A9 | Roya Bahesti

Instructions: For this lab, you will be investigating projectile motion for an object launched at an angle. You will make a paper football, TUTORIAL, and "flick" it as your projectile in the hallway, Tutorial, outside your classroom or at your home. Use cell phones to video record projectiles in slow motion.

	Max. Height d_y (cm)	Range d_x (cm)
Trial 1	.37	1.9
Trial 2	.37	2.2
Trial 3	.39	2.1
Average	Hight = .38	Range = 2

1. Use A4 paper to make a paper football.
2. Place two meter-sticks on the ground and place the third meter-stick vertically in the middle of the first two.
3. Flick the football from the ground near the wall so you can count the brick to find the max height (or you can get it from a vertically standing meter-stick).
4. Follow the same procedure to find the range

$d_y = v_{iy}t + \frac{1}{2}a_y t^2$ ($a_y = -g$)

$0 = v_{iy}t - \frac{1}{2}gt^2$

$\frac{1}{2}gt^2 = v_{iy}t$

$gt^2 = 2v_{iy}t$

$gt = 2v_{iy}$

$t = 2v_{iy}/g$

$d_x = v_{ix}t$

$d_x = v_{ix}\left(\frac{2v_{iy}}{g}\right)$

$d_x = \frac{v\cos\theta \, 2v\sin\theta}{g}$

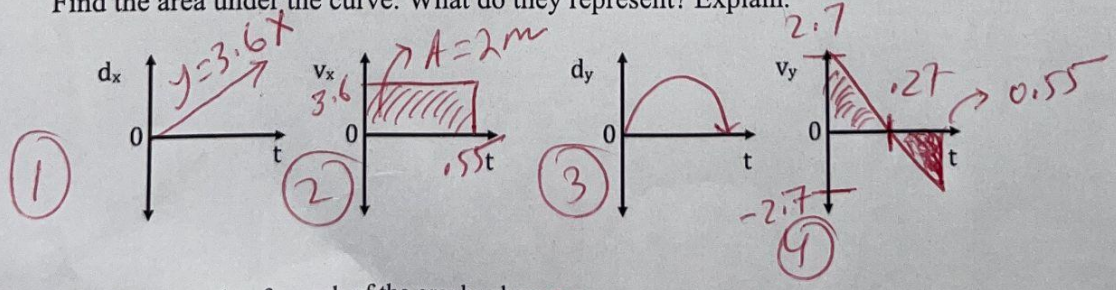
$d_x = \frac{v^2 2\cos\theta\sin\theta}{g}$

$d_x = \frac{v^2 \sin 2x}{g}$

Show your work, including the equation and substitution with units.

1. Calculate $v_{i,y}$	2. Elapsed time	3. Calculate v_{iX}
$g = -10$ $v_f^2 = v_{iy}^2 + 2a_y d_y$ $0 = v_{iy}^2 - 2gh$ $V_{iy} = 2.7$ m/s	$t = \frac{2v_{iy}}{g}$ $d_y = v_{iy}t + \frac{1}{2}a_y t^2$ $0 = 2.7t - 4.9t^2$ $0 = t(2.7 - 4.9t)$ $t = 0.55$ sec	$d_x = v_{ix}t + \frac{1}{2}a_x t^2$ $v_{ix} = \frac{d_x}{t} = \frac{2}{0.55}$ $v_{ix} = 3.6$ m/s
4. Find V_i	**5. Find the angle**	**6. Find d_X by range equation.**
$c^2 = a^2 + b^2$ $v_i^2 = v_{ix}^2 + v_{iy}^2$ $v_i = \sqrt{3.6^2 + 2.7^2}$ $v_i = 4.5$ m/s	$v_i = 4.5$, $v_{iy} = 2.7$, $v_{ix} = 3.6$ $\theta = \tan^{-1}\left(\frac{2.7}{3.6}\right)$ $\theta = 37^\circ$	$R = \frac{v^2 \sin 2\theta}{g}$ $R = \frac{4.5^2 \sin(74)}{9.8}$ $R = 2$m

Exit Slip: (7) Sketch the following graphs to describe the projectile created by paper Football. Find the area under the curve. What do they represent? Explain.



8. Find the equation for each of the graphs above.

① $p(t) = 3.6t$

② $p'(t) = 3.6$

③ $p(t) = -4.9t^2 + 2.7t$

④ $p'(t) = v(t) = -9.8t + 2.7$