Dynamics Problems P6,7 pg 11

P6] a) $\vec{F}_1 = 265N$ [E]

$\vec{F}_2 = 122N$ [W]

$\vec{F}_3 = ?$

$\vec{F}_{net} = \Sigma\vec{F} = 0\ N$

Analysis:

$\Sigma\vec{F} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3$ Let E = +

$\vec{F}_3 = \Sigma\vec{F} - (\vec{F}_1 + \vec{F}_2)$

$\vec{F}_3 = 0 - (\vec{F}_1 + \vec{F}_2)$

$\boxed{\vec{F}_3 = -(\vec{F}_1 + \vec{F}_2)}$

$\vec{F}_3 = -(265N - 122N)$

$\vec{F}_3 = -143N$

$\vec{F}_3 = 143N$ [W]

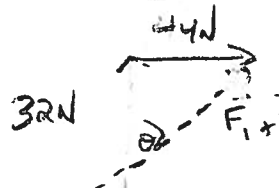
b) $\vec{F}_1 = 32N$ [N]

$\vec{F}_2 = 44N$ [E]

$\vec{F}_3 = ?$

$\vec{F}_{net} = 0\ N$

As before, $\vec{F}_3 = -(\vec{F}_1 + \vec{F}_2)$



$\vec{F}_1 + \vec{F}_2 = \sqrt{32^2 + 44^2} = 54.4\ N$ $\theta = \tan^{-1}\left(\frac{44}{32}\right) = 53.97°$

$\approx 54°$

$\vec{F}_1 + \vec{F}_2 = 54N$ [54° E of N]

$-(\vec{F}_1 + \vec{F}_2) = 54N$ [54° W of S]

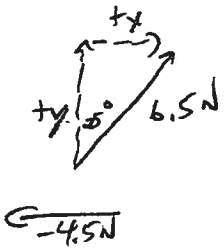
c) $\vec{F}_1 = 6.5N$ [25° E of N]

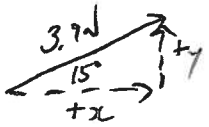
$\vec{F}_2 = 4.5N$ [W]

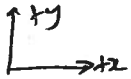
$\vec{F}_3 = 3.9N$ [15° N of E]

$\vec{F}_4 = ?$

$\vec{F}_{net} = 0\ N$







Analysis

$\vec{F}_{net} = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \vec{F}_4$

$0 = \vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \vec{F}_4$

$\boxed{\vec{F}_4 = -(\vec{F}_1 + \vec{F}_2 + \vec{F}_3)}$

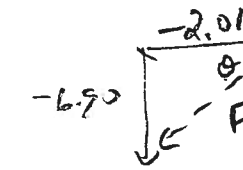
$F_{4x} = -(F_{1x} + F_{2x} + F_{3x})$

$= -(6.5\sin 25 - 4.5 + 3.9\cos 15) = -2.014\ N$

$F_{4y} = -(F_{1y} + F_{2y} + F_{3y})$

$= -(6.5\cos 25 + 0 + 3.9\sin 15) = -6.90\ N$

Combining components



$F_4 = \sqrt{2.01^2 + 6.90^2}$

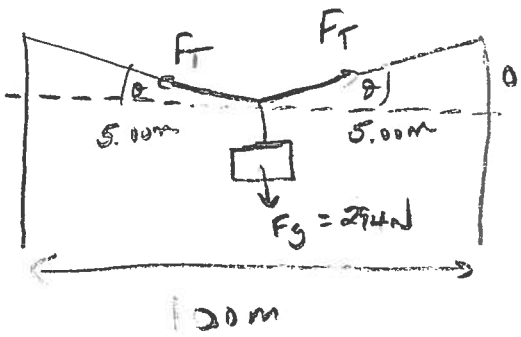
$= 7.1kN$

$\theta = \tan^{-1}\left(\frac{6.90}{2.01}\right) = 74°$

$\vec{F}_4 = 7.2N$ [74° S of W] or

$7.2N$ [16° W of S]

7)

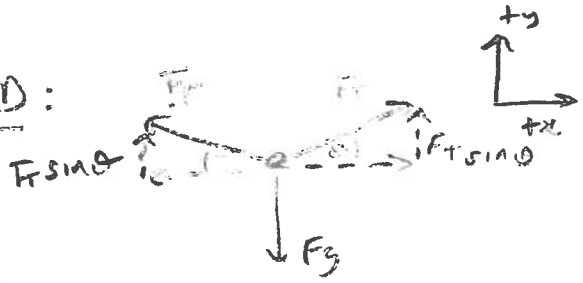


$\tan\theta = \frac{0.40}{5.00m}$

$\theta = \tan^{-1}\left(\frac{0.40}{5.00}\right) = 4.6°$

$F_T = ?$

FBD:



Consider the Y dir: $\sum F_y = 0$

$\sum F_y = F_T \sin 4.6° + F_T \sin 4.6° - F_g$

$2F_T \sin 4.6° - F_g = 0$

$F_T = \frac{F_g}{2\sin 4.6°}$

$F_T = \frac{294N}{2(\sin 4.6°)} = 1843.4N$

∴ the tension in the line is $1.8 \times 10^3 N$.

