Coyote and Road Runner

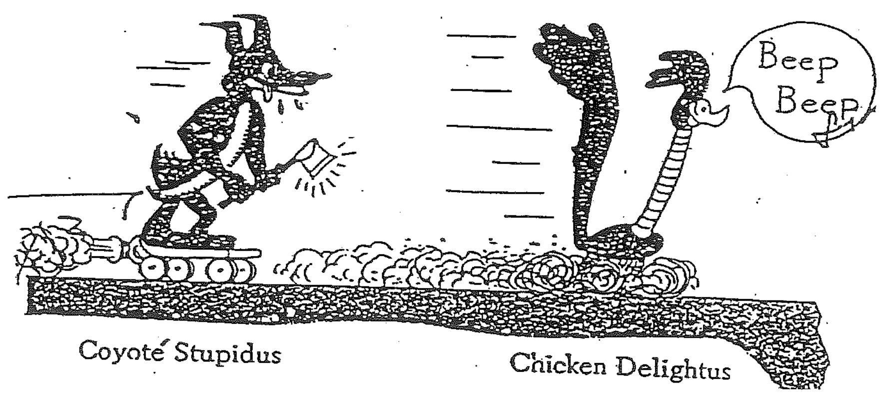
Challenge Q's

The determined coyote is out to capture the elusive road runner. The coyote wears a pair of Acme jet powered roller skates, which provide a constant horizontal acceleration of 15.0 m/s^2. The coyote starts from rest 70.0 m from the edge of a cliff at the instant the road runner zips by in the direction of the cliff.

(a) If the road runner moves with a constant speed, determine the minimum speed he must have in order to reach the cliff before the coyote.

(b) If the cliff is 100m above the base of a canyon, determine where the coyote lands in the canyon (assume the skates are still in operation when he is in "flight")

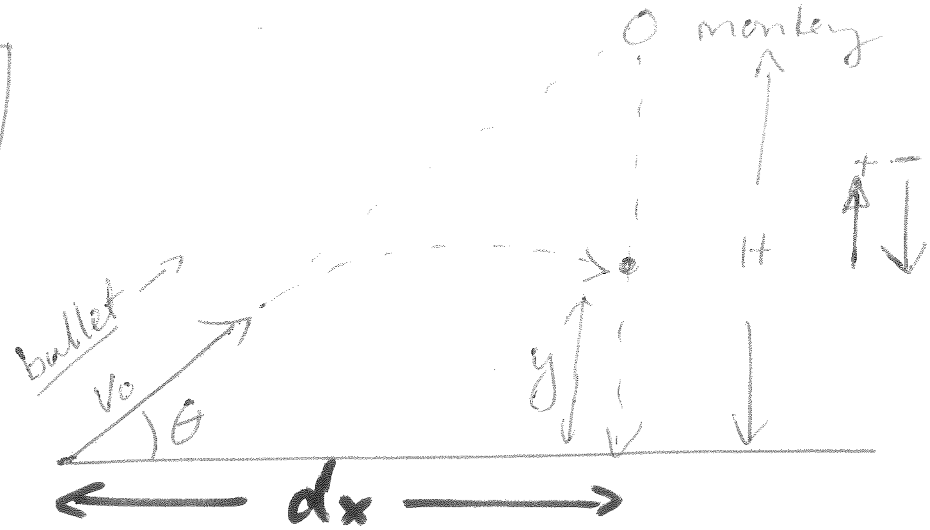
(c) Determine the coyote's velocity components just before he lands in the canyon. (as usual, the road runner is saved by making a sudden turn at the cliff.)



Classic Physics prob

The monkey gun: A monkey is sitting on a tree branch at a height "y" above the ground. A hunter (yikes) stands a distance "x" from the base of the tree. The hunter aims his gun directly at the monkey and pulls the trigger (yikes again!). The monkey, thinking he can outwit the hunter, lets go of the branch and drops towards the ground at exactly the same instant that the hunter pulls the trigger. Prove mathematically that the monkey will definitely be hit, no matter what the values of x and y are *(assuming x and y are greater than zero, and that the bullet and the monkey meet before hitting the ground)*. Poor monkey!

Monkey Gun



$$\tan\theta = \frac{H}{d_x}$$

$$\therefore d_x = \frac{H}{\tan\theta} = \frac{H\cos\theta}{\sin\theta}$$

bullet

x

$$V_{0x} = V_0\cos\theta$$

$$t = t$$

$$d_x = V_x t = V_0\cos\theta\, t$$

$$\therefore \frac{H\cancel{\cos\theta}}{\sin\theta} = V_0\cancel{\cos\theta}\, t$$

$$\therefore t = \frac{H}{V_0\sin\theta}$$

y

$$V_{0y} = V_0\sin\theta$$

$$\Delta d_y = y$$

$$a_y = -g$$

$$t = \frac{H}{V_0\sin\theta}$$

$$\Delta d_y = \tfrac{1}{2}a_y t^2 + V_{0y}t$$

$$\therefore y = \tfrac{1}{2}(-g)\left(\frac{H}{V_0\sin\theta}\right)^2 + V_0\cancel{\sin\theta}\left(\frac{H}{\cancel{V_0\sin\theta}}\right)$$

$$\boxed{y = -\frac{1}{2}g\frac{H^2}{V_0^2\sin^2\theta} + H}$$

Monkey

$$V_0 = 0$$

$$a = -g$$

$$\Delta d_y = -(H-y)$$

$$t = \frac{H}{V_0\sin\theta}$$

$$\Delta d_y = \tfrac{1}{2}a_y t^2 + V_{0y}t$$

$$-(H-y) = \tfrac{1}{2}(-g)\left(\frac{H}{V_0\sin\theta}\right)^2 + 0$$

$$-H + y = -\frac{1}{2}g\frac{H^2}{V_0^2\sin^2\theta}$$

$$\therefore \boxed{y = -\frac{1}{2}g\frac{H^2}{V_0^2\sin^2\theta} + H}$$

SAME for all H, θ, & V_0