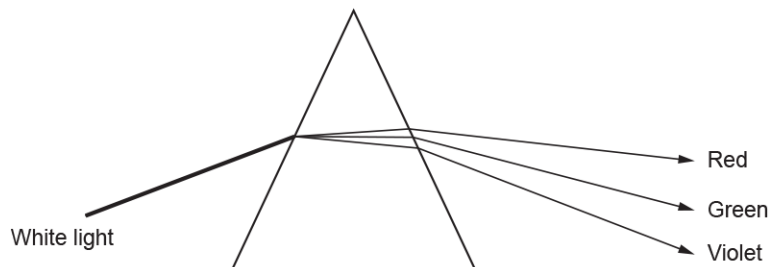


The Electromagnetic Spectrum (H)

1. Look at the diagram of white light as it passes through a prism.



A spectrum of colours is seen. It ranges from red to violet.

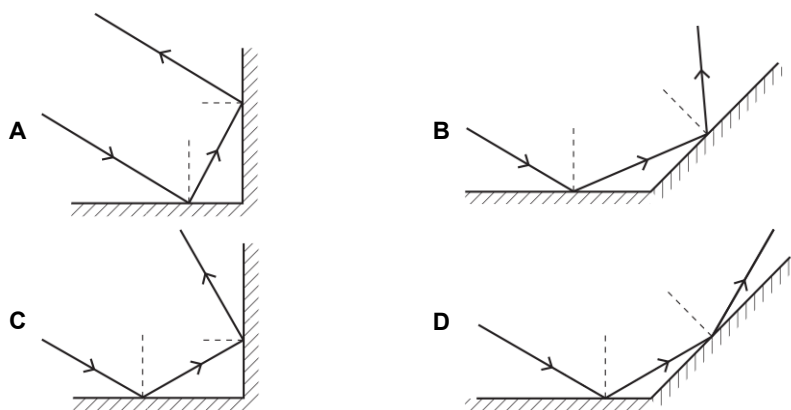
Why does the **violet** light refract **more** than the red light?

- A Violet light changes frequency more than red light.
- B Violet light has the largest change in speed.
- C Violet light has the smallest change in speed.
- D Violet light increases its speed in the glass prism.

Your answer

[1]

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



Which diagram is correct?

Your answer

[1]

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

Explain why.

[1]

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

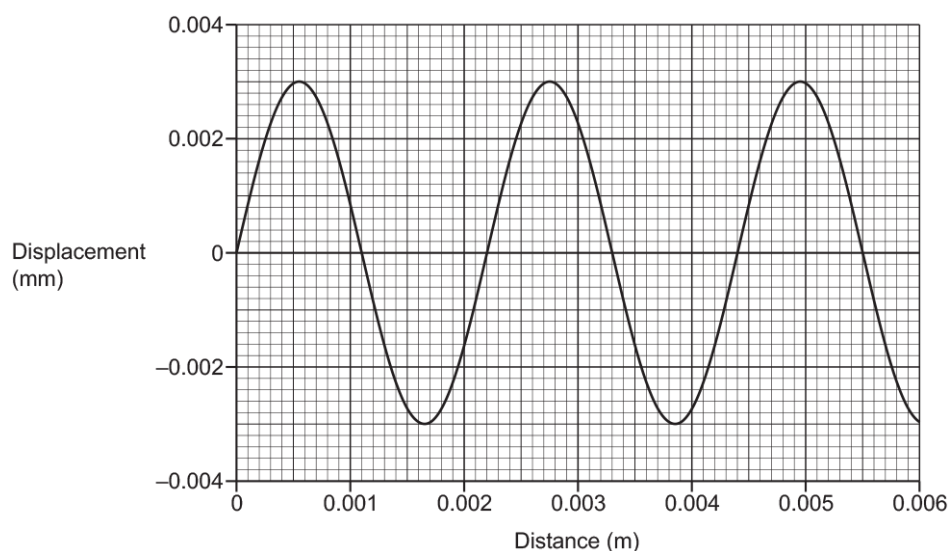


Fig. 19.1

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

Wavelength = m [1]

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

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

Use the equation: wave speed = frequency \times 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.

