Dynamics Review

(1) (a) Weight = $F_g = mg$

$= (100\ kg)(9.8\ m/s^2)$

$= \underline{980\ N}$

(b) Weight = $F_g = mg$

$= (100\ kg)(1.63\ N/kg)$

$= \underline{163\ N}$

(2) $F = ma$

$m = \frac{F}{a} = \frac{0.02\ N}{8\ m/s^2} = \underline{0.003\ kg}$

(3) $F = ma$

$a = \frac{F}{m} = \frac{2.4 \times 10^{10}\ N}{3.2 \times 10^{9}\ kg} = 7.5\ m/s^2$

(4) $v_i = 0$

$d = 40\ m$

$t = 3.0\ s$

$a = ?$

$d = v_i t + \frac{1}{2} a t^2$

$a = \frac{2d}{t^2} = \frac{2(40\ m)}{(3.0\ s)^2} = 8.89\ m/s^2$

$F = ma$

$= (710\ kg)(8.89\ m/s^2)$

$F = \underline{6300\ N}$

(5) $F = ma$

$F_{brakes} = ma$

$a = \frac{F_{brakes}}{m}$

$= \frac{5000\,N}{1000\,kg}$

$a = 5\,m/s^2$

$v_i = 25\,m/s$

$v_f = 0$

$a = -5\,m/s^2$

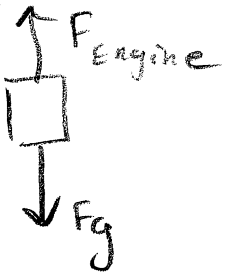
$d = ?$

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

$d = \frac{-v_i^2}{2a} = \frac{-(25\,m/s)^2}{2(-5\,m/s^2)}$

$d = 62.5\,m$

(6) (a) (i)



(ii)

(b)

$v_f = 0$

$a = -9.8\,m/s^2$

$d = 5\times10^{-3} - 1\times10^{-3} = 4\times10^{-3}\,m$

$v_i = ?$

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

$v_i = \sqrt{-2ad}$

$= \sqrt{-2(-9.8)(4\times10^{-3}\,m)}$

$v_i = 280\,m/s$

(c)

$v_f = 280\,m/s$

$d = 1\times10^{-3}\,m$

$a = ?$

$v_i = 0$

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

$a = \frac{v_f^2}{2d} = \frac{(280\,m/s)^2}{2(1\times10^{-3}\,m)}$

$a = 39.2\,m/s^2$

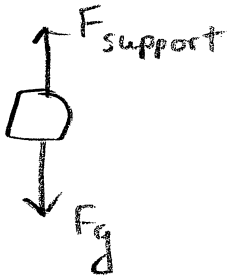
6 (d) $F = ma$

$F_{engine} = ma$

$= (1.0 \times 10^3 \text{ kg})(39.2 \text{ m/s}^2)$

$= 3.9 \times 10^4 \text{ N}$

(7)



$F = ma$

$F_{support} - F_g = ma$

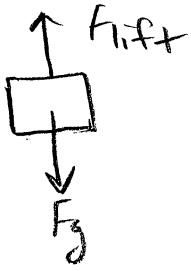
$F_{support} - mg = ma$

$a = \dfrac{F_{support} - mg}{m}$

$= \dfrac{5.6 \times 10^{-4} \text{ N} - (.1 \times 10^{-3} \text{ kg})(9.8 \text{ m/s}^2)}{.1 \times 10^{-3} \text{ kg}}$

$a = -4.2 \text{ m/s}^2$

(8) (a)



$F_{lift} - F_g = ma$

$F_{lift} = ma + F_g$

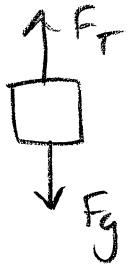
$= ma + mg$

$= m(a + g)$

$= (5000 \text{ kg} + 2000 \text{ kg})(.5 \text{ m/s}^2 + 9.8 \text{ m/s}^2)$

$F_{lift} = 7.2 \times 10^4 \text{ N}$

8. (b)



$$F = ma$$

$$F_T - F_g = ma$$

$$F_T - mg = ma$$

$$F_T = ma + mg$$

$$= m(a+g)$$

$$= 2000\,kg\,(.5\,m/s^2 + 9.8\,m/s^2)$$

$$\underline{F_T = 2.1 \times 10^4\,N}$$

(9)

