Conceptual Questions for Chapter 10

6. Although the distance traveled by the mass during each cycle is proportional to the amplitude of the oscillation, the maximum velocity of the mass is as well. If the mass has farther to go, for example, it travels correspondingly faster. This is how the period of the mass-spring system can be independent of amplitude.

8. For the mass and spring system, the period will remain 1 s, because the period depends only on the mass and the spring constant. For a pendulum, the period depends on the length and the gravitational field strength. With a stronger gravitational field, the period of the pendulum would be less than 1 s.

10. The breaking point of a rope is determined by the maximum strain it can withstand. The strain is the ratio of the change in the length of the rope to the original length—the maximum strain is therefore independent of the rope's length. The strain is directly proportional to the stress—defined as the force per unit area. Thus, ropes of varying length that are otherwise identical require the same force to reach the breaking point. The actual distance the rope stretches before breaking is greater for a longer rope—more work, and thus more energy, is required to break a longer rope.

12. Concrete is much stronger under compressive stress than tensile stress. As a result of this, concrete is very strong in vertical columns where most of the force is compressive. Concrete is weaker in horizontal columns because it must withstand additional tensile stresses. Steel rods with a high tensile strength are therefore inserted into the concrete to reinforce it against these tensile stresses.

17. In the mass-spring system, the restoring force supplied by the spring is independent of the object's mass. Thus, the larger inertia of a more massive object produces a longer period. The restoring force for small amplitude oscillations of the pendulum is the horizontal component of the tension in the string. In this case, the magnitude of the tension is approximately equal to the weight of the bob. Although a more massive bob has more inertia, it also has a proportionally larger restoring force. Thus, the period of oscillation of the pendulum is independent of the mass.