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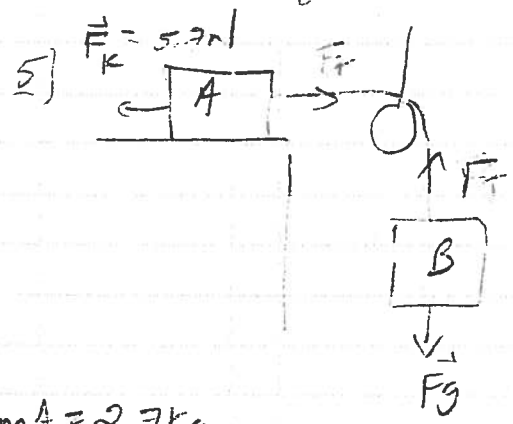
5]



$m_A = 2.7kg$

$m_B = 3.7kg$

$\vec{a}_s = ?$ $T = ?$

a)

System FBD

$F_g = m_B \cdot g$

$= 3.7kg (9.81 m/s^2)$

$= 36.26N$

$\vec{a}_s = \frac{\vec{F}_{net}}{m_{tot}}$

$\vec{a}_s = \frac{\vec{F}_g + \vec{F}_K}{m_A + m_B}$

$\vec{a}_s = \frac{F_g - F_K}{m_A + m_B}$

$\vec{a}_s = \frac{36.26N - 5.7N}{2.7kg + 3.7kg}$

$= \frac{30.56N}{6.4kg}$

$= 4.775 m/s^2 [\downarrow]$

SFBD FOR B

b)

