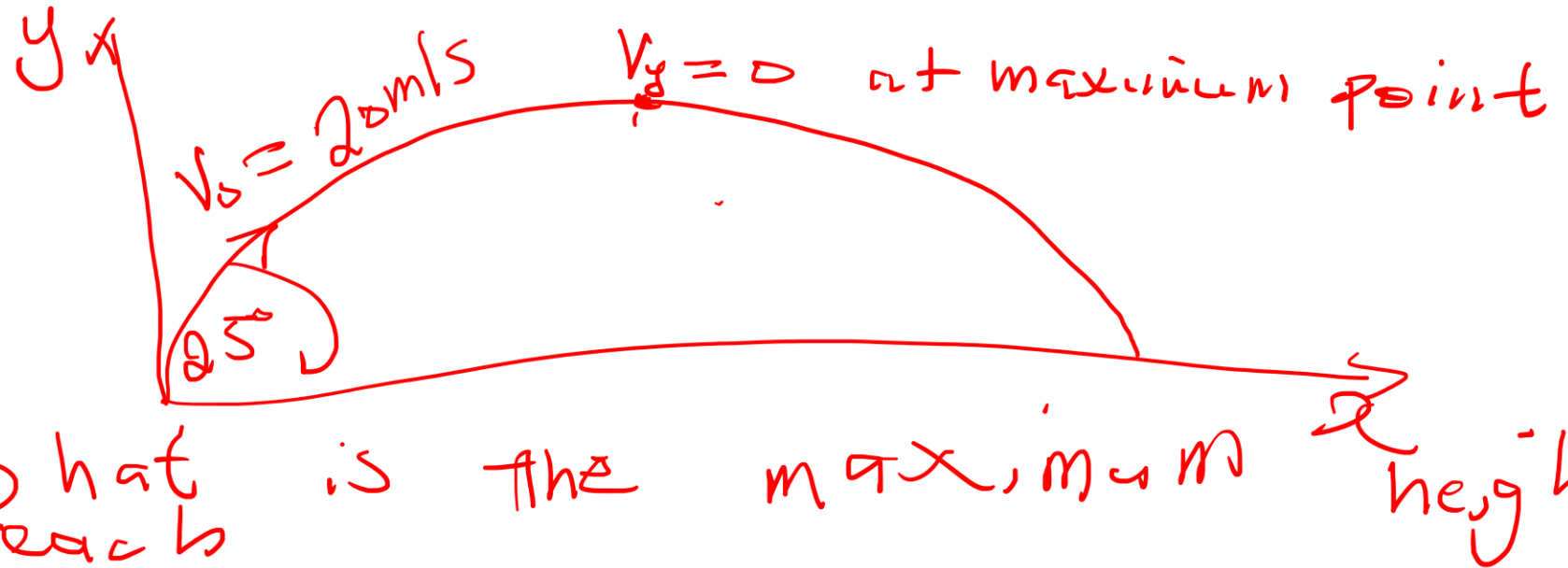


Q. An object is launched at a velocity of 20 m/s in a direction making an angle of 25° with the horizontal.



(a) What is the maximum height reached

$$v_y = v_0 \sin \theta - gt$$

$v_y = 0$ at maximum point

$$t = \frac{v_0 \sin \theta}{g} = \frac{20 \sin 25}{9.8} = 0.86 \text{ seconds}$$

$$y_1 - y_0 = v_0 \sin \theta t - \frac{1}{2} g t^2$$

$$y_1 - y_0 = 20 \sin 25 \times 0.86 - \frac{1}{2} \times 9.8 \times (0.86)^2$$

$$y_1 - y_0 = \text{Height} = \underline{\underline{3.64 \text{ m}}}$$

(b) What is the total flight time

$$s = ut + \frac{1}{2} g t^2$$

$$0 = v_0 \sin \theta t - \frac{1}{2} g t^2 \quad \text{upwards}$$

$$t = 0$$

$$\text{or } t = 0 \Rightarrow 0 = t$$

$$0 = v_0 \sin \theta - \frac{1}{2} g t$$

$$t = \frac{2 v_0 \sin \theta}{g}$$

$$t = \frac{2 \times 20 \times \sin 25^\circ}{9.8} = \underline{\underline{1.72 \text{ seconds}}}$$

