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# Physics: *Waves and Sound HW*

**Set 1: Simple Harmonic Motion of a Mass-Spring System**

1. A spring of force constant 24.5 N/m is attached to different masses and the system is set in motion. Find the period and frequency of vibration for masses of the following magnitudes:

 a. 2.82 kg

 b. 83 g

2. Four people in a 1268 kg car have a combined mass of 248 kg. The car’s frame is supported by four springs, each with a force constant of 35 kN/m. What is the period of vibration of the car when it is driven over a pothole?

3. A 0.37 kg mass is attached to a spring and set into vibration. If the period is 0.186 s, what is the spring constant?

4. A 289 N object vibrates with a period of 3.11 s when hanging from a vertical spring. Determine the spring constant.

5. A mass of 250 g is attached to a certain spring and set in motion. It is observed to make ten complete vibrations in 12.8 s. Determine the force constant of the spring.

ANSWERS: 1a. T = 2.13 s, f = 0.469 Hz 2. 0.65 s 4. 120. N/m

1b. T = 0.37 s, f = 2.7 Hz 3. 420 N/m 5. 6.0 N/m

**Set 2: Hooke’s Law**

6. A 65 N weight is attached to a vertical spring, causing the spring to stretch 17.5 cm. Find the spring constant.

7. A water-balloon launcher shoots balloons with the aid of two elastic bands. If it takes a 360 N force to stretch the bands 0.94 m, what is the equivalent spring constant of the two bands?

8. Suppose a vertically-suspended spring stretches 21.3 cm from its equilibrium position when a 600. g mass is attached to it.

 a. Find the spring constant.

 b. Compared to a spring having k = 75 N/m, is the spring in Q8a stiffer or less stiff? Explain briefly.

9. How much force is required to pull a spring 6.40 cm from its equilibrium position if the spring constant is

18.4 kN/m?

**Set 3: Simple Harmonic Motion of a Simple Pendulum**

10. You need to know the height of a balcony. If a pendulum suspended nearly to the ground from the balcony has a period of 9.28 s, how tall is the tower?

11. What should be the length of a pendulum, if its period is to be 5.00 s?

ANSWERS: 6. 370 N/m 8a. 27.6 N/m 9. 1180 N 11. 6.21 m

7. 380 N/m 8b. less stiff 10. 21.4 m

12. A 46.7 kg circus-performer swings back and forth on a trapeze in a pendulum-like motion. If the period of motion is 4.16 s, calculate the effective length of the pendulum.

13. Calculate the period and frequency of a 2.000 m long pendulum in the following global cities:

 a. Rio de Janeiro, where g = 9.788 m/s2 b. Helsinki, where g = 9.819 m/s2

**Set 4: Wave Speed**

14. On a piano, the G above middle-C has a frequency of 384 Hz. If the air temperature is 0.00oC, find the wavelength of the sound waves of this note on the piano.

15. A tuning fork produces sound with a frequency of 426 Hz and a wavelength in air of 0.829 m.

 a. For this case, what is the speed of sound in air?

 b. What would be the wavelength of this same sound in copper, in which sound travels at 3900 m/s?

16. The light emitted by a particular argon laser has a wavelength of 466 nm and travels at 3.00 x 108 m/s. Determine the frequency of this laser’s light.

17. The speed of all electromagnetic radiation in empty space is 3.00 x 108 m/s. Determine the wavelength of electromagnetic waves emitted at the following frequencies:

 a. radio waves at 670 kHz b. gamma rays at 1 x 1014 MHz

ANSWERS: 12. 4.30 m 14. 0.862 m 16. 6.44 x 1014 Hz

13a. T = 2.840 s, f = 0.3521 Hz 15a. 353 m/s 17a. 450 m

13b. T = 2.836 s, f = 0.3526 Hz 15b. 9.2 m 17b. 3 x 10–12 m

**Set 5: Harmonics**

18. A string 76.4 cm long has a fundamental frequency of 442 Hz. What is the speed of the waves on the string?

19. A recorder is basically an open tube. If the length of a typical recorder is 43.5 cm, what are the first three harmonics of a recorder when all keys are closed and the air temperature is 20.0oC?

20. Find the fundamental frequency of a 28.0 cm harp string when the speed of waves on the string is 287 m/s.

21. Find the fundamental frequency of a 0.296 m long, closed organ pipe, if the air temperature is 25.0oC.

**Set 6: Intensity of Sound Waves**

22. Find the sound intensity 6.0 m away from an amplifier when its power output is 0.178 W.

23. At one point during a concert, the sound power output of a junior high band is 63 W. What is the intensity of the sound to a listener 15 m from the band?

24. If an alto’s voice generates 6.4 x 10–7 W/m2 at 2.5 m, how much sound power is the singer generating?

25. The power output of a cello is 0.24 W. At what distance is the intensity of the cello 3.8 x 10–4 W/m2?

ANSWERS: 18. 675 m/s 20. 512 Hz 22. 3.9 x 10–4 W/m2 24. 5.0 x 10–5 W

19. 394 Hz, 788 Hz, 1182 Hz 21. 292 Hz 23. 0.022 W/m2 25. 7.1 m