

Name: \_\_\_\_\_  
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**Newton's Second Law and Weight**

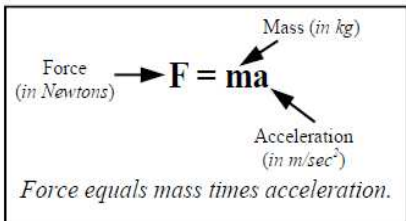
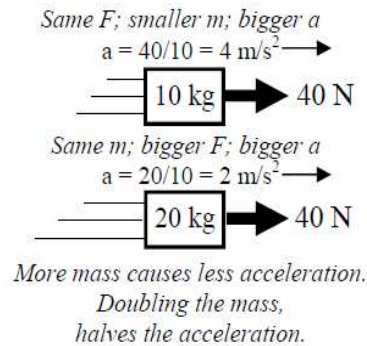
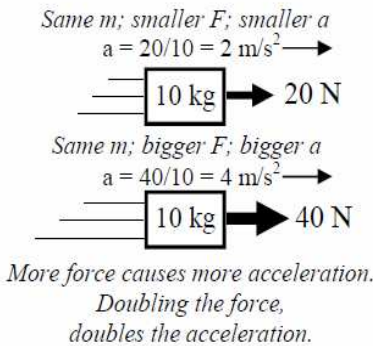
*You already know that if you push harder on an object it will accelerate more. Also, if you push with the same force on a heavier object it will have less acceleration. You instinctive know Newton's Second Law of Motion.*

**Newton's Second Law:  $F = ma$**

The acceleration of an object is proportional to the force acting on it and inversely proportional to its mass.

OR

*More force causes more acceleration; more mass causes less acceleration.*



*Ex. How big a force does it take to give a 50 kg object an acceleration of 40 m/s<sup>2</sup>.*

Variables: $m = 50 \text{ kg}$ $a = 40 \text{ m/s}^2$ $F = \underline{\hspace{2cm}}$	Equation: $F = ma$ Solve: $F = 50(40)$ $F = \underline{2000\text{N}}$
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The acceleration of a mass is actually due to the **net force** acting on the object:

**$F_{\text{net}} = \Sigma F = ma$**

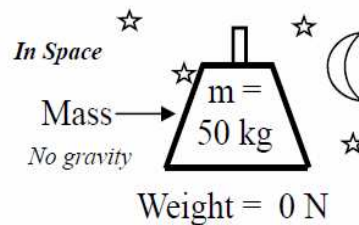
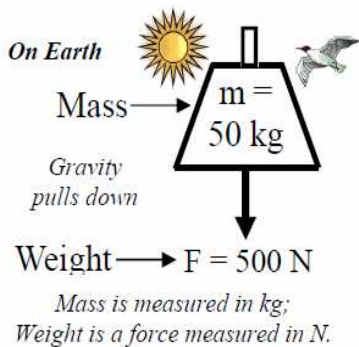
*You must add up all of the forces to find the acceleration.*

**Mass vs. Weight**

In everyday speech we use mass and weight interchangeably, but in science mass and weight are very different.

**Mass** is the amount matter in an object (all of its atoms and molecules).

**Weight** is the force of gravity pulling on mass.

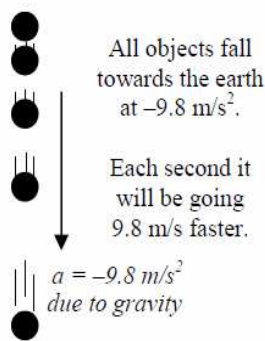


*In space an object still has mass, because it still has its atoms and molecules, but there is no weight, because there is no gravity.*

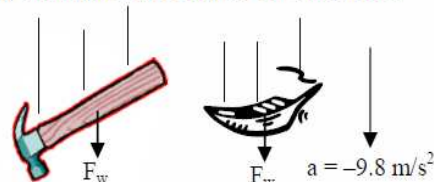
**Acceleration Due to Gravity**

All objects fall with the same acceleration:  $-9.8 \text{ m/s}^2$ . This is known as the acceleration due to gravity ( $g$ ).  
*This is not the force of gravity.*

**$g$  is a constant:  $-9.8 \text{ m/s}^2$**   
**The acceleration of all falling objects is the same on the earth.**



**Heavy and light object fall at the same rate.**

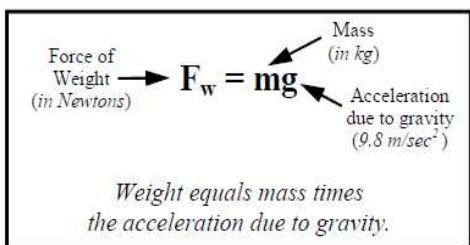


*If it wasn't for air friction a feather and a hammer would fall at the same rate:  $-9.8 \text{ m/s}^2$ . In air, the hammer's extra weight allows it to push thru the air molecules faster.*

**Measuring Weight**

If you already know mass it is easy to calculate weight: just multiply mass times  $9.8 \text{ m/s}^2$ .

