

Velocity of Projectiles

All projectiles can have their velocity calculated after launch. The important thing to remember is that projectiles are just KINEMATICS with a velocity in the X direction and a velocity in the Y direction.

2 formulas $V_f = V_0 + at$ or $V_f^2 = V_0^2 + 2ad$

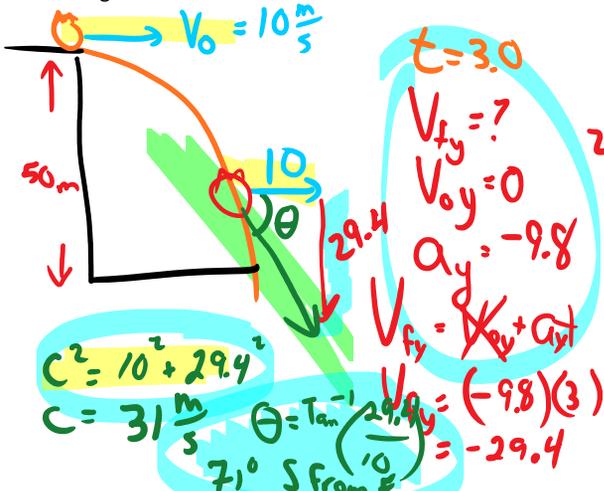
To find the X velocity remember that $a_x = 0$ because of this the velocity in the X direction NEVER changes. This means the final velocity in X = the initial velocity in X. Or in equation:

$V_{fx} = V_{0x}$ or $V_{fx}^2 = V_{0x}^2$

This means the only real calculation you need to do is to find the final velocity in the Y direction. You will either be given a TIME or a HEIGHT (DISTANCE) at which you must find the velocity. Use a kinematics equation to find the final velocity that has either time or distance.

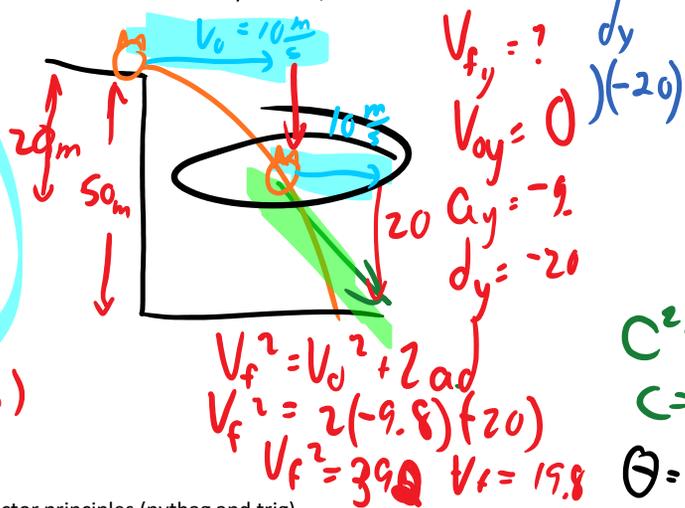
$V_f = V_0 + at$ or $V_f^2 = V_0^2 + 2ad$

Find the velocity of a cat 3.0 seconds after being launched horizontally at 10 m/s from a 50 m high cliff.



