

Newton's 1<sup>st</sup> Law: Objects in motion, remain in motion in a straight line  
and at a constant  
velocity, and objects at rest stay at rest - unless acted  
upon by an unbalanced force

Give one example each of a balanced force and an unbalanced force.

Unbalanced Force: speeding up, slowing down, or changing direction

Balanced Forces: Sitting Still or constant speed and straight line

Newton's 2<sup>nd</sup> Law:  $F = ma$   
Force ← acceleration  
mass

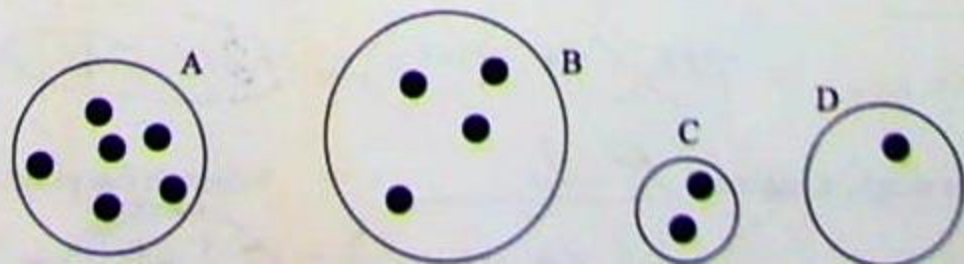
Mass: The amount of "stuff" in an object.  
On Earth

Metric Unit for Mass = Kilogram (kg). A 1kg mass weighs about 2.2 pounds.

Volume: Size; Amount of space something takes up.

Weight: Force of gravity acting on an object.

Practice Questions: The circles below represent objects with varying masses, volumes, and densities. The dots inside the objects represent identical pieces of "stuff." The rest of the object is empty space.



See other side for #1-5

- Which object has the greatest volume? B Least volume?
- Which object has the greatest mass? A Least mass?
- Which is heaviest? A Which is lightest? D
- In outer space (not on a planet), which object is the heaviest? None. Nothing has weight in space -- no gravity.
- In outer space (not on a planet), which object has the most mass? A

Acceleration Due to Gravity Comparison

Body	Acceleration Due to Gravity, "g" [m/s <sup>2</sup> ]
Sun	274.13
Mercury	3.59
Venus	8.87
Earth	<u>9.81</u>
Moon	1.62
Mars	<u>3.77</u>
Jupiter	25.95
Saturn	11.08
Uranus	10.67
Neptune	14.07
Pluto	0.42

Metric Unit of Force: Newton (N)

English Unit of Force: Pounds

1 Newton = 0.224 pounds      1 pound = 4.5 N

6. A 6kg mass is accelerated at a rate of 2m/s<sup>2</sup>. What net force is acting on the mass?

$F = ma$        $F = (6\text{kg})(2\text{m/s}^2) = 12\text{N}$

7. What is the weight of a 30kg child who is standing on the Earth?

8. What is the weight of the same 30kg child, if that child is standing on Mars?

weight = Force of gravity  
 $F = ma$  ← accel. of gravity  
 ↑  
 child's mass

$F = 30\text{kg}(9.81\text{m/s}^2) = 294.3\text{N}$        $F = ma = 30\text{kg}(3.77\text{m/s}^2) = 113.1\text{N}$

9. How much would a 70kg adult weigh on Neptune?

Weight = Force of Gravity =  $ma$        $F = 70\text{kg}(14.07\text{m/s}^2) = 984.9\text{N}$

10. Where would that adult be the heaviest? The lightest? What would his/her weight be on those two planets?

70kg = 154 lbs on Earth

a. Planet where weight is heaviest: Jupiter

Weight on that planet:

$F = ma = 70\text{kg}(25.95\text{m/s}^2) = 1816.5\text{N}$  ← 406 lbs

a. Planet where weight is lightest: Pluto

Weight on that planet:

$F = ma = 70\text{kg}(0.42\text{m/s}^2) = 29.4\text{N}$  ← 6.6 lbs

Use a meter stick, a timer, and a balance to complete the table below.

$$a = \frac{\Delta v}{\Delta t} = \frac{0.96 \text{ m/s}}{4.72 \text{ s}} =$$

Trial	Distance from Start Line to Finish Line	Time from Start To Finish (s) - Do this at least three times! Circle a time that you think is accurate.	Starting Velocity	Average Velocity	Final Velocity	Acceleration of Cart	Cart Mass (g)	Cart Mass (kg) [mass in g / 1000]	Force Acting On Cart (N)
Example	2.14m	4.42s	0 m/s	0.48 m/s	0.96 m/s	0.217 m/s <sup>2</sup>	657g	0.657 kg	0.143 N
Car									
Car + 1 mass									
Car + 2 masses									

Car  $\approx$  600g  
 Mass  $\approx$  500g