# Newton's Laws

AP Physics – Mr. Hall

**WORKSHEET #2**

Name: _____

**1.** A frog jumps at an angle of 42.5° to the horizontal with a speed of 13.5 m/s. How far does it travel?

$v_{vert} = 13.5\ m/s \cdot \sin(42.5°) = 9.1204678\ m/s$
$v_{horiz} = 13.5\ m/s \cdot \cos(42.5°) = 9.953244\ m/s$

$v = v_i + at$
$-9.1204678\ m/s = 9.1204678\ m/s + (-9.8\ m/s^2)t$
$t = (-18.2409356\ m/s)/(-9.8\ m/s^2) = 1.86131996\ s$

$d = vt = 9.953244\ m/s \cdot 1.86131996\ s = 18.5261717\ m =$ **18.5 m**

**2.** A 450 kg mass is accelerated at 2.5 $m/s^2$ . (a) What is the net force causing this acceleration? (b) How much distance will have been covered after 3.5 s?

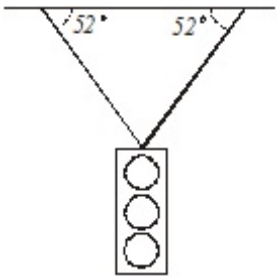
a) $F = ma$
$F = 450\ kg \cdot 2.5\ m/s^2 = 1125\ N =$ **1100 N**

b) $d = d_i + v_i t + \frac{1}{2} at^2$
$d = 0\ m + (0\ m/s)\ 3.5\ s + \frac{1}{2}(2.5\ m/s^2)(3.5\ s)^2$
$d = 15.3125\ m =$ **15 m**

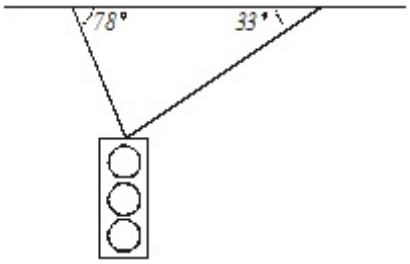
**3.** A book sits on a table. The book has a mass of 1.25 kg. Draw a free body diagram of the thing.

**4.** A boy pushes a lawnmower. The handle of the lawn mower makes an angle of 22° with the horizontal. If the boy pushes with a force of 135 N, what are the horizontal and vertical components of the force?

**5.** A 46.5 kg traffic light hangs from two cables which are at the angles shown. Calculate the tensions in the two cables.




**6.** A 50.5 kg traffic light hangs from two cables which are at the angles shown. Calculate the tensions in the two cables.




$T_{1\,vert} + T_{2\,vert} + w_{light} = 0 \quad (a_{vert} = 0)$
$T_{1\,horiz} + T_{2\,horiz} = 0 \quad (a_{horiz} = 0)$

$T_1 \cdot \sin(78°) + T_2 \cdot \sin(33°) + 50.5\ kg \cdot (-9.8\ m/s^2) = 0$
$-T_1 \cdot \cos(78°) + T_2 \cdot \cos(33°) = 0$

$T_1 \cdot \sin(78°) + T_2 \cdot \sin(33°) = 50.5\ kg \cdot 9.8\ m/s^2$
$T_1 \cdot \cos(78°) = T_2 \cdot \cos(33°)$

$T_1 \cdot \sin(78°) + T_2 \cdot \sin(33°) = 494.9\ N$
$T_1 = T_2 \cdot \cos(33°)/\cos(78°)$

$(T_2 \cdot \cos(33°)/\cos(78°)) \cdot \sin(78°) + T_2 \cdot \sin(33°) = 494.9\ N$

$T_2 \cdot 3.9456348 + T_2 \cdot 0.544639 = 494.9\ N$
$T_2\,(3.9456348 + 0.544639) = 494.9\ N$
$T_2\,(4.490274) = 494.9\ N$
$T_2 = 110.215995\ N =$ **110 N**

$T_1 = T_2 \cdot \cos(33°)/\cos(78°)$
$T_1 = 110.215995\ N \cdot 4.0337826 = 444.58736668\ N =$ **440 N**