Answer on Question 59636, Physics, Other

Question:

Daring darlene sends her stunt car horizontally off a cliff at $79.6\ km/hr$. If she lands $68.6\ m$ from the base of the cliff, how high was the cliff above the ground?

Solution:

We can find the height of the cliff from the equations of vertical and horizontal motion of the car (let's, also, take the downwards as the positive direction, for convenience):

$$v_{0x}t = x, \qquad (1)$$

$$h = v_{0y}t + \frac{1}{2}gt^2, \qquad (2)$$

here, $v_{0x} = v_0 cos\theta = v_0 cos0^{\circ} = v_0$ is the projection of the initial velocity of the car on axis x; $v_{0y} = v_0 sin\theta = v_0 sin0^{\circ} = 0$ is the projection of the initial velocity of the car on axis y; t is the time of flight of the car; x is the horizontal distance from the base of the cliff to the place where the car lands; h is the height of the cliff we are searching for and $g = 9.8\ m/s^2$ is the acceleration due to gravity (it will be with sign plus because we take the downwards as the positive direction).

So, we can rearrange our equations (1) - (2):

$$v_0 t = x, \qquad (3)$$

$$h = \frac{1}{2}gt^2, \qquad (4)$$

Let's first find the time of flight of the car from the equation (3):

$$t = \frac{x}{v_0}.$$

As we know the time of flight of the car, we can substitute it into the second equation and find the height of the cliff:

$$h = \frac{1}{2}gt^2 = \frac{1}{2}g\left(\frac{x}{v_0}\right)^2.$$

Let's convert the initial velocity of the car from km/hr to m/s:

$$v_0 = \left(79.6\ \frac{km}{hr}\right) \cdot \left(\frac{1000\ m}{1\ km}\right) \cdot \left(\frac{1\ hr}{3600\ s}\right) = 22.11\ ms^{-1}.$$

Finally, we can calculate the height of the cliff:

$$h = \frac{1}{2} g \left(\frac{x}{v_0}\right)^2 = \frac{1}{2} \cdot 9.8\ ms^{-2} \cdot \left(\frac{68.6\ m}{22.11\ ms^{-1}}\right)^2 = 47.2\ m.$$

Answer:

$h = 47.2\ m.$