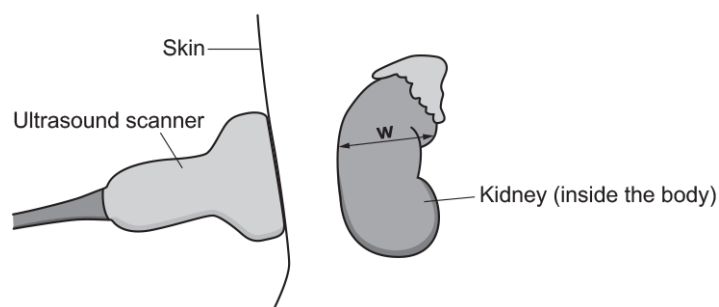


Fig. 19.2

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 .

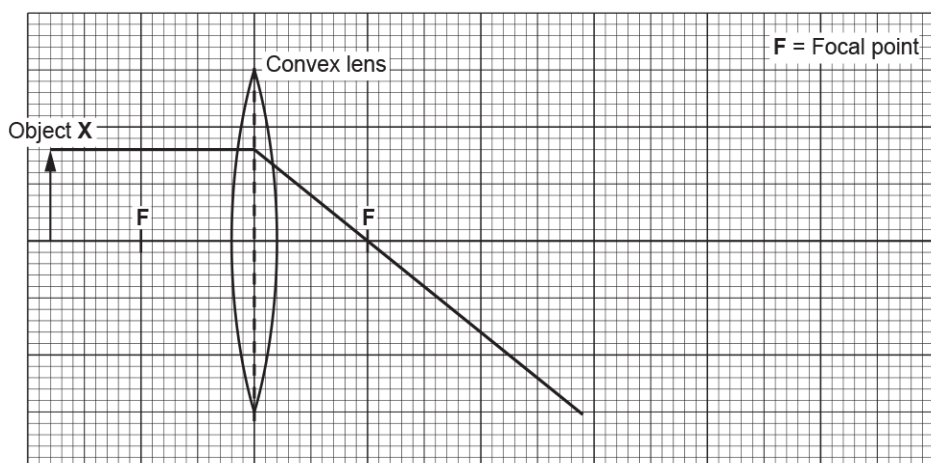
Explain how ultrasound waves are used to measure w .

[2]

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

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.

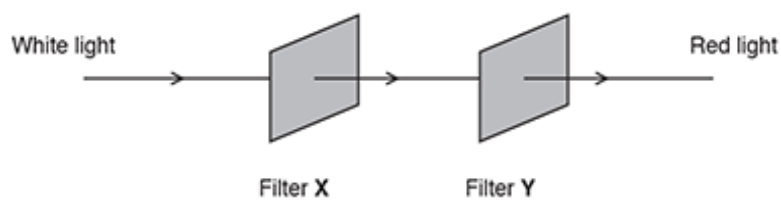
[2]

5 (a). White light is made of different colours.

White light passes through a transparent filter **X**.

Filter **X** absorbs green, blue, indigo and violet light.

The light then passes through another transparent filter, **Y**, as shown in **Fig. 18.3**.



The light that leaves filter **Y** is red.

i. What colours are transmitted by filter **X**?

[1]

- ii. What colours are absorbed by filter Y?

----- [1]

- (b). A wall is painted red.

When some coloured lights shine on it, the wall appears black.

- i. Explain why.

----- [1]

- ii. Suggest **two** different colours of light that would cause the wall to appear black.

and

----- [1]

- (c). An optician uses red and green light to test vision.

Fig. 18.4 is a ray diagram showing **red light** passing through a lens.

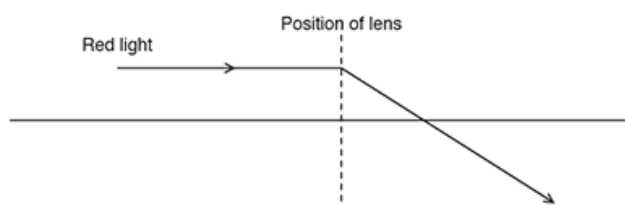


Fig. 18.4

- i. Green light passes through the same lens as in **Fig. 18.4**.

