Homework 8

Due Wednesday, October 30 at 7pm

Finish reading Ch. 7 and start Ch. 8.

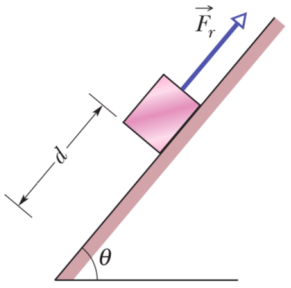
Exercises:

1. A father racing his son has half the kinetic energy of the son, who has half the mass of the father. The father speeds up by 1.0 m/s and then has the same kinetic energy as the son. What are the original speeds of (a) the father and (b) the son?

2. An ice block floating in a river is pushed through a displacement $\vec{d} = (15m)\hat{i} + (12m)\hat{j}$ along a straight embankment by rushing water, which exerts a force $\vec{F} = (210N)\hat{i} + (150N)\hat{j}$ on the block. How much work does the force do on the block during the displacement?

3. A luge and its rider, with a total mass of 85 kg, emerge from a downhill track onto a horizontal straight track with an initial speed of 37 m/s. If a force slows them to a stop at a constant rate of 2.0 m/s^2, (a) what magnitude F is required for the force, (b) what distance d do they travel while slowing, and (c) what work W is done on them by the force? What are (d) F, (e) d, and (f) W if they, instead, slow at 4.0 m/s^2?

4. In the Figure at right, a block of ice slides down a frictionless ramp at angle $\theta = 50°$ while an ice worker pulls on the block (via a rope) with a force $\vec{F}_r$ that has a magnitude of 50 N and is directed up the ramp. As the block slides through distance $d = 0.5$ m along the ramp, its kinetic energy increases by 80 J. How much greater would its kinetic energy have been if the rope had not been attached to the block?



5. A cave rescue team lifts an injured spelunker directly upward and out of a sinkhole by means of a motor-driven cable. The lift is performed in three stages, each requiring a vertical distance of 10.0 m: (a) the initially stationary spelunker is accelerated to a speed of 5.00 m/s; (b) he is then lifted at the constant speed of 5.00 m/s; (c) finally he is decelerated to zero speed. How much work is done on the 80.0 kg rescuee by the force lifting him during each stage?

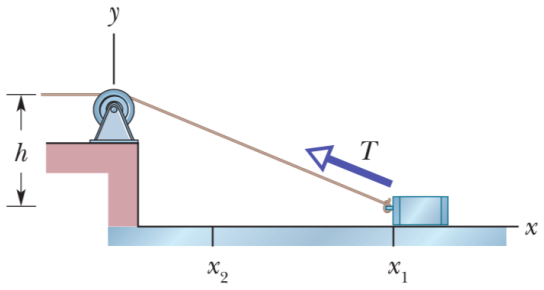
6. HRW Chap 7, P32.
7. HRW Chap 7, P36.

8. A skier is pulled by a towrope up a frictionless ski slope that makes an angle of 12° with the horizontal. The rope moves parallel to the slope with a constant speed of 1.0 m/s. The force of the rope does 900 J of work on the skier as the skier moves a distance of 8.0 m up the incline. (a) If the rope moved with a constant speed of 2.0 m/s, how much work would the force of the rope do on the skier as the skier moved a distance of 8.0 m up the incline? At what rate is the force of the rope doing work on the skier when the rope moves with a speed of (b) 1.0 m/s and (c) 2.0 m/s?

9. A fully loaded, slow-moving freight elevator has a cab with a total mass of 1200 kg, which is required to travel upward 54 m in 3.0 min, starting and ending at rest. The elevators counter-weight has a mass of only 950 kg, and so the elevator motor must help. What average power is required of the force the motor exerts on the cab via the cable?

Physical problem:

10. The Figure below shows a cord attached to a cart that can slide along a frictionless horizontal rail aligned along an x-axis. The left end of the cord is pulled over a pulley, of negligible mass and friction and at cord height $h = 1.5$ m, so the cart slides from $x_1 = 3.0$ m to $x_2 = 1.0$ m. During the move, the tension in the cord is a constant 25.0 N. (a) Before plugging in numbers check that your answer gives the right value in the limit $h \to 0$. (b) What is the change in the kinetic energy of the cart during the move?



[Hints: Notice that while the magnitude of the tension force is constant, its direction is not. Also, a useful technique for finding integrals you've never done before is to guess an answer and then take the derivative of that expression to check if it gives the integrand (the guts of the integral). Try taking the derivative of $\sqrt{h^2 + x^2}$ and seeing what you get.]