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SPECA

GCSE Combined Science (AQA Trilogy) · Physics

Waves · Mark Scheme

For use with the Tiered Worksheet. Marking points are indicative, not exhaustive: award equivalent correct answers.

Section A: Foundation (Q1 to 12)

1) Similarity: both transfer energy without transferring matter (1). Difference: transverse wave oscillations are perpendicular to the direction of travel; longitudinal wave oscillations are parallel to (along) the direction of travel (1) [2]

2) Compression (1); rarefaction (1) [2]

3) The distance between two equivalent points on adjacent waves (e.g. from one crest to the next) (1) [1]

4) $T = 1 \div f = 1 \div 5$ (1 method) = 0.2 s (1 answer) [2]

5) $f = v \div \lambda = 340 \div 0.68$ (1 method) = 500 Hz (1 answer); correct unit shown (1) [3]

6) Amplitude = 3 cm (1); wavelength = 12 cm (1) [2]

7) Radio, microwave, infrared, visible light, ultraviolet, X-ray, gamma ray (2 marks for all seven correct in order; 1 mark for at least four consecutive correct) [2]

8) Visible light (1) [1]

9) Microwaves: satellite communication OR cooking (1); infrared: electrical heaters OR cooking OR infrared cameras (1) [2]

10) X-rays and gamma rays carry enough energy to remove electrons from atoms/molecules in tissue, ionising them (1); this can damage cells/DNA and increase the risk of mutation or cancer (1) [2]

11) Indicative content, mark holistically to a maximum of 3: stand a known, measured distance from a hard reflective surface (e.g. a wall); make a short, sharp sound (e.g. a clap) and start a timer at the same moment; stop the timer when the echo is heard, and use the total distance travelled (there and back) divided by the time taken to calculate speed. Accept other valid methods (e.g. using two microphones a known distance apart connected to a timer/data logger). [3]

12) The CT scan delivers the greatest dose (1); it is $10 \div 0.02 = 500$ times greater than the chest X-ray (1) [2]

Section B: Higher (Q13 to 18)

13) As the wave crosses the boundary, its speed changes (1); this causes the wave to change direction, unless it crosses the boundary at 90° (along the normal) (1); the greater the change in speed, the greater the change in direction (1) [3]

14) Since $v = f \times \lambda$ and frequency stays constant, wavelength must decrease when speed decreases (1); wavelength and speed are directly proportional when frequency is fixed (1) [2]

15) The alternating current in the aerial/circuit causes electrons to oscillate (1); this oscillation generates an electromagnetic (radio) wave with the same frequency as the oscillating current (1) [2]

16) The absorbed radio wave causes electrons in the receiving aerial/circuit to oscillate (1); this induces an alternating current in the circuit, at the same frequency as the radio wave (1) [2]

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17) Indicative content, mark holistically to a maximum of 3: X-rays pass through soft tissue (which is less dense) but are absorbed by denser material such as bone; this creates a difference in the amount of radiation reaching a detector/film behind the body, producing a clear image where bone shows up against soft tissue; different soft tissues absorb X-rays much more similarly to each other, so the contrast between them is much lower, giving less useful detail. [3]

18) Gamma rays can penetrate deep enough into the body to reach a tumour inside it (1); gamma rays are ionising and carry enough energy to damage/kill cells, whereas radio waves are non-ionising and do not have this effect (1) [2]

Total: 24 marks (Section A) + 14 marks (Section B) = 38 marks

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