

Physics 10310 — General Physics I

Hour Exam 2 – Fall 2009

**There are 5 problems. Please do all problems.
Please show all work.**

1. A tractor of mass 800 kg is pulling a sled loaded with 1450 kg of hay bales. The coefficient of kinetic friction between the sled and the ground is 0.58.
 - (a) What horizontal force must the tractor exert (on the ground) to move at constant speed?
 - (b) What is the tension in the rope between the tractor and the sled?
 - (c) If the tractor and sled stop, how much horizontal force must it exert (on the ground) to get the sled moving again if $\mu_S=0.70$?
2. Trained athletes can exert power for their movements at a rate of about 3700 Watts for one second or 300 Watts for periods extending over several hours.
 - (a) A bicyclist is limited by wind resistance which is of the form $F = Av^2$, where $A = 0.08 \text{ kg/m}$. Estimate the speed cyclists can maintain for 1 hour?
 - (b) Estimate the time it takes a weightlifter to lift 100 kg a distance of 2 m?

- (c) How fast is it possible, for a person of mass 60 kg, to climb three flights of steps, a vertical distance of 12 m?
3. A mass m is hauled from ground level up an inclined plane that makes an angle θ with the horizontal by means of a rope passing over a frictionless pulley. The mass is pulled along until it reaches height H
- (a) Show that if the contact between the mass and the ramp is frictionless, the work done by the tension in the rope is independent of the angle θ .
- (b) Calculate the work done by the tension in the rope as a function of the ramp angle θ if the coefficient of kinetic friction between the mass and the surface is μ_K .
4. While a 1700 kg car is moving at a constant speed of 15 m/s (33.6 mi/h) the motor provides 16,000 Watts of power (21.4 horsepower) to overcome friction, wind resistance and so on.
- (a) What is the effective retarding force associated with all the frictional forces combined?
- (b) What power must the motor provide if the car is to move up an 8% grade, (8m vertical rise for every 100m horizontal) at a constant 15 m/s, including the

same resistance from part (a)?

(c) At what incline (downward slope) would the car coast (with no power applied to the wheels) at a constant 15 m/s?

5. The mass of a simple pendulum of length $L = 1\text{m}$ is released from rest with the string in the horizontal position.

(a) Calculate the speed of the mass at its lowest point.

(b) What is the speed when the string makes an angle of 45° with the vertical?

(c) Determine the tension in the string in both positions if the mass is 0.2 kg.