

Fire Up Your Neurons!

Take 3-5 minutes and write a few detailed sentences about how all of Newton's 3 Laws applies to rockets from launch to orbit.

$$\vec{F}_{net} = m \vec{a}$$

$$\uparrow \vec{a} = \frac{\vec{F}_{net}}{m} \leftarrow \downarrow$$



- . When a 20 kg child steps off a 3.0 kg (initially) stationary skateboard with an acceleration of 0.50 m/s^2 , with what acceleration will the skateboard travel in the opposite direction? – hint: apply Newton's third law ($a = 3.3 \text{ m/s}^2$)

$$F_{\text{net}} = ma$$

$$|F_{\text{net on Child}}| = |F_{\text{net on Skate Board}}|$$

$$m_c a_c = m_{sb} a_{sb}$$

$$20(0.5) = (3) a_{sb}$$

$$10 = 3 a_{sb}$$

$$\frac{10}{3} = a_{sb} \rightarrow 3.33 \text{ m/s}^2 = a_{sb}$$

Combining Dynamics and Kinematics

We will now be mathematically solving problems that could require one or more of a large selection of equations (review handbook).

$$\vec{F}_{net} = m\vec{a}$$

Involve problems we've done previously with common forces like applied force, gravity and friction.

Involve concepts from kinematics incorporating displacement, velocity, and acceleration.

This section takes practice. Review problem solving strategies. You will have many mathematical problems to solve, but unlike your math class, you will need to determine what equations apply to the problem first.



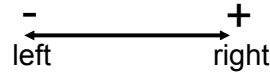
**very important difference*

Let's do some examples \Rightarrow

Combining Dynamics and Kinematics

An applied force of 50 N is used to accelerate an object to the right across a frictional surface. The object encounters 10 N of friction. The mass of the object is 8.0 kg.

1. Calculate the net force. (40 N)
2. Calculate the acceleration. (5.0 m/s²)
3. From the initial push, calculate how far the object will travel if the constant force was applied for 12 seconds. (360 m)
4. Calculate the instantaneous velocity after 5 seconds. (24.5 m/s)



1. $F_{net} = ?$

$$\vec{F}_a = 50\text{ N}$$

$$F_f = -10\text{ N}$$

$$F_{net} = \sum \text{Forces}$$

$$F_{net} = F_a + F_f$$

$$F_{net} = 50 + (-10)$$

$$F_{net} = 40\text{ N}$$

2. $\vec{a} = ?$

$$m = 8.0\text{ kg}$$

$$\vec{F}_{net} = m \vec{a}$$

$$40 = (8) a$$

$$\frac{40}{8} = a$$

$$5.0\text{ m/s}^2 = a$$

3. $\vec{d}_f = ?$

$$t = 12\text{ s}$$

$$\vec{a} = 5.0\text{ m/s}^2$$

$$d_f = d_o + v_o t + \frac{1}{2} a t^2$$

$$\vec{d}_o = 0\text{ m}$$

$$d_f = 0 + (0)(12) + \frac{1}{2}(5)(12)^2$$

$$\vec{v}_o = 0\text{ m/s}$$

$$d_f = 2.5(144)$$

$$d_f = 360\text{ m}$$

Your Turn:

Combining Dynamics and Kinematics

Undergoing an acceleration a 750 kg car's velocity goes from 21 m/s [E] to 15 m/s [W] in 7.5 s.

1. Calculate the average (net) force acting on the car. (-3600 N)
2. Calculate the final position of the car assuming the initial position is zero. (22.5 m)

1. $F_{net} = ?$

$\vec{v}_0 = 21 \text{ m/s [E]}$

$\vec{v}_f = -15 \text{ m/s [E]}$

$t = 7.5 \text{ s}$

$m = 750 \text{ kg}$

$\vec{F}_{net} = \sum \text{Forces}$ *no info!*

$\vec{F}_{net} = m \vec{a}$

Find $\vec{a} = ?$

$\vec{a} = ?$

$$\vec{a} = \frac{\vec{v}_f - \vec{v}_0}{t}$$

$$= \frac{(-15) - (21)}{7.5}$$

$$\vec{a} = \frac{-36}{7.5} = \underline{\underline{-4.8 \text{ m/s}^2}}$$

$$F_{net} = m a$$

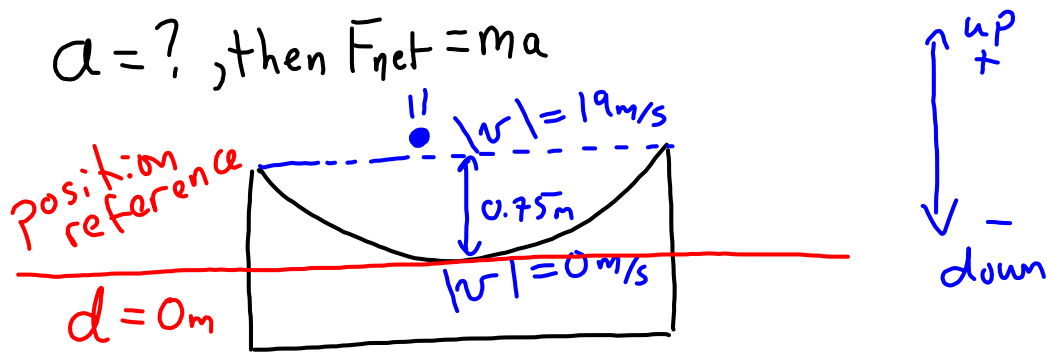
$$= (750)(-4.8)$$

$$\vec{F}_{net} = -3600 \text{ N}$$

Combining Dynamics and Kinematics

A 2.5 kg ball falls on an air mattress. Just as it hit the ball had a speed of 19 m/s. The air mattress depressed 0.75 m to stop the ball. Calculate the average stopping force acting on the ball. (602 N)

$$a = ? , \text{ then } F_{\text{net}} = ma$$



$$v_0 = -19 \text{ m/s} \quad d_0 = 0.75 \text{ m} \quad \vec{a} = ?$$

$$v_f = 0 \text{ m/s} \quad d_f = 0 \text{ m}$$

$$v_f^2 = v_0^2 + 2a(d_f - d_0)$$

$$0^2 = (-19)^2 + 2a(0 - (0.75))$$

$$0 = 361 + 2a(-0.75)$$

$$-361 = -1.5a$$

$$\frac{-361}{-1.5} = a \quad +241 \text{ m/s}^2 = a$$

$$F_{\text{net}} = (2.5 \text{ kg})(+241)$$

$$= +602 \text{ N}$$

Attachments

forces-and-motion-basics_all.jar

forces-1d_all.jar