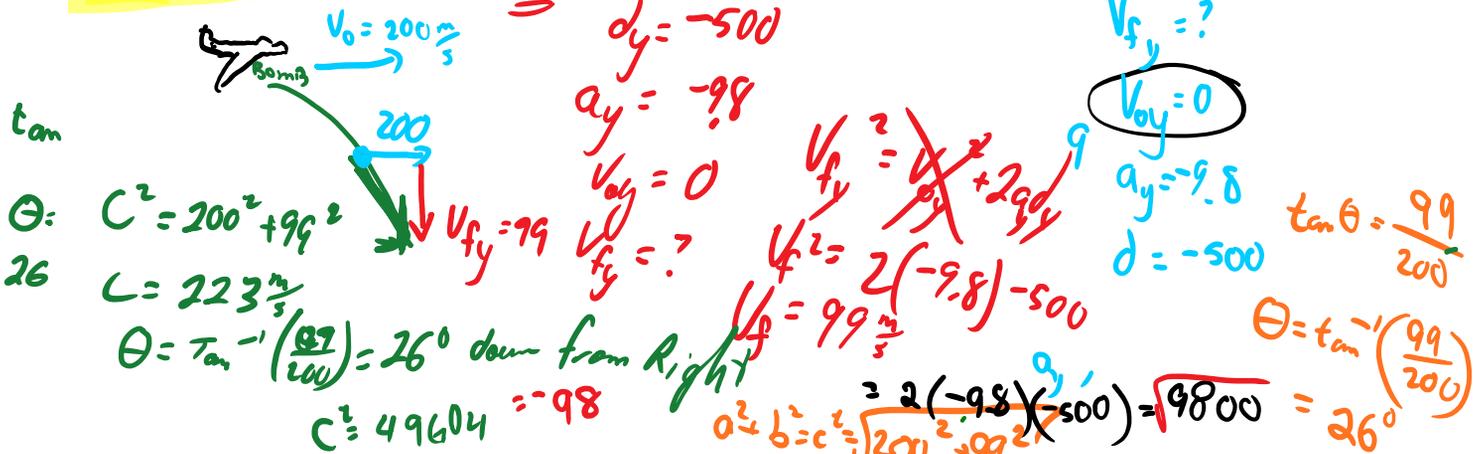
Once you have V_{fx} and V_{fy} , find the resultant using vector principles (pythag and trig)

Find the velocity of a cat 20 meters below the top of a 50 m high cliff after being launched horizontally at 10 m/s from it.



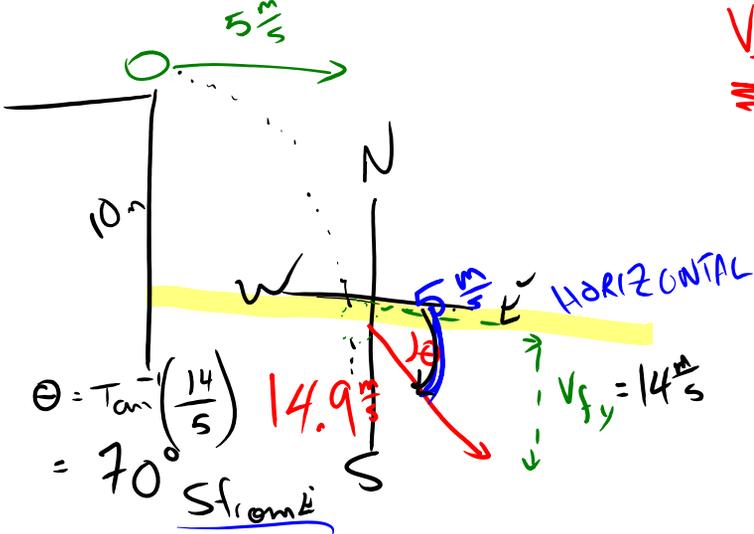
$C^2 = 10^2 + 20^2 = 500$
 $C = 22.2 \frac{m}{s}$
 $\theta = \tan^{-1}(\frac{20}{10}) = 63^\circ$ down from right

A bomb is dropped from a plane flying horizontally at 200 m/s from height 2.0 km, find the bomb's velocity after a) 10 seconds and b) after having fallen 500 m.



1) What is the velocity (mag. and dir) of an object which is thrown at 5.0 m/s horizontally when it reaches the bottom

of a 10.0 m high cliff?