$$F = ma$$

$$F_N - F_g = ma$$

$$F_N - mg = ma$$

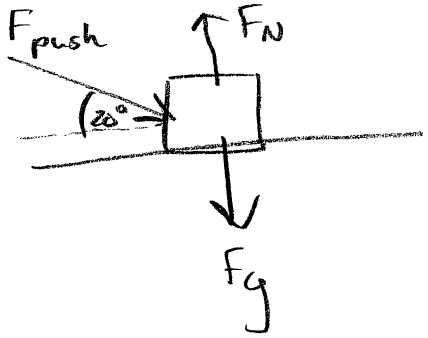
$$F_N = ma + mg$$

$$= m(a+g)$$

$$= 70\,kg\,(-5\,m/s^2 + 9.8\,m/s^2)$$

$$\underline{F_N = 336\,N}$$

(10) (a)



(b)(i) $F_x = F_{push} \cos 20° = 25N \cos 20° = \underline{23.5\ N}$

(ii) $F = ma$

$F_x = ma$

$a = \frac{F_x}{m} = \frac{23.5N}{5\ kg} = \underline{4.7\ m/s^2}$

(iii) y direction $F = ma$

$F_N - F_{push\,y} - F_g = ma$

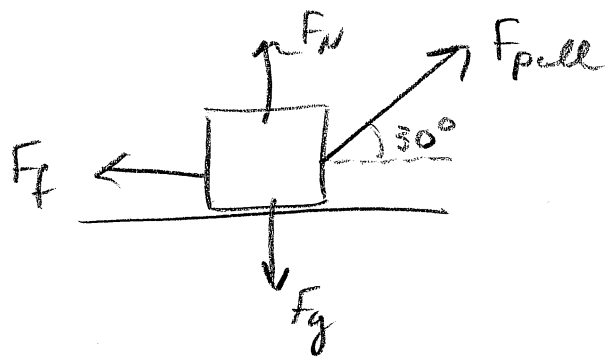
$F_N - F_{push} \sin 20 - mg = 0$

$F_N = F_{push} \sin 20 + mg$

$= 25N \sin 20° + (5\ kg)(9.8\ m/s^2)$

$\underline{F_N = 57.6\ N}$

(11)



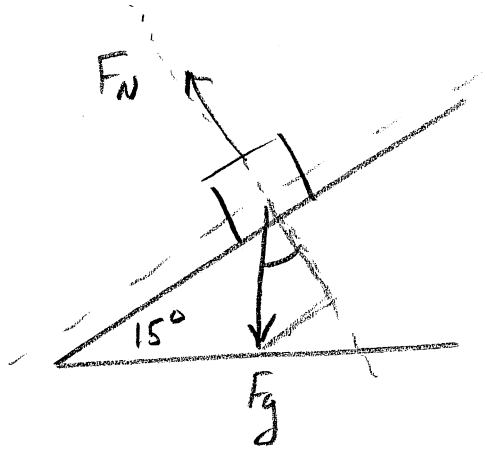
$F = ma$

$F_{pull}\cos 30° - F_f = ma$

$a = \dfrac{F_{pull}\cos 30° - F_f}{m} = \dfrac{400\,N \cos 30° - 75\,N}{70\,kg}$

$a = 3.88\ m/s^2$

(12) (a)



