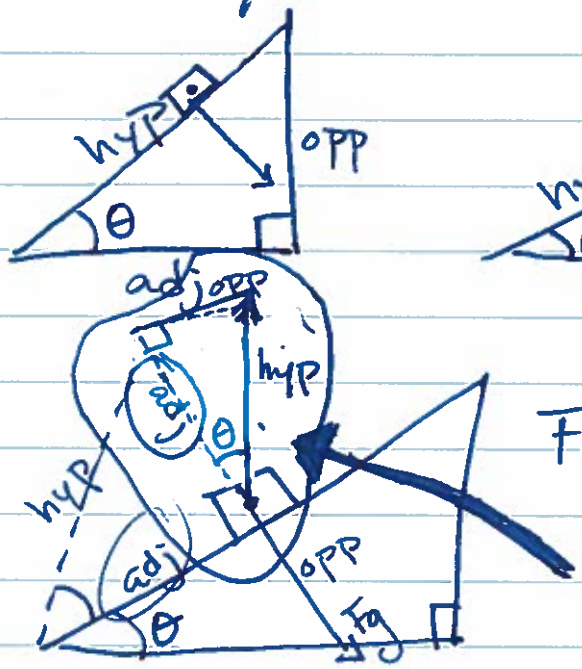
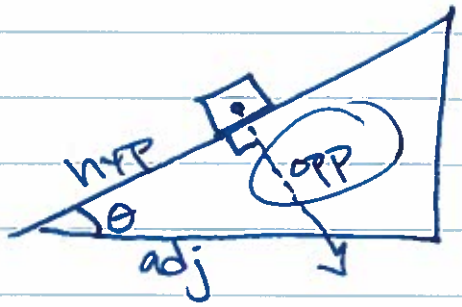
Helpful Hints – 4.3/4.4 P.P.

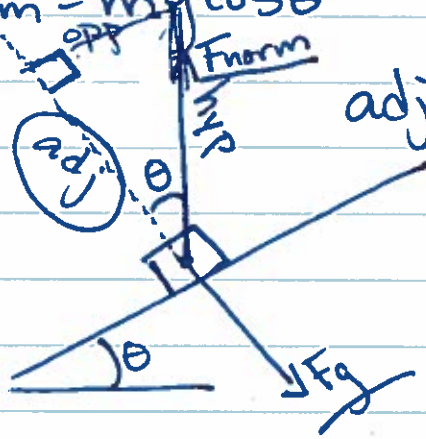
- Newton's 2nd Law = $F=ma$
- $ma = mg$ b/c gravity is an acceleration
- You may need to use the Ch 2 eqs I printed for you to solve for acceleration
- When you have an angle:





$F_{down} = mg\sin\theta$

$F_{norm} = mg\cos\theta$



$adj = \cos$

- Force Friction (F_f)

$F_f = \mu_k F_{norm}$

μ_k ← coefficient of friction

* Plug in values to solve for diff. variables

* $F_{net} = F_{applied} - F_{k(friction)}$

$F_{net} = ma_{net}$

$F_{k(friction)} = \mu_k mg$

4.3 Practice Problems

1. $\Delta V = 173\,km/hr - 0\,km/hr = 173\,km/hr$

$$\frac{173\,km}{hr} \times \frac{1000\,m}{1\,km} \times \frac{1\,hr}{60\,min} \times \frac{1\,min}{60\,s} = \underline{48.1\,m/s}$$

* Use final velocity after displacement eq.

$$V_f^2 = V_i^2 + 2ax$$

$$\frac{V_f^2 - V_i^2}{2x} = \frac{2ax}{2x} \qquad a = \frac{V_f^2 - V_i^2}{2x}$$

Given:
- $V_i = 173\,km/hr$
- $V_f = 0\,km/hr$
- $\Delta x = .660\,m$
- $m = 70.0\,kg$
- $g = 9.8\,m/s^2$

$$a = \frac{(0\ m/s)^2 - (48.1\,m/s)^2}{2(.660\,m)} = \boxed{-1.75 \times 10^3\,m/s^2}$$

$$F = ma$$

$$(70.0\,kg)(-1.75 \times 10^3\,m/s^2) = \boxed{-1.23 \times 10^5\,N}$$

$N = kg \cdot m/s^2$

Compare w/ weight:

$F = mg$ (g = gravity)

$$F = (70.0\,kg)(9.8\,m/s^2) = \boxed{686\,N}$$

$1.23 \times 10^5 / 686 =$ **179** = Force of deceleration is nearly 179 times his weight.

