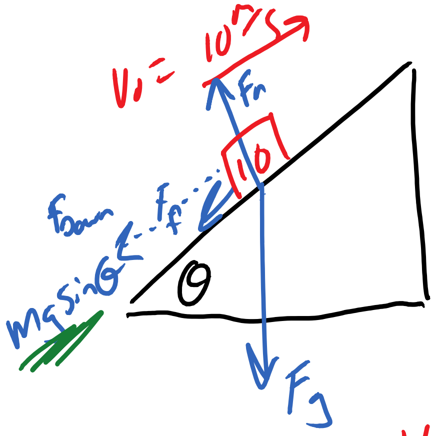
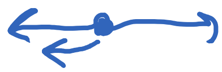
Momentum and impulse

Friday, January 29, 2010 2:54 PM





$F_{net} = -F_{down} - F_f$

$ma = -mg\sin\theta - \mu mg\cos\theta$

$a = -g\sin\theta - \mu g\cos\theta$

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

$0 = (10)^2 + 2[\quad]d$

Momentum was defined by Isaac Newton in the 1600's as "the quantity of motion". Today we know momentum is the product of mass and velocity.

p = m v units: kg m /s

$N = kg\ m/s^2$ $p \rightarrow N\cdot s$

CHANGE IN ANYTHING MUST BE FOUND BY TAKING THE FINAL VALUE INITIAL VALUE

$\Delta p = mv_f - mv_i$

Impulse: the change in momentum, it is caused by making a force act on an object for a period of time.

$= m(v_f - v_i)$

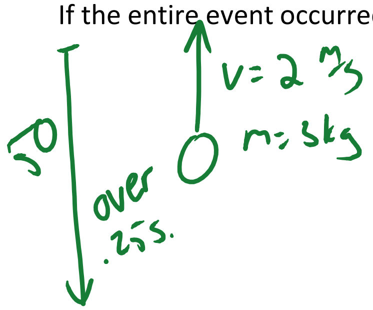
$= m\Delta v$

$m\Delta v = at\,m$

$\Delta p = mat$

$\Delta p = F\cdot t$ = impulse

A cat is moving north at 2.0 m/s when suddenly the 3.0 kg cat is kicked in the face with a force of 50 N [S]. If the entire event occurred in 0.25 s, what is the final velocity of the cat?



$\Delta p = F\cdot t$

$3(v_f - 2) = -50(.25)$

$v_f = \frac{-12.5 + 6}{3} = -2.17$ m/s [South]

The cat's v is 2.17 m/s south.

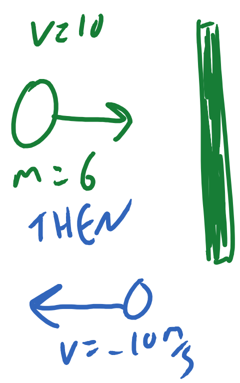
What was the cat's change in momentum?

$$\Delta p = m(v_f - v_i)$$
$$= 3(-2.17 - 2)$$
$$= -12.51\ N\cdot s$$

$N\cdot s$

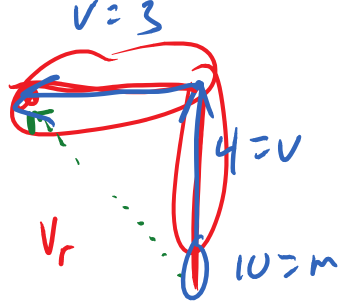
The ~~~ is ~~~

A cat runs toward a wall at 10 m/s, if the cat has mass 6.0 kg and **REBOUNDS** off the wall at 10.0 m/s what is its change in momentum?



$$\Delta p = m\Delta v$$
$$= 6(-10 - 10)$$
$$= -120\ N\cdot s$$

A cat of mass 10 kg runs 4.0 m/s [N] it gets kicked and is seen later travelling at 3.0 m/s [W] what impulse was delivered during the kick?



