Name: Date: Period:

Unit 08 Review (Simle Harmonic Motion & Waves)

1. You are floating in the ocean. The waves have an amplitude of 1.5 meters. The frequency with which you bob up and down is 0.2 Hz. How far apart are the waves if they are traveling at 3 m/s?

Solution: Knowns/Unknowns: $A = 1.5$ m, $f = 0.2$ Hz, $v = 3$ m/s.

$$\begin{aligned} v &= f\lambda \\ 3 &= (0.2)\lambda \\ 15\,\text{m} &= \lambda \end{aligned}$$

2. A 0.3-kg mass is attached to a vertical spring. When the mass is attached, the spring stretches by 0.15 m. Calculate the spring constant of the spring.

Solution: Knowns/Unknowns: $m = 0.3$ kg, $d = -0.15$ m, $k = ?$.
Since the spring is being stretched by gravity, $F_S = F_G$. Therefore,

$$\begin{aligned} F_S &= F_G \\ -kd &= mg \\ -k(-0.15) &= (0.3)(9.8) \\ k &= 19.6\,\text{N/m} \end{aligned}$$

3. Calculate the period and frequency of a pendulum with length 1.4 m.

Solution: Knowns/Unknowns: $\ell = 1.4$ m, $T = ?$, $f = ?$.

$$T_P = 2\pi\sqrt{\frac{\ell}{g}} = 2(3.14)\sqrt{\frac{1.4}{9.8}} = 2.37\,\text{s}$$

$$f = \frac{1}{T} = \frac{1}{2.37} = 0.42\,\text{Hz}$$

4. A spring makes 9 oscillations in 15 s. The spring constant is 80 N/m. What mass is on the spring?

Solution: Knowns/Unknowns: $\#osc = 9$, $t = 15$ s, $k = 80$ N/m $m = ?$.
First, $T = \frac{15}{9} = 1.67$ s. Then,

$$\begin{aligned} T_S &= 2\pi\sqrt{\frac{m}{k}} \\ 1.67 &= 6.28\sqrt{\frac{m}{80}} \\ 2.78 &= \frac{39.48m}{80} \\ 5.67\,\text{kg} &= m \end{aligned}$$

5. What are the four equations you need to have memorized?

Solution:

$$T = \frac{t}{\#osc} \qquad f = \frac{\#osc}{t} \qquad T = \frac{1}{f} \qquad f = \frac{1}{T}$$

6. Define the following:
   (a) amplitude

   Solution: the maximum displacement from equilibrium

   (b) equilibrium

   Solution: the point where restoring force is zero

   (c) frequency

   Solution: how many oscillations happen in a second

   (d) longitudinal wave

   Solution: a wave in which the particles in the medium move parallel to the motion of the wave

   (e) medium

   Solution: the matter that waves travel through

   (f) period

   Solution: the time of one oscillation

   (g) restoring force

   Solution: a force that pulls an object toward a fixed equilibrium point

   (h) spring constant

   Solution: k, a measure of the stregth of the spring. Measured in N/m.

   (i) transverse wave

   Solution: a wave in which the particles in the medium move perpendicular to the motion of the wave

   (j) wavelength

   Solution: the distance before a wave repeats itself

7. Explain why an oscillator keeps moving when it gets to equilibrium, even though the net force there is zero.

Solution: the inertia carries it past

8. Why doesn't amplitude affect period?

Solution: Oscillators with a larger amplitude have a larger speed. They also travel a farther distance. These two effect counteract each other

9. What two factors affect the period of a spring? What two factors affect the period of a pendulum?

Solution: Mass and spring constant affect the period of a spring. Length and acceleration of gravity affect the period of a pendulum.

10. What do waves transport and what do they not transport?

Solution: a wave transports energy without transporting matter

11. Draw an example of constructive and destructive intereference. Label each.

Solution:

12. What is the only thing you can do to change the speed of a wave?

Solution: the only thing that affects the speed of a wave is the medium it is traveling through

13. How are frequency and wavelength related?

Solution: they are inversely proportional to each other