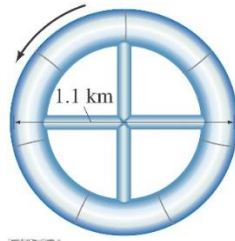


Seminar 3: Lectures 5-6

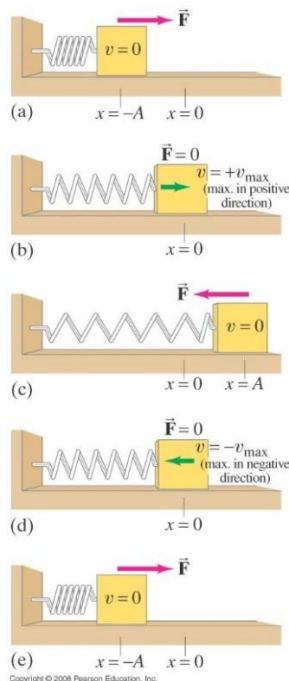
Uniform Circular Motion:

1. What is the maximum speed with which a 1200 kg car can round a turn of radius 80.0 m on a flat road if the coefficient of friction between tires and road is 0.65? Is this result independent of the mass of the car?
2. A proposed space station consists of a circular tube that will rotate about its centre (like a tubular bicycle tyre), as shown in the figure below. The circle formed by the tube has a diameter of about 1.1 km. What must be the rotation speed (revolutions per day) if an effect equal to gravity at the surface of the Earth (1.0 g) is to be felt?



Simple Harmonic Motion:

3. An elastic cord is 65 cm long when a weight of 75 N hangs from it, but is 85 cm long when a weight of 180 N hangs from it. What is the spring constant, k , of this elastic cord?
4. Construct a table indicating the position x of the mass in the figure below at times $t = 0$, $\frac{1}{4}T$, $\frac{1}{2}T$, $\frac{3}{4}T$, T , and $\frac{5}{4}T$, where T is the period of oscillation. On a graph of x vs. t , plot these six points. Now connect these points with a smooth curve. Based on these simple considerations, does your curve resemble that of a cosine or sine wave?



Energy in SHM:

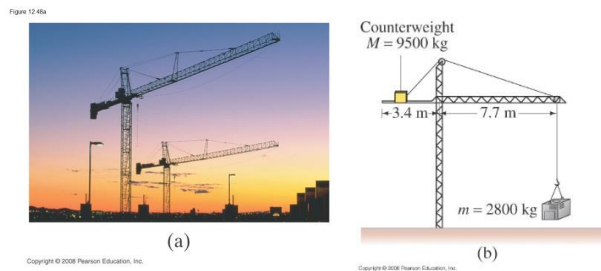
5. A 0.0125 kg bullet strikes a 0.240 kg block attached to a fixed horizontal spring whose spring constant is $2.25 \times 10^3 \text{ Nm}^{-1}$, and sets it into oscillation with an amplitude of 12.4 cm. What was the initial speed of the bullet if the two objects move together after impact?

The Simple Pendulum:

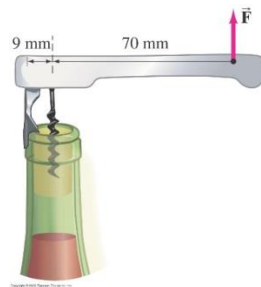
6. What is the period of a simple pendulum 53 cm long (a) on the Earth, and (b) when it is in a freely-falling elevator?

Equilibrium:

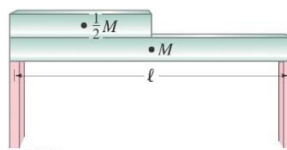
7. A tower crane (as shown in the left figure below) must always be carefully balanced so that there is no net torque tending to tip it. A particular crane at a building site is about to lift a 2800 kg air conditioning unit. The crane's dimensions are shown in the figure below on the right. (a) Where must the crane's 9500 kg counterweight be placed when the load is lifted from the ground? (Note that the counterweight is usually moved automatically via sensors and motors to precisely compensate for the load. (b) Determine the maximum load that can be lifted with this counterweight when it is placed at its full extent. Ignore the mass of the beam.



8. The force required to pull the cork out of the top of a wine bottle is in the range of 200 to 400 N. A common bottle opener is shown in the figure below. What range of forces, F , is required to open a wine bottle with this device?



9. A uniform steel beam has a mass of 940 kg. On it is resting half of an identical beam, as shown in the figure below. What is the vertical support force at each end?



10. A uniform ladder of mass m and length l leans at an angle θ against a frictionless wall, as shown in the figure below. If the coefficient of static friction between the ladder and the ground is μ_s , determine a formula for the minimum angle at which the ladder will not slip.

