Phys 201

Work and Energy Homework - Due Tuesday, March 6

1) A particle is subject to a force $F_x$ that varies with position as in the figure below. Find the work done by the force on the particle as it moves (a) from $x = 0$ to $x = 5.00$ m, (b) from $x = 5.00$ m to $x = 10.0$ m, and (c) from $x = 10.0$ m to $x = 15.0$ m. (d) What is the total work done by the force over the distance $x = 0$ to $x = 15.0$ m?

Answers: a) 7.50J  b) 15J  c) 7.50J  d) 30.0J

2) When a 4.00-kg object is hung vertically on a certain light spring that obeys Hooke's law, the spring stretches 2.50 cm. If the 4.00-kg object is removed, (a) how far will the spring stretch if a 1.50-kg block is hung on it, and (b) how much work must an external agent do to stretch the same spring 4.00 cm from its unstretched position?

Answer: a) 0.938m  b) 1.25J

3) Truck suspensions often have “helper springs” that engage at high loads. One such arrangement is a leaf spring with a helper coil spring mounted on the axle, as in Figure P7.17. The helper spring engages when the main leaf spring is compressed by distance $\gamma_0$, and then helps to support any additional load. Consider a leaf spring constant of $5.25 \times 10^5$ N/m, helper spring constant of $3.60 \times 10^5$ N/m, and $\gamma_0 = 0.500$ m. (a) What is the compression of the leaf spring for a load of $5.00 \times 10^5$ N? (b) How much work is done in compressing the springs?

Answer: a) 0.768m  b) $1.68 \times 10^5$ J
4). A 4.00-kg particle is subject to a total force that varies with position as shown in figure for problem 1. The particle starts from rest at $x = 0$. What is its speed at (a) $x = 5.00$ m, (b) $x = 10.0$ m, (c) $x = 15.0$ m?

a) 1.94 m/s  

b) 3.35 m/s  

c) 3.87 m/s

5). You can think of the work-kinetic energy theorem as a second theory of motion, parallel to Newton’s laws in describing how outside influences affect the motion of an object. In this problem, solve parts (a) and (b) separately from parts (c) and (d) to compare the predictions of the two theories. In a rifle barrel, a 15.0-g bullet is accelerated from rest to a speed of 780 m/s. (a) Find the work that is done on the bullet. (b) If the rifle barrel is 72.0 cm long, find the magnitude of the average total force that acted on it, as 

$$ F = \frac{W}{\Delta r \cos \theta}.$$  

(c) Find the constant acceleration of a bullet that starts from rest and gains a speed of 780 m/s over a distance of 72.0 cm. (d) If the bullet has mass 15.0 g, find the total force that acted on it as $\sum F = ma$.

a) 4.56 kJ  

b) 6.34 kN  

c) 422 km/s$^2$  

d) 6.34 kN

6) A 40.0-kg box initially at rest is pushed 5.00 m along a rough, horizontal floor with a constant applied horizontal force of 130 N. If the coefficient of friction between box and floor is 0.300, find (a) the work done by the applied force, (b) the increase in internal energy in the box-floor system due to friction, (c) the work done by the normal force, (d) the work done by the gravitational force, (e) the change in kinetic energy of the box, and (f) the final speed of the box.

a) 650 J  

b) 588 J  

c) 0 J  

d) 0 J  

e) 62.0 J  

f) 1.76 m/s