

## Universal Forces

1. Electromagnetic Forces
  1. Electric forces
  2. Magnetic forces
2. Nuclear Forces
3. Gravitational Force
4. Centripetal force
5. Satellites

### Magnetic forces

- act on certain **metals**, on poles of **magnets**, and on moving **charges**
- Have two poles, **north** and **south**, that **attract** each other
- Two poles that are alike **repel** each other
- Two opposite poles **attract** each other

### Gravitational Force

- An attractive force between any two **masses**
- Newton's law of universal gravitation states that **every object in the universe attracts every other object**
- Mass needs to be very **large** to have a noticeable pull of gravity
  - So that's why you don't notice a pull of gravity between your textbook and your body

### Electromagnetic Forces

- Associated with charged particles
- **Electric** force and **magnetic** force are the only forces that can both attract and repel

### Nuclear Forces

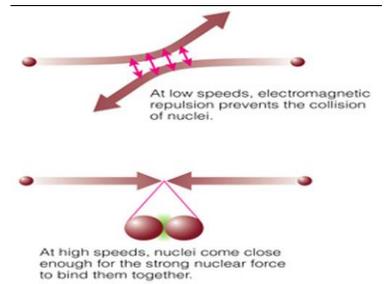
- Two forces act within the **nucleus** of the **atom** to hold it together
  - Strong** Nuclear force: force of attraction that acts only on the neutrons and protons holding them together
    - **Overcomes** the electric force of **repulsion** that acts among the protons in the nucleus
  - Weak** Nuclear force: acts only over a short range
    - Involved in certain types of radioactive processes

### Gravitational Force

- Gravity acts over **large** distances
- However, the force between two objects is proportional to their **masses** and decreases rapidly as the **distance** between them increases
- Gravity is the **weakest** universal force but it is the most **effective** force over long distances
  - It keeps **you** on Earth, the **moon** in orbit around Earth, the planets in orbit around the **sun**, and the stars in orbit around their galaxies

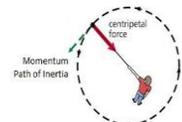
### Electric forces:

- **Act between charged objects or particles** such as protons and electrons (parts of the atom)
- Objects with opposite charges (+ and -) **attract** one another
- Objects with like charges (+ and + or - and -) **repel** one another



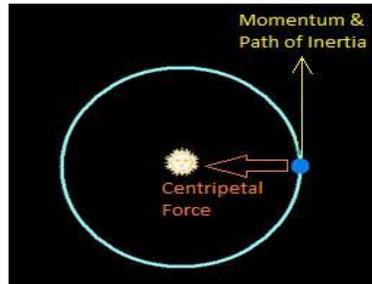
### Centripetal force

- A center-directed force that continuously changes the **direction** of an object to make it move in a **circle**
- Like the earth and moon and satellites



## Satellites

- Much like the moon, satellites only need the centripetal force provided by **gravity** and its **inertia** to maintain its orbit
- If the satellite loses **speed** it loses altitude and will eventually reenter Earth's atmosphere
  - It will either burn up or fall to Earth's surface



## Assembling an Electromagnet

- <https://www.youtube.com/watch?v=PwVuLK0Q-po>

### Magnetic Forces

- Magnetic forces are produced by magnetic poles.
- Every magnet has both a North and South pole.
- Like poles repel, unlike poles attract.

### Magnetic Fields

- Magnetic fields transmit magnetic forces.
- Direction of the field is from N to S.
- Field is stronger where field lines are closer.
- Unit of magnetic field strength is the Tesla. The older unit Gauss is sometimes used.
  - Earth's magnetic field strength is about  $10^{-4}$  Tesla or about 1 Gauss

### How Magnets Attract

- A magnet near an unmagnetized piece of iron causes Attractive magnetic force on the iron
- This causes the iron to become temporarily magnetized

### Electric Currents & Magnetism

- Since moving charges create magnetic fields, an electric current creates a magnetic field.
- A coil of wire can concentrate the magnetic field and create an electromagnet.

### Motors

- An electric motor uses a magnet to exert a force on a current-carrying coil of wire.

### The Earth as a Magnet

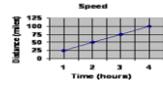
- Earth itself is a magnet.
- N and S poles do not correspond exactly to the geographic poles. The discrepancy is called magnetic declination.
- Strength of Earth's field varies with time.
- N/S Poles have switched in the past.

**Force and Motion Study Guide**

1. What is motion? What do we use to help us determine if an object is in motion?
2. Write the formula for speed. Calculate the speed of an object that has traveled 42 meters in 12 seconds.
3. What is velocity?
4. What is a force? What unit do we use to measure force?
5. How does each type of force affect the motion of an object?
  - a) Balanced forces
  - b) Unbalanced forces
6. What is friction? Name one thing you can do to reduce friction and one thing you can do to increase friction.
7. When looking at a graph of motion, what does the slope of the line tell us?
8. What is acceleration? What unit do we use to measure acceleration? What are the three ways that acceleration can happen?
9. What is gravity?
10. What does Newton's 3rd law of motion mean?

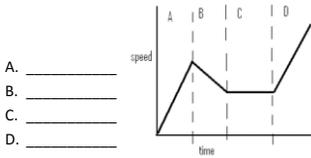
11. \_\_\_\_\_ forces maintain motion at constant velocity.
12. \_\_\_\_\_ forces acting on an object produce accelerated motion.
13. \_\_\_\_\_ is the tendency of an object to resist change in its motion.
14. To increase acceleration, one could decrease \_\_\_\_\_.
15. A push or a pull, are both known as \_\_\_\_\_.
16. \_\_\_\_\_ is the force that one surface exerts on another when the two rub against each other. It also depends upon the types of surfaces involved, and how hard the two push together.
17. The forces of gravity increases as the \_\_\_\_\_ of objects increase.
18. What are action and reaction pairs?
19. What is Net force? How do we draw an object with 50N of force pushing from the