1. At what point on the trajectory will the fish’s speed be minimum?
(A) at take-off,  (B) at landing,  (C) at the maximum height  (D) somewhere else.
(E) There is no minimum, speed is constant throughout

- At what point(s) will its speed be maximum?
(A) at take-off,  (B) at landing,  (C) at the maximum height  (D) somewhere else.
(E) There is no maximum, speed is constant throughout

Briefly, explain your reasoning for both these questions here:
2. The x-component of the initial velocity is: \( v_{0x} = +v_0 \cos \theta \), where \( v_0 = |\vec{v}_0| \).  
(Do you agree? I assumed up is the positive y-direction and right is the positive x-direction.) 
As a warmup, find a very similar expression for the y-component of the initial velocity.

3. We are writing the fish’s velocity vector at take-off as \( \vec{v}_o = (v_{0x}, v_{0y}) \). What will the velocity vector be when the fish reaches the apex (or top) of its trajectory? **Explain your reasoning.**

(A) \((v_{0x}, v_{0y})\)  
(B) \((v_{0x}, 0)\)  
(C) \((0, v_{0y})\)  
(D) \((v_{0x}, -v_{0y})\)  
(E) \((-v_{0x}, -v_{0y})\)

(F) Something entirely different.

4. Using the y-component of the initial velocity from Q#2, find the time \( t_1 \) to rise to the highest point. Show us in the figure (either one) where that highest point (apex) is (it is not H!)

Hint: Begin your work with the following equation:

\[ v_y = v_{0y} + g t_1 \]

(What is \( a_y \) here? What is \( v_y \) at the apex?)

Your final answer for \( t_1 \) should only involve the following variables: \( v_0 \), g, and \( \theta \).

5. You can now find the height of the fish above the ground at its highest point, the apex. Show that this maximum height (again, this is not H!) is given by the following equation:

\[ h_{\text{max}} = \frac{(v_0 \sin \theta)^2}{??g} \]

(Where the ?? means, **perhaps**, there is some coefficient of “g” down there

(Is it 1? A number? Maybe a sign? Work it out for us, get the formula fixed up!)
6. If we solve for the time for the fish to drop from the apex into the second bowl, we can treat the motion in the $y$-direction as an object dropped from rest. (Do you see why?)

Show that the time $t_2$ to go from the apex into the second bowl is given by this equation:

$$t_2 = \frac{?? (h_{\text{max}} - H)}{g}.$$

(Once again, there is a mystery ?? in there. Is it the number 1? Another number? A sign? Fix it up, show your work)

7. Show us that the horizontal distance “d” the fish jumped in the figure is simply

$$d = v_0 \cos \theta (t_1 + t_2)$$

Explain your reasoning

8. At last, some numbers! Suppose $\theta = 60$ deg, and let’s suppose our fish can leap at an initial speed of 1.5 m/s. For simplicity, let’s assume the second bowl is not any higher than the first, so set $H=0$. How far away, horizontally, can our little fish jump? (In other words, solve for $d$)

Do these numbers seem physically reasonable for a goldfish?