Waves – 2021/20 GCSE Gateway Physics A

1. Nov/2021/Paper_J249/02/No.6

Water waves are made in a ripple tank.

A student counts 4 waves passing a point per second.

What has the student worked out?

A Amplitude

B Frequency

C Period

D Wave speed

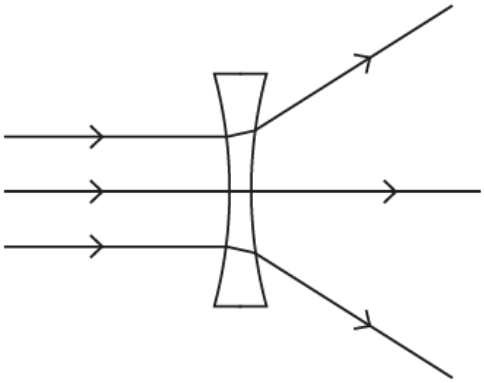
Your answer ☐ **[1]**

2. Nov/2021/Paper_J249/02/No.9

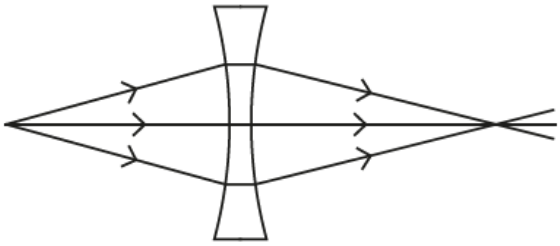
A student draws ray diagrams for some lenses.

Which ray diagram is correct?

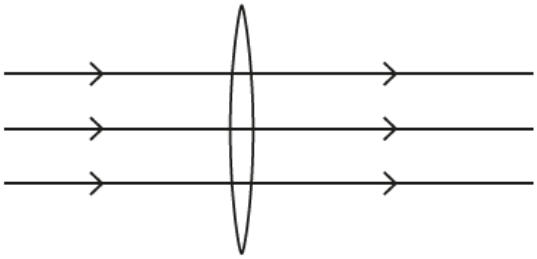
A



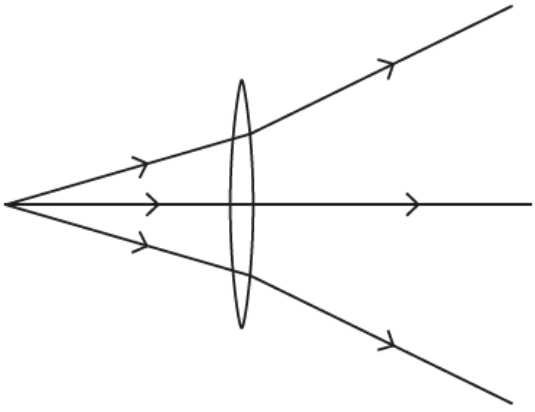
B



C



D



Your answer ☐ **[1]**

3. Nov/2021/Paper_J249/02/No.13

The table shows **two** uses of electromagnetic radiation.

Which row in the table is correct?

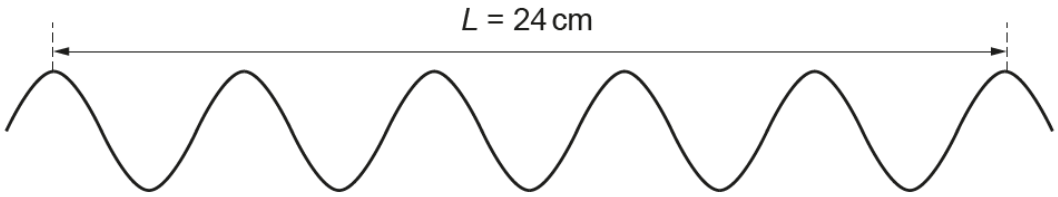
	Used for satellite communication	Used for measuring temperature
A	Microwaves	Infra red
B	Microwaves	Ultraviolet
C	Visible light	Infra red
D	Visible light	Ultraviolet

Your answer ☐ **[1]**

4. Nov/2021/Paper_J249/02/No.15

A student makes a wave in a ripple tank.

The student measures distance, *L*.



What is the wavelength of the wave?

A 2.4 cm

B 4.0 cm

C 4.8 cm

D 24 cm

Your answer ☐ **[1]**

5. Nov/2021/Paper_J249/02/No.18

A musician plays a guitar.

This makes a sound wave in the air.

(a) The frequency of the sound wave is 440 Hz.

The speed of sound is 330 m/s.

Calculate the wavelength of the sound wave.

Use the equation: wave speed = frequency × wavelength

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

(b) Explain how sound travels through the air from the guitar.

Write about air particles in your answer.

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.....

.....

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

(c) **Fig. 18.1** is a graph of a sound wave.

