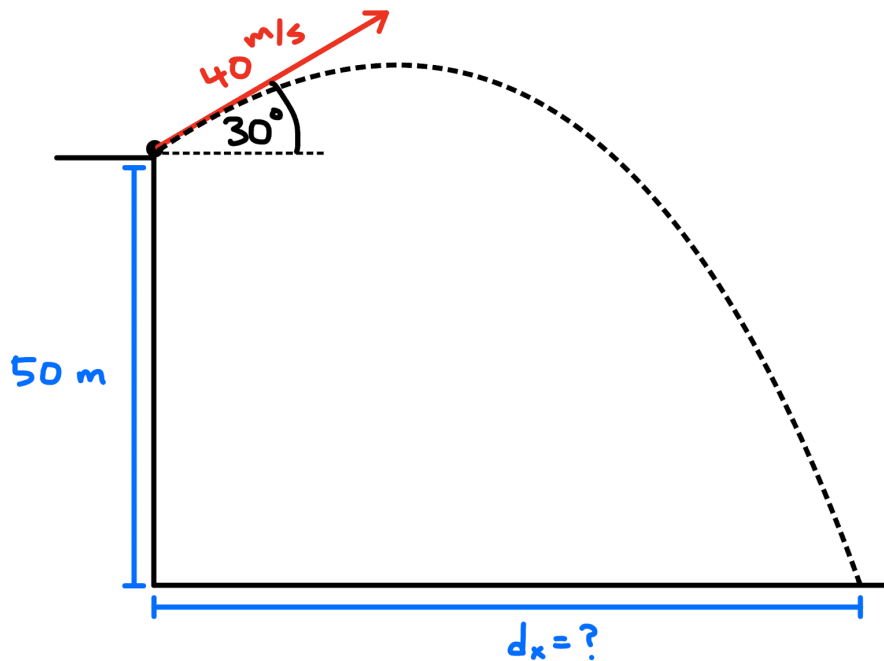
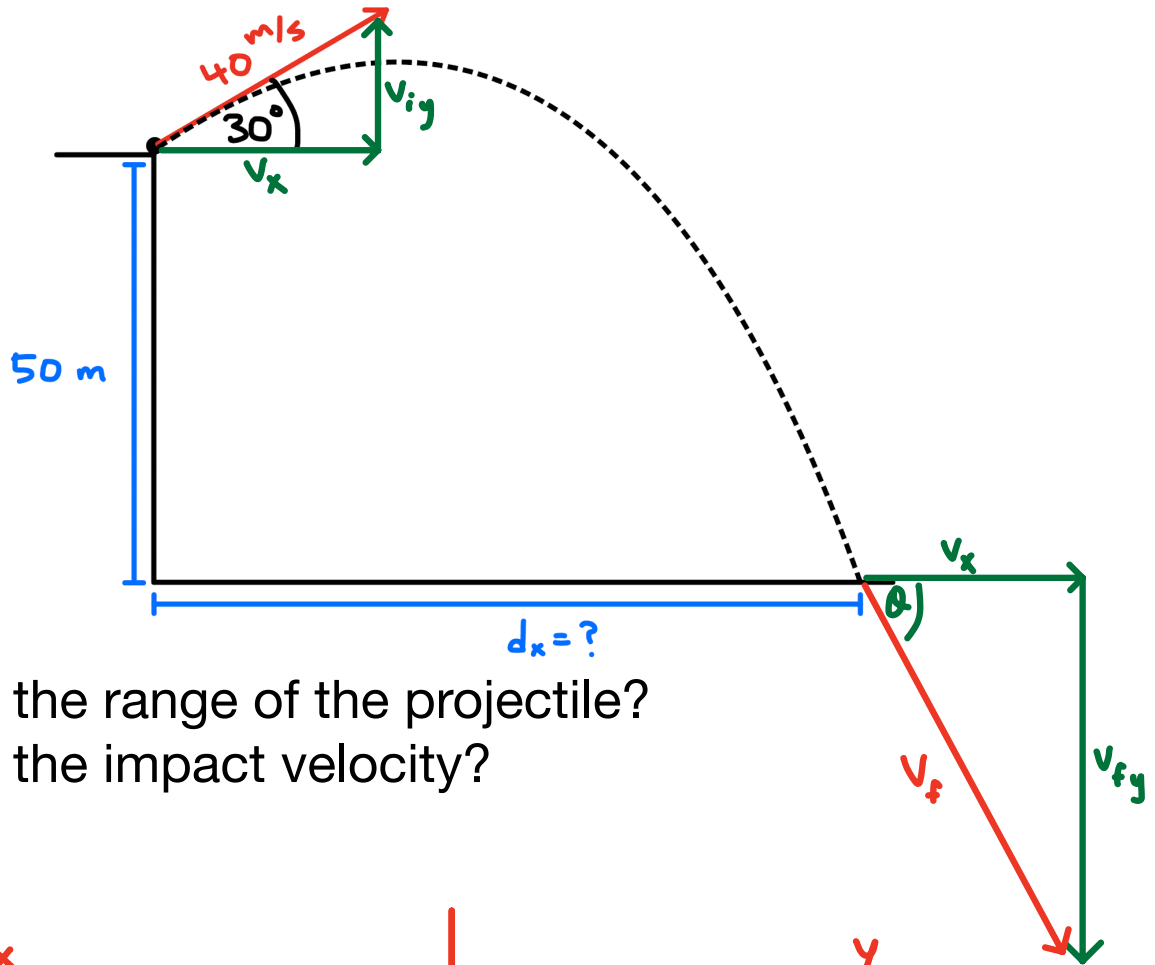


