Dynamics Problems

① $\Sigma F = ma$

$41.6 = m(4.2)$

$m = \frac{41.6}{4.2} = 9.9 \text{ kg}$

② a) $v_i = 0$, $d = 5.2\text{ m}$, $t = 3.2\text{ s}$, $a = ?$

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

$5.2 = (0)(3.2) + \frac{1}{2}a(3.2)^2$

$5.2 = 0 + 5.12a$

$a = \frac{5.2}{5.12} = 1.02 \text{ m/s}^2$

b) $\Sigma F = ma$

$0.4 = m(1.02)$

$m = \frac{0.4}{1.02} = 0.39 \text{ kg}$

③ Part 1 - Puck Only

$\Sigma F = ma$

$= (1.5)(0.018 \text{ m/s}^2)$

$\Sigma F = 0.027 \text{ N}$

Part 2 - Puck + Rock

$\Sigma F = ma$

$0.027 = m(0.008 \text{ m/s}^2)$

$m = 3.375 \text{ kg}$ (rock + puck)

$m_{rock} = 3.375 - 1.5 = 1.875 \text{ kg}$

④ $\Sigma F = ma$

$= (12.7)(1.2)$

$\Sigma F = 15.24\ N$

$\Sigma F = F_A - F_f$

$15.24 = F_A - 4.8$

$F_A = 20.04\ N$

⑤ $\Sigma F = ma$

$= (7.8)(0.61)$

$\Sigma F = 4.758\ N$

$\Sigma \vec{F} = \vec{F}_A + \vec{F}_f$

$4.758 = 5.2 + \vec{F}_f$

$\vec{F}_f = -0.442\ N$

⑥ $\Sigma F = F_x - F_f$

$= 2.25 \times 10^3 - 750$

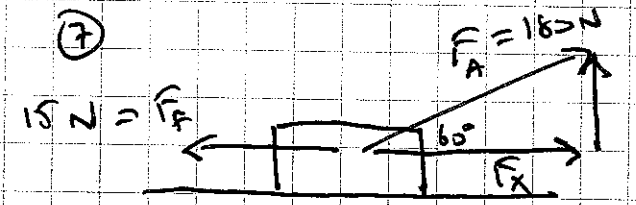
$\Sigma F = 1500\ N$

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

$= \frac{1500}{400}$

$a = 3.75\ m/s^2$

⑦



$\Sigma F = F_x - F_f$

$= 90 - 15$

$\Sigma F = 75\ N$

$\cos 60 = \frac{F_x}{180}$

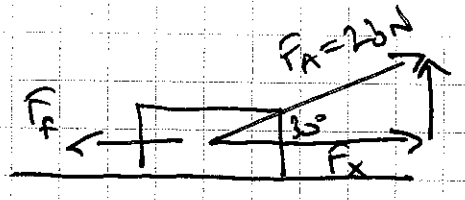
$F_x = 180 \cos 60 = 90\ N$

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

$= \frac{75}{20}$

$a = 3.75\ m/s^2$

(8)



$F_x = 23 \cos 30$

$F_x = 19.919\ N$

$\Sigma F = F_x - F_f$

$= 19.919 - 7.5$

$\Sigma F = 12.419\ N$

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

$= \frac{12.419}{5.6}$

$a = 2.2\ m/s^2$

(9) $v_i = 0$

$v_f = 8\ m/s$

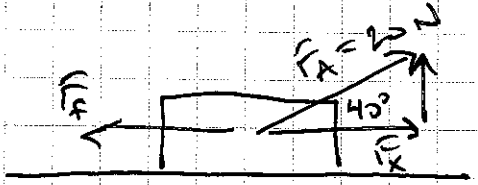
$t = 2.5\ s$

$a = ?$

$v_f = v_i + at$

$8 = 0 + a(2.5)$

$a = \frac{8}{2.5} = 3.2\ m/s^2$



$F_x = 20 \cos 45$

$F_x = 15.321\ N$

$\Sigma F = ma$

$= (4)(3.2)$

$\Sigma F = 12.8\ N$

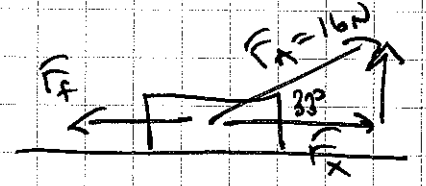
$\vec{\Sigma F} = \vec{F_x} + \vec{F_f}$

