Past-paper walk-through

Electromagnetic spectrum ▪ 7.4

eXercise

Questions in this set

- 9702/14 N25 Q25 ▪ 1 mark
- 9702/11 J25 Q27 ▪ 1 mark
- 9702/12 J25 Q5 ▪ 1 mark
- 9702/13 J25 Q27 ▪ 1 mark
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Question 25

9702/14 N25 ▪ Q25 ▪ 1 mark

Which statement about electromagnetic waves is correct? **[1]**

A A wave of wavelength 5.0×10^{-6} m is invisible to the human eye.

B They can all travel at different speeds in free space.

C They \textbf{cannot} be polarised.

D They consist of vibrating atoms.

Solution 25

A A wave of wavelength 5.0×10^{-6} m is invisible to the human eye. ✓

B They can all travel at different speeds in free space.

C They \textbf{cannot} be polarised.

D They consist of vibrating atoms.

Why

- 5.0×10^{-6} m is 5000 nm, well beyond the red end of the visible range.
- That is infrared, so the eye cannot detect it.
- B and C are false for all electromagnetic waves, and D describes a mechanical wave.

Question 27

9702/11 J25 ▪ Q27 ▪ 1 mark

Which wavelength of electromagnetic radiation in free space could be green light? **[1]**

A 4.9×10^{-9} m

B 6.6×10^{-9} m

C 5.5×10^{-7} m

D 8.6×10^{-7} m

Solution 27

A 4.9×10^{-9} m

B 6.6×10^{-9} m

C 5.5×10^{-7} m ✓

D 8.6×10^{-7} m

Why

- Visible light runs from about 400 nm to 700 nm, that is 4×10^{-7} to 7×10^{-7} m.
- Green sits near the middle, around 550 nm $= 5.5 \times 10^{-7}$ m.
- A and B are X-ray wavelengths; D is just past the red end, in the infrared.

Question 5

9702/12 J25 ▪ Q5 ▪ 1 mark

Radio waves can be used to measure the distance between Earth and the planet Jupiter.

A pulse of radio waves is emitted from the surface of Earth. The pulse reflects from the surface of Jupiter and is detected again on Earth.

The time between emitting and receiving the pulse is 3960 s.

What is the distance between Earth and Jupiter? **[1]**

A 5.94×10^{8} km

B 1.19×10^{9} km

C 5.94×10^{11} km

D 1.19×10^{12} km

Solution 5

A 5.94×10^8 km ✓

B 1.19×10^9 km

C 5.94×10^{11} km

D 1.19×10^{12} km

Why

- The pulse travels there and back, so the one-way time is $3960/2 = 1980$ s.
- $d = ct = 3.0 \times 10^8 \times 1980 = 5.94 \times 10^{11}$ m.
- The options are in kilometres, so that is 5.94×10^8 km – C is the same figure left in metres.

Question 27

9702/13 J25 ▪ Q27 ▪ 1 mark

27 An electromagnetic wave travelling in free space is **not** visible to the human eye.

What is a possible wavelength of the wave?

A 4.5×10^{-10} km

B 6.2×10^{-7} m

C 5.4×10^{-6} cm

D 4.2×10^{-4} mm

Solution 27

Answer: **C**

Why

- Convert every option to metres first – that is the whole question.
- A is 4.5×10^{-7} m, B is 6.2×10^{-7} m and D is 4.2×10^{-7} m, all inside the visible 400–700 nm band.
- C is 5.4×10^{-8} m $= 54$ nm, which is ultraviolet and so invisible.

Question 23

9702/14 J25 ▪ Q23 ▪ 1 mark

23 Which row could describe electromagnetic waves?

	type of wave	speed in free space
A	longitudinal	faster for shorter wavelengths
B	longitudinal	the same for all wavelengths
C	transverse	faster for shorter wavelengths
D	transverse	the same for all wavelengths

Question 23

Solution 23

Answer: **D**

Why

- Electromagnetic waves are transverse.
- In free space they all travel at the same speed, $c = 3.0 \times 10^8$ m s^{-1}, whatever the wavelength.
- Only inside a medium does the speed start to depend on wavelength.

Question 22

9702/12 M25 ▪ Q22 ▪ 1 mark

22 Which row correctly identifies the properties of all electromagnetic waves?

	transverse wave	longitudinal wave	can travel in free space
A	✓	✗	✓
B	✓	✗	✗
C	✗	✓	✓
D	✗	✓	✗

key

✓ = property of an electromagnetic wave

✗ = **not** a property of an electromagnetic wave

Solution 22

Answer: **A**

Why

- All electromagnetic waves are transverse – electric and magnetic fields oscillating at right angles to the travel direction.
- None of them is longitudinal.
- They all travel through free space, at 3.0×10^8 m s^{-1}.

Question 23

9702/12 M25 ▪ Q23 ▪ 1 mark

23 What is the approximate range of wavelengths in free space for infrared radiation?

A 100 nm to 400 nm

B 300 μm to 30 cm

C 400 nm to 700 nm

D 800 nm to 1000 μm

Solution 23

Answer: **D**

Why

- Infrared lies just beyond the red end of the visible spectrum, so it begins around 700–800 nm.
- It extends to about 1 mm, where the microwave region takes over.
- A is ultraviolet, B is radio, and C is the visible range itself.