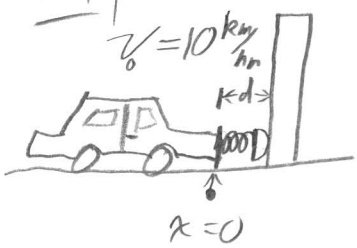
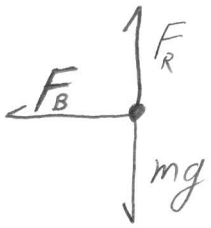
Physics 111
Homework

11-21



FBD



NSL

$x: -F_B = ma$

$v_0 = 10\ km/hr$

$F_B = 65 \times 10^3\ N$

$m = 1300\ kg$

Maximum acceleration provided by bumper:

$$a = -\frac{F_B}{m}$$

Kinematics to Find d

$$x = x_0 + v_0 t + \tfrac{1}{2} a t^2$$

$$d = 0 + v_0 t - \tfrac{1}{2} \frac{F_B}{m} t^2$$

$$v = v_0 + at$$

$$0 = v_0 - \frac{F_B}{m} t$$

$$t = v_0 \frac{m}{F_B}$$

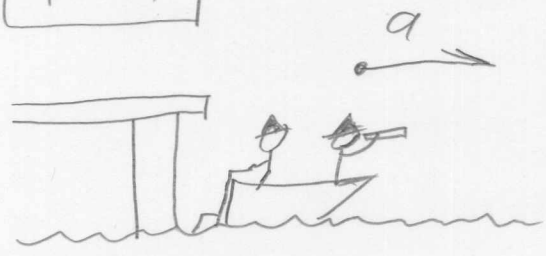
$$d = v_0^2 \frac{m}{F_B} - \tfrac{1}{2} \frac{F_B}{m} v_0^2 \frac{m^2}{F_B^2}$$

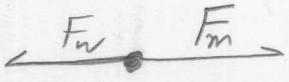
$$\boxed{d = \frac{1}{2} \frac{v_0^2 m}{F_B}} \Rightarrow d = \frac{1}{2} \frac{\left(10\ km/hr \cdot \frac{1\ hr}{3600\ s} \cdot 1 \times 10^3\ m/km\right)^2 (1300\ kg)}{65 \times 10^3\ N}$$

$$\boxed{d = 0.15\ m}$$

Phys III
Homework

4-29





Given

$m = 930\ kg$

$a = 2.3\ m/s^2$

$F_m = 3.9\ kN$

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

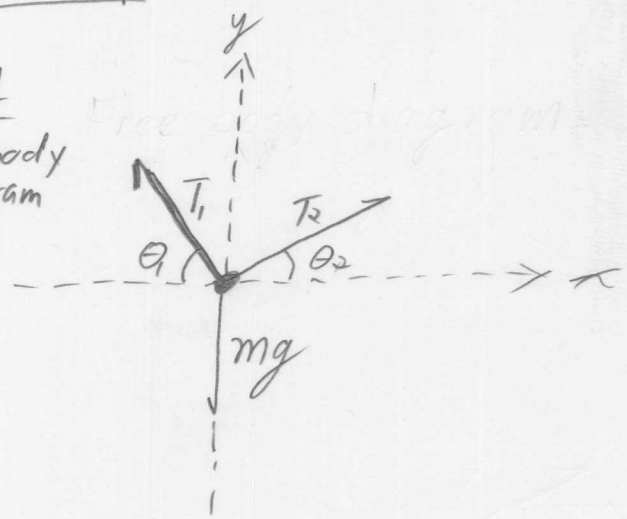
$$F_m - F_w = ma \Rightarrow \boxed{F_w = F_m - ma}$$

$$F_w = 3.9 \times 10^4 - (930)(2.3)$$

$$\boxed{F_w = 3.69 \times 10^4}$$

Phys 111
5-36

Step 1
Free body diagram



GIVEN
$m = 26\ kg$
$\theta_1 = 71°$
$\theta_2 = 28°$

Step 2: $\sum \vec{F} = m\vec{a}$ → Break into x and y

x: $T_2 \cos\theta_2 - T_1 \cos\theta_1 = 0$ y: $T_1 \sin\theta_1 + T_2 \sin\theta_2 - mg = 0$

① $T_2 \cos\theta_2 = T_1 \cos\theta_1$ ② $T_2 \sin\theta_2 = mg - T_1 \sin\theta_1$

Divide ② by ①

$$\frac{T_2 \sin\theta_2}{T_2 \cos\theta_2} = \frac{mg - T_1 \sin\theta_1}{T_1 \cos\theta_1} \Rightarrow T_1 \cos\theta_1 \tan\theta_2 = mg - T_1 \sin\theta_1$$

$$T_1(\cos\theta_1 \tan\theta_2 + \sin\theta_1) = mg$$

$$T_1 = \frac{mg}{\cos\theta_1 \frac{\sin\theta_2}{\cos\theta_2} + \sin\theta_1} = mg \frac{\cos\theta_2}{\cos\theta_1 \sin\theta_2 + \sin\theta_1 \cos\theta_2}$$

③ $$\boxed{T_1 = mg \frac{\cos\theta_2}{\sin(\theta_1 + \theta_2)}}$$

5-36 continued...

Combine ① and ③

$$T_2 \cancel{\cos\theta_2} = \underbrace{\left(mg \frac{\cancel{\cos\theta_2}}{\sin(\theta_1+\theta_2)}\right)}_{\downarrow \; T_1 \text{ from eq } ③} \cos\theta_1$$

$$\boxed{T_2 = mg \frac{\cos\theta_1}{\sin(\theta_1+\theta_2)}}$$

$$T_1 = (26)(9.8)\frac{\cos(28)}{\sin(28+71)} = \underline{227\ N}$$

$$T_2 = (26)(9.8)\frac{\cos(71)}{\sin(28+71)} = \underline{839\ N}$$