$12.8 = 15.321 + \vec{F_f}$

$\vec{F_f} = -2.5\ N$

(10) $v_i = 0$
$v_f = 6$ m/s
$t = 1.5$ s
$a = ?$

$v_f = v_i + at$
$6 = 0 + a(1.5)$
$a = \frac{6}{1.5} = 4$ m/s^2



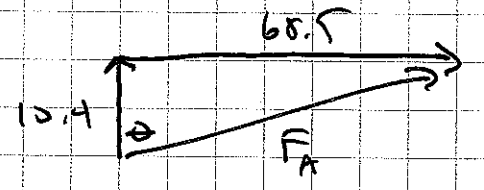
$F_x = 16 \cos 33$
$F_x = 13.419$ N

$\Sigma F = ma$
$= (2.5)(4)$
$\Sigma F = 10$ N

$\Sigma \vec{F} = \vec{F}_x + \vec{F}_f$
$10 = 13.419 + \vec{F}_f$
$\vec{F}_f = -3.4$ N

(11) Step 1 - Add the two applied forces.

	N	E
F_1	$37.5 \sin 45$	$37.5 \cos 45$
F_2	$-45 \sin 21$	$45 \cos 21$
Total	10.4	68.528



$F_A^2 = 10.4^2 + 68.528^2$
$F_A = 69.311$ N

$\theta = \tan^{-1}\left(\frac{68.528}{10.4}\right)$

$\theta = 81.379°$

(11) Step 2 - Subtract friction to get ΣF

$$\Sigma \vec{F} = \vec{F}_A - \vec{F}_f$$

$$= 69.311 - 7.5$$

$$\Sigma F = 61.811 \text{ N}$$

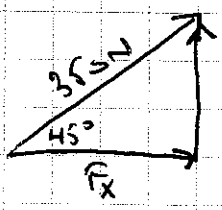
Step 3 - Determine a

$$a = \frac{\Sigma F}{m} = \frac{61.811}{80} = 0.77 \text{ m/s}^2 \ [81.4^\circ \text{ E of N}]$$

or

$$0.77 \text{ m/s}^2 \ [8.6^\circ \text{ N of E}]$$

(12)



$$F_x = 350 \cos 45 = 247.487 \text{ N}$$

Since both horses exert the same force at the same angle, the total force will be $2F_x$.

$$\Sigma \vec{F} = 2\vec{F}_x - \vec{F}_f$$

$$= 2(247.487) - 50$$

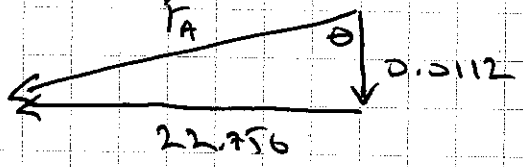
$$\Sigma F = 444.975 \text{ N}$$

$$a = \frac{\Sigma F}{m} = \frac{444.975}{1000} = 0.44 \text{ m/s}^2$$

Note: the y-components cancel, which is why I didn't bother calculating them.

(13) Same method as #11.

