Study Guide: Forces and Motion

Study all vocab:

Force: push or a pull

Newton: The unit used to express force

net force: combination of all the forces acting on an object

balanced force: will not cause a change in motion of a moving object or cause a non-moving object to start moving

unbalanced force: produces a change in an object's motion- could be a change in speed or direction or both

friction: a resistance to motion caused by surfaces moving past each other

normal force: The force that opposes gravity

gravity: The force by which a planet or other body draws objects toward its center.

law of universal gravitation: This law states that two objects attract each other with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them

acceleration due to gravity: $9.8\ m/s^2$ Or 9.8m/s/s

terminal velocity: the constant speed that a freely falling object eventually reaches when the resistance of the medium through which it is falling prevents further acceleration.

free fall: free fall is any motion of a body where gravity is the only force acting upon it

air resistance: is a force that is caused by air. The force acts in the opposite direction to an object moving through the air

projectile motion: Projectile motion is a form of motion experienced by an object or particle that is thrown near the Earth's surface and moves along a curved path under the action of gravity only.

centripetal force: a force that acts on a body moving in a circular path and is directed toward the center around which the body is moving.

Study Guide: Forces and Motion

1. **Know what force is and the unit to measure force.**
   Force is a push or a pull. The unit of measure is a Newton (N)

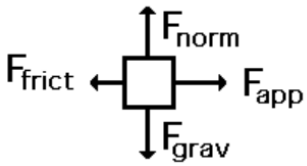
2. **Know the difference between balanced and unbalanced forces and the effect on motion. (Accelerating or not accelerating).**

A balanced force will not cause a change in motion of a moving object or cause a non-moving object to start moving. An u**nbalanced force will** produce a change in an object's motion-could be a change in speed or direction or both.
Accelerating=object has a change in velocity over time
not accelerating=no change in velocity when an object is observed

3. **Also know how to calculate net force (add or subtract) Be able to make and interpret a *free body diagram*.**

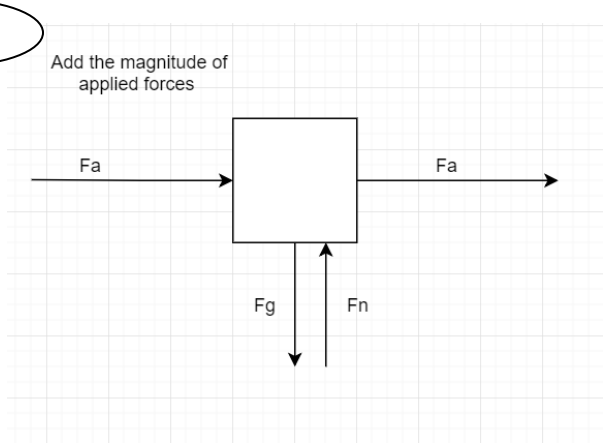
Example 1

A rightward force is applied to a book in order to move it across a desk with a rightward acceleration. Consider frictional forces. Neglect air resistance. A free-body diagram for this situation looks like this:



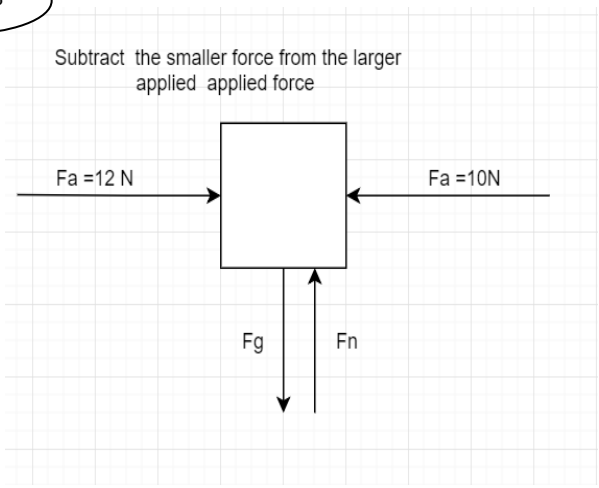
Fnet= add when forces are exerted in the same direction, subtract when forces are exerted in opposite directions.

