See the HiHW grading rubric posted on Carmen

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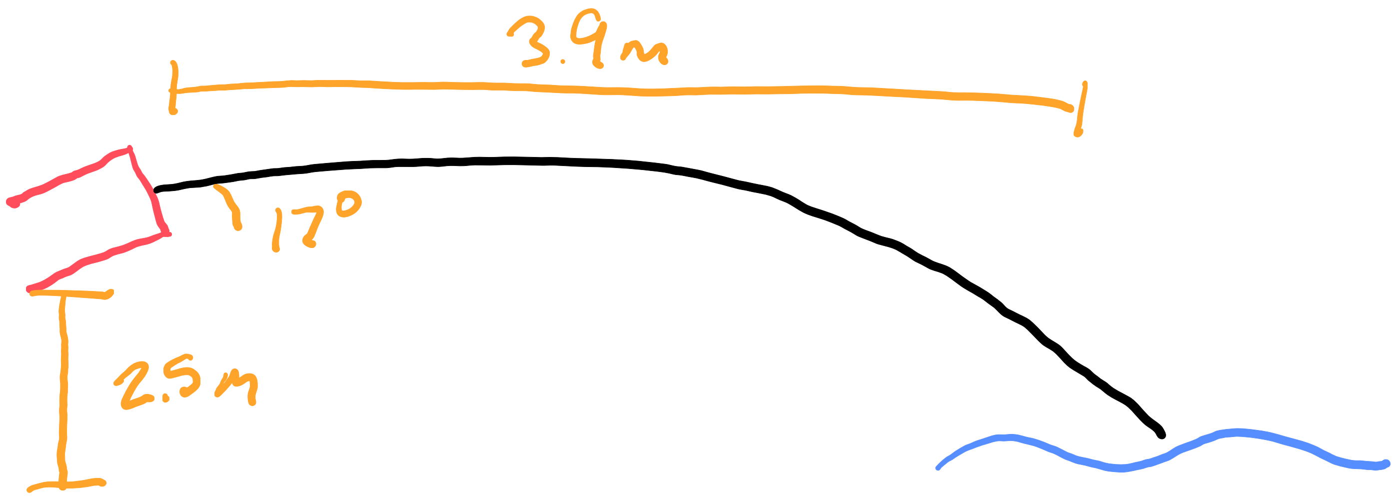
Most species of salmon must swim upstream in order to reach their spawning grounds. When an artificial dam prevents this migration, wildlife managers sometimes transport them to the top of the dam using a flexible tube that contains flowing water (known as the "Salmon Cannon"). Suppose that a salmon emerges from the transport tube at a height $h = 2.5\,\text{m}$ above the water level at the top of the dam, and with a launch angle of $\theta = 17°$ above the horizontal. If the salmon covers a horizontal distance of $x = 3.9\,\text{m}$ before hitting the water, then how much time did it spend airborne? For the limits check, investigate what happens to the flight time t as the horizontal distance x approaches zero.

Representation:	0	1	2
Physics Concept(s):	0	1	2
Initial Equation(s):	0	0.5	1
Symbolic Answer:	0		1
Units Check:	0	0.5	1
Limits Check:	0	0.5	1
Neatness:	-2	-1	0
Total:			
Correct Answer:	Y	N	

Representation



Physics Concept(s) (Refer to the list posted on Carmen)

(1) Projectile Motion

Initial Equations

$$v_i^2 = v_0^2 + 2a\Delta y$$

$$\Delta y = \left(\frac{v+v_0}{2}\right)t$$

$$\Delta y = v_0 t + \frac{1}{2}at^2$$

$$\frac{y}{x} = \tan(\theta)$$

↓ Show Your Equation Work On Next Page ↓

Algebra Work (Symbols only. Don't plug in any numbers yet.)

$$\frac{y}{x} = \tan\theta \rightarrow y = x\tan\theta$$

$$V_1^2 = V_0^2 + 2ay \rightarrow V_0^2 = V_1^2 + 2ay \rightarrow V_0 = \sqrt{V_1^2 + 2ay}$$

$$y_1 = \left(\frac{V_1 + V_0}{2}\right)t \rightarrow t_1 = \frac{2y_1}{V_1 + V_0}$$

$$y_2 = V_0 t + \frac{1}{2}at^2 \rightarrow 0 = \frac{1}{2}at^2 + V_0 t - y_2 \rightarrow \frac{-V_0 \pm \sqrt{V_0^2 - 4(\frac{1}{2}a)(-y_2)}}{a} = t_2$$

$$t_1 + t_2 = t$$

Symbolic Answer: $$\frac{2y_1}{V_1 + V_0} + \frac{-V_0 \pm \sqrt{V_0^2 - 4(\frac{1}{2}a)(-y_2)}}{a} = t$$

Units Check

$$\frac{m}{m/s} + \frac{m/s + \sqrt{m/s - (m/s^2)(m)}}{m/s^2}$$

$$\frac{m/s + m/s}{m/s^2}$$

$$s + s = s$$

Limits Check

a) As $x \to 0$, what limit does t approach?

$t \rightarrow .714$ sec.

b) Why does the result make physical sense?

Even if x is 0, the fish still travels straight down from y=2.5m

Numerical Answer: (Obtain this by plugging numbers into your symbolic answer.)

1.362 sec.