Waves, Sound & Standing Waves

Waves · 5 questions · step-by-step answers at the end

Name: Date: Score: / 5

USEFUL EQUATIONS

$v = f\lambda$ $T = 1/f$ $f_n = nv/(2L)$ $f_n = nv/(4L)$, n odd $v_{\text{sound}} \approx 343$ m/s

Questions

Show your working in the space under each question.

1. A wave has f = 5.0 Hz and λ = 0.40 m. What is its speed?

2. A 1.2 m string has a wave speed of 120 m/s. Find its fundamental and third harmonic. Then find the fundamental of a 0.80 m pipe that is (a) open at both ends and (b) closed at one end.

3. Sound passes from air into water, where it travels about 4× faster. What happens to f and λ?

4. The tension in a guitar string is quadrupled. What happens to its fundamental frequency?

5. Which travels faster in a vacuum, X-rays or radio waves?

Step-by-step answers

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1. $v = f\lambda = (5.0)(0.40) =$ **2.0 m/s**.

2. 1. String: $f_1 = v/(2L) = 120/2.4 =$ **50 Hz**; $f_3 = 3f_1 =$ **150 Hz**.
2. Open pipe: $f_1 = 343/(2 \times 0.80) =$ **214 Hz**.
3. Closed pipe: $f_1 = 343/(4 \times 0.80) =$ **107 Hz**, an octave lower.
4. The closed pipe's next resonance is $3f_1 = 322$ Hz, because only odd harmonics are allowed.

Answer: String: 50 Hz, 150 Hz · open pipe 214 Hz · closed pipe 107 Hz

3. f is **unchanged**; λ becomes **4× longer**.

4. $v \propto \sqrt{F_T}$, so v and f **double**.

5. **Neither**: all EM waves travel at c.