Problem 1

Standing on the side of a hill, an archer shoots an arrow with an initial velocity of 250 ft/s at an angle $\alpha = 15^\circ$ with the horizontal. Determine the horizontal distance $d$ traveled by the arrow before it strikes the ground at B.

$$a = 15^\circ$$

$$x = V_0 x t = V_0 \cos \alpha t \quad (1)$$

$$y = y_0 + V_0 y t - \frac{1}{2} g t^2 \quad (2)$$

When $x = d \Rightarrow t = \frac{d}{V_0 \cos \alpha} \quad (3)$

$$y = -d \tan \beta$$

Substituting 3 into 2: $y = y_0 + V_0 \sin \alpha \left( \frac{d}{V_0 \cos \alpha} \right)^2 - \frac{1}{2} g \left( \frac{d}{V_0 \cos \alpha} \right)^2$

$$y = -d \tan \beta = \frac{V_0 \sin \alpha \cdot \frac{d}{V_0 \cos \alpha}}{2} - \frac{1}{2} g \left( \frac{d}{V_0 \cos \alpha} \right)^2$$

Solve for $d$

So $d = 0$ or $d = \frac{(\tan \beta + \tan \alpha)2V_0^2 \cos^2 \alpha}{g}$

Note: Physically correct answer

$$d = 1600 \text{ ft}$$