

Past-paper walk-through

Electromagnetic spectrum ■ 3.3

eXercise

Questions in this set

- 0625/21 N25 Q22 ■ 1 mark
- 0625/23 N25 Q22 ■ 1 mark
- 0625/43 N25 Q5 ■ 10 marks
- 0625/21 J25 Q22 ■ 1 mark
- 0625/21 J24 Q21 ■ 1 mark
- 0625/21 N23 Q22 ■ 1 mark
- 0625/21 J23 Q21 ■ 1 mark
- 0625/41 J23 Q6 ■ 9 marks

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- **//** separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = “or words to that effect” – the wording need not match.

Question 22

0625/21 N25 ■ Q22 ■ 1 mark

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

Question 22

D	shorter wavelength than infrared	lower frequency than ultraviolet
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Solution 22

Answer: **D**

Why

- The electromagnetic spectrum runs from long-wavelength radio to short-wavelength gamma.
- Ultraviolet lies beyond violet and infrared lies beyond red, so ultraviolet has the shorter wavelength.
- Shorter wavelength means higher frequency, since c is the same for both.

Question 22

0625/23 N25 ■ Q22 ■ 1 mark

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.

Solution 22

Answer: **D**

Why

- In a vacuum every electromagnetic wave travels at the same speed, 3.0×10^8 m/s.
- So microwaves cannot travel faster than visible light.
- What differs is wavelength and frequency: X-rays have the shortest wavelength of the three and microwaves the longest.

Question 5

0625/43 N25 ■ Q5 ■ 10 marks

- 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
security marking
Bluetooth
optical fibres
detection of cancer

Region of e-m spectrum
gamma rays
ultraviolet
infrared
radio waves

Question 5

Fig. 5.1

[2]

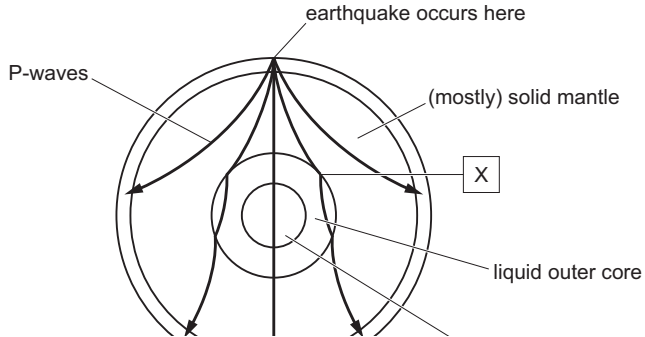
- (ii) State **one** advantage of using microwaves compared with radio waves to transmit mobile (cell) phone signals.

Question 5

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

Question 5

- (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.



Question 5



Fig. 5.2 (not to scale)

- (i) State the type of wave that P-waves can be modelled as.

Question 5

- (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.

Question 5

- (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.

Question 5

[Total: 10]

Solution 5

(a)(i) Mark scheme

- all four correct = 2 marks; any two correct = 1 mark
- security marking
- gamma rays
- Bluetooth
- ultraviolet
- optical fibres
- infrared
- detection of cancer

Solution 5

- radio waves

Solution 5

(a)(ii) Mark scheme

- any one from:
 - ■
 - only require a short aerial / antenna
 - ■
 - can pass through the atmosphere / ionosphere to satellites
 - ■
 - can transmit large amounts of data at high speeds / high rate of data transmission

Solution 5

(b) Mark scheme

- any two from:
- transverse:
 - ■
- oscillations / vibrations are at right angles to direction of propagation
- ■
- medium not required / can travel through a vacuum (for e-m wave)
- ■
- have crests / peaks and troughs

Solution 5

- longitudinal:
 - ■
 - oscillations / vibrations are parallel to direction of propagation
 - ■
 - medium is required
 - ■
 - have rarefactions and compressions

Solution 5

(c)(i)

Mark scheme

- longitudinal

Solution 5

(c)(ii) Mark scheme

- refraction
- any one from:
 - ■
- change in speed of the wave
- ■
- change in density of the medium
- 0625/43
- October/November 2025

Solution 5

(d) Mark scheme

- increase in carbon dioxide / greenhouse gases (in the atmosphere)
- OR
- increase in methane / water vapour (in the atmosphere)
- any one from:
 - prevents / reduces (re-emitted) radiation escaping (into space)
 - OR
 - radiation re-emitted / reflected back to surface (by atmosphere / greenhouse gases)
 - OR

Solution 5

- (amount of) radiation absorbed is greater than (the amount of) radiation leaving the atmosphere

Question 22

0625/21 J25 ■ Q22 ■ 1 mark

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

Solution 22

Answer: **D**

Why

- A satellite that stays above the same point on Earth is in geostationary orbit.
- That lets a fixed dish stay pointed at it.
- The signals used are microwaves, which pass easily through the atmosphere.

Question 21

0625/21 J24 ■ Q21 ■ 1 mark

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

- A** radio
- B** microwaves
- C** ultraviolet
- D** X-rays

Solution 21

Answer: **C**

Why

- Fake banknotes are detected by markings that glow under ultraviolet light.
- Ultraviolet causes fluorescence in certain inks.
- Radio and microwaves have far too long a wavelength, and X-rays are used for looking *through* objects.

Question 22

0625/21 N23 ■ Q22 ■ 1 mark

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** $1.5 \times 10^6 \text{ m}$

Solution 22

Answer: **C**

Why

- $\lambda = v/f$, and radio waves travel at 3.0×10^8 m/s.
- $f = 200$ kHz = 2.0×10^5 Hz.
- $\lambda = 3.0 \times 10^8 / 2.0 \times 10^5 = 1.5 \times 10^3$ m.

Question 21

0625/21 J23 ■ Q21 ■ 1 mark

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 $7.5 \times 10^{14} \text{ Hz}$

Solution 21

Answer: **D**

Why

- $f = c/\lambda$, with $c = 3.0 \times 10^8$ m/s.
- The *longest* wavelength gives the *lowest* frequency:
 $3.0 \times 10^8 / 7.0 \times 10^{-7} = 4.3 \times 10^{14}$ Hz.
- The shortest gives the highest: $3.0 \times 10^8 / 4.0 \times 10^{-7} = 7.5 \times 10^{14}$ Hz.

Question 6

0625/41 J23 ■ Q6 ■ 9 marks

- 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.

Question 6

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

Question 6

[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.

Question 6

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

Question 6

[2]

[Total: 9]

Solution 6

(a)

Mark scheme

- (wavelength =) 0.16 m
- $v = f \lambda$ OR (=) v / f OR (=) $3 \times 10^8 / 1.9 \times 10^9$

Solution 6

(b)

Mark scheme

- (microwaves) only need short aerials / antennas
- (microwaves) penetrate (some) walls
- 0625/41
- May/June 2023

Solution 6

(c)(i)

Mark scheme

- labelled diagram of digital (signal) with blocks of high (1) and low (0) AND labelled diagram of analogue with continuously
- variable signal
- digital (signal) consists of two values owtte
- analogue (signal) varies over a range (of values) owtte

Solution 6

(c)(ii) Mark scheme

- any two from:
 - ■
 - faster (data) transmission rate OR data can be compressed
 - ■
 - data / signal transmitted over long(er) distances (as signal can be regenerated)
 - ■
 - noise easily removed (from signal / data) OR signal can be regenerated