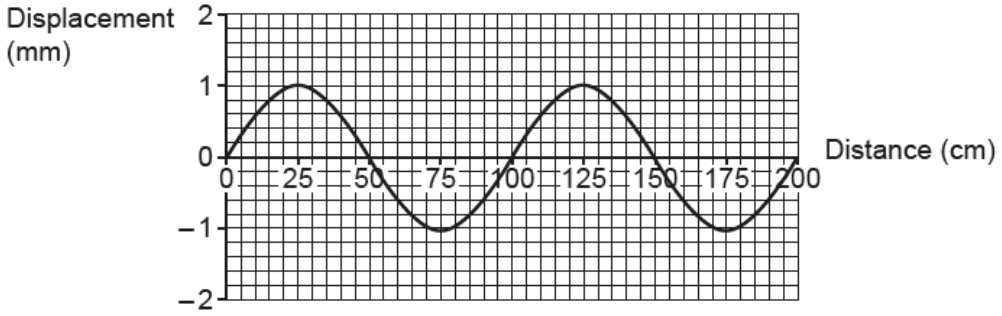


Fig. 18.1

Another sound wave has a **higher** frequency. The amplitude of the wave remains the **same**.

Draw this sound wave on **Fig. 18.2**.

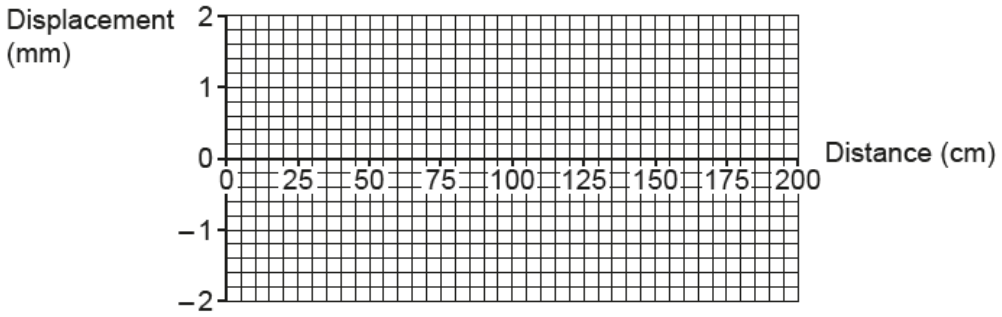


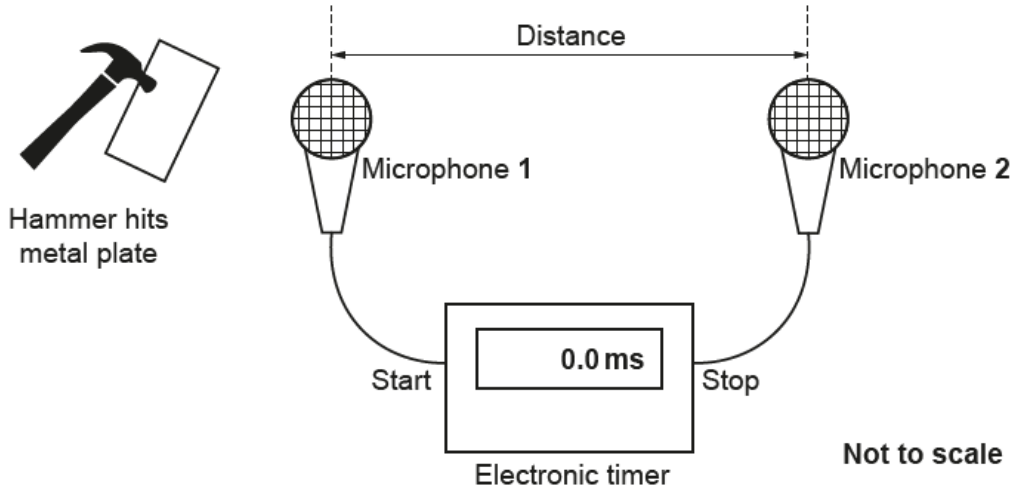
Fig. 18.2

[2]

6. Nov/2021/Paper_J249/02/No.21

A student measures the speed of sound.

They use this equipment:



This is the student's method:

- A sound is created when the hammer hits the metal plate.
- When the sound reaches microphone **1**, the electronic timer starts.
- When the sound reaches microphone **2**, the electronic timer stops.
- This process is repeated several times.

(a) They record the time displayed on the timer in a table:

Measurement	Time (ms)
1	6.7
2	6.3
3	6.7
4	6.6

Calculate the mean time.

Give your answer to **2** significant figures.

Mean time = ... ms **[2]**

(b) They do **not** place the hammer and plate **between** the two microphones.

Suggest **one** reason why.

.....

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

(c) Another student repeats the same experiment.

These are the student's measurements:

- The distance between the microphones is 2.4 m.
- The mean time measured is 7.5 ms.

(i) Calculate the speed of sound.

Use the equation: distance travelled = speed × time

Speed of sound = ... m/s **[4]**

(ii) Describe how the student can measure the distance between the microphones.

.....

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

(iii) The student looks up the speed of sound on a reliable website. They find the value for the speed of sound is 330 m/s.

Suggest why this is different from your value calculated in **21(c)(i)**.

.....

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

7. Nov/2021/Paper_J249/02/No.22

This question is about visible light.

(a) (i) State **one** change that happens to light when it travels from water into air.

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

(ii) Diagram in **Fig. 22.1** shows a ray of light from a fish in a container of water.

Complete the ray diagram in **Fig. 22.1** to show the path of the ray after it leaves the water.

Include a normal line in your diagram.

