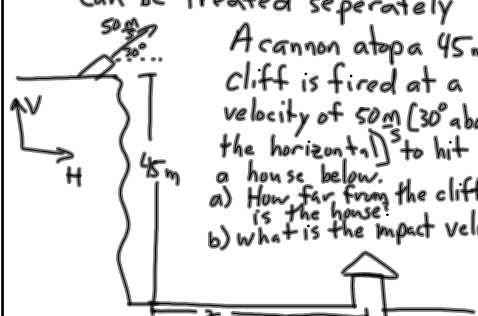


Projectile Motion

→ horizontal motion is independent of vertical motion, and can be treated separately



A cannon atop a 45 m cliff is fired at a velocity of 50 m [30° above the horizontal] to hit a house below.

a) How far from the cliff is the house?  
b) What is the impact velocity?

<p><u>Vert.</u></p> <p><math>d = -45 \text{ m}</math></p> <p><math>v_i = 50 \sin 30 = 25 \frac{\text{m}}{\text{s}}</math></p> <p><math>a = -9.8 \frac{\text{m}}{\text{s}^2}</math></p> <p><math>v_f = ?</math></p> <p><math>t = T</math></p>	<p><math>d = v_i t + \frac{1}{2} a t^2</math></p> <p><math>-45 = 25T - 4.9T^2</math></p> <p><math>4.9T^2 - 25T - 45 = 0</math></p> <p><math>T = \frac{25 \pm \sqrt{(25)^2 - 4(4.9)(-45)}}{9.8}</math></p> <p><math>T = \frac{25 \pm 32.6}{9.8}</math></p> <p><math>T = 5.88 \text{ s}</math></p>	<p><u>Hor.</u></p> <p><math>d = x</math></p> <p><math>v = 50 \cos 30 = 43.3 \frac{\text{m}}{\text{s}}</math></p> <p><math>d = v t = 254 \text{ m}</math></p>
--	--	--

Vert.

$v_i = 25 \frac{\text{m}}{\text{s}}$

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

$d = -45 \text{ m}$

$v_f = ?$

$v_f^2 = v_i^2 + 2ad$

$= 625 + 2(-9.8)(-45)$

$= 625 + 882$

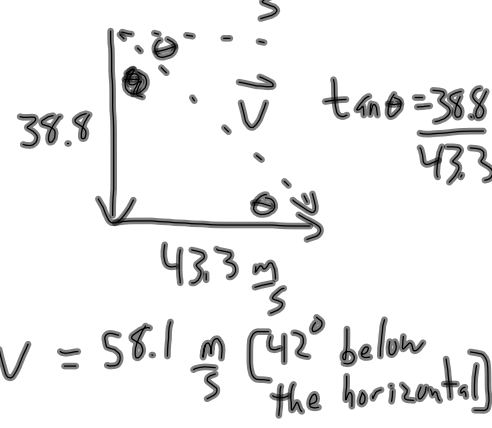
$= 1507$

$v_f = \pm 38.8 \frac{\text{m}}{\text{s}}$

$v_f = -38.8 \frac{\text{m}}{\text{s}}$

Hor.

$v = 43.3 \frac{\text{m}}{\text{s}}$



$\tan \theta = \frac{38.8}{43.3}$

$v = 58.1 \frac{\text{m}}{\text{s}}$  [42° below the horizontal]