Physics 1441 Review Problems

A ball is thrown horizontally from the top of a 60.0-m building and lands 100.0 m from the base of the building. Ignore air resistance. (a) How long is the ball in the air? (b) What must have been the initial horizontal component of the velocity? (c) What is the vertical component of the velocity just before the ball hits the ground? (d) What is the velocity (including both the horizontal and vertical components) of the ball just before it hits the ground?

A team of eight dogs pulls a sled with waxed wood runners on wet snow (μ_s=0.14 and μ_k=0.10). The dogs have average masses of 19.0 kg, and the loaded sled with its rider has a mass of 210 kg. (a) Calculate the magnitude of the acceleration starting from rest if each dog exerts an average force of 185 N backward on the snow. (b) What is the magnitude of the acceleration once the sled starts to move? (c) For both situations, calculate the magnitude of the force in the coupling between the dogs and the sled.

A large centrifuge is used to expose aspiring astronauts to accelerations similar to those experienced in rocket launches and atmospheric reentries. At what angular velocity is the centripetal acceleration 10g if the rider is 15.0 m from the center of rotation?

Calculate the acceleration due to gravity on the surface of the Sun. By what factor would your weight increase if you could stand on the Sun? (Never mind that you cannot.)

A car's bumper is designed to withstand a 4.0-km/h (1.1-m/s) collision with an immovable object without damage to the body of the car. The bumper cushions the shock by absorbing the force over a distance. Calculate the magnitude of the average force on a bumper that collapses 0.200 m while bringing a 900-kg car to rest from an initial speed of 1.1 m/s.

A 30,000-kg freight car is coasting at 0.850 m/s with negligible friction under a hopper that dumps 110,000 kg of scrap metal into it. (a) What is the final velocity of the loaded freight car? (b) How much kinetic energy is lost?

A soccer player extends her lower leg in a kicking motion by exerting a force with the muscle above the knee in the front of her leg. She produces an angular acceleration of 30.00 rad/s^2 and her lower leg has a moment of inertia of 0.750 kg $\cdot$ m^2. What is the force exerted by the muscle if its effective perpendicular lever arm is 1.90 cm?

Three children are riding on the edge of a merry-go-round that is 100 kg, has a 1.60-m radius, and is spinning at 20.0 rpm. The children have masses of 22.0, 28.0, and 33.0 kg. If the child who has a mass of 28.0 kg moves to the center of the merry-go-round, what is the new angular velocity in rpm?

If your body has a density of 995 kg/m^3 what fraction of you will be submerged when floating gently in: (a) Freshwater? (b) Salt water, which has a density of 1027 kg/m^3?

A bicycle tire has a pressure of $7.00 \times 10^5 N/m^2$ at a temperature of 18.0ºC and contains 2.00 L of gas. What will its pressure be if you let out an amount of air that has a volume of $100cm^3$ at atmospheric pressure? Assume tire temperature and volume remain constant.

On a certain dry sunny day, a swimming pool's temperature would rise by 1.50ºC if not for evaporation. What fraction of the water must evaporate to carry away precisely enough energy to keep the temperature constant?