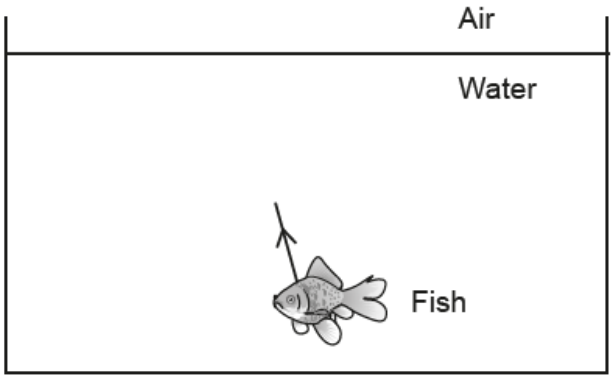


Fig. 22.1

[3]

(b) Diagram in **Fig. 22.2** shows three incident rays hitting the surface of the fish. Light is scattered from the surface of the fish.

Complete the diagram in **Fig. 22.2** to show the scattered rays.

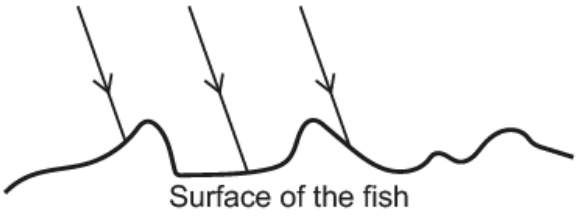


Fig. 22.2

[1]

(c) The fish appears red under white light.

Explain why the fish appears black under green light.

.....

.....

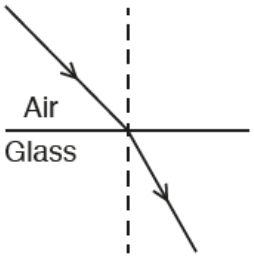
..... **[2]**

8. Nov/2020/Paper_J249/02/No.5

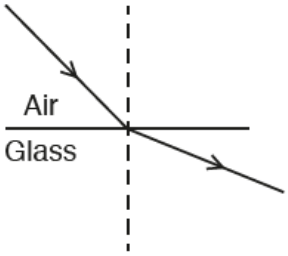
A light ray passes from air into glass.

Which diagram shows the **refraction** of this light ray?

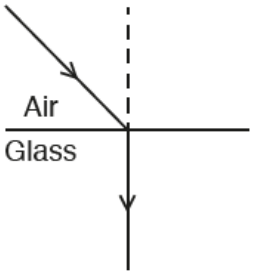
A



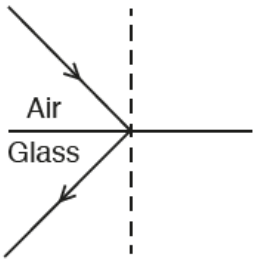
B



C



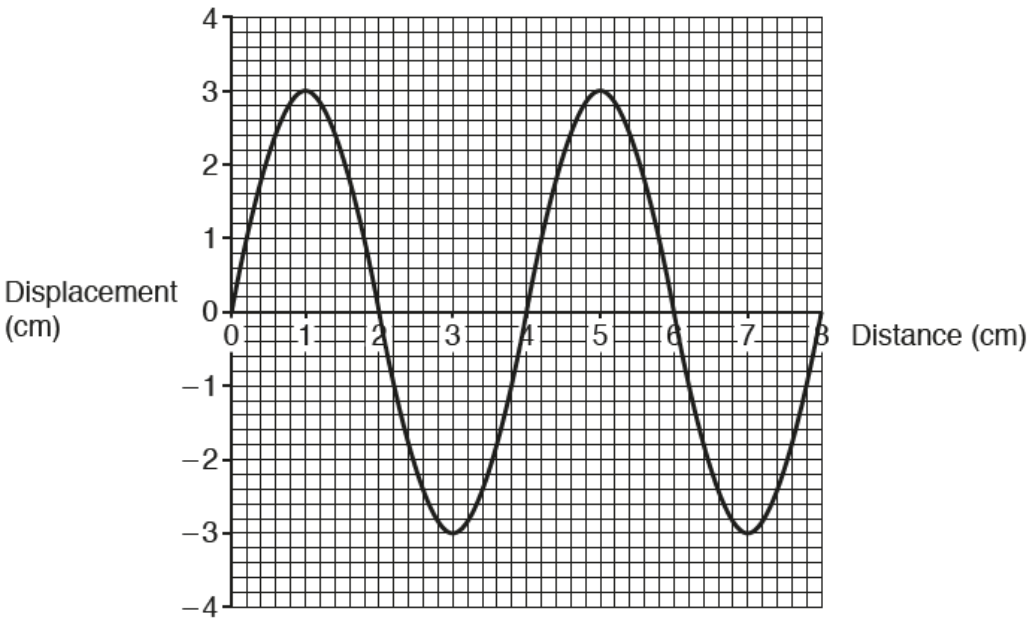
D



Your answer ☐ **[1]**

9. Nov/2020/Paper_J249/02/No.6

Look at the diagram of a wave.



What is the wavelength of the wave?

A 2 cm

B 3 cm

C 4 cm

D 6 cm

Your answer ☐ **[1]**

10. Nov/2020/Paper_J249/02/No.15

Four students measure the time it takes a wave to travel the length of a ripple tank.

Each student collects three measurements of the time.