A projectile is launched from a 50 m high cliff with a velocity of 40 m/s 30° above the horizontal.



- What is the range of the projectile?
- What is the impact velocity?

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x

$$v_x = 40 \cos 30^\circ \frac{\text{m}}{\text{s}}$$

$$= 34.641 \frac{\text{m}}{\text{s}}$$

$$d_x = ?$$

$$t = ?$$

y

$$v_{iy} = +40 \sin 30^\circ \frac{\text{m}}{\text{s}}$$

$$= +20 \frac{\text{m}}{\text{s}}$$

$$a_y = -9.8 \frac{\text{m}}{\text{s}^2}$$

$$d_y = -50 \text{ m}$$

$$t = ?$$

$$v_{fy} = ?$$

a)

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

$$0 = -\frac{1}{2}a_yt^2 - v_{iy}t + d_y$$

$$0 = \underbrace{4.9t^2}_a - \underbrace{20t}_b - \underbrace{50}_c$$

$$d_x = v_x t$$

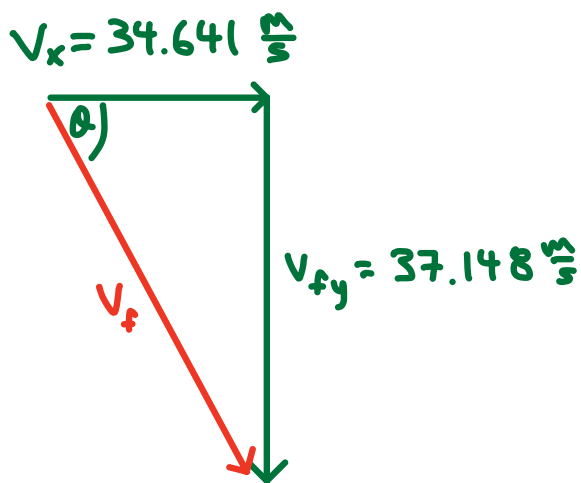
$$= (34.641)(5.8315)$$

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

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

$$= -1.7498 \text{ s}, \quad \boxed{5.8315 \text{ s}}$$

b)



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

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

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

$$= \pm 37.148 \frac{m}{s}$$

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

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

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

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

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

$$= 47.0^\circ$$

$50.8 \frac{m}{s}$ 47.0° BELOW THE HORIZONTAL