Complete the ray diagram in **Fig. 18.5** for **green light**. The focal point for red light F_R is shown.

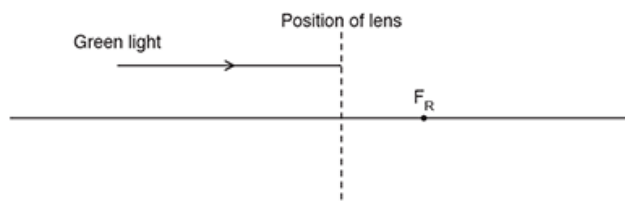


Fig. 18.5

[1]

- ii. Explain your answer to (i).

----- [1]

- iii. Is the lens in **Fig. 18.4** and **18.5** suitable for correcting long-sight or short-sight?

Tick (✓) **one** box.

Long-sight

Short-sight

Explain your answer.

----- [2]

- (d). A student investigates reflection and refraction of light rays.

The student sends a ray of red light into a glass prism.

Fig. 18.1 shows the light ray as it leaves the glass prism.

On **Fig. 18.1** complete the ray of light as it travels towards **and** through the glass prism.

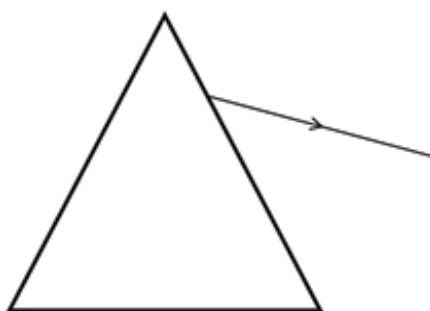


Fig. 18.1

[2]

(e). Fig. 18.2 shows two mirrors placed at 90° to each other.

A light ray hits one of the mirrors at 45° .

On Fig. 18.2 complete the ray of light as it reflects from both mirrors.

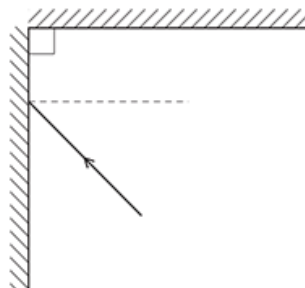


Fig. 18.2

[2]

6. Ultra-violet waves can damage human skin.

Describe the damage caused to human skin by ultra-violet waves.

----- [1]

7. An electromagnetic wave transfers energy.

Which row in the table is correct?

	Electromagnetic wave	Energy transfer
A	Infra-red	From a heating element of a toaster to the bread inside
B	Radio	From a radio to a transmitter
C	Gamma rays	From a high voltage supply to heating water in food
D	X-rays	From bones in the body to an X-ray machine

Your answer

[1]

8. Which waves can damage cells and cause cancer?

- A Radio, X-rays and infra-red.
- B Sound, gamma-rays and microwaves.
- C Sound, visible light and ultraviolet.
- D Ultraviolet, gamma-rays and X-rays.

Your answer

[1]

9. All bodies emit electromagnetic radiation.

Body **R** is at a higher temperature than body **S**.

Which statement is correct?

- A **R** emits radiation with a mean higher frequency.
- B **R** emits radiation with a mean longer wavelength.
- C **S** emits radiation with a higher intensity.
- D **S** emits radiation with a mean shorter wavelength.

Your answer

[1]

10. 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]

11. Electromagnetic waves can be ordered by frequency.

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

Low frequency \longrightarrow 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]

12. Ultrasound wave pulses are used by vets to scan inner tissues inside animals.

The ultrasound pulses partially reflect from different layers of tissue. These reflected wave pulses (echoes) are collected by the detector as shown in **Fig. 24.2**.