Student	Time taken (s)		
	1st measurement	2nd measurement	3rd measurement
A	2	2	1
B	2.1	2.1	2.4
C	2.1	2.0	2.2
D	2.11	2.49	2.23

Which student collected the **most** precise data?

Your answer ☐ **[1]**

11. Nov/2020/Paper_J249/02/No.16(a, b)

This question is about X-rays and visible light.

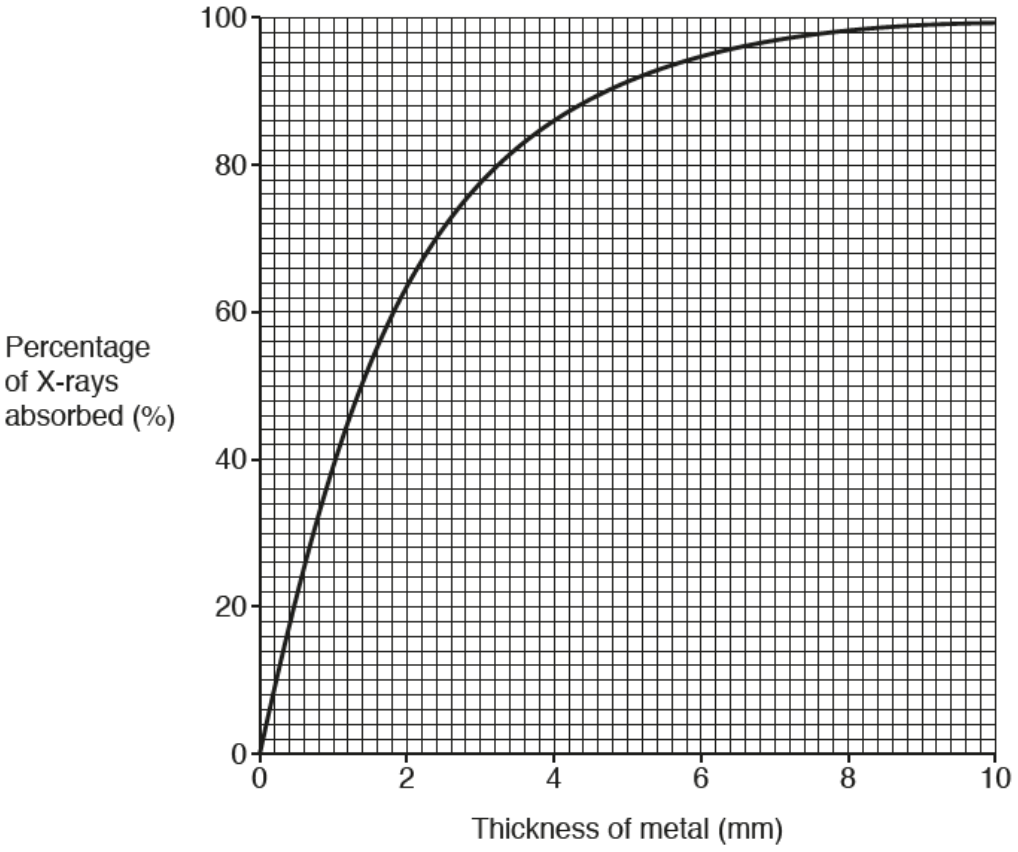
(a) State one **similarity** and one **difference** between X-rays and visible light.

Similarity .....

Difference .....

[2]

(b) This graph shows how the absorption of X-rays changes with the thickness of metal.



(i) What percentage of X-rays is absorbed by 4 mm of metal?

Percentage of X-rays absorbed = ... % **[1]**

(ii) Calculate the percentage of X-rays passing **through** 4 mm of metal.
Use your answer to **16(b)(i)** to help you.

Percentage of X-rays = ... % **[2]**

(c) Use the words from the list to complete the sentences about the Universe.

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

Big-Bang	**Contracting**	**CMBR**	**Expanding**
LDR	**Red giant**	**Red shift**	**Solar system**

The ..... is a model of how the universe began.

Light from distant galaxies has a longer wavelength when it reaches Earth than when it was emitted.

This is called ..... .

Distant galaxies are moving away faster so the universe is

..... .

[3]

12. Nov/2020/Paper_J249/02/No.17

Ripples are made on the surface of the water. The ripples can be used to model waves.

(a) (i) State the type of wave modelled by the ripples.

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

(ii) Describe how the water molecules move as the wave travels across the pond.

.....

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

(iii) 10 ripples hit the side of the pond in 20 seconds.

Calculate the frequency of the ripples.

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

(b) Student **A** and student **B** drop stones into a pond.

(i) Student **A** measures the frequency and wavelength of the water ripples. **Table 17.1** shows his results:

Frequency (Hz) of ripples	0.6
Wavelength (m) of ripples	0.1

Table 17.1

Calculate the wave speed of the ripples.

Use the equation: wave speed = frequency × wavelength

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

(ii) Student **B** measures the same ripples as student **A**.

She measures:

- The distance one ripple travels.
- The time it takes the ripple to travel this distance.

Table 17.2 shows student **B**'s results:

Distance ripple travels (m)	2.40
Time taken (s)	30.0

Table 17.2

Name the equipment student **B** uses to measure the distance and time.

Distance .....

Time .....
[2]

(iii) Use results in **Table 17.2** to calculate the wave speed of the ripples.

