves.

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

(b) Alex counts 27 plane water waves passing a point on the white paper (screen) in 12 seconds.

(i) Calculate the frequency of the plane water waves.

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

(ii) Alex measures the wavelength of a plane water wave to be 2.4 cm.

Calculate the speed of the plane water waves.

Use your answer to **(b)(i)**.

Use the equation: wave speed = frequency × wavelength

Give your answer in **m/s**.

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