

22 Ultraviolet radiation and infrared radiation are both parts of the electromagnetic spectrum.

However, they differ in wavelength and frequency.

Which row describes how they differ?

	ultraviolet	infrared
A	longer wavelength than infrared	higher frequency than ultraviolet
B	longer wavelength than infrared	lower frequency than ultraviolet
C	shorter wavelength than infrared	higher frequency than ultraviolet
D	shorter wavelength than infrared	lower frequency than ultraviolet

22 Visible light, X-rays and microwaves are all components of the electromagnetic spectrum.

Which statement about the waves is correct?

- A In a vacuum, microwaves travel faster than visible light and have a shorter wavelength than visible light.
- B In a vacuum, microwaves travel at the same speed as visible light and have a shorter wavelength than visible light.
- C In a vacuum, X-rays travel faster than visible light and have a shorter wavelength than visible light.
- D In a vacuum, X-rays travel at the same speed as visible light and have a shorter wavelength than visible light.

5 (a) (i) Electromagnetic waves have many uses.

On Fig. 5.1 draw **one** line from each use to the region of the electromagnetic (e-m) spectrum it uses.

Use	Region of e-m spectrum
security marking	gamma rays
Bluetooth	ultraviolet
optical fibres	infrared
detection of cancer	radio waves

Fig. 5.1

[2]

(ii) State **one** advantage of using microwaves compared with radio waves to transmit mobile (cell) phone signals.

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..... [1]

(b) Describe the difference between transverse waves and longitudinal waves.

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..... [2]

- (c) Fig. 5.2 shows a simplified diagram of seismic P-waves travelling through the Earth. The paths of the waves are curved. Seismic waves are produced by rock movements in earthquakes.

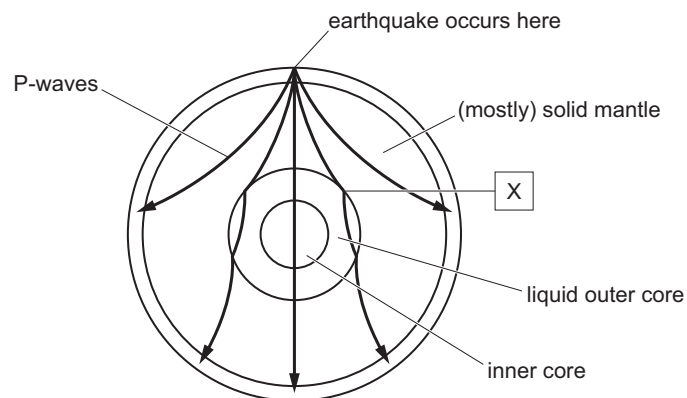


Fig. 5.2 (not to scale)

- (i) State the type of wave that P-waves can be modelled as.
 [1]
- (ii) At point X, the P-wave travels from the solid mantle to the liquid core. There is a sudden change in direction of the path of the wave.

Explain the change in direction of the P-wave at point X.

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 [2]

- (d) The Earth's surface absorbs incoming radiation from the Sun and also emits thermal radiation from its surface.

Over the past 50 years, scientists estimate that the average temperature of the Earth's surface has increased by approximately 0.75°C .

Explain what is causing this average temperature rise.

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 [2]

- 22 Satellites are sometimes used to receive and re-transmit television signals.

Which row shows the type of satellite and the electromagnetic waves used?

	type of satellite	electromagnetic waves used
A	low orbit	infrared
B	low orbit	microwaves
C	geostationary	infrared
D	geostationary	microwaves

- 21 Which region of the electromagnetic spectrum is used for detecting fake bank notes?

- A radio
 B microwaves
 C ultraviolet
 D X-rays

- 22 A radio transmitter broadcasts at a frequency of 200 kHz.

What is the wavelength of these radio waves?

- A $6.7 \times 10^{-4} \text{ m}$ B 1.5 m C $1.5 \times 10^3 \text{ m}$ D $1.5 \times 10^6 \text{ m}$

- 21 Visible light has wavelengths in the range $4.0 \times 10^{-7} \text{ m}$ to $7.0 \times 10^{-7} \text{ m}$.

What is the range of the frequencies of visible light?

- A 0.12 Hz to 0.21 Hz
 B 120 Hz to 210 Hz
 C $4.3 \times 10^{11} \text{ Hz}$ to $7.5 \times 10^{11} \text{ Hz}$
 D $4.3 \times 10^{14} \text{ Hz}$ to $7.5 \times 10^{14} \text{ Hz}$

- 6 A mobile phone (cell phone) network uses microwaves of frequency $1.9 \times 10^9 \text{ Hz}$ to transmit and receive signals.

The speed of microwaves in air is $3.0 \times 10^8 \text{ m/s}$.

- (a) Calculate the wavelength of these microwaves in air.

wavelength = [2]

- (b) State **two** reasons why microwaves are used for mobile phone (cell phone) signals.

1

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2

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[2]

- (c) All mobile phone (cell phone) networks use digital signals to communicate with the phone.

- (i) Describe, with the aid of a diagram, how a digital signal differs from an analogue signal.

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..... [3]

- (ii) State **two** advantages of using digital signals rather than analogue signals.

1

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2

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[2]

[Total: 9]