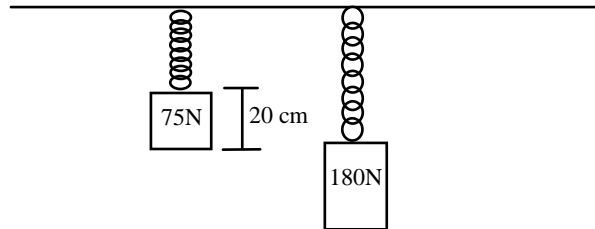


Chapter 11

1. The amplitude is $\frac{1}{2}$ the total vertical distance, and a simple harmonic oscillator travels twice the vertical distance in one oscillation.
2. The spring stretched (85cm - 65cm) when the force was increased..



Equation 11-1 can also be expressed as $k = \frac{\Delta F}{\Delta x}$. Solve for k.

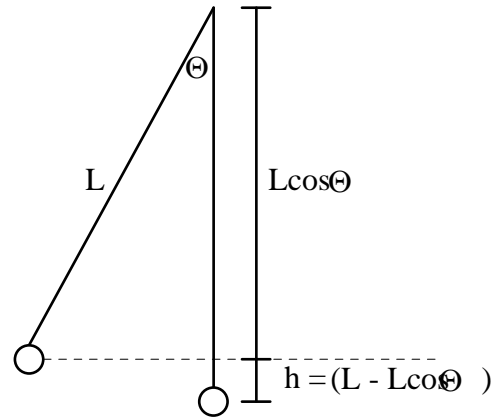
3. This problem will take two steps. First find the spring constant using equation 11-1 on page 310, the mass of the man and the amount he causes the springs to depress. Once you have the spring constant, use equation 11-7b for frequency in terms of mass and spring constant found on page 315. This time, use the mass of the man plus the car to find the frequency, because both the man and the car are bouncing.
4. a) You're given mass and stretch distance, find the spring constant (k) using the weight of the spring as the force and equation 11-1 on page 310.
b) You now have k and m, and you are given the amplitude in part B. Use equation 11-7b on page 315 and solve for the frequency.
5. Use algebraic wizardry to rearrange the frequency equation to solve for k. List your variables as m_1, m_2, f_1, f_2 and set the two equations equal to each other. You're given m_1, m_2 , and f_1 . Solve for f_2 .
6. Figure 11-2 is on page 288. The oscillator will be a maximum distance from the equilibrium point at each $\frac{1}{4}$ time. It will cross the point of equilibrium at each whole or $\frac{1}{2}$ time.
7. See Example 11-6 on page 293. Convert grams to kilograms.
a) List your variables and use the frequency equation to solve for k.
b) Use the k you found in (a) and the mass given in part b to solve for frequency, f .
8. Use equation 11-7b on page 293. Use it to derive an equation for spring constant, k. Since it is the same spring, set $k_1 = k_2$, cancel out $4\pi^2$ on both sides and solve for m_2 .

9. Use frequency and mass to solve for the spring constant (k).
- List your variables and solve for maximum velocity.
 - List your variables and use the Dave Equation to solve for velocity at x.
 - $TE = KE(\max)$ or $PEg(\max)$ or $PE(sp)(\max)$ You choose.
 - At $t=0$ at $x = \max$, you get a cosine curve.
12. Use Hooke's Law, the mass of the spring and the original stretch distance to find the spring constant. The additional 0.130 meters is the amplitude of the vibration when the system is released. It will take $\frac{1}{4}$ of the period to reach equilibrium again.
14. You are given the Force necessary to compress the spring and the distance it was compressed. Use this information given to calculate the spring constant. List your variables and find the potential energy stored in the spring. That will be converted to KE when the trigger is pulled. Set the $PE = KE$ and solve for velocity.
15. The energy necessary to compress the spring is now the potential energy of the spring.
- Use conservation of energy and solve for k.
 - The compression distance is also the amplitude. The maximum acceleration is equal to the maximum restoring force (kA).
16. a) and b) Find the amplitude and the frequency from the equation given.
- $TE = KE(\max)$ or $PEg(\max)$ or $PE(sp)(\max)$. You were given mass and you found frequency in part b. Use algebraic wizardry to solve equation 11-7b for the spring constant (k). You found amplitude in part a). Use equation 11-4b on page 312 to find the maximum spring potential energy. This is the total energy.
 - Use Dave equation to solve for v at $x = 0.3m$. Use that velocity to find the kinetic energy at $x = 0.3m$ and subtract from the total energy (part e) to get the potential energy at $x = 0.3m$.
19. Using mass and frequency, solve for the spring constant.
- Use the circle analogy equation assuming the pumpkin starts from its highest point.
 - If you know the frequency you can find the period. The time from the either maximum extension to the equilibrium point is just half the period.
 - List your variables and solve for maximum velocity.
 - Maximum acceleration is at the maximum extension points where there are two accelerating forces; gravity down and the force of the spring up. Add the vectors to get the resultant force and solve for resultant acceleration.
21. a), and b) Use the circle analogy equation to find amplitude and solve for frequency.
- The period is the inverse of the frequency.
 - $TE = KE(\max)$ or $PEg(\max)$ or $PE(sp)(\max)$. You were given mass and you found frequency in part b. Use algebraic wizardry to solve equation 11-7b for the spring constant (k). You found amplitude in part a). Use equation 11-4b on page 312 to find the maximum spring potential energy. This is the total energy.