(b) (i) $F_{gx} = F_g \sin 15° = mg \sin 15 = (2\,kg)(9.8\,m/s^2)\sin 15$

$F_{gx} = 5.1\,N$

(ii) $F = ma$

$F_{gx} = ma$

$a = \dfrac{F_{gx}}{m} = \dfrac{5.1\,N}{2\,kg} = 2.6\ m/s^2$

14 (a) $v_i = 20\ m/s$

$v_f = 0$

$a = -5.88\ m/s^2$

$t = ?$

$v_f = v_i + at$

$$t = \frac{-v_i}{a} = \frac{-20\ m/s}{-5.88\ m/s^2} = \underline{3.4\ s}$$

(b) $v_i = 20\ m/s$

$v_f = 0$

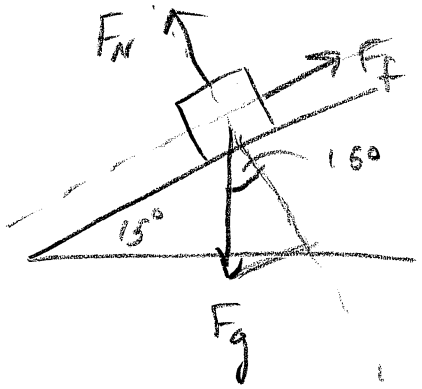
$a = -5.88\ m/s^2$

$d = ?$

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

$$d = \frac{-v_i^2}{2a} = \frac{-(20\ m/s)^2}{2(-5.88\ m/s^2)} = \underline{34\ m}$$

(13)



$$F = ma$$

$$F_g \sin 15 - F_f = 0$$

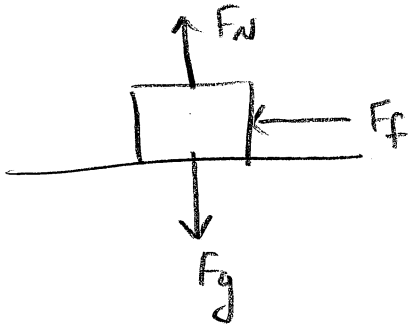
$$F_f = F_g \sin 15$$

$$= mg \sin 15$$

$$= (5\,kg)(9.8\,m/s^2)\sin 15$$

$$\underline{F_f = 12.7\,N}$$

(14) (a)



x

$$F = ma$$

$$F_f = ma$$

y

$$F = ma$$

$$F_N - F_g = 0$$

$$F_N = F_g = mg$$

$$F_f = \mu F_N$$

$$ma = \mu mg$$

$$a = 0.6\,(9.8\,m/s^2)$$

$$a = 5.88\,m/s^2$$

(15) $v_i = 2\ m/s$

$v_f = 0$

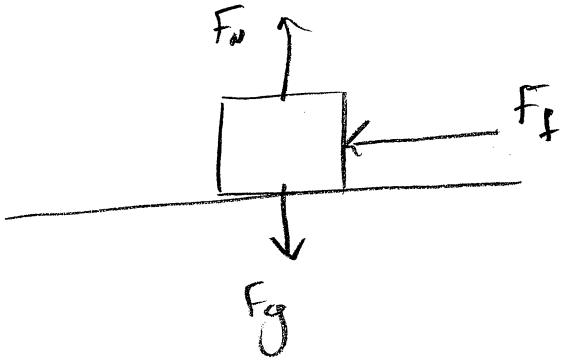
$d = 1.5\ m$

$a = ?$

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

$a = \frac{-v_i^2}{2d} = \frac{-(2\ m/s)^2}{2(1.5)}$

$a = -1.33\ m/s^2$



x

$F = ma$

$F_f = ma$

$-F_f = (.2kg)(-1.33 m/s^2)$

$F_f = 0.267\ N$

y

$F_N = F_g$

$F_N = mg$

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

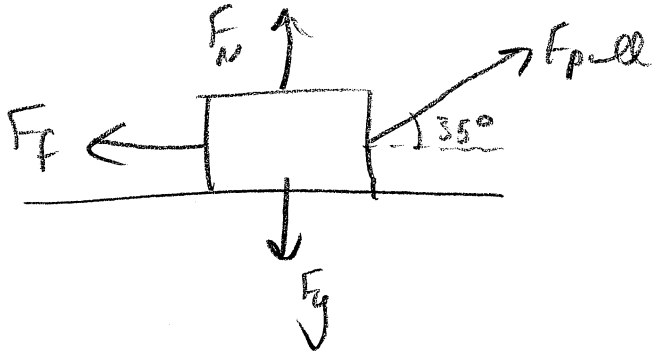
$F_N = 1.96\ N$

$F_f = \mu F_N$

$\mu = \frac{F_f}{F_N} = \frac{0.267\ N}{1.96\ N}$

$\mu = 0.14$

(16)