$\vec{a}_B = \vec{a}_s$

$\sum \vec{F} = m\vec{a}$

$F_g - F_T = m_B \vec{a}_s$

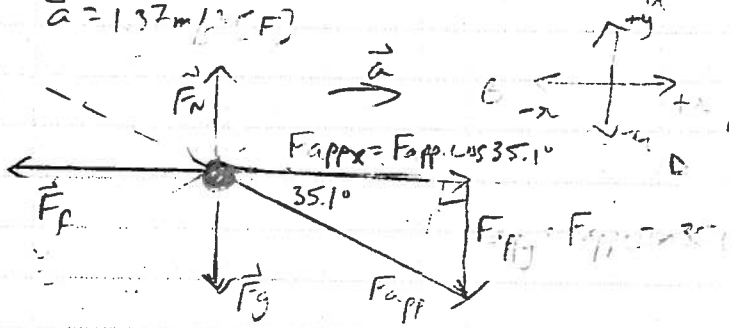
$-F_T = m_B \vec{a}_s - F_g$

$F_T = F_g - m_B \vec{a}_s$

$= 36.26N - (3.7kg)(4.775 m/s^2)$

$= 36.26N - 17.67N$

$\vec{a} = 1.37 m/s^2 [F]$



$m = 17.5kg$ $F_{app} = 32.9N$

a) Vertically forces are balanced

$\sum F_y = 0$

$\sum F_y = F_N - F_g - F_{app} \cdot \sin 35.1° = 0$

$F_N = F_g + F_{app} \cdot \sin 35.1°$

$= (mg) + F_{app} \sin 35.1°$

$= (17.5kg)(9.8N) + 32.9N (\sin 35.1°)$

$= 175.42N + 18.92N$

$= 194.33N$

$\sim 194N$

b) $\sum F_x = ma$

$F_{app_x} - F_f = ma$

$-F_f = ma - F_{app_x}$

$F_f = F_{app_x} - ma$

$= (F_{app} \cdot \cos 35.1°) - (17.5kg)(1.37 m/s^2)$

$= (32.9N)\cos 35.1° - (17.5kg)(1.37 m/s^2)$

$= 26.9N - 24.5N$

$= 2.4N$

c) $v_2 = ?$

$v_1 = 0$

$a = 1.37 m/s^2$

$\Delta t = 0.58s$

$v_2 = v_1 + a\Delta t$

$v_2 = a\Delta t$

$v_2 = (1.37 m/s^2)(0.58s)$

$= 0.795 m/s [F]$

$\sim 0.80 m/s [F]$

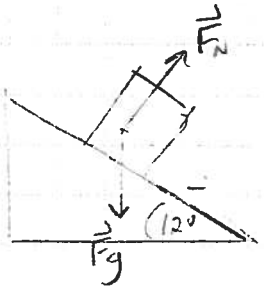
d) At constant velocity $\sum F_x = 0$

$F_{app_x} = F_f$

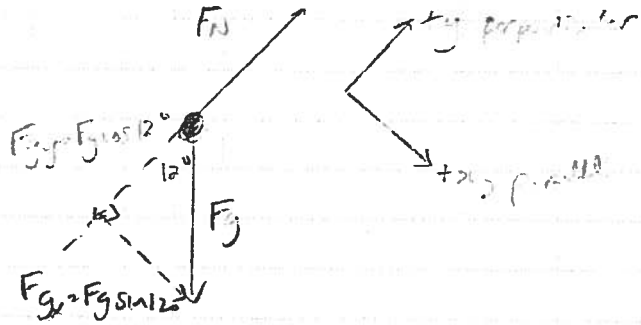
$F_{app} \cdot \cos 35.1° = F_f$

$F_{app} = F_f = 2.4N = 2.93N$

7)



$m = 65\,kg$



a) Vertically, forces are balanced

$$\Sigma F_y = 0$$
$$F_N - F_{g_y} = 0$$
$$F_N = F_g \cos 12$$
$$= m g \cos 12°$$
$$= (65\,kg)(9.8\,N/kg)\cos 12°$$
$$= 623.1\,N$$
$$\sim 6.2 \times 10^2\,N$$

b) $\Sigma F_x = ma$

$$F_g \sin 12 = ma$$
$$a = \frac{mg \sin 12°}{m}$$
$$= (9.8\,N/kg)(\sin 12°)$$
$$= 2.0\,m/s^2$$

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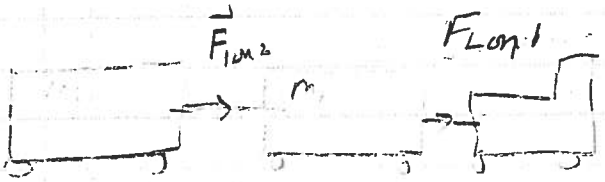
P10

$\vec{a} = 0.33 m/s^2$ [F]

$m_1 = m_2 = 3.1 \times 10^4 kg$



a) $\vec{a} = 0.33 m/s^2$ [F]

$\vec{F}_{1on2} = ?$

$m_2 = 3.1 \times 10^4 kg$

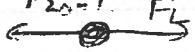
$\vec{F}_{1on2} = m_2 \vec{a}$

$= 10230 N$ [F]

$= 1.0 \times 10^4 N$ [F]

$\vec{F}_L = ?$

$F_{net} = \vec{F}_{2on1} + \vec{F}_L$



[F] +

$m_1 = 3.1 \times 10^4 kg$

$\vec{a} = 0.33 m/s^2$ [F]

$\vec{F}_{net} = m\vec{a}$

$\vec{F}_L + F_{2on1} = m_1 \vec{a}$

$F_L - 10230N = (3.10 \times 10^4 kg)(0.33 m/s^2)$

$F_L = (3.10 \times 10^4 kg)(0.33 m/s^2) + 10230 N$

$= 20460N$

$\sim 2.0 \times 10^4 N$ [F]

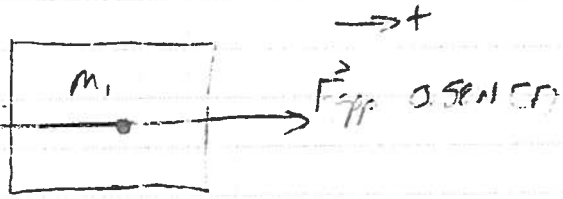
$\Sigma F = (m_1 + m_2) a$

$0.58N = (1.01kg + m_2)(0.21 m/s^2)$

$\frac{0.58N}{0.21 m/s^2} - 1.01kg = m_2$

$m_2 = 1.76 kg \sim 1.8 kg$

b) similar



$\vec{a} = 0.21 m/s^2$ [F]

$\Sigma \vec{F} = m_1 \vec{a}$

$F_{app} + \vec{F}_{2on1} = m_1 \vec{a}$

$\vec{F}_{2on1} = m_1 \vec{a} - \vec{F}_{app}$

$= (1.01kg)(0.21 m/s^2) - 0.58N)$

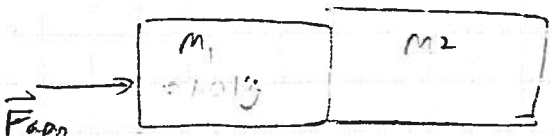
$= 0.21N - 0.58N$

$= -0.37N$

$\therefore F_{2on1} = 0.37N$ [backward]

$|F_{2on1}| = |F_{1on2}| = 0.37 N$

11)



$\vec{a} \Rightarrow 0.21 m/s^2$ [F]

$\vec{F}_{net} = \vec{F}_{app} = 0.58N$ [F]