Wave speed = ...m/s **[3]**

(iv) Student **A** and student **B** obtained different answers for the wave speed of the ripples.

Suggest why.

.....

.....

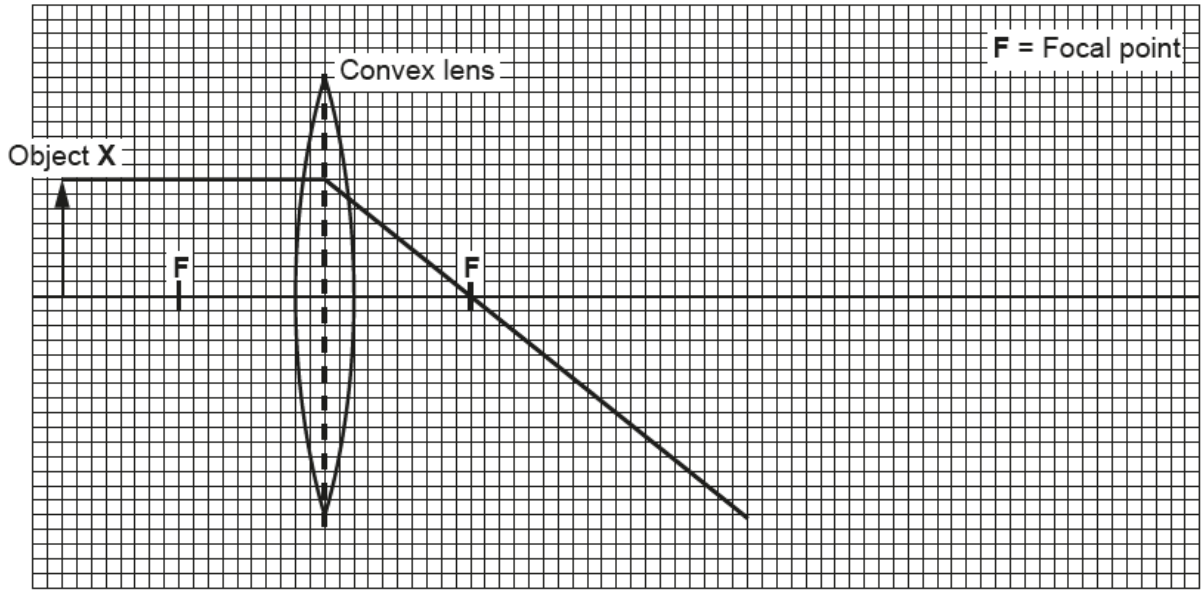
..... **[1]**

13. Nov/2020/Paper_J249/02/No.21

A projector is used to create a larger image of an object.

(a) The diagram shows one light ray as it passes through the convex lens.

Draw **one** more ray on the diagram to show where the image is formed. Label the image **Y**.



[2]

(b) The projector contains a white light source.

Explain how this white light source can be used to get **red** light.

.....

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

(c) **(i)** The projector is connected to the mains power supply. The projector has an earth wire.

State the potential difference between the earth wire and the live wire in normal use.

Potential difference = ... V **[1]**

(ii) A projector with a plastic case does not need an earth wire.
A projector with a metal case needs an earth wire.

Explain why.

.....

.....

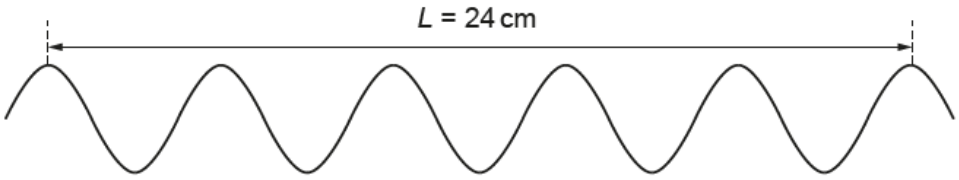
.....

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

14. Nov/2021/Paper_J249/04/No.2

A student makes a wave in a ripple tank.

The student measures distance, *L*.



What is the wavelength of the wave?

A 2.4 cm

B 4.0 cm

C 4.8 cm

D 24 cm

Your answer ☐ **[1]**

15. Nov/2021/Paper_J249/04/No.3

Which statement about infra red radiation is correct?

A Infra red has the shortest wavelength in the electromagnetic spectrum.

B Infra red is emitted by humans.

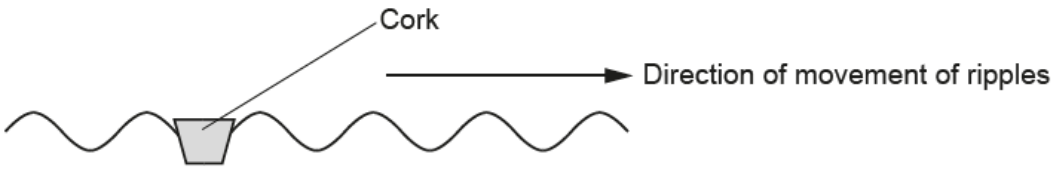
C Infra red is next to radio waves in the electromagnetic spectrum.

D White objects absorb more infra red than black objects.

Your answer ☐ **[1]**

16. Nov/2021/Paper_J249/04/No.6

A cork floats on water. Ripples move across the surface of the water.



Which statement describes the motion of the cork?