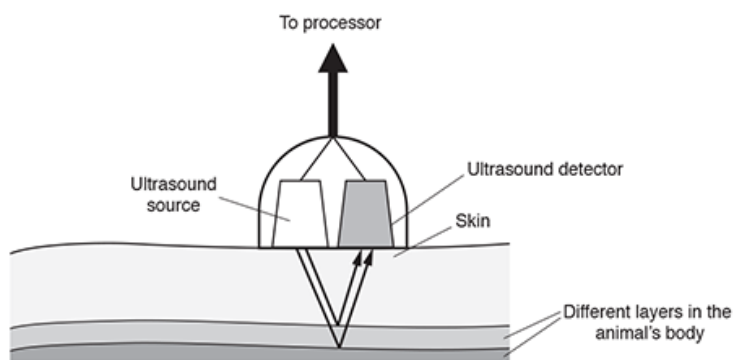


Fig. 24.2

In a scan using ultrasound pulses, three layers of tissue are detected, with each layer having a different thickness.

Describe and explain how the results from the detector can show:

- that there are three layers
- that each layer has a different thickness.

[3]

13. *The Earth contains a crust, mantle and core as shown in **Fig. 22.1**.

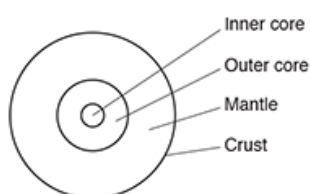


Fig. 22.1

Table 22.1 gives some data about seismic waves and the Earth.

	Density (g / cm ³)	P wave speed (km / s)	S wave speed (km / s)
Top of crust	2.2	5.55	3.25
Top of mantle	3.4	7.97	4.55
Top of outer core	9.9	8.10	-
Bottom of outer core	12.2	10.30	-

Table 22.1

Describe what information the data in **Table 22.1** gives about the structure of the Earth.

In your answer you should explain any trends in the data in **Table 22.1**.

----- [6]

14(a). Energy is transferred at high voltages in the national grid.

This house is near to a transmission line.



Explain why radio waves may be produced by the transmission line.

----- [2]

(b). Explain why it is more efficient to transfer energy at high voltages.

----- [2]

(c). The transmission line has a power loss of 6.156 kW.

Its resistance is 15.39 Ω .

Calculate the current in the transmission line.

Current = A [5]

15 (a). Look at the table showing information about the electromagnetic spectrum.

Radio	Micro-wave	Infra-red	Visible light	Ultra-violet	X-rays	Gamma-rays
3 MHz	30 GHz	3 THz		3000 THz	3 000 000 THz	300 000 000 THz
100 m	1 cm	100 μm				

The speed of all electromagnetic radiation is 3×10^8 m/s.

- i. Use data in the table to show that the speed of microwaves is 3×10^8 m/s.

[2]

- ii. Ultra-violet waves typically have a frequency of 3000 THz.

Calculate the wavelength of these ultra-violet waves in nm.

Answer = _____ nm [3]

- (b). * Ultrasound and X-rays are used to scan patients in hospital.

Look at the information about these two different waves.

Name	Frequency	Wavelength	Type	Description
Ultrasound	≥ 2 MHz	$\leq 1.6 \times 10^{-4}$ m	Longitudinal	Pressure sound wave
X-rays	$\geq 3 \times 10^{16}$ Hz	≤ 10 nm	Transverse	Electromagnetic wave

Ultrasound and X-rays are used to scan different parts of the patient.

Explain how ultrasound and X-rays are used and evaluate the risks and benefits of using these two different waves to scan patients in hospital.

Use the information in the table in your answer.

[6]

(c). Sun cream can be used to protect skin from ultra-violet waves. Sun creams have different sun protection factors (SPF).

Look at the information about a bottle of sun cream.

This sun cream has a SPF of 10.

If used sensibly it can allow you up to 10 × longer in the Sun without increasing the risk from ultra-violet waves.

- i. A doctor says 'adults should not sunbathe for more than 20 minutes in the midday sunshine when **not** using sun cream'.

If an adult used sun cream with SPF 6, how long could they safely sunbathe for?

Answer _____ minutes
= _____ **[1]**

- ii. The doctor says that children should always use at least SPF 50 sun cream.

Suggest reasons why.

[2]

END OF QUESTION PAPER