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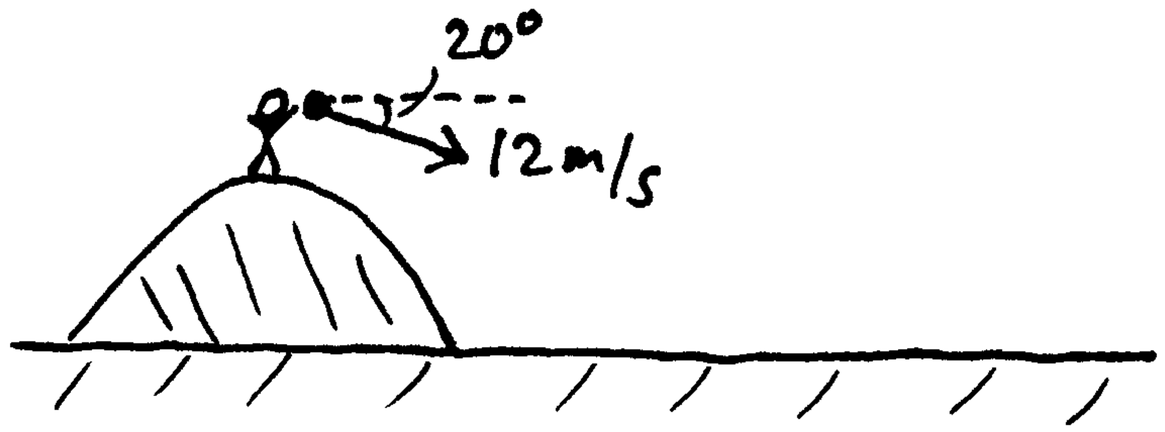
Feb. 2, 2020

This is a problem involving projectile motion.



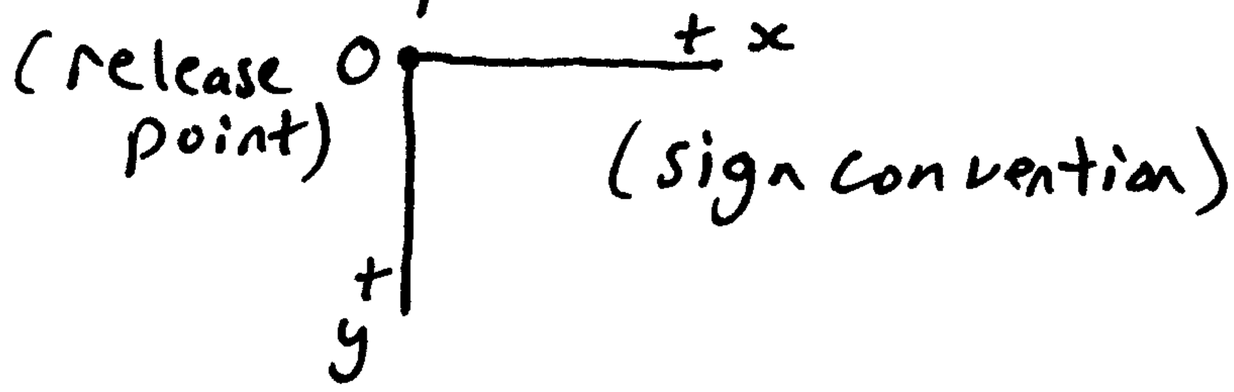
A person standing at the top of a hill throws a rock with an initial velocity of 12 m/s at an angle of 20° below the horizontal.

(a) Calculate the horizontal displacement of the rock 1.5 s later.

(b) Calculate the vertical displacement of the rock 1.5 s later.

Solution: Assumption: - ignore air resistance → negligible

Set up an xy coordinate frame with origin at the release point of the rock, as shown:



(a) The equation for horizontal motion is:

$$d_x = (v_0 \cos 20°)\, t$$

d_x = ? (horizontal displacement of rock)

v_0 = 12 m/s (magnitude of initial rock velocity)

t = 1.5 s (desired time interval)

Substitute:

$$d_x = (12 \cos 20°)(1.5) = 16.9 \text{ m (answer)}$$

(b) The equation for vertical motion is:

$$d_y = (v_0 \sin 20°)t + \frac{1}{2} g t^2$$

d_y = ? (vertical displacement of rock)

$g = 9.8 \text{ m/s}^2$

Substitute:

$$d_y = (12 \sin 20°)(1.5) + \frac{1}{2}(9.8)(1.5)^2$$

$$d_y = 17.2 \text{ m (answer)}$$