A It does not move.

B It moves in the same direction as the direction of movement of the ripples.

C It moves sideways parallel to the direction of movement of the ripples.

D It moves up and down.

Your answer ☐ **[1]**

17. Nov/2021/Paper_J249/04/No.9

Which answer equals 2.45×10^9 Hz?

A 2.45 GHz

B 2.45 kHz

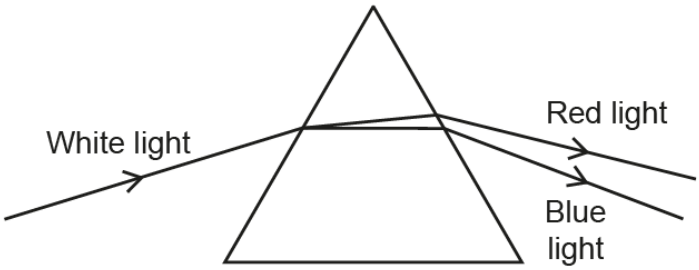
C 2.45 MHz

D 2.45 THz

Your answer ☐ **[1]**

18. Nov/2021/Paper_J249/04/No.10

A student uses a glass prism to split white light into different colours.



Which statement describes the light in the prism?

A Blue light is refracted less than red light.

B Blue light slows down more than red light.

C Red light has a shorter wavelength than blue light.

D Red light has a smaller frequency change than blue light.

Your answer ☐ **[1]**

19. Nov/2021/Paper_J249/04/No.12

An electrical circuit has an alternating current.

What type of wave can be produced by the alternating current?

A Gamma rays

B Radio

C Ultraviolet

D X-rays

Your answer ☐ **[1]**

20. Nov/2021/Paper_J249/04/No.13

An atom loses an electron after absorbing some electromagnetic radiation.

Which row of the table describes what happens?

	Energy of electron	Charge on the atom
A	Decreases	Negative
B	Decreases	Positive
C	Increases	Negative
D	Increases	Positive

Your answer ☐ **[1]**

21. Nov/2021/Paper_J249/04/No.16

This question is about visible light.

(a) (i) State **one** change that happens to light when it travels from water into air.

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

(ii) Diagram in **Fig. 16.1** shows a ray of light from a fish in a container of water.

Complete the ray diagram in **Fig. 16.1** to show the path of the ray after it leaves the water.

Include a normal line in your diagram.

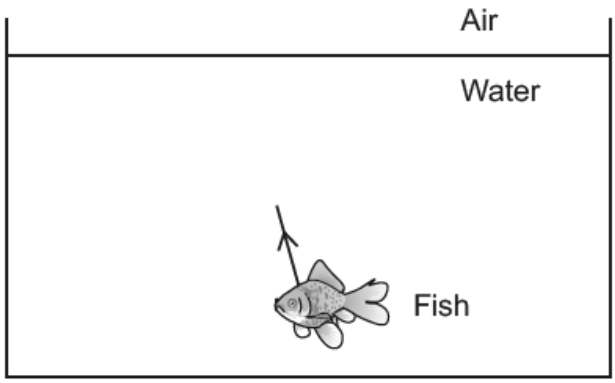


Fig. 16.1

[3]

(b) Diagram in **Fig. 16.2** shows three incident rays hitting the surface of the fish. Light is scattered from the surface of the fish.

Complete the diagram in **Fig. 16.2** to show the scattered rays.

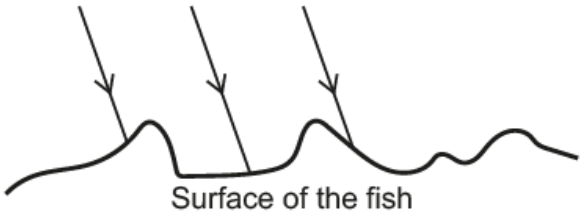


Fig. 16.2

[1]

(c) The fish appears red under white light.

Explain why the fish appears black under green light.

.....

.....

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

22. Nov/2020/Paper_J249/04/No.1

Four students measure the time it takes for a wave to travel the length of a ripple tank.

Each student collects three measurements of the time.

Student	Time taken (s)		
	1st measurement	2nd measurement	3rd measurement
A	2	2	1
B	2.1	2.1	2.4
C	2.1	2.0	2.2
D	2.11	2.49	2.23

Which student collected the **most** precise data?

Your answer ☐ **[1]**

23. Nov/2020/Paper_J249/04/No.2

Which row in the table describes all electromagnetic waves?

	Type of wave	Speed of wave in space
A	Longitudinal	Changes with wavelength.
B	Longitudinal	Stays the same.
C	Transverse	Changes with wavelength.
D	Transverse	Stays the same.

Your answer ☐ **[1]**

24. Nov/2020/Paper_J249/04/No.5

Electromagnetic waves can be ordered by frequency.

Which answer shows the waves in order of **increasing** frequency?

Low frequency ⟶ **High** frequency

A	Infra-red	Visible light	X-rays
B	Visible light	Infra-red	X-rays
C	Visible light	X-rays	Infra-red
D	X-rays	Visible light	Infra-red

Your answer ☐ **[1]**

25. Nov/2020/Paper_J249/04/No.8

The maximum frequency of sound that a person can hear changes as they get older.

Which row in the table explains this change?

