1. A projectile is fired at an upward angle of 45° from the top of a 233 m cliff with a speed of 192 m/s. What will be its speed when it strikes the ground below?

Solution.

Given: $\theta = 45°$, $h_0 = 939\ m, h = 233$ m, $v = 192\ \frac{\text{m}}{\text{s}}$,

Find: $v_1 -?$

$$v_x = const = v \cdot cos45° = 192 \frac{\text{m}}{\text{s}} \cdot \frac{\sqrt{2}}{2} = 135.765 \frac{\text{m}}{\text{s}}$$

$$v_{y_0} = v \cdot sin45° = 192 \frac{\text{m}}{\text{s}} \cdot \frac{\sqrt{2}}{2} = 135.765 \frac{\text{m}}{\text{s}}$$

$$h_0 = \frac{{v_{y_0}}^2}{2g} = \frac{{v_{y_0}}^2}{2g} = 939\ m,$$

$$h_0 + h = \frac{{v_{y_1}}^2}{2g}, v_{y_1} = \sqrt{2g \cdot (h_0 + h)} = \left(151.640 \frac{\text{m}}{\text{s}}\right),$$

$$v_1 = \sqrt{{v_{y_1}}^2 + {v_{y_0}}^2} = \sqrt{\left(151.640 \frac{\text{m}}{\text{s}}\right)^2 + \left(135.765 \frac{\text{m}}{\text{s}}\right)^2} = 203.536\ \frac{\text{m}}{\text{s}}$$

Answer:

$v_1 = 203.536\ \frac{\text{m}}{\text{s}}$