x

$F = ma$

$F_{pull}\cos 35 - F_f = 0$

$F_f = F_{pull}\cos 35$

$F_f = 250N \cos 35$

$F_f = 204.78N$

y

$F = ma$

$F_{pull}\sin 35 + F_N - F_g = 0$

$F_{pull}\sin 35 + F_N - mg = 0$

$F_N = mg - F_{pull}\sin 35$

$F_N = (51kg)(9.8 m/s^2) - 250N \sin 35$

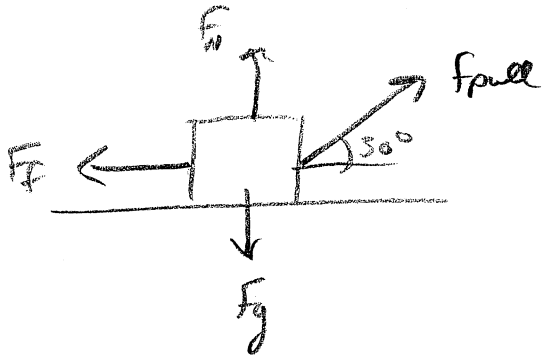
$= 493.606N$

$F_f = \mu F_N$

$\mu = \frac{F_f}{F_N} = \frac{204.78N}{493.606N}$

$\mu = 0.41$

(17)



x

$F = ma$

$F_{pull}\cos 30 - F_f = ma$

$F_f = f_{pull}\cos 30 - ma$

y

$F = ma$

$F_{pull}\sin 30 + F_N - F_g = 0$

$F_N = F_g - F_{pull}\sin 30$

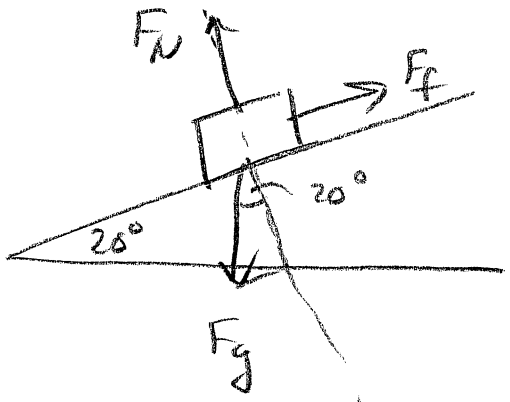
$F_f = \mu F_N$

$F_{pull}\cos 30 - ma = \mu(mg - F_{pull}\sin 30)$

$180N\cos 30 - (50kg)a = .2(50kg(9.8 m/s^2) - 180N\sin 30)$

$a = 1.52\ m/s^2$

(18) (a)



x

$F = ma$

$-F_g \sin 20 + f_f = 0$

$F_f = F_g \sin 20$

$F_f = mg \sin 20$

y

$F = ma$

$-F_g \cos 20 + F_N = 0$

$F_N = F_g \cos 20$

$F_N = mg \cos 20$

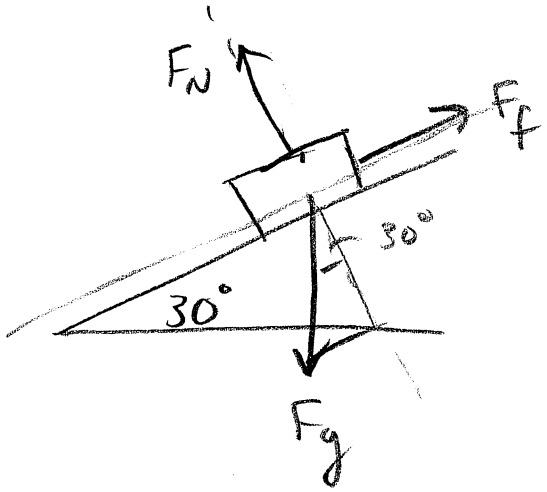
$$F_f = \mu F_N$$

$$mg \sin 20 = \mu mg \cos 20$$

$$\mu = \frac{\sin 20}{\cos 20} = \tan 20$$

$$\mu = 0.36$$

18 (b)



x

$F = ma$

$-F_g \sin 30 + f_f = ma$

$F_f = ma + mg \sin 30$

y

$F = ma$

$-F_g \cos 30 + F_N = 0$

$F_N = mg \cos 30$

$F_f = \mu F_N$

$ma + mg \sin 30 = \mu mg \cos 30$

$\mu = \dfrac{a + g \sin 30}{g \cos 30}$

$= \dfrac{-2\ m/s^2 + (9.8\ m/s^2) \sin 30}{(9.8\ m/s^2) \cos 30}$

$\mu = 0.34$