$$\text{impulse} = F\cdot t = \Delta p = m\Delta v$$

$$\Delta p = m\Delta v$$
$$= 10(v_f - 4)$$

$$V_r = \sqrt{3^2 + 4^2}$$
$$= 5$$

$$\Delta p = mV$$
$$= 10(5)$$
$$= 50\ Ns$$

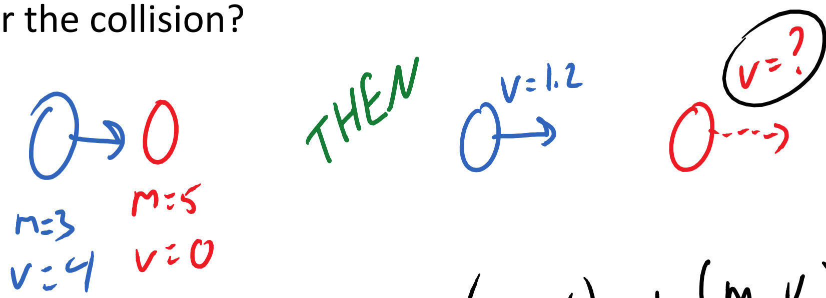
$$\theta = \tan^{-1}\left[\frac{3}{4}\right] = 36.9^\circ\ W\ of\ N$$

The Law of Conservation of Momentum

Wednesday, November 24, 2010 12:00 PM

This states the total momentum of the universe remains constant from before to after any event. THIS IS A UNIVERSALLY OBEYED LAW. Be sure to total the X, Y and Z directions separately.

Imagine a cat of mass 5.0 kg at rest is struck by a 3.0 kg leg moving east at 4.0 m/s. If the leg is seen after the collision moving east at 1.2 m/s what velocity has the cat after the collision?



$$(m_1V_1)_i + (m_2V_2)_i = (m_1V_1)_f + (m_2V_2)_f$$

$$3(4) + 5(0) = 3(1.2) + 5(V_f)$$

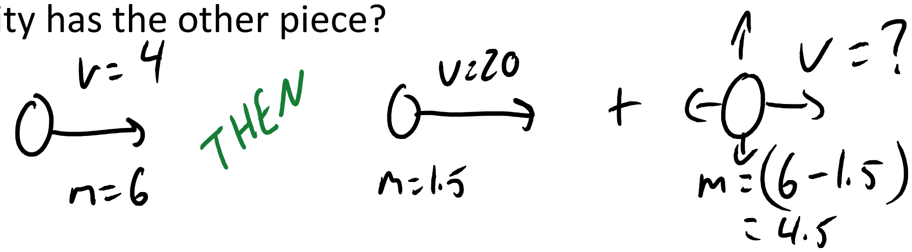
$$12 = 3.6 + 5V_f$$

$$\frac{12 - 3.6}{5} = V_f$$

$$1.68 \text{ m/s} =$$

Explosions: separate object such that the sum of the momenta must be equal to the starting momentum

A cat of mass 6.0 kg, traveling at 4.0 m/s [E] explodes into 2 pieces. If the front piece is mass 1.5 kg and has a final velocity of 20 m/s [E] what velocity has the other piece?



$$(\Sigma p)_i = (\Sigma p)_f$$

$$6(4) = 1.5(20) + 4.5V$$

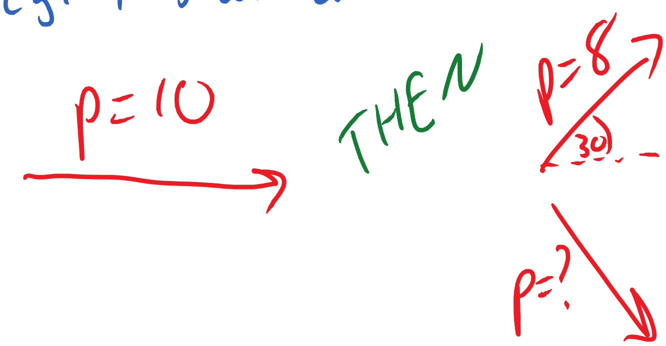
$$\frac{6(4) - 1.5(20)}{4.5} = V$$

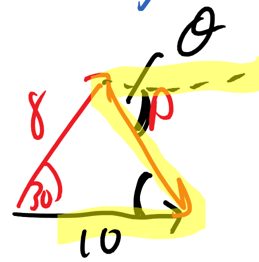
$$= -1.33 \ m/s$$

h

In two dimensions the law still holds. Xtotal before collision = Xtotal after collision AND Ytotal before collision = Ytotal after collision.

eg: I shoot a watermelon at the sky.





$$c^2 = a^2 + b^2 - 2ab\cos\theta$$

$$= 10^2 + 8^2 - 2(10)(8)\cos 30$$

$$= 5.0$$

$$\theta \Rightarrow \frac{\sin\theta}{8} = \frac{\sin 30}{5}$$

$$\theta = \sin^{-1}\left[\frac{8\sin(30)}{5}\right]$$

$$= 53^\circ \text{ S of E.}$$