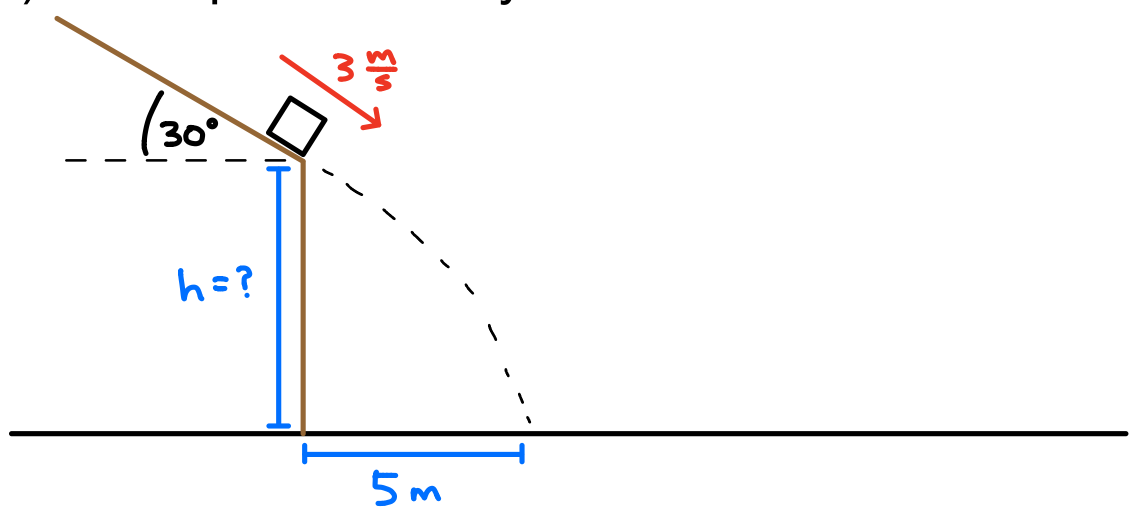
A block slides down a roof angled at 30° to the horizontal. It leaves the roof at a speed of 3 m/s and impacts the ground 5 m from the base of the building. Determine

a) the height at which the block left the building

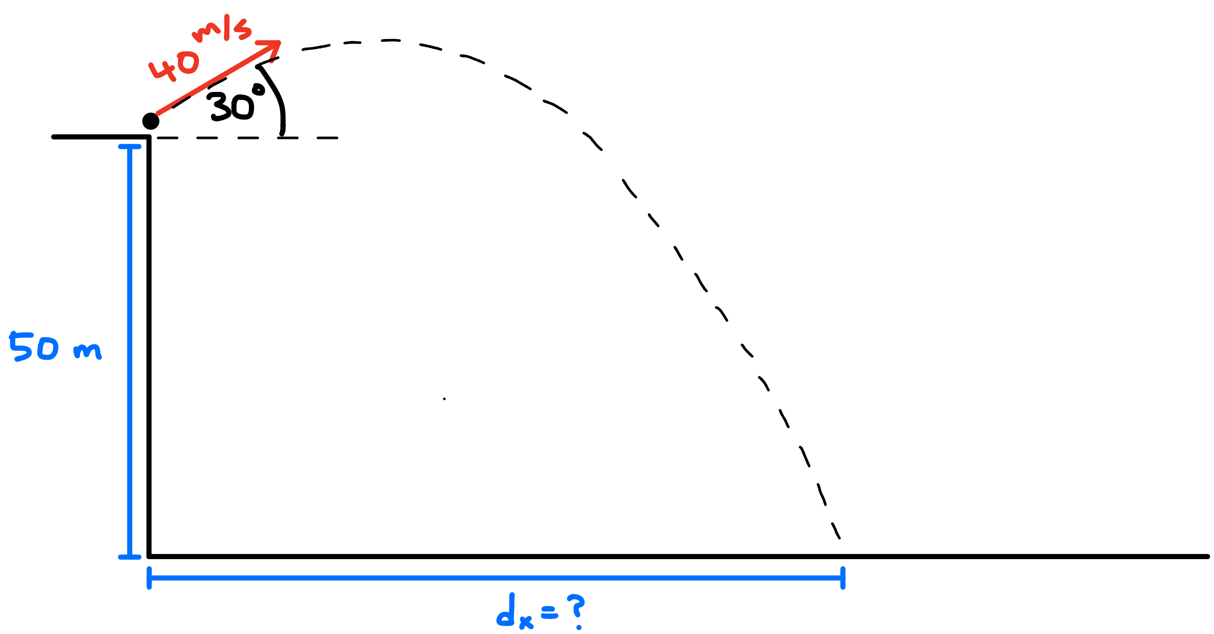
b) the impact velocity



A projectile is launched from a 50 m high cliff with a velocity of 40 m/s 30° above the horizontal. Determine

