

Answer on Question #70963, Physics – Mechanics – Relativity

A Spanish Galleon enters a harbor defended by a cannon placed on top of a castle wall which is 135 meters above the water level. The cannon has a known muzzle velocity of 323 m/s and is aimed 28 degrees above the horizontal. How far from the base of the castle wall will the galleon be within range of the cannon.

Solution

The coordinates of the cannon are: $x_0 = 0$, $y_0 = 135$.

The coordinates of the galleon are: $x_g = X$, $y_g = 0$.

Let's find X .

We need the following formulas:

1) $x_g = x_0 + v_0 t \cos \alpha = v_0 t \cos \alpha$ – the change of x-coordinate.

2) $y_g = y_0 + v_0 t \sin \alpha - \frac{1}{2} g t^2$ – the change of y-coordinate.

Find the time of the cannon ball flight from the last equation.

$$0 = 135 + 323 \times 0,4695 t - 4,9 t^2$$

$$-4,9 t^2 + 151,64 t + 135 = 0$$

$$t^2 - 30,95 t - 27,55 = 0$$

After all of calculations we'll get $t = 31,8$ (s) – time of the cannon ball flight.

Let's find X from the first equation:

$$X = 323 \times 31,8 \times 0,8829 = 9\,069 \text{ (m)}$$

Answer

The galleon will be within range of the cannon **9 069 meters** far from the base of the castle wall.

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