Cole
Lamers

College Physics 1

Newton's Laws Worksheet

Please write your answer in the corresponding blank for each assigned problem. When a problem requires work to solve, please show all work next to that corresponding problem. In order to gain proper credit, all corresponding work (if applicable) must be shown to the right of and/or below the corresponding answer blank. ***All responses should ALWAYS take into account significant figures and proper applicable units.***

35F
Kms

1. An airboat with mass 3.75×10^2 kg, including the passenger, has an engine that produces a net horizontal force of 6.90×10^2 N, after accounting for forces of resistance (*as in lecture Figure 4.6*). **(a)** Find the acceleration of the airboat. **(b)** Starting from rest, how long does it take the airboat to reach a speed of 13.9 m/s? After reaching that speed, the pilot turns off the engine and drifts to a stop over a distance of 55.0 m. **(c)** Find the resistance force, assuming it's a constant.

x 55.0m
a 1.85 m/s²
t 7.51 s
V_0
V_f 13.9 m/s
V

x
a
t
V_0 13.9
V_f 0

(a) 1.85 m/s²

(b) 7.51 s

(c) −660 N

(a) $F = ma$, $a = \frac{F}{m} = \frac{690N}{375kg}$, $a = 1.85 m/s^2$

(b) $V = V_0 + at$

$13.9 m/s = 0 + 1.85 m/s^2 (t)$

$\frac{13.9 m/s}{1.85 m/s^2}$, $t = 7.51 s$

(c1) $V^2 = V_0^2 + 2a\Delta x$

$0 = 13.9^2 m/s + 2a(55m)$

-193.21

$\frac{-193.21 m^2/s^2}{110m} = \frac{110m(a)}{110m}$

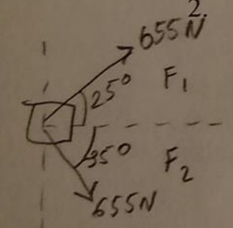
$a = -1.76 m/s^2$

(c2) $F = ma$

$F = (375kg)(-1.76 m/s^2)$

$F = -660 N$

2. Two horses are pulling a barge with mass 2410 kg along a canal (*as shown similarly in lecture Figure 4.7, but with different measurements*). The cable connected to the first horse makes an angle of θ_1 = 25.0° with respect to the direction of the canal, while the cable connected to the second horse makes an angle of θ_2 = -35.0° Find the initial acceleration of the barge [both **(a)** magnitude and **(b)** direction], starting from rest, if each horse exerts a force of magnitude 655 N on the barge. Ignore forces of resistance on the barge.



35F
Kms

(a) .471 m/s²

(b) −5.00°

(a) $F_{1x} = F_{1x}\cos\theta_1$

$655\cos 25 = 594 N$

$F_{2x} = F_{2x}\cos\theta_2$

$655\cos -35 = 537 N$

$F_{1x} + F_{2x} = F_x$

$594 + 537 = 1130N$

$F_{1y} = F_{1y}\sin\theta_1$

$655\sin 25 = 277N$

$F_{2y} = F_{2y}\sin\theta_2$

$655\sin -35 = -376N$

$F_{1y} + F_{2y} = F_y$ $277N + -376N = -99N$

$F = ma$ $a = \frac{F}{m}$ $a_x = \frac{F_x}{m}$ $a_y = \frac{F_y}{m}$

(a2) $a_x = \frac{1130N}{2410kg} = .469 m/s^2$

$a_y = \frac{-99N}{2410kg} = -.041 m/s^2$

$a = \sqrt{a_x^2 + a_y^2} = \sqrt{(.469)^2 + (-.041)^2}$

$a = .471 m/s^2$

(b) .469 m/s², −.041 m/s²

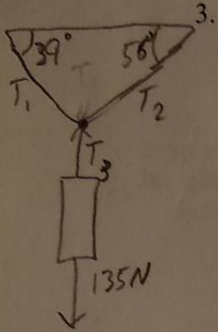
$\theta = \tan^{-1}\left(\frac{y}{x}\right)$

$\tan^{-1}\left(\frac{-.041}{.469}\right)$

$-5.00°$

35F
Kmg

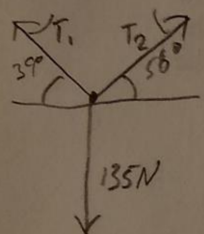
3. A traffic light weighing 135 N hangs from a vertical cable tied to two other cables that are fastened to a support (*as shown similarly in lecture Figure 4.14, but with different measurements*). The upper cables make angles of 39.0 ° (with T_1) and 56.0 ° (with T_2). Find the tension in **(a)** T_1, **(b)** T_2, and **(c)** T_3.



(a) 75.8N

(b) 105N

(c) 135N



c) $\Sigma F_y = T_3 - 135N = 0$; $+135N \; +135N$; $T_3 = 135N$

a1) $\Sigma F_x = T_{2x} - T_{1x} = 0$

$(T_2)\cos 56 - (T_1)\cos 39 = 0$
$+(T_1)\cos 39 \quad (T_1)\cos 39$

$\frac{(T_2)\cos 56}{\cos 56} = \frac{(T_1)\cos 39}{\cos 56}$

$T_2 = \frac{\cos 39}{\cos 56}(T_1)$

$T_2 = 1.39(T_1)$

a2) $\Sigma F_y = T_{2y} + T_{1y} - T_3 = 0$

$(T_2)\sin 56 + (T_1)\sin 39 - 135N = 0$
$+135N \quad +135N$

$1.39(T_1)\sin 56 + (T_1)\sin 39 = 135N$

$1.15(T_1) + (T_1).629 = 135N$

$\frac{1.78(T_1)}{1.78} = \frac{135N}{1.78}$

$T_1 = 75.8N$

b. $T_2 = 1.39(T_1)$

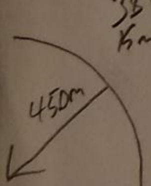
$T_2 = 1.39(75.8N)$

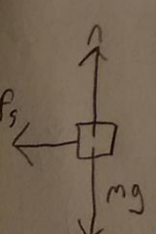
$T_2 = 105.36$

$T_2 = 105N$

4. A car travels at a constant speed of 35.0 mi/h on a level circular turn of radius 45.0 m, as shown in the bird's eye view (*as in lecture Figure 7.13*). **(a)** What minimum coefficient of static friction, μ_s, between the tires and roadway will allow the car to make the circular turn without sliding?

35F
Kms





(a) .552

$\frac{35\,mi}{hr} \cdot \frac{1hr}{3600s} \cdot \frac{1609m}{1mi} = 15.6\,m/s$

$n - mg = 0$, traveling at a constant speed

$n = mg$

$\mu_s = \frac{v^2}{rg} = \frac{(15.6m/s)^2}{45m(9.8m/s^2)} = .552$