Example 2



When two equal forces act on the same object in opposite directions, the net force is smaller than either force

Example 3



Sample question 1: Magnitude is not required.

Block A is sitting on a table and you are looking down on it (aerial view).

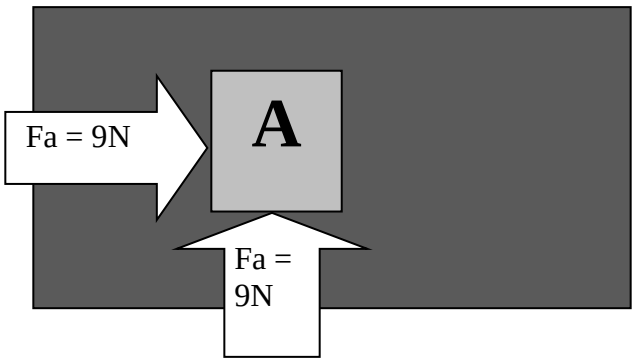
a. Identify all forces shown AND any forces present that are not shown acting on Block A. Include their magnitude (if known) and direction.

Fa=9N right/east
Fa=9N up/north
Fg=gravity downward/south
Fn=normal force upward/north

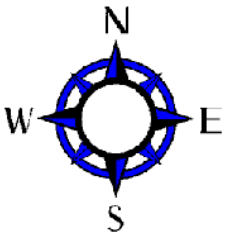
b. What is the direction of the net force? Northeast

c. Are the forces balanced or unbalanced? unbalanced

d. Is the object accelerating? yes



Sample question 2: Read directions below (next to compass) before answering



Use the following diagram and the compass rose to answer the sample question. Assume a frictional force of 1 N if it is present (it is not automatically drawn into the diagram). Remember that more forces are present acting on the block than are shown in the diagram. (8 points)

Block A is falling off of your desk and you are looking at it from a side view.

a. **Identify all forces shown AND any forces present that are not shown acting on Block A. Include their magnitude (if known) and direction.**
   Fg= 10N downward/south
   Fn=10N upward/north
   Fair=1N upward

b. **What is the net force? (include direction)**
   Fnet= 10N downward/south-1N upward/north
   =9N downward/south

c. **Are the forces balanced or unbalanced?**
   unbalanced

d. **Is the object accelerating?** Yes, at 9.8 m/s/s

4. **Know the *rate of acceleration due to gravity* and how to calculate velocity of an object in free fall.**

   The rate of acceleration due to gravity is 9.8m/s/s

5. **Know the difference between the terms free fall, air resistance, and terminal velocity and how to apply the terms in a real-life situation.**

   Terminal velocity, steady speed achieved by an object freely falling through a gas or liquid. A typical terminal velocity for a parachutist who delays opening the chute is about 150 miles (240 kilometers) per hour. An object dropped from rest will increase its speed until it reaches terminal velocity; an object forced to move faster than its terminal velocity will, upon release, slow down to this constant velocity.

6. **Know what the law of universal gravitation is and know the 2 circumstances in which gravitational force is increased.**

   Gravitational force is increased when mass increases and when distance decreases.

7. **Know what projectile motion is and the 2 components involved.**

   The horizontal velocity of a projectile is constant (a never changing in value). There is a vertical acceleration caused by gravity; its value is 9.8 m/s/s, down. The vertical velocity of a projectile changes by 9.8 m/s each second. The horizontal motion of a projectile is independent of its vertical motion.

8. **Know what causes objects to stay in orbit.**

   The reason that an object will maintain its orbit, regardless of its position in the orbit, is because the gravitational force from the larger object will constantly act upon the smaller object, thereby pulling the smaller object towards the larger object.

9. Know how Newton's 3rd law of motion applies to a baseball player running from one base to the next.

Newton's third law can be stated as: All forces act in pairs. Whenever one object exerts a force on a second object, the second object exerts and equal and opposite force on the first.

When the baseball player places his feet on the ground with every step toward the next base, the ground pushes back with an equal and opposite force. With every step placed on the ground the baseball player exerts and action force. The reaction force is the force exerted by the ground that pushes up on the foot stepping down.