- e) Use Dave equation to solve for v at $x = 9\text{cm}$ (convert to meters). Use that velocity to find the kinetic energy at $x = 9\text{cm}$ and subtract from the total energy (part e) to get the potential energy at $x = 9\text{ cm}$.
- f) According to the information given, this will be a sine curve. Label the axes of your graph so that the amplitude and period accurate.
23. a) Use equation 11-7v on page 293 to solve for frequency and then period of motion.
- b) The initial speed is also the maximum speed. Set the $\text{KE}(\text{max})$ of the mass equal to the $\text{PE}(\text{max})$ of the spring, and solve for x , which, at maximum PE, is the amplitude.
- c) Combine Newton's 2nd Law and Hooke's Law to find maximum acceleration, which occurs at the amplitude.
- d) Since the problem begins at equilibrium (the mass was at rest when it was struck), this will be a sine curve.
- e) $\text{TE} = \text{KE}(\text{max}) = \text{PE}(\text{max})$.
26. This is a two-things-stick together problem, and it will take two steps to solve.
- i) You're given the spring constant, amplitude and mass and will need to derive an equation for the maximum velocity. Put maximum kinetic energy equal to maximum potential energy of the spring and solve for velocity. This is the maximum velocity of the bullet/block system and the final velocity of the two-things-stick-together problem. List your variables and solve for the maximum speed of the vibrating system.
- ii) Use the maximum velocity of the bullet/block system as the final velocity in your two-things-stick-together problem and solve for the initial velocity of the bullet.
27. Use the information given to calculate the period of the spring and then the spring constant. At the equilibrium point the gravitational force down = the force of the bungee up. From that you can calculate x_0 , or the "stretch distance." Once you know the distance the bungee stretched, you can calculate the length of the unstretched bungee.
28. You're given # vibrations and time. The period is the time for # vibrations, and the frequency is the # vibrations per time.
29. Rearrange equation 11-11a for the period of a pendulum found on page 297 to solve for length. Substitute the variables given and solve for the length of the pendulum.
30. Use the equation for the period of a pendulum, and substitute g on Mars for g on Earth.
31. "g" on a freely falling elevator = 0.
32. a) Use the equation for the frequency of a pendulum.
- b) You'll have to do problem 32 in order to do this problem.
- c) $\text{TE} = \text{PE}(\text{max})$ or $\text{KE}(\text{max})$

34. The potential energy of the pendulum at its maximum height is equal to the kinetic energy it has at the bottom of the swing.

Set these two equations equal to each other and solve for v .



37. $v = \lambda f$. The distance between any two crests = the wavelength.
38. $v = \lambda f$ You're given frequencies and velocity. Find wavelengths at each of the extremes given for AM and FM.
39. Use equations 11-4a and 11-4b on page 304, and the table of Elastic Moduli on page 238 to solve these.
41. List your variables and find the velocity of the wave along the string. You know that the distance the wave must travel is the distance between the two supports. Find the time to travel that far.
43. Find the velocity of sound in seawater in Table 12-1 (page 348). The time to travel to the sea floor is half the time it took to hit the sea floor and bounce back up. You know time and velocity, solve for distance.
47. The intensity varies inversely with the square of the distance. $I_1 R_1^2 = I_2 / r_2^2$
Power = IA
54. 4 loops is the wave pattern for the 4th harmonic, where $f_4 = 4f$. Solve for $f_1 - f_5$
55. From velocity and frequency you can find wavelength. The wavelength can be determined from the distance between adjacent nodes.
57. Use equation 11-13 on page 302 to find the velocity of the wave. Then use 11-19b to find the fundamental frequency and first two overtones.
68. The kinetic energy of the car will be converted to PE(spring) of the car bumper when it has stopped. Set these two equations equal to each other and solve for amplitude (maximum compression).

69. The potential energy of the person 20m up = the spring potential energy of the fire net after it has stretched to its maximum. Set these two equations equal to each other, plug in your givens and solve for the spring constant of the net. If the person just lies in the net, then the gravitational force down = the force of the net pushing up. From this you can calculate x_0 or the stretch distance. To find the amplitude of the fire net if the person jumps from 35 m, set the PE of the person at 35 m = PE(spring) at maximum amplitude. Plug in your known values and solve for the amplitude.
73. a), and b) Use the circle analogy equation to find amplitude and solve for frequency.
c) $TE = KE(\max)$ or $PEg(\max)$ or $PE(sp)(\max)$. You were given mass and you found frequency in part b. Use algebraic wizardry to solve equation 11-7b for the spring constant (k). You found amplitude in part a). Use equation 11-4b on page 312 to find the maximum spring potential energy. This is the total energy.
d) Use Dave equation to solve for v at $x = 0.26$ m. Use that velocity to find the kinetic energy at $x = 0.26$ m and subtract from the total energy (part c) to get the potential energy at $x = 0.26$ m.
82. Use the equation for the period of a pendulum and solve for L in each case.

