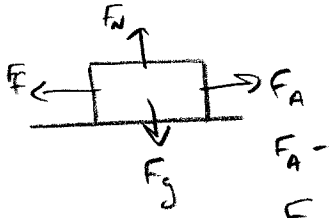
Dynamics Worksheet #2
(adapted)

1. A 1.2×10^3 kg car is accelerating at 1.6 m/s^2. If the coefficient of friction of friction is 0.15, what is the force supplied by the engine?



$F_A - F_f = ma$ (x)

$F_A - 1764N = (1.2\times10^3 kg)(1.6 m/s^2)$

$F_A = 3684N$

$F_f = \mu F_N$

$F_f = (0.15)(11760N)$

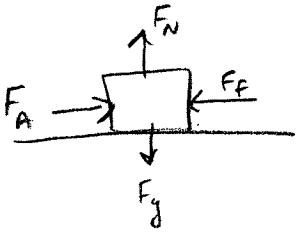
$= 1764N$

$F_N - F_g = 0$ (y)

$F_N = F_g = (1.2\times10^3 kg)(9.8 m/s^2)$

$= 11760N$

2. You are pushing a 55 kg refrigerator along at a speed of 1.5 m/s using an applied force of 2.5 x 10^2 N when you hit a carpet. The carpet has a coefficient of friction of 0.62. How far will the fridge travel before it stops on the carpet?



$F_A - F_f = ma$ (x)

$2.5\times10^2 - 334.18 = (55kg)a$

$a = -1.53 m/s^2$

$F_f = \mu F_N$

$= .62(539N)$

$= 334.18N$

$F_N - F_g = 0$ (y)

$F_N = F_g = (55kg)(9.8 m/s^2)$

$= 539N$

$V_i = 1.5 m/s$

$a = -1.53 m/s^2$

$V_f = 0$

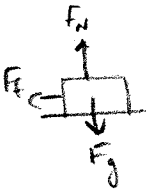
$d = ?$

$V_f^2 = V_i^2 + 2ad$

$0 = (1.5)^2 + 2(-1.53)d$

d 0.74m

3. A car is travelling at 120 km/hr when it slams on the brakes. How long is the skid mark if the coefficient of friction is 0.62 ? (hint: convert km/hr to m/s)



120 km/hr = 33.33 m/s

$V_i = 33.33 m/s$

$V_f = 0$

$a = -6.076$

$d = ?$

$F_f = ma$

$.62(9.8m) = ma$

$F_f = \mu F_N$

$= .62(9.8m)$

$F_N - F_g = 0$

$F_N = F_g = mg = m(9.8)$

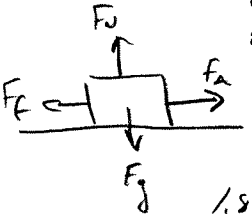
$a = 6.076 m/s^2$ (but it must be negative)

$V_f^2 = V_i^2 + 2ad$

$0 = (33.33)^2 + 2(-6.076)d$

$d = 91.4m$

4. A skidder is dragging a 5.2×10^2 kg log through the forest at a constant speed of 3.5 m/s. If the skidder is applying a force of 1.8×10^3 N to the log to keep it moving, what is the coefficient of friction between the log and the ground? (Hint: what does constant speed say about the forces?)



$F_f = \mu F_N$

$1.8\times10^3 = \mu\, 5096$

$\mu = 0.35$

$F_A - F_f = 0$ (x)

$F_f = F_A$

$= 1.8\times10^3 N$

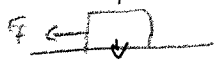
$F_N - F_g = 0$ (y)

$F_N = mg$

$= (5.2\times10^2)(9.8)$

$= 5096N$

5. A curler gives a rock an initial velocity of 4.2 m/s. After travelling down the 32m ice sheet (coefficient of kinetic friction = 0.0035) the rock runs onto the carpet (coefficient of kinetic friction = 0.41). How far does the rock slide on the carpet? (Hint: find the acceleration on the ice, then find the final velocity as it leaves the ice, then find the distance on the carpet)



ice

$v_i = 4.2\ m/s$

$d = 32m$

$v_f = ?$

$a = ?$

$F_f = ma$ $\quad F_N = F_g = mg$

$F_f = \mu F_N$

$ma = \mu_k mg$

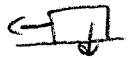
$= (.0035)(9.8\ m/s^2)$

$a = 0.0343\ m/s^2$

$v_f^2 = v_i^2 + 2(-0.0343)$

$v_f = 3.93\ m/s$

carpet



$v_i = 3.93\ m/s$

$v_f = 0$

$a = -4.018\ m/s^2$

$d = ?$

$F_f = ma$ $\quad F_N = F_g = mg$

$F_f = \mu F_N$

$ma = \mu mg$

$a = \mu g$

$= (0.41)(9.8\ m/s^2)$

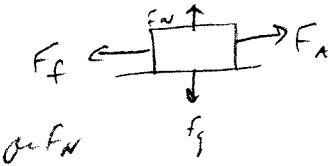
$= -4.018\ m/s^2$

$v_f^2 = v_i^2 + 2ad$

$0 = (3.93)^2 + 2(-4.018)d$

$d = 1.9m$

6. A tow-truck is trying to pull a 1.4×10^3 kg car out of some mud. The coefficient of static friction is 0.76. What force will the tow truck have to apply to the car before it will start to move?



$F_A = F_f$

$F_f = \mu F_N$

$F_N = F_g$

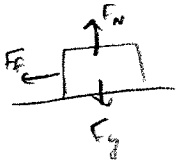
$F_A = \mu F_N = \mu F_g = \mu mg$

$= (.76)(1.4 \times 10^3\ kg)(9.8\ m/s^2)$

$= 10\ 427\ N$

7. A 3.2×10^3 kg sailboat is sailing at 6.2 knots (1 knot = 1.852 km/h) when the wind dies. The boat drifts for 65 m before coming to a stop.

(a) What is the coefficient of friction between the hull and the water?



$6.2\ knots = 11.482\ km/h = 3.19\ m/s$

$F_f = ma$ $\quad F_f = \mu F_N$ $\quad F_N - F_g = 0$

$\mu_k mg = ma$ $\quad = \mu F_g$ $\quad F_N = F_g$

$\mu (9.8\ m/s^2) = (.078\ m/s^2)$

$\mu = 0.008$

$v_i = 3.19\ m/s$

$v_f = 0$

$a = ?$

$d = 65m$

$v_f^2 = v_i^2 + 2ad$

$0 = (3.19)^2 + 2a(65m)$

$a = -0.078\ m/s^2$

(b) How long does it take to stop?

$v_f = v_i + at$

$0 = 3.19 + (-0.078)t$

$t = 40.9s$