a) the range of the projectile

b) the impact velocity



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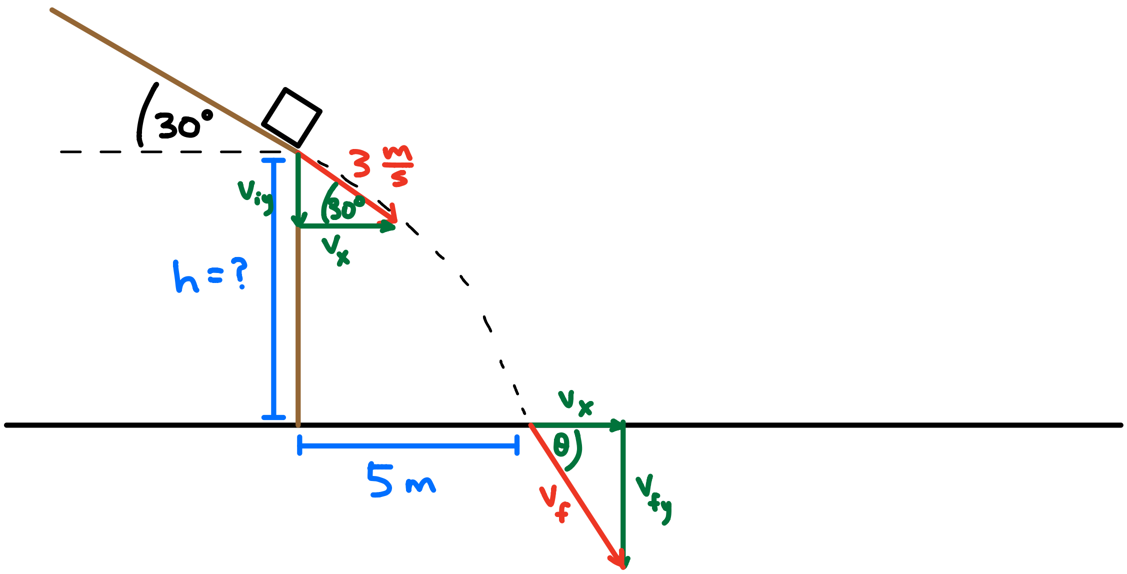


x	y
$v_x = 3\cos 30°$ m/s	$v_{iy} = +3\sin 30°$ m/s
$= 2.5981$ m/s	$= +1.5$ m/s
$d_x = 5$ m	$\downarrow +$ $a_y = +9.8$ m/s²
$t = ?$	$t = ?$
	$d_y = ?$
	$v_{fy} = ?$

a) $d_x = v_x t$

$$t = \frac{d_x}{v_x} = \frac{5}{2.5981} = 1.9245 \text{ s}$$

b)

$$d_y = v_{iy}t + \frac{1}{2}a_y t^2$$

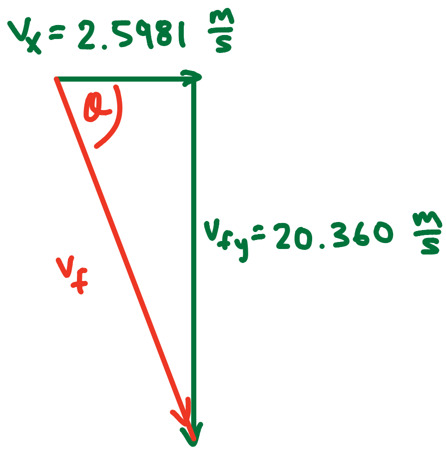
$$= (1.5)(1.9245) + \frac{1}{2}(9.8)(1.9245)^2$$

