Post Lab Problems:

1. A box of mass 10 kg is pushed with a horizontal force of 200 N for a distance of 5 m. The surface of the floor has a coefficient of friction with the box of $\mu_k = 0.4$
   a. What is the amount of Work done on the box by the horizontal force?
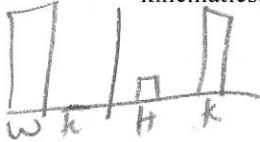
   $$W = F \cdot \Delta x = 200 \cdot 5 = \boxed{1000 \text{ J}}$$

   b. Heat is the work done by friction, so the equation for heat is: $H = f(\Delta x)$. Using that equation, what is the Heat loss as the box slides the 5 m?

   $$f = \mu N = (.4)(10 \cdot 9.8) = 39.2 N$$
   $$H = f \Delta x = 39.2 \cdot 5 = \boxed{196 \text{ J}}$$

   c. What is the final velocity of the box? (Use conservation of Energy, not Newton's 2nd Law and kinematics.)

   $$W = H + K$$
   $$1000 = 196 + k$$
   $$K = 804 J$$

   $$804 = \tfrac{1}{2} m v^2 = \tfrac{1}{2}(10) v^2$$
   $$\boxed{v = 12.68 \text{ m/s}}$$

2. A ball of mass 0.5 kg is thrown straight up with an initial velocity of 20 m/s. It reaches a maximum height of 18 m. What was the average force of air resistance during its rise to the maximum? **(0.656 N)**

   $$K = U_g + H$$
   $$\tfrac{1}{2}(.5)(20)^2 = (.5)(9.8)(18) + H$$
   $$100 = 88.2 + H$$
   $$H = 11.8 J = f \cdot \Delta y = f(18)$$
   $$\boxed{f = 0.656 N}$$

3. A car of mass 1500 kg is going 70 mph (1,609 m = 1 mi) when it slams on its breaks and skids to a stop. If the car stops in a distance of 71.34 m, determine the coefficient of kinetic friction between the tires and the road, USING ENERGY! **(0.7)**
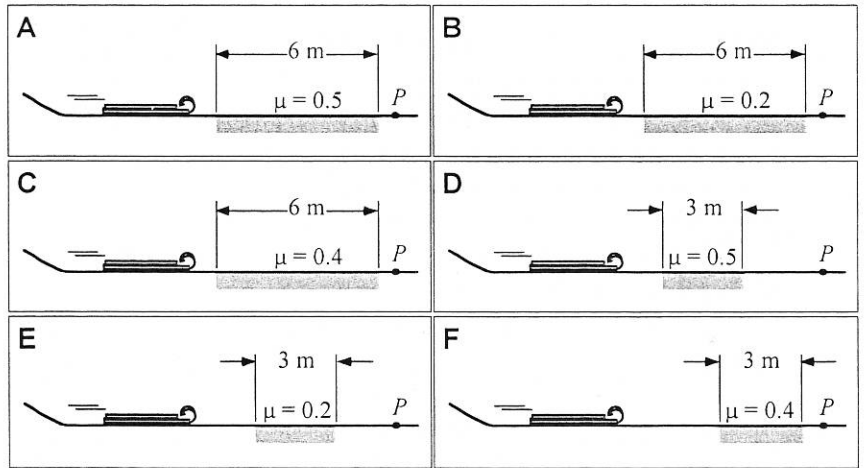
   $$v = 70 \tfrac{mi}{hr}\left(\tfrac{1609 m}{1 mi}\right)\left(\tfrac{1 hr}{3600 s}\right) = 31.29 \text{ m/s}$$

   $$K = H$$
   $$\tfrac{1}{2} m v_i^2 = \mu \cdot m \cdot g \cdot \Delta x$$
   $$\mu = \tfrac{v_i^2}{2 \cdot g \cdot \Delta x}$$

   $$\tfrac{31.29^2}{2 \cdot 9.8 \cdot 71.34} = \boxed{0.7}$$

4. The figures below represent identical toboggans that have traveled down a snowy hill. The toboggans all have the same speed at the bottom of the hill. Assume that the horizontal surfaces that they travel along are frictionless except for the shaded areas, where the coefficient of friction is given. These shaded areas have different lengths as shown.

   A — 6 m — $\mu = 0.5$ P

   B — 6 m — $\mu = 0.2$ P

   C — 6 m — $\mu = 0.4$ P

   D — 3 m — $\mu = 0.5$ P

   E — 3 m — $\mu = 0.2$ P

   F — 3 m — $\mu = 0.4$ P

   Rank these situations on the basis of the speed of the toboggans as they reach point P.

   Greatest 1 __E__ 2 __B__ 3 __F__ 4 __D__ 5 __C__ 6 __A__ Least

   Explain your reasoning:

   biggest Heat will be smallest velocity. $H = f \Delta x = \mu m g \Delta x$

   A: $.5 \cdot m \cdot g \cdot 6 = 3mg$ D: $1.5 mg$

   B: $1.2 mg$ E: $0.6 mg$

   C: $2.4 mg$ F: $1.2 mg$