Review 4

1. A rifle bullet of mass 10 g has a muzzle velocity of 900 m/s and the length of the rifle barrel is 80 cm. What is the net force accelerating the bullet, assuming it to be constant?

$v^2 = v_i^2 + 2ad$

$(900)^2 = (0)^2 + 2a(0.8\,m)$

$a = 5.06 \times 10^5$

$F = ma$

$= .01\,kg \cdot 5.06 \times 10^5$

$= \boxed{5.06 \times 10^3\,N}$

2. A 30 kg sled is coasting with constant velocity at 5 m/s over perfectly smooth, level ice. It enters a rough stretch of ice 20 m long in which the force of friction is 12 N. With what speed does the sled emerge from the rough stretch?

$F_{NET} = F_m - F_{fr}$

$F_{NET} = 0 - 12\,N$

$-12\,N = 30\,k\,a$

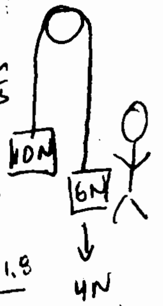
$a = -0.4\,\frac{m}{s^2}$

$v^2 = v_i^2 + 2ad$

$v^2 = (5\,\frac{m}{s})^2 + 2(-0.4\,\frac{m}{s^2})\,20\,m$

$\boxed{v = 3\,\frac{m}{s}}$

3. A bag of feed weighing 10 N is being hoisted at a steady speed of 1.8 m/s by a farmer who uses a 6 N counterweight and also applies a downward 4 N force to a rope which passes over a pulley. If the farmer releases the rope, what will be the velocity of the feed bag after 3 s? No friction on the pulley.



$v = 1.8\,\frac{m}{s}$

$F_{NET} = F_U - F_D$

$= 6\,N - 10\,N$

$F_{NET} = -4\,N$

$w = mg$

$10 = m\,9.8$

$m = 1.02\,kg$

$F_{NET} = ma$

$4\,N = 1.632\,a$

$a = 2.45\,\frac{m}{s^2}$

$a = \frac{v_f - v_i}{t}$

$2.45 = \frac{v_f - 1.8}{3\,s}$

$\boxed{v_f = 5.82\,\frac{m}{s}}$

4. If the coefficient of sliding friction between tires and dry pavement is 0.8, what is the shortest distance in which an automobile can be stopped by locking the brakes when traveling at 20.1 m/s? On wet pavement the coefficient of friction is only 0.25. How fast would you drive on wet pavement in order to be able to stop in the same distance as above?

$F_{NET} = F_m - F_{fr}$

$0 = F_m - F_{fr}$

$F_m = F_{fr}$

$ma \Rightarrow .8\,mg$

$a = .8(9.8)$

$a = -7.84$

$v^2 = v_i^2 + 2ad$

$0 = (20.1)^2 + 2(-7.84)d$

$d = \boxed{2.58 \times 10^1\,m}$

$F_{NET} = F_m - F_{fr}$

$F_m = F_{fr}$

$ma = .25\,mg$

$a = -2.45$

$v^2 = v_i^2 + 2ad$

$0 = v_i^2 + 2(-2.45)(2.58 \times 10^1)$

$\boxed{v_i = 1.12 \times 10^1}$

5. A worker pushes a small crate with a mass of 8.75 kg on a horizontal surface with a constant speed of 4.5 m/s/ The coefficient of sliding friction between the crate and the surface is 0.2. What horizontal force must be applied by the worker to maintain the motion. If force is removed how soon does the crate come to rest?

$F_{NET} = F_m - F_{fr}$

$0 = F_m - F_{fr}$

$F_m = F_{fr}$

$F_f = (.2)(8.75)(9.8)$

$= \boxed{1.72 \times 10^1\,N}$

$F_{NET} = 0 - F_{fr}$

$= -1.72 \times 10^1\,N$

$F = ma$

$17.2\,N = -8.75(a)$

$a = -0.509\,\frac{m}{s^2}$

$v = v_i + at$

$0 = 4.5\,\frac{m}{s} + (-.509)t$

$\boxed{t = 8.84\,s}$

6. What force would be necessary to stop a 950 kg automobile traveling initially at 13.4 m/s in a distance equal to the diameter of a dime, which is 1.8 cm?

$F_{NET} = F_m - F_R$

$0 = F_m - F_R$

$F_m = F_R$

$v^2 = v_i^2 + 2ad$

$0 = (13.4\,\frac{m}{s})^2 + 2a(.018\,m)$

$a = 4.99 \times 10^4\,\frac{m}{s^2}$

$F = ma$

$= 950\,kg \cdot 4.99 \times 10^4\,\frac{m}{s^2}$

$= \boxed{4.74 \times 10^7\,N}$