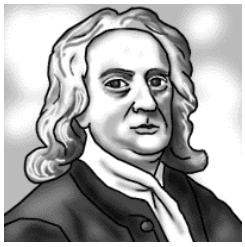
Newton's Laws

HW: Page 25 #1-3



Newton's First Law: (or "Law of Inertia")

An object at rest will stay at rest
and an object in motion will stay in motion
with the same speed and in the same direction
UNLESS acted upon by an unbalanced force

Examples:

Magician removes table cloth

Popping a water balloon

Car crash

1. Imagine a place in the *cosmos* far from all gravitational and frictional influences. Suppose that you visit that place (just suppose) and throw a rock. The rock will

a. gradually stop.
(b) continue in motion in the same direction at constant speed.

2. A 2-kg object is moving horizontally with a speed of 4 m/s. How much net force is required to keep the object moving at this speed and in this direction?

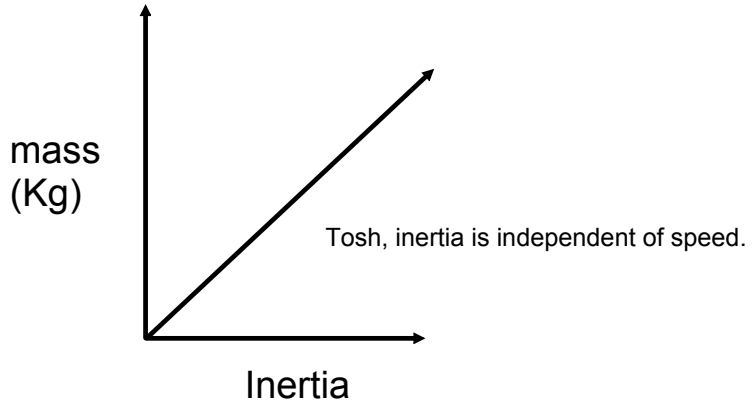
F = 0 N

Joe wants to push Ms. Nigro's car into traffic for making the test so difficult. Can he easily accomplish this task?

Inertia:
Tendency of mass to resist change in velocity

Speed doesn't matter!!!!!

3. Mac and Tosh are arguing in the cafeteria. Mac says that if he flings the Jell-O with a greater speed it will have a greater inertia. Tosh argues that inertia does not depend upon speed, but rather upon mass. Who do you agree with? Explain why.



4. Which has more inertia?
a. 1 kg mass at 30 m/s
b. 10 kg mass at 3 m/s
c. 100 kg mass at rest

Newton's Second Law:
An unbalanced force causes an object to accelerate

$$F_{net} = ma$$

Ex 1:

With how much force must Joe push Ms. Nigro's 500 kg car to give it an acceleration of 2 m/s²?

F = ma
F = 500kg(2m/s2)
F = 1000 N

Ex 2:

Joe pushes with a force of 11N, and Matt joins him pushing with the same force. Ms. Nigro desperately pushes in the opposite direction with a force of 9 N. What is the resulting acceleration of Ms. Nigro's 500 kg car?

F = ma
11N + 11 N - 9 N = 500 kg (a)
a = .026 m/s2)

DO NOW...not later

HW: Page 25 # 3, 4, 8

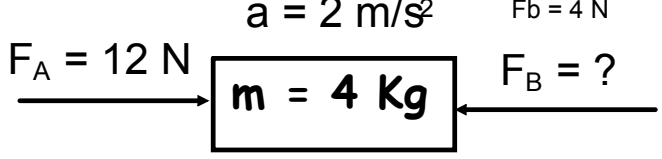
1. In a frictionless environment, a 6 Kg object is moving at a constant speed of 13 m/s. How much force is required to maintain this motion?

F = 0 N

2. In a frictionless environment, a 6 Kg object is moving with a constant acceleration of 13 m/s². How much force is required to maintain this motion?

F = ma
F = (6 kg)(13 m/s2)
F = 78 N

3. Find the magnitude of F_B



F = ma
12 N + Fb = (4kG)(2 m/s2)
Fb = 4 N

HW Answers:
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1) m = 11.2 kg
2) a = 0.8 m/s²
3) a = 2.1 m/s²
F = 4641 N

A **force** is a push or pull upon an object resulting from the object's *interaction* with another object. Whenever there is an *interaction* between two objects, there is a force upon each of the objects. When the *interaction* ceases, the two objects no longer experience the force. Forces only exist as a result of an interaction.

Contact Forces

Frictional Force
Tension Force
Normal Force
Air Resistance Force
Applied Force
Spring Force

Action-at-a-Distance Forces

Gravitational Force
Electrical Force
Magnetic Force

$$1\ \text{Newton} = 1\ \text{kg}^* \frac{\text{m}}{\text{s}^2}$$

Weight and Mass

Weight (in Newtons - N): VECTOR Force of gravity acting upon an object. Changes with planets. Ex: F_g = 100 N, or a car weighs 10000 N

Mass (in Kilograms - kg): SCALAR. Amount of matter contained by the object. Same in all planets. Ex: m = 10 kg, or a car has a mass of 1000 kg

If we are given mass we can find the weight and vice versa, by using

$$F_g = mg$$

F_g = weight in N
m = mass in kg
g = acceleration due to gravity = 9.8 m/s^2 near the surface of the Earth

Example 1:

A force of 23 N East pushes a 5 Kg block and gives it an acceleration of 2 m/s^2. What is the magnitude and direction of the force of friction?

F = ma
23 N + Ff = (5 kg)(2 m/s2)
Ff = -13 N

Example 2:

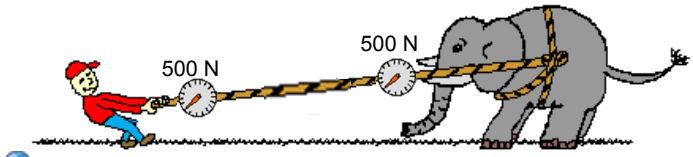
Ms. Nigro pushes a 200 kg grocery cart with a force of 20 N at a constant speed of 4 m/s. What is the magnitude and direction of the force of friction?

F = ma
20 N + Ff = (200 kg)(0 m/s2)
Ff = -20 N

Newton's Third Law: (Action - Reaction)

For every action there is an equal and opposite reaction.

HW Answers:
Page 25:
4) F = 8000 N
8) Ff = 20N



Action - Reaction in outer space

The mass of the elephant is 10 times the mass of the person.

a. Who is pulling harder?

Both the same

b. Who will experience a greater acceleration?

The person