4.3 P.P.

2. $F = ma$

$a = \Delta V / t$

$\Delta V = \Delta d / t$

Given

$m = 2.232 \times 10^6 \text{ kg}$

$g = 9.8 \text{ m/s}$

$a_{net} = 0 \text{ m/s}^2$

(a.) $F_{net} = ma_{net} = ma_{up} - mg_{down}$ (solve for)

$F_{up} - F_{down}$

$ma_{up} = ma_{net} + mg_{down}$

$= (2.232 \times 10^6)(0) + (2.232 \times 10^6)(9.8)$

$ma_{up} = 2.19 \times 10^7$

$F_{up} = 2.19 \times 10^7 \text{ N}$

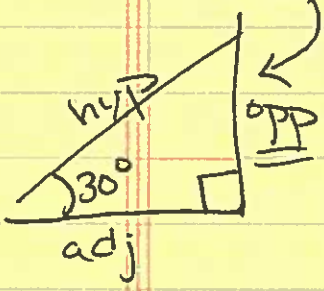
Given

$m = 2.232 \times 10^6 \text{ kg}$

$a_{net} = 0 \text{ m/s}^2$

$g = 9.8 \text{ m/s}^2$

(b.) $F_{down} = mg\sin\theta$



$a = \frac{F_{net}}{m} = \frac{F_{up} - F_{down}}{m} = \frac{mg - mg\sin\theta}{m}$

$a = \frac{((2.232 \times 10^6)(9.8)) - ((2.232 \times 10^6)(9.8)(\sin 30))}{(2.232 \times 10^6)}$