*To make calculations easier we often use  $g = 10 \text{ m/s}^2$ .*











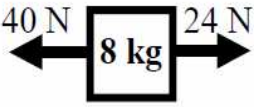
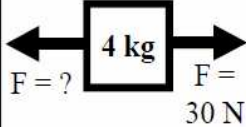

*Ex. Find the weight of a 2 kg mass.*

Variables: $m = 2 \text{ kg}$ $g = 10 \text{ m/s}^2$ $F_w = \underline{\hspace{2cm}}$	Equation: $F_w = mg$ Solve: $F = (2)(10)$ $F = 20 \text{ N}$
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*Ex. Find the mass of a 2 N object.*

Variables: $F_w = 2 \text{ N}$ $g = 10 \text{ m/s}^2$ $m = \underline{\hspace{2cm}}$	Equation: $F_w = mg$ Solve: $2 = (m)(10)$ $m = 2/10 = 0.2 \text{ kg}$
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All sections marked with a  are considered essential concepts and must be completed to receive full credit on WS.

1. Weight 2. Mass 3. N 4. $F = ma$ 5. g	A. The units of weight and force.  B. Newton's Second Law mathematically. C. The acceleration due to gravity = $-9.8\text{m/s}^2$ . D. The force of gravity on matter. E. How much matter an object contains.	Which of Newton's Three Laws Applies: Law 1, 2, or 3? ___ Pushing a cart down the hall, when you try to turn it it tries to go straight.  ___ More acceleration takes more force. ___ When you push your knuckles into a table, it hurts your knuckles. ___ A ball thrown into the ground bounces back up.
<i>Will an object accelerate faster or slower?</i> If its mass is increased?  If the force pulling on it decreases? If the force pushing on it increases? If its mass is decreased?		A 6 kg object experiences a $5\text{ m/s}^2$ acceleration? Find the force that caused this acceleration.   A 3 kg rock accelerates to the left at $12\text{ m/s}^2$ . Find the net force that caused this.  A 12 kg box is pushed to the left by a 48 N force. Find its acceleration.
Why is $F = ma$ not entirely correct?  <i>More, less, or the same as on the Earth?</i>  When an astronaut lands on the moon: The astronaut's mass is: _____ The astronaut's weight is: _____ The astronaut's inertia is: _____		Without air friction, which falls faster, heavy or light objects? Why?  If there is air friction, which falls faster? Why?  How fast is the acceleration due to gravity? If an object falls from rest, how fast will it be going: after 1 second?    after 2 seconds?    after 6 seconds?  Using the weight equation, calculate the weight of a 45 kg rock?
Calculate the mass of a 10 N apple.  What is the mass of a 100 gram apple in kilograms?  What is the weight of the above apple?  What is the weight of a 250 N object?  If 100 kg person weighed 400 N on the planet Zorg, what is the acceleration due to gravity on Zorg?		<div style="display: flex; align-items: center;"> <div style="text-align: center; margin-right: 20px;"> <math>30\text{ N}</math>    <math>25\text{ N}</math> </div> <div>             A) Calculate the object's net force.               B) Calculate the object's acceleration.           </div> </div> <div style="display: flex; align-items: center; margin-top: 20px;"> <div style="text-align: center; margin-right: 20px;"> <math>40\text{ N}</math>    <math>24\text{ N}</math> </div> <div>             Calculate the object's acceleration.           </div> </div> <div style="display: flex; align-items: center; margin-top: 20px;"> <div style="text-align: center; margin-right: 20px;"> <math>a = 6\text{ m/s}^2 \rightarrow</math>    <math>F = ?</math>                      <math>F = 30\text{ N}</math> </div> <div>             Find the force pulling left.  </div> </div> <div style="margin-top: 20px;"> <p><i>12 N pulls to the left and 20 N pulls to the right on a 2 kg object.</i>              Draw the problem:</p> <p>Calculate the object's acceleration.</p> </div>