$$= \boxed{21.0\ m}$$

$$v_{fy} = v_i + at$$

$$= (1.5) + (9.8)(1.9245)$$

$$= 20.360\ \frac{m}{s}$$



$$v_f = \sqrt{v_x^2 + v_{fy}^2}$$

$$= \sqrt{(2.5981)^2 + (20.360)^2}$$

$$= 20.5\ \frac{m}{s}$$

$$\theta = \tan^{-1}\left(\frac{v_{fy}}{v_x}\right)$$

$$= \tan^{-1}\left(\frac{20.360}{2.5981}\right)$$

$$= 82.7^\circ$$

$$\boxed{20.5\ \tfrac{m}{s}\quad 82.7^\circ \text{ BELOW THE HORIZONTAL}}$$

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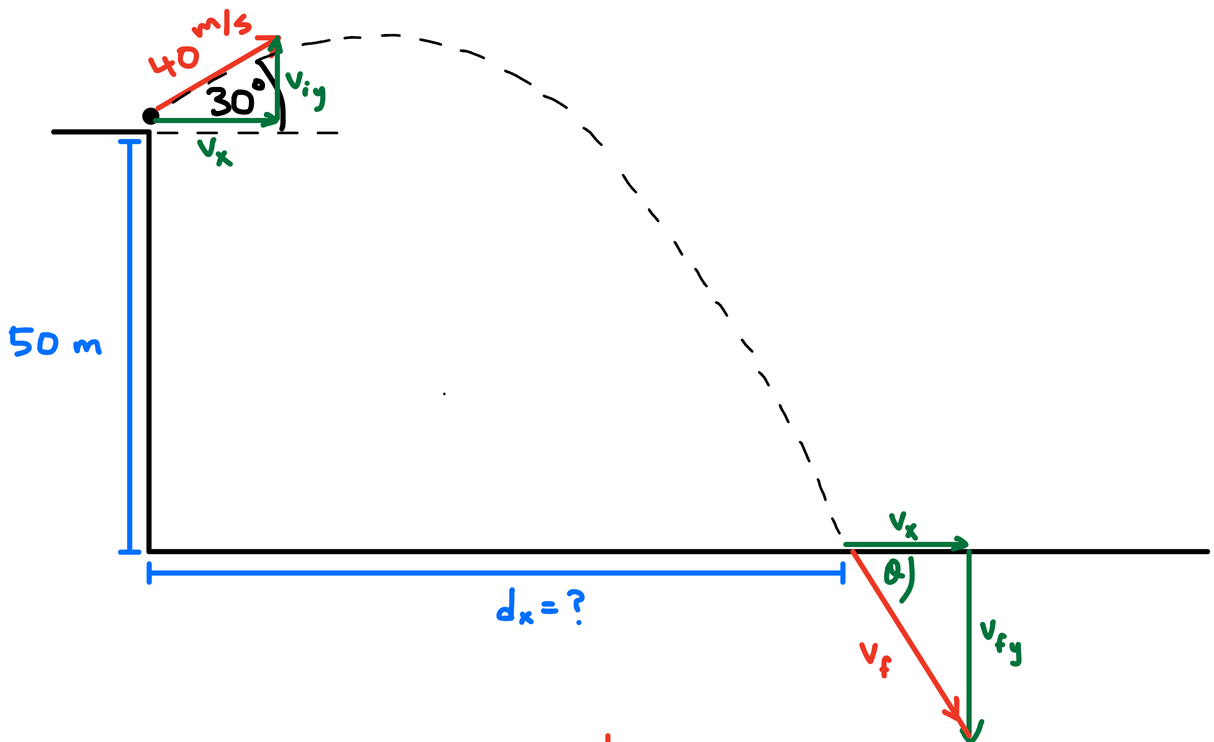
a) the range of the projectile

b) the impact velocity



x	y (+ ↑)
$V_x = 40 \cos 30° \ \frac{m}{s}$	$v_{iy} = +40 \sin 30° \ \frac{m}{s}$
$= 34.641 \ \frac{m}{s}$	$= +20 \ \frac{m}{s}$
$d_x = ?$	$a_y = -9.8 \ m/s^2$
$t = ?$	$d_y = -50 \ m$
	$t = ?$
	$v_{fy} = ?$

a)

$$d_y = v_{iy}t + \tfrac{1}{2}a_y t^2$$

$$0 = -\tfrac{1}{2}a_y t^2 - v_{iy}t + d_y$$

$$0 = \underbrace{4.9}_{a}t^2 \underbrace{-20}_{b}t \underbrace{-50}_{c}$$

$$t = \frac{-(-20) \pm \sqrt{(-20)^2 - 4(4.9)(-50)}}{2(4.9)}$$

$$= \cancel{-1.7498\ s},\ 5.8315\ s$$

$$d_x = v_x t$$

$$= (34.641)(5.8315)$$

$$= \boxed{202\ m}$$

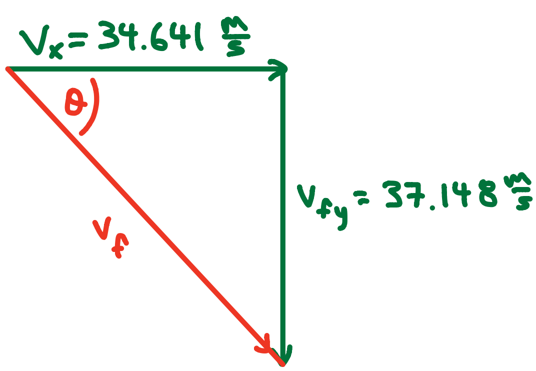
b)

$$v_{fy}^2 = v_{iy}^2 + 2a_y d_y$$

$$v_{fy} = \pm\sqrt{v_{iy}^2 + 2a_y d_y}$$

$$= \pm\sqrt{(20)^2 + 2(-9.8)(-50)}$$

$$= \cancel{+}-\,37.148\ \tfrac{m}{s}$$



$$v_f = \sqrt{v_x^2 + v_{fy}^2}$$

$$= \sqrt{(34.641)^2 + (37.148)^2}$$

$$= 50.8\ \tfrac{m}{s}$$

$$\theta = \tan^{-1}\left(\frac{v_{fy}}{v_x}\right)$$

$$= \tan^{-1}\left(\frac{37.148}{34.641}\right)$$

$$= 47.0^\circ$$

$$\boxed{50.8\ \tfrac{m}{s}\quad 47.0^\circ\ \text{BELOW THE HORIZONTAL}}$$