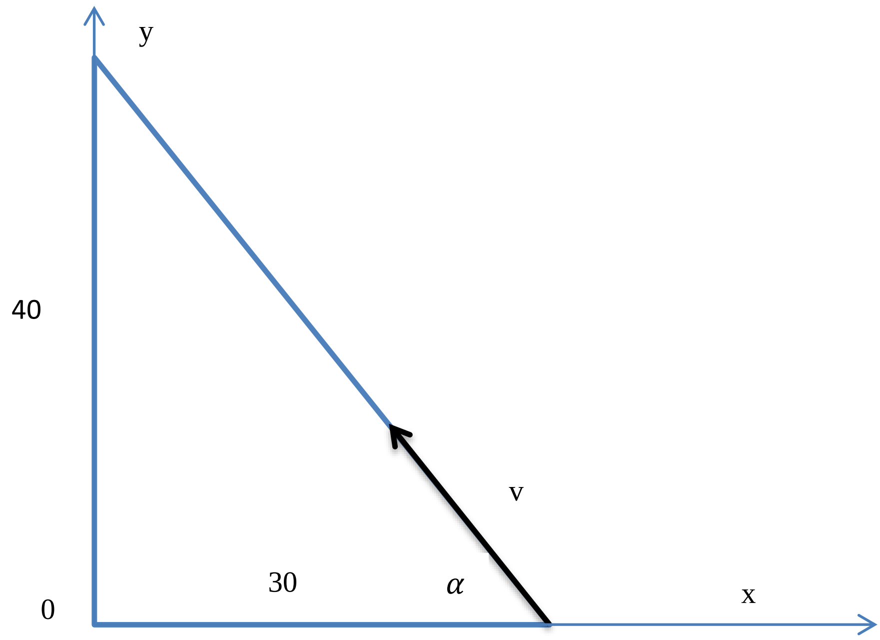
A stone is dropped vertically from the top of a tower of height 40 m. At the same time a gun is aimed directly at the stone from the ground at a horizontal distance 30 m from the base of the tower and fired. If the bullet from the gun is to hit the stone before it reaches the ground, the minimum velocity of the bullet must be, approximately?



Coordinate of the stone equals:

$$y_s = 40 - \frac{gt^2}{2}$$

Coordinates of the bullet equals:

$$x_b = 30 - v\cos\alpha\, t$$

$$y_b = v\sin\alpha\, t - \frac{gt^2}{2}$$

Bullet can hit stone only in point $x = 0$:

$$0 = 30 - v\cos\alpha\, t$$

$$t_0 = \frac{30}{v\cos\alpha}$$

And at this time $y_s = y_b$

$$40 - \frac{g{t_0}^2}{2} = v\sin\alpha\, t_0 - \frac{g{t_0}^2}{2}$$

$$40 = v \sin\alpha\, t_0$$

$$40 = v \sin\alpha \frac{30}{v \cos\alpha}$$

$$40 = \sin\alpha \frac{30}{\cos\alpha} = \frac{40}{50}\frac{30}{30/50} = 40$$

So, bullet hits the stone anyway, therefore, minimal velocity will be if they meet at point (0,0):

$$v \sin\alpha\, t - \frac{g t_0^2}{2} = 0$$

$$v \sin\alpha - \frac{g \frac{30}{v\cos\alpha}}{2} = 0$$

$$v \sin\alpha = g \frac{30}{2v \cos\alpha}$$

So, minimal velocity equals:

$$v = \sqrt{\frac{30g}{\sin 2\alpha}} = 25\frac{m}{s}$$

Answer: $25\frac{m}{s}$