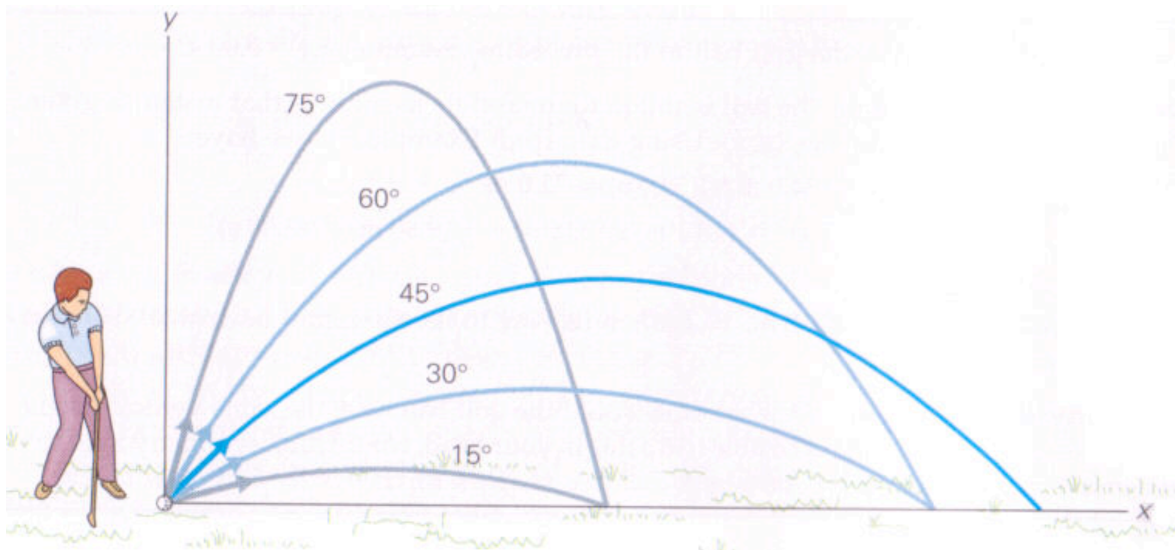
# Range

& more projectile motion practice

- **Range** = how far a projectile travels horizontally = x
- In the lab, we launched projectiles at an angle and they landed at (approximately) the same height.




- We (should have) found that complementary angles lead to the same range.

$\mathbf{x = v_{0x}t}$ for max range, you want high $v_{0x}$ and max t

- Small angles have high horizontal velocity but small t.
- Big angles have small horizontal velocity but big t.

# Derivation of the "Range Equation"

$$R = x = v_{0x}t$$

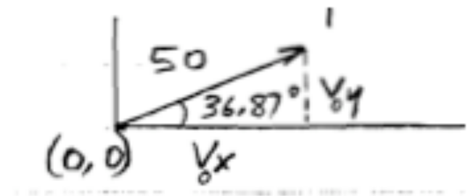
We can use this equation any time a projectile is launched at an angle and returns to the same height.

**Ex:** On the “More Projectile Motion” WS, we solved how far away a soccer ball would land when kicked at 15 m/s at a $53^0$ angle in problem 2C. Confirm your answer using our shortcut equation.

In the absence of air resistance, maximum range occurs at $45^0$. A projectile launched at this angle has a lot of horizontal velocity and will be in the air for a long time.

**Ex 1:** Ori Throws a football with initial velocity 50 m/s at $36.9^0$.

Find:




1. Total time airborne

2. Range

3. Maximum altitude

4. Time to reach apex

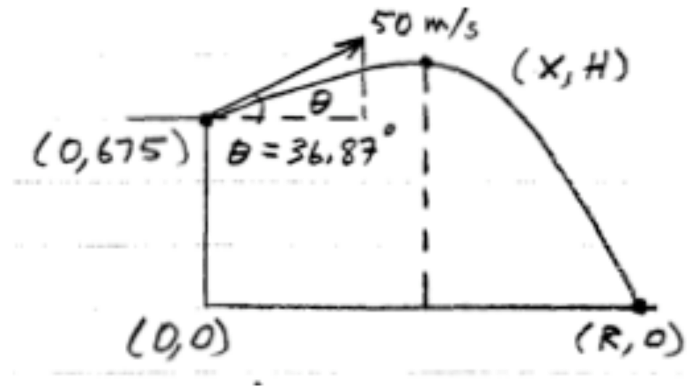
5. Location at t=5

6. Velocity at t=5

* Note: 1. If we run horizontally at 40 m/s, we will stay underneath the ball at all times. 2. A ball thrown straight up at 30 m/s will be airborne for the same time (6 sec) as a ball thrown with an initial mixed velocity vector where $v_{0y}$ = 30 m/s.

**Ex 2:** Justin throws a basketball at 50 m/s at $36.9^0$ from atop a gymnasium whose elevation is 675 m.

Find:




A. Total time airborne

B. Range

C. Time to maximum elevation

D. Location of maximum elevation

E. Location at which the total speed is 85 m/s