	N	E
$\vec{F}_1$	$10 \sin 30.3$	$-10 \cos 30.3$
$\vec{F}_2$	$-15 \sin 19.7$	$-15 \cos 19.7$
Total	-0.0112	-22.756



$\vec{F}_A^2 = 0.0112^2 + 22.756^2$

$\vec{F}_A = 22.756 \text{ N}$

$\theta = \tan^{-1}\left(\frac{22.756}{0.0112}\right)$

$\theta = 89.972^\circ \approx 90^\circ$

$\therefore \vec{F}_A \approx 22.756 \text{ N } [\omega]$

$\Sigma \vec{F} = \vec{F}_A - \vec{F}_f$

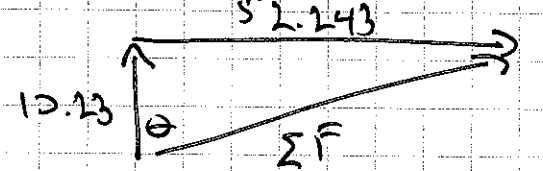
$= 22756 - 5$

$\Sigma \vec{F} = 17.756 \text{ N } [\omega]$

$a = \frac{\Sigma \vec{F}}{m} = \frac{17.756}{12.5} = 1.42 \text{ m/s}^2 \ [\omega]$

(14)

	N	E
F_1	$40 \sin 45$	$40 \cos 45$
F_2	$-30 \sin 37$	$30 \cos 37$
ΣF	10.23	52.243



$\Sigma F^2 = 10.23^2 + 52.243^2$

$\Sigma F = 53.235$

$m = \frac{\Sigma F}{a} = \frac{53.235}{1.5} = 35.5 \text{ Kg}$

(15)

	N	E
F_1	$70 \cos 25$	$-70 \sin 25$
F_2	$70 \cos 25$	$70 \sin 25$
F_A	126.883	0

$\vec{F}_A = 126.883 \text{ N } [N]$

$\Sigma \vec{F} = \vec{F}_A - \vec{F}_f$

$= 126.883 - 26.9$

$\Sigma F = 99.983 \text{ N}$

$m = \frac{\Sigma F}{a} = \frac{99.983}{2.2}$

$m = 45.4 \text{ Kg}$

(16) We can think of up as "north" and then the 2 forces become:

$F_1 = 54\ N\ [30°\ N\ of\ W]$ $F_2 = 54\ N\ [30°\ N\ of\ E]$

The third force is gravity, which points down, or "south".

	N	E
F_1	$54 \sin 30$	$-54 \cos 30$
F_2	$54 \sin 30$	$54 \cos 30$
F_g	$-(10)(9.8)$	0
ΣF	-44	0

$\Sigma F = 44\ N\ [Down]$

$a = \frac{\Sigma F}{m} = \frac{44}{10} = 4.4\ m/s^2\ [Down]$

(17) Same idea as #16

$\vec{F}_1 = 88\ N\ [21°\ W\ of\ N]$ $\vec{F}_2 = 88\ N\ [21°\ E\ of\ N]$

	N	E
F_1	$88\cos 21$	$-88\sin 21$
F_2	$88\cos 21$	$88\sin 21$
F_g	$-(13.5)(9.8)$	0
ΣF	32.010	0

$\Sigma F = 32.010\ N\ [U_p]$.

$a = \frac{\Sigma F}{m} = \frac{32.010}{13.5} = 2.37\ m/s^2\ [U_p]$

(18) a)

$$\Sigma F = F_T - F_g$$

$$ma = F_T - mg$$

$$m(1.2) = 200 - m(9.8)$$

$$1.2m + 9.8m = 200$$

$$11m = 200$$

$$m = \frac{200}{11} = 18.182 \text{ Kg.}$$

$$F_g = mg = (18.182)(9.8) = 178.2 \text{ N}$$

b) $$\Sigma F = F_T - F_g$$

$$= 150 - 178.2$$

$$18.182a = -28.2$$

$$a = -1.55 \text{ m/s}^2$$

c) $$\Sigma F = F_T - F_g$$

$$ma = F_T - F_g$$

$$(18.182)(9.8) = F_T - 178.2$$

$$F_T = 0$$