S5 Physics Practice Paper (Set 2): Wave Properties and Wave Speed, Refraction and Total Internal Reflection, Convex Lens Imaging, Standing Waves and Pipes, Sound Intensity Level, Electromagnetic Waves and Doppler Effect

S5 Physics | Time: 75 minutes | Total: 100 marks | 24 questions

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Section A: Wave Properties and Wave Speed (16 marks)

Show all working with units and simplify your answers.

1. A wave has frequency 250 Hz and wavelength 1.36 m. Find its speed.

2. A sound wave of the same 250 Hz travels in water at 1500 m/s. Find its wavelength in water.

3. What is the period of the 250 Hz wave in milliseconds?

4. The wave moves from deep to shallow water and slows to 136 m/s. If the frequency is unchanged, find the new wavelength.

Section B: Refraction and Total Internal Reflection (16 marks)

Take the refractive index of air as 1.00; give angles in degrees to 1 decimal place.

5. Light enters glass of refractive index 1.50 from air at an angle of 30°. Find the angle of refraction.

6. Find the critical angle for light going from this glass (n = 1.50) to air.

7. Water has refractive index 1.33. Find the critical angle at a water-air boundary.

8. An optical fibre has core index 1.50 and cladding index 1.45. Find the critical angle at the core-cladding boundary.

Section C: Convex Lens Imaging (20 marks)

Use 1/f = 1/u + 1/v and magnification m = -v/u; v is negative for a virtual image.

9. A convex lens of focal length 10.0 cm has an object at 15.0 cm. Find the image distance and magnification, and state whether it is real.

10. With the same lens the object is moved to 5.0 cm. Find the image distance and magnification, and describe the image.

11. Same lens, object distance 25.0 cm. Find the image distance and magnification to 3 significant figures.

12. A convex lens of focal length 8.0 cm is used as a magnifier with the object at 4.0 cm. Find the image distance and magnification.

Section D: Standing Waves and Pipes (20 marks)

A string is fixed at both ends; an open pipe has antinodes at both ends and a closed pipe has a node at the closed end.

13. A string 0.80 m long is fixed at both ends and has a fundamental frequency of 220 Hz. Find the wave speed on the string.

14. Find the frequency and wavelength of the third harmonic of the same string.

15. An open pipe 0.65 m long (open at both ends) with sound speed 340 m/s. Find its fundamental frequency.

16. A closed pipe of the same 0.65 m length (one end closed): find its fundamental frequency and explain the difference.

Section E: Sound Intensity and Intensity Level (16 marks)

Use L = 10 log(I/I0) with I0 = 1 x 10^-12 W m^-2; give answers to 1 decimal place.

17. The sound intensity at a point is 1 x 10^-4 W m^-2. Find the intensity level in dB.

18. Elsewhere the intensity is 2 x 10^-5 W m^-2. Find the intensity level.

19. Two identical tuning forks each producing 60 dB sound together. What is the combined intensity level?

20. By how many dB does the intensity level fall when the distance from a point source is doubled?

Section F: Electromagnetic Waves and Doppler Effect (12 marks)

Take c = 3.0 x 10^8 m/s and the speed of sound as 340 m/s.

21. Visible light of frequency 5.0 x 10^14 Hz: find its wavelength in nm.

22. A microwave oven uses 0.125 m waves. Find the frequency in GHz.

23. A car sounding a 500 Hz horn approaches a stationary observer at 30 m/s. Find the frequency heard.

24. A sound is sent towards a cliff and the echo returns after 0.60 s. Find the distance to the cliff.

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