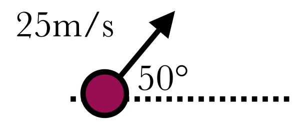
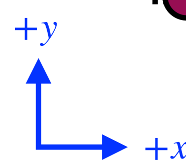
Alternate Homework Week 2

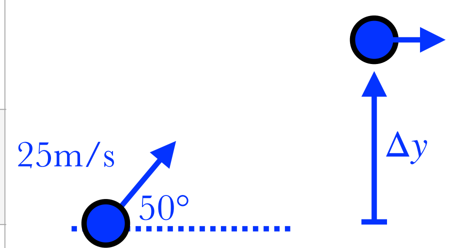
Solutions

1. A ball is shot into the air with a speed of 25m/s at a 50° angle with the horizontal. How high does the ball go above the ground?



	x	y
Δx		NEED
v_i	$+25\cos 50°$	$+25\sin 50°$
v_f		0
a	0	-9.8
Δt		





Choose the initial moment to be when the ball leaves the ground, and the final moment as when the ball is at its highest point, where the vertical component of the velocity is zero. We have three knowns in the Y column, so that will allow us to solve for Δy. Time is our DKDC variable, so we use

$$v_{fy}^2 = v_{iy}^2 + 2a\Delta y$$

$$0^2 = (25\sin 50°)^2 + 2(-9.8)\Delta y$$

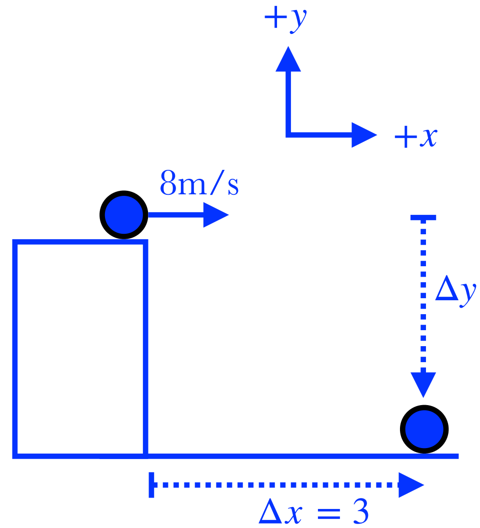
$$19.6\Delta y = (19.2)^2$$

$$\implies \Delta y = \frac{(19.2)^2}{19.6}$$

which is **18.7m.**

2. A pool ball rolls off a flat table with a speed of 8m/s. The ball lands 3m from the base of the table. How tall is the table?

	x	y
Δx	+3	NEED
v_i	+8	0
v_f	?	?
a	0	-9.8
Δt		



We want to solve for Δy, but we only have two values in that column. But we *do* have three values in the X column, so we can solve that column for time, and then solve for Δy.

To solve the X column for time, we use

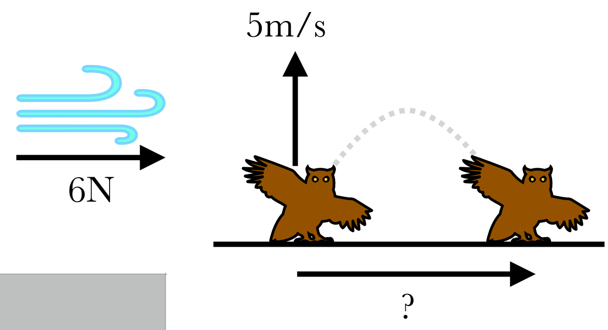
$$\Delta x = v_{ix}\Delta t + \frac{1}{2}a_x(\Delta t)^2$$
$$3 = 8\Delta t + 0$$
$$\implies \Delta t = \frac{3}{8}$$

or **0.375s.** We can use the same equation for the Y column.

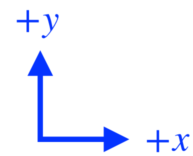
$$\Delta y = v_{iy}\Delta t + \frac{1}{2}a_y(\Delta t)^2$$
$$= 0 + \frac{1}{2}(-9.8)(0.375)^2$$

or −**0.69m**. (It's negative because the ball ends up lower than it starts.)

3. A 2kg owl jumps directly upward into the air with a speed of 5m/s, but a wind is blowing which exerts a 6N force on the owl to the right. How far away does the owl land?



	x	y
Δx	NEED	0
v_i	0	+5
v_f		
a	+6N/2kg	−9.8
Δt		



The initial velocity is 5m/s straight up, so $v_{ix} = 0$. The owl feels two forces: its weight 2(9.8) = 19.6N downward and the force of the wind. The net force on the owl is thus $\vec{F}_{net} = \langle +6, -19.6 \rangle$N, and so its acceleration is

$$\vec{a} = \frac{\vec{F}_{net}}{m} = \frac{\langle +6, -19.6 \rangle}{2} = \langle 3, -9.8 \rangle \text{m/s}^2.$$

We want to solve for Δx, but we only have two values in that column. But we *do* have three values in the Y column, so we can solve that column for time, and then solve for Δx. To solve the Y column for time, we use

$$\Delta y = v_{iy}\Delta t + \frac{1}{2}a_y(\Delta t)^2$$

$$0 = 5\Delta t - \frac{1}{2}(9.8)(\Delta t)^2$$

$$4.9\Delta t = 5$$

(We divided both sides by Δt in the third step because we know $\Delta t \neq 0$.) Now $\Delta t = 5/4.9 =$ **1.02s.** Now we can solve for Δx:

$$\Delta x = v_{ix}\Delta t + \frac{1}{2}a_x(\Delta t)^2$$

$$= 0 + \frac{1}{2}(3)(1.02)^2$$

or **1.56m.**