	Maximum frequency of sound a person can hear	**What part of the ear is damaged?**
A	Decreases with age	Cochlea
B	Decreases with age	Eardrum
C	Increases with age	Cochlea
D	Increases with age	Eardrum

Your answer ☐ **[1]**

26. Nov/2020/Paper_J249/04/No.9

Six wave peaks hit a wall in one minute.

Determine the frequency of the waves.

A 0.1 Hz

B 6 Hz

C 10 Hz

D 360 Hz

Your answer ☐ **[1]**

27. Nov/2020/Paper_J249/04/No.10

When an electron in an atom changes energy level, it emits electromagnetic radiation.

Which row in the table is correct?

	Energy level of the electron	Type of radiation emitted
A	Decreases	Almost any electromagnetic radiation.
B	Decreases	Visible light only.
C	Increases	Almost any electromagnetic radiation.
D	Increases	Visible light only.

Your answer ☐ **[1]**

28. Nov/2020/Paper_J249/04/No.12

The average temperature on the Earth has increased over the last century.

Which statement explains why?

A Radiation absorbed by the Earth has decreased.

B Radiation absorbed is less than radiation emitted.

C Radiation absorbed is greater than radiation emitted.

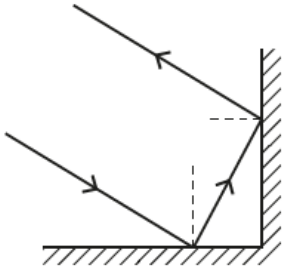
D Radiation emitted by the Earth has increased.

Your answer ☐ **[1]**

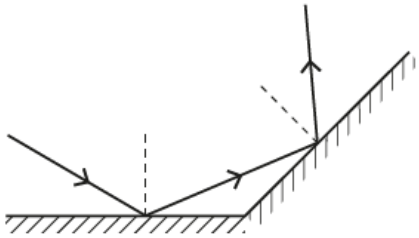
29. Nov/2020/Paper_J249/04/No.13

Look at the diagrams of a light ray reflecting from two identical surfaces.

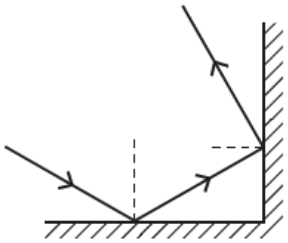
A



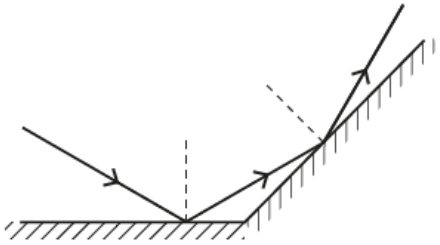
B



C



D



Which diagram is correct?

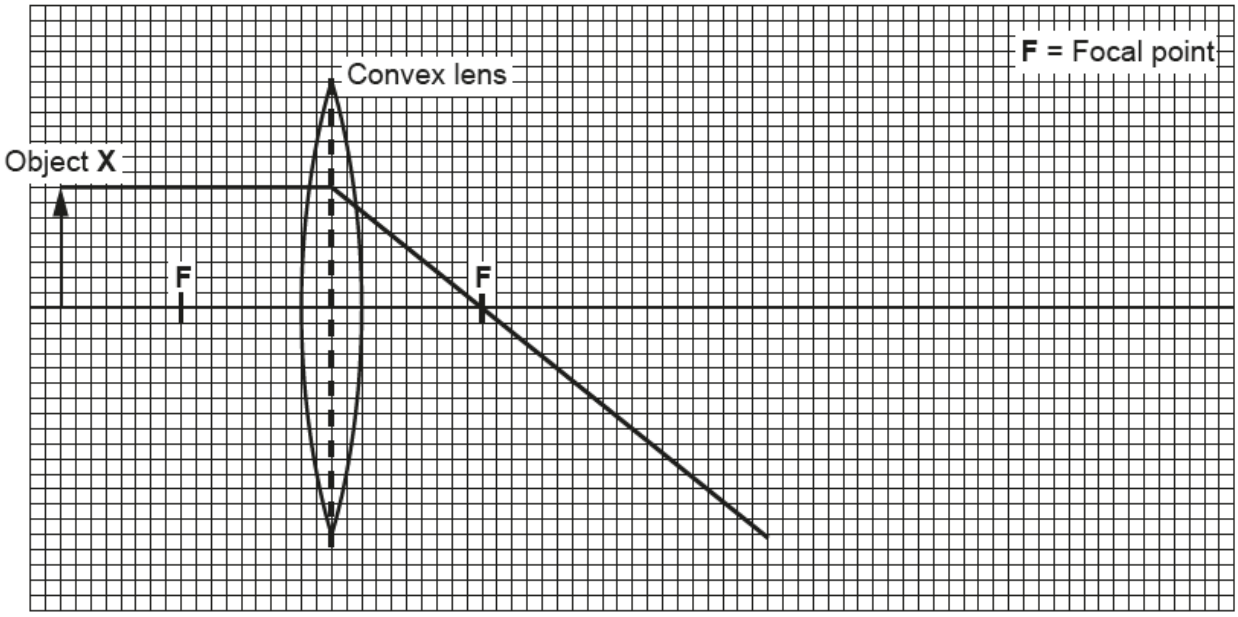
Your answer ☐ **[1]**

30. Nov/2020/Paper_J249/04/No.16

A projector is used to create a larger image of an object.