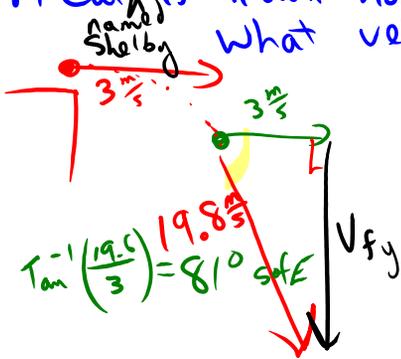


$$v_f^2 = v_{ox}^2 + 2a_y d_y$$

$$v_f^2 = v_{ox}^2 + 2(-9.8)(-10)$$

$$v_f = 14.0 \frac{m}{s}$$

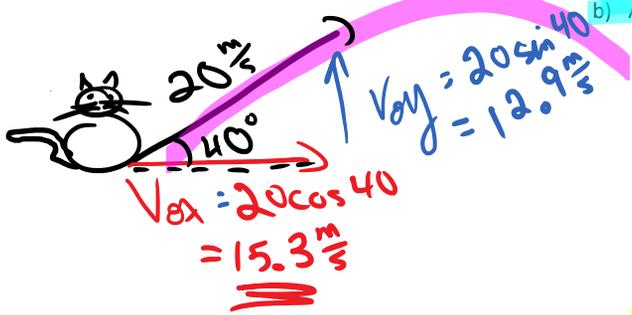
A cat is thrown horizontally at $3.0 \frac{m}{s}$ off a high building. What velocity will it have after $2.0 s$?



$$v_{fy} = v_{oy} + a_y t$$

$$= 0 + (-9.8)(2) = -19.6 \frac{m}{s}$$

cat kicked at $20 \frac{m}{s}$ at 40° from the horizontal, find its velocity a) at the high point b) After $2.2 s$



x, y, hyp

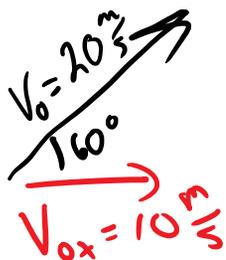
$$v_{fy} = v_{oy} + a_y t$$

$$= 12.9 + (-9.8)(2.2)$$

$$= 12.9 - 21.6 = -8.7$$

$$v_f = \sqrt{15.3^2 + 8.7^2} = 17.6 \frac{m}{s}$$

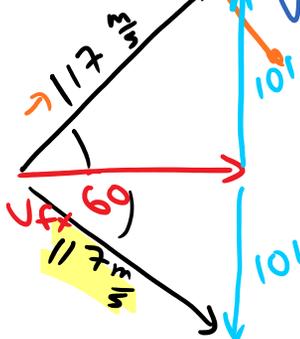
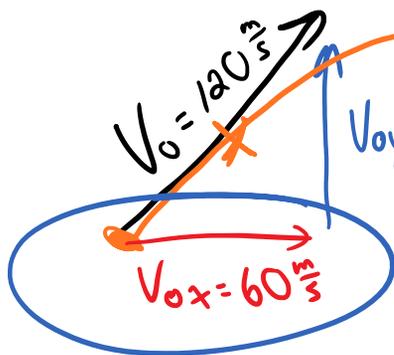
$$\theta = \tan^{-1}\left(\frac{8.7}{15.3}\right) = 30^\circ \text{ down from right}$$



Find velocity at high point

- a) $0 \frac{m}{s}$
- b) $10 \frac{m}{s}$
- c) $17.3 \frac{m}{s}$
- d) $20 \frac{m}{s}$

A physics troll tears off your cat's head and throws it at 120 m/s at 60° above the horizontal, what is the velocity when it reaches a height of 30 m?



$$V_{fy}^2 = V_{0y}^2 + 2(a_y)dy$$

$$V_{fy}^2 = 104^2 - 588$$

$$V_{fy} = \sqrt{10228}$$

$$= \pm 101$$

$$\Theta = \tan^{-1}\left(\frac{101}{60}\right)$$

$$= 59^\circ \text{ up or down from right}$$

