WELCOME TO 1103 PERIOD 5

Homework Exercise #4 is due today.
What are fundamental forces?
How do Newton’s three laws describe the motion of objects?
How can you find the center of mass of objects?
Fundamental force – gravity

The **gravitational force** is an attractive force that exists between all objects.

- The gravitational force between the center of the Earth and objects near it causes objects to fall toward the surface of the Earth.

- The gravitational force between the Earth and the Sun holds the Earth in an orbit around the Sun.
The **electromagnetic force** holds matter together by providing the force that binds atoms into molecules.

The force between particles of opposite charge is attractive.

The force between particles of the same charge is repulsive.

Since positive charges repel one another, how can positively charged protons exist closely packed in an atomic nucleus?
Fundamental force – strong nuclear

The **strong nuclear force** holds protons $+P$ and neutrons $0_n$ together in atomic nuclei.

- It is the strongest force.
- It acts over very short distances inside a nucleus.
Fundamental force – weak nuclear

The **weak nuclear force** is responsible for some kinds of radioactive decay.

- The fission (splitting) of Uranium-235 nuclei into smaller fragments in nuclear power plants is an example of the weak force.
- The weak force acts only when particles are close together.
- The weak force is the next to the weakest force. (The gravitational force is the weakest of the forces.)
Summary of the fundamental forces

✓ The **gravitational force** is an attractive force that exists between all objects.

✓ The **electromagnetic force** holds matter together by providing the force that binds atoms into molecules.

✓ The **strong nuclear force** holds protons and neutrons together in atomic nuclei.

✓ The **weak nuclear force** is responsible for some kinds of radioactive decay.
Newton’s First Law

An object remains at rest or moves at constant velocity (constant speed in a straight line) unless a net force acts on it.

- To make an object at rest move, a force must act on that object.

- To make a moving object change speed or direction (accelerate or decelerate), a force must act on it.
Newton’s Second Law

If forces act on an object, and if the forces do not balance one another, the object experiences a net force and accelerates.

\[
\text{Force} = \text{Mass} \times \text{acceleration}
\]

\[
F = M \times a
\]

\(F\) = force (in newtons)

\(M\) = mass (in kilograms)

\(a\) = acceleration (in meters/second\(^2\))
Newton’s Third Law

If one object exerts a force on a second object, the second object exerts an equal and opposite force on the first object.

Will the cart move when the fan is turned on?

Will the cart move if the fan blows onto a sail?
Summary of Newton’s Laws of Motion

1) An object remains at rest or moves at constant velocity (constant speed in a straight line) unless a net force acts on it.

2) If the forces acting on an object do not balance one another, the object experiences a net force and accelerates. \((F = M a)\)

3) If one object exerts a force on a second object, the second object exerts an equal and opposite force on the first object.
Center of mass

The center of mass is the average position in space of all the protons, neutrons, and electrons that make up the object.

- The center of mass of an object with a uniform distribution of mass is at its center.

- The center of mass of an object is the point at which the force of gravity acts on the object.
Center of mass and stability

What happens when an object’s center of mass is not supported?
Center of mass and stability

What happens when an object’s center of mass is not supported?
BEFORE THE NEXT CLASS…

✓ Read textbook chapter 6
✓ Complete Homework Exercise 5
✓ Bring a blank Activity Sheet 6 to class.