Review for Final 2nd Installment

1. A punter accelerates a football from rest to a speed of 15 m/s in 0.2 seconds. Assuming the football is regulation and has a mass of 0.5 kg, what average force did she exert on the ball?

$v_i = 0\ m/s$, $v_f = 15\ m/s$, $t = 0.2\ s$, $a = ?$, $\Delta x = ?$

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

$a = \frac{15 - 0}{0.2}$

$a = 75\ m/s^2$

$F = m \cdot a$

$F = (0.5\ kg)(75\ m/s^2)$

$= \boxed{37.5\ N}$

2. What average force is required to accelerate a 9.5 **gram** bullet from rest to 600 m/s over a distance of 0.9 m along the barrel of a rifle?

$v_i = 0\ m/s$, $v_f = 600\ m/s$, $\Delta x = 0.9\ m$, $a = ?$, $t = ?$

$v_f^2 = v_i^2 + 2a\Delta x$

$a = \frac{v_f^2 - v_i^2}{2\Delta x}$

$a = \frac{600^2 - 0^2}{2(0.9)} = 200{,}000\ m/s^2$

$F = m \cdot a$

$F = (0.0095\ kg)(200{,}000\ m/s^2)$

$F = \boxed{1900\ N}$

3. A shopper in a supermarket pushes a loaded cart with a horizontal force of 15 N. If the cart has a mass of 30 kg, what is the acceleration of the cart? (Ignore friction)

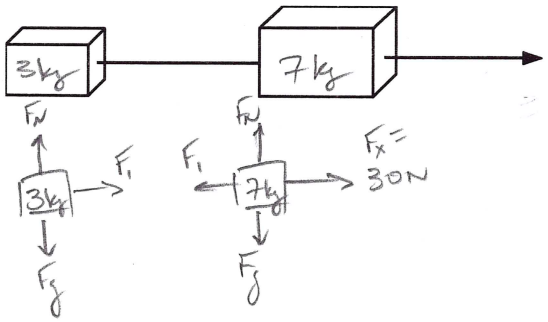
$F = 15\ N$, $m = 30\ kg$, $a = ?$

$F = m \cdot a$

$a = \frac{F}{m}$

$a = \frac{15\ N}{30\ kg} = \boxed{0.5\ m/s^2}$

4. Two crates of masses 3 kg and 7 kg, are pulled across the frictionless surface of a frozen pond by an ice fisherman. If he exerts a force of 30 N on the first crate as shown, determine the acceleration of the system and the tension in the cord connecting the crates.




$F_x - F_1 = m_1 a$

$30 - F_1 = 7a$

$30 - (3a) = 7a$

$\frac{30}{10} = \frac{10a}{10}$

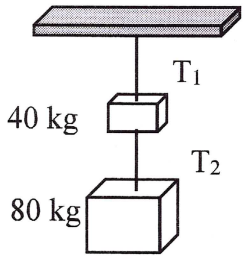
$a = \boxed{3\ m/s^2}$

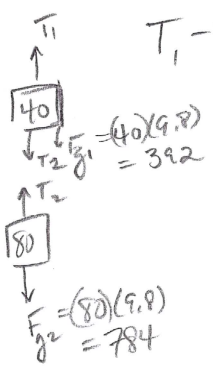
$F_1 = m_2 a$

$F_1 = 3a$

$F = 3(3) = \boxed{9N}$

5. Two blocks are fastened to the ceiling of an elevator as shown. If the acceleration of the system is 2.7 m/s/s find $T_1$ and $T_2$.




$T_1 - T_2 - F_{g1} = m_1 a$

$T_1 - 1000 - 392 = (40)(2.7)$

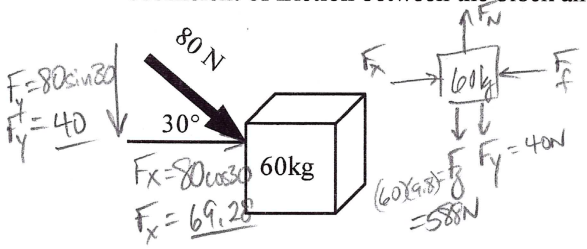
$T_1 = \boxed{1500\ N}$

$T_2 - F_{g2} = m \cdot a$

$T_2 - 784 = (80)(2.7)$

$T_2 = \boxed{1000\ N}$

6. A 60 kg block slides with an acceleration of .3 m/s$^2$ under the action of a 80 N force as shown in the picture. What is the coefficient of friction between the block and the floor?




$F_N - F_y - F_g = 0$

$F_N = 588 + 40$

$= 628\,N$

$F_x - F_f = ma_x$

$F_x - F_N\mu = ma_x$

$\mu = \dfrac{F_x - ma_x}{F_N}$

$\mu = \dfrac{69.28 - (60)(0.3)}{628}$

$\mu = \boxed{0.08}$

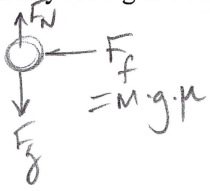
7. A tennis ball weighing 0.8 N initially rolling at 6 m/s rolls to a stop in 5 seconds. What is the coefficient of friction between the tennis ball and the floor?

$F_g = 0.8N$ $\quad \mu = ?$

$v_i = 6m/s$ $\quad a = ?$

$v_f = 0m/s$

$t = 5s$




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

$= \dfrac{-6}{5}$

$= -1.2\,m/s^2$

$F_f = ma$

$mg\mu = ma$

$\mu = \dfrac{a}{g} = \dfrac{-1.2\,m/s^2}{-9.8\,m/s^2} = \boxed{0.12}$

8. A flatbed truck with a crate of baby gazelles on it is speeding carelessly along the highway at 25/s! The $\mu_s$ between the truck bed and the crate is 0.3. What is maximum acceleration in which the truck can come to a complete stop without the crate moving?

$v_i = 25m/s$

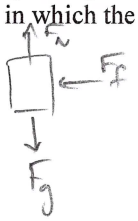
$\mu_s = 0.3$

$a = ?$

$F_g = m \cdot g$

$F_N = F_g = m \cdot g$

$F_f = F_N \cdot \mu = m \cdot g \cdot \mu$

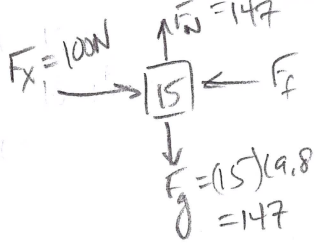



$F_f = ma$

$mg\mu = ma$

$a = g\mu = (9.8)(0.3) = \boxed{2.94\,m/s^2}$

9. A box with a mass of 15 kg is pushed horizontally with a force of 100 N. What is the acceleration of the box? The coefficient of static friction is 0.6 and the coefficient of kinetic friction is 0.3.




$F_x - F_f = ma$

$100 - 44.1 = 15a$

$\boxed{a = 3.73\,m/s^2}$

$F_N - F_g = 0$

$F_N = 147N$

$F_{fs} = F_N \mu_s$

$= (147)(0.6)$

$= 88.2\,N$

$F_{fk} = F_N \mu_k$

$= (147)(0.3)$

$= 44.1\,N$

$100 > 88.2$

so use