(c) What is the horizontal range?
 $x - x_0 = v_0 \cos \theta$

$$= 20 \cos 25^\circ \times 1.72 \text{ sec} = \underline{\underline{31.26 \text{ m}}}$$

(d) What is the magnitude of the velocity of the object just before it hits the ground

Horizontal motion

$$V_x = \frac{dx}{dt} = \frac{d}{dt}(V \cos \theta t)$$

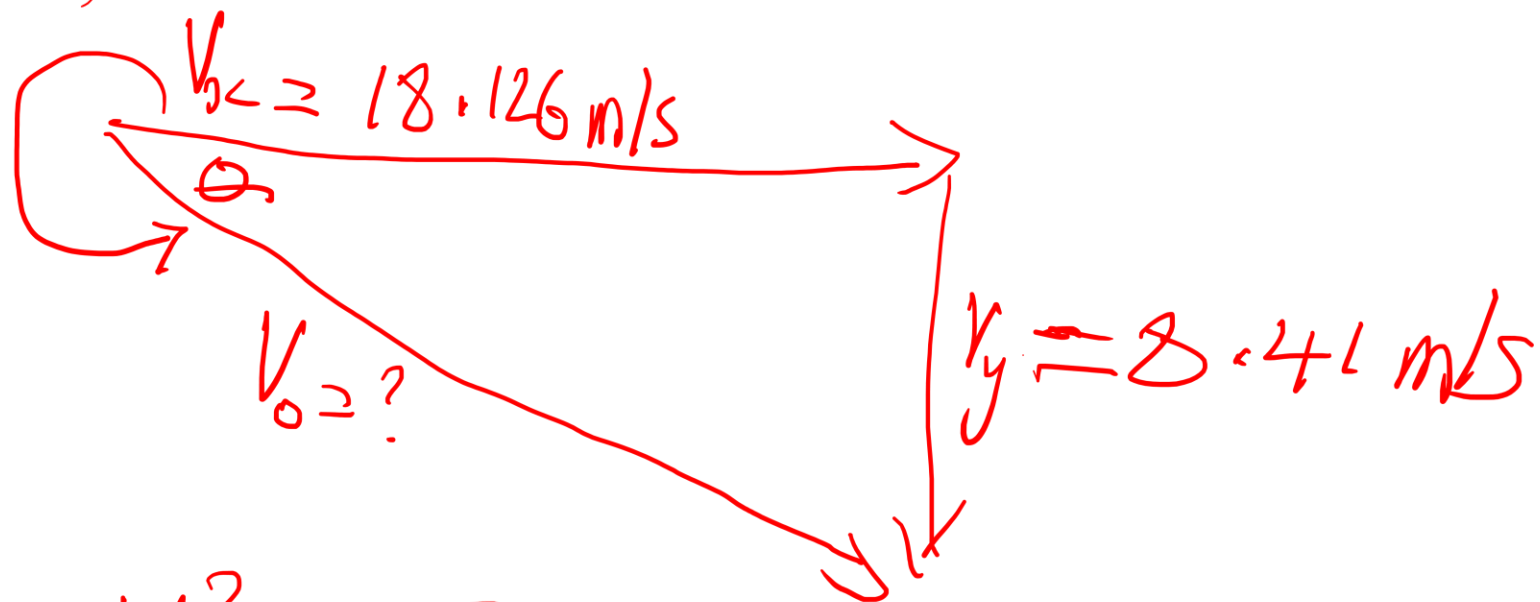
$$V_x = V \cos \theta = 20 \cos 25 = 18.126 \text{ m/s}$$

Vertical motion

$$V_y = \frac{dy}{dt} = \frac{d}{dt}(V \sin \theta t - \frac{1}{2} g t^2)$$

$$V_y = V \sin \theta - g t = 20 \sin 25 - 9.8 \times 1.72$$

$$V_y = \underline{-8.41 \text{ m/s}}$$



$$v_0^2 = v_x^2 + v_y^2$$

$$v_0^2 = (18.126)^2 + (-8.41)^2$$

$$v_0 = \sqrt{399.2}$$

$v_0 = 19.98 \text{ m/s}$ below positive ~~x~~ axis