(a) The diagram shows one light ray as it passes through the convex lens.

Draw **one** more ray on the diagram to show where the image is formed. Label the image **Y**.



[2]

(b) The projector contains a white light source.

Explain how this white light source can be used to get **red** light.

.....

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

(c) **(i)** The projector is connected to the mains power supply. The projector has an earth wire.

State the potential difference between the earth wire and the live wire in normal use.

Potential difference = ...V **[1]**

(ii) A projector with a plastic case does not need an earth wire.
A projector with a metal case needs an earth wire.

Explain why.

.....

.....

.....

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

31. Nov/2020/Paper_J249/04/No.19

Ultrasound waves can be used to create an image of part of the inside of a body.

(a) Ultrasound waves have a higher frequency than ripples on the surface of water.

Describe **another** difference between ultrasound waves and ripples on the surface of water.

Explain your answer.

.....

.....

.....

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

(b) The graph in **Fig. 19.1** shows how displacement of the ultrasound wave varies with distance.

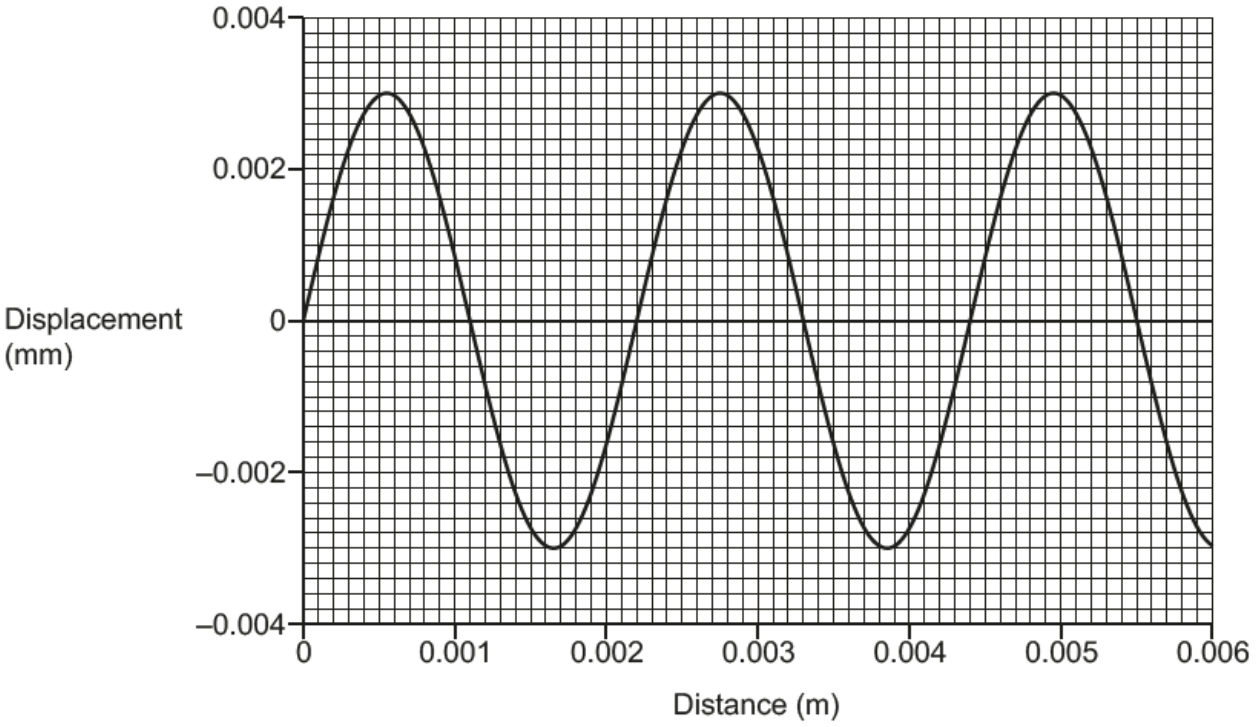


Fig. 19.1

(i) Use the graph in **Fig. 19.1** to determine the wavelength of the ultrasound wave.

Wavelength = ... m **[1]**

(ii) The speed of ultrasound waves in **(b)(i)** is 4500 m / s.

Calculate the frequency of the ultrasound wave in **Fig. 19.1**.

Use the equation: wave speed = frequency × wavelength

Give your answer in **standard form** and to **2** significant figures.

Frequency = ... Hz **[4]**

(c) Doctors can use an ultrasound scan to measure the size of a person's kidney.

Fig. 19.2

Complete the sentences using the words below.

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

Increases **Decreases** **Stays the same**

The ultrasound scanner is made from a solid ceramic material.

As the wave enters the body, the speed ..... .

As the wave enters the body, the frequency ..... .

[2]

(d) **(i)** Explain what happens to the ultrasound wave when it reaches the kidney.

.....

.....

.....

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

(ii) **Fig. 19.2** shows the thickness of the kidney, **w**.

Explain how ultrasound waves are used to measure **w**.

.....

.....

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

(e) A doctor uses an ultrasound scan instead of X-rays to measure the kidneys.

Explain why.

.....

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