$a = 4.9 \text{ m/s}$

4.3 PP

5. **Given**

$m = 2.20 \times 10^2 kg$

$a_{net} = 75.0 m/s^2$

$g = 9.8 m/s^2$

$F_{net} = F_{avg} - F_g$

$F_{avg} = F_{net} + F_g$

$F_{avg} = ma_{net} + mg$

$F_{avg} = (2.20 \times 10^2 kg)(75.0 m/s^2) + (2.20 \times 10^2 kg)(9.8 m/s^2)$

$\boxed{F_{avg} = 1.87 \times 10^4 N}$

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6. **Given**

$m = 2.00 \times 10^4 kg$

$\Delta t = 2.5 s$

$V_i = 0 m/s$

$V_f = 1.0 m/s$

$F_T = ?$

$a_{net} = \frac{V_f - V_i}{t} = \frac{1.0 m/s - 0 m/s}{2.5 s}$

$a_{net} = \underline{0.4 m/s^2}$

$F_{net} = F_T - F_g$

$F_T = F_{net} + F_g$

$F_T = ma_{net} + mg$

$F_T = (2.00 \times 10^4 kg)(.4 m/s^2) + (2.00 \times 10^4 kg)(9.8 m/s^2)$

$\boxed{F_T = 2.04 \times 10^5 N}$

4.4 Part 1

1. Given

$m = 11.0\,kg$

$\mu_k = 0.39$

$g = 9.8\,m/s^2$

$F_f = \mu_k F_n$

$F_f = \mu_k mg$

$F_f = (.39)(11.0kg)(9.8m/s^2)$

$\boxed{F_f = 42.0N}$

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3. Given

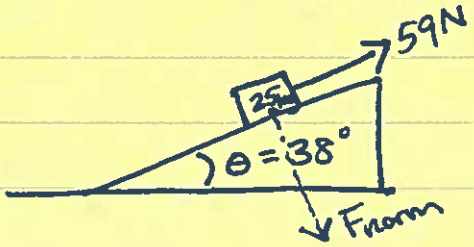
$m = 25.0kg$

$F_{applied} = 59.0N$

$\theta = 38°$

$\mu_s = 0.599$

$g = 9.8m/s^2$



$F_{norm} = mg\cos\theta + F_{applied}$

$F_{norm} = (25)(9.8)\cos(38) + 59N$

$F_{norm} = 252N$

$F_{g,max} = \mu_s F_{norm}$

$F_s = (.599)(252N) = \boxed{151\,N}$

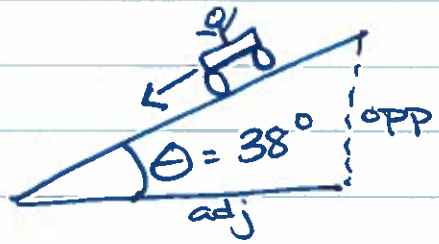
4.4 part 1

(4) Given

$\theta = 38°$

$g = 9.8 m/s$

$\mu_k = ?$



$F_{net} = mg(\sin\theta) - F_k = 0$

$mg(\sin\theta) = F_k$

$F_k = \mu_k F_{norm} = \mu_k mg(\cos\theta)$

$\mu_k mg(\cos\theta) = mg(\sin\theta)$

$\mu_k = \frac{mg\sin\theta}{mg\cos\theta} = \tan\theta = \tan(38°)$

$\boxed{\mu_k = 0.091}$

(7.) Given

$m = 1.90 \times 10^5 kg$

$\mu_s = 0.460$

$g = 9.8 m/s^2$

$F_{net} = F_{applied} - F_k = 0$

$F_{app} = F_k$

$F_k = \mu_k F_n = \mu_s mg$

$F_k = (.460)(1.90 \times 10^5)(9.8)$

$\boxed{F_k = 8.57 \times 10^5 N}$

$F_{app} =$

4.4 part 2

1. **Given**

$F_{app} = 130\,N$

$a_{net} = 1.00\,m/s^2$

$\mu_k = 0.158$

$m = ?$

$g = 9.8\,m/s^2$

$F_{net} = F_{app} - F_k = ma_{net}$

$F_k = \mu_k F_n = \mu_k mg$

$F_{net} = F_{app} - F_k = ma_{net}$

$F_{app} = ma_{net} + \mu_k mg$

$F_{app} = ma_{net} + \mu_k mg$

$F_{app} = m(a_{net} + \mu_k g)$

$$m = \frac{F_{app}}{a_{net} + \mu_k g} = \frac{130\,N}{1.00 + (.158)(9.8)} = \boxed{51\,kg}$$

4.4 part 2

(2.) Given

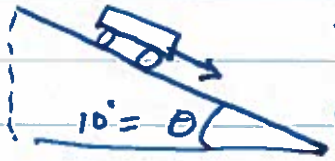
$F_{net} = -2.00 \times 10^4 N$

$\theta = 10°$

$\mu_k = .797$

$g = 9.8 m/s^2$

$F_{net} = ma_{net} = mg\sin\theta - F_k$



$F_k = \mu_k F_n = \mu_k mg$

$F_k = \mu_k mg\cos\theta$

$F_{net} = mg\sin\theta - \mu_k mg\cos\theta$

$F_{net} = m(g\sin\theta - \mu_k g\cos\theta)$

$$m = \frac{F_{net}}{(g\sin\theta - \mu_k g\cos\theta)} = \frac{-2.00 \times 10^4 N}{((9.8)(\sin 10)) - ((.797)(9.8)(\cos 10))}$$

$$m = 3.34 \times 10^3 kg$$

$F_{norm} = mg\cos\theta = (3.34 \times 10^3)(9.8)(\cos 10)$

$$F_{norm} = 1.73 \times 10^4 N$$

4.4 Part 2

(4.) Given

$m = 9.50\,kg$

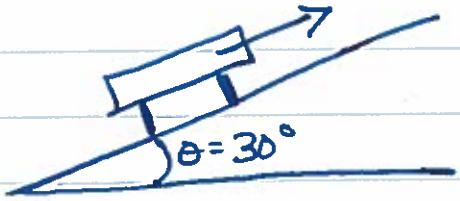
$\theta = 30°$

$F_{app} = 80N$

$a_{net} = 1.64\ m/s^2$

$g = 9.8\ m/s^2$

$\mu_k = ?$



$F_{net} = ma_{net} = F_{app} - F_{fk} - mg\sin\theta$

$F_{fk} = \mu_k F_{norm} = \mu_k mg\cos\theta$

$ma_{net} = -F_{app} + F_{fk} + mg\sin\theta$

$F_{fk} = \dfrac{ma_{net} + F_{app} - mg\sin\theta}{mg\cos\theta}$

$F_{fk} = \mu_k mg\cos\theta$

$\dfrac{\mu_k mg\cos\theta}{mg\cos\theta}$

$\mu_k = \dfrac{((9.5)(1.64)) + (80N) - ((9.5)(9.8)(\sin(30)))}{((9.5)(9.8)(\cos(30)))}$

$\boxed{\mu_k = 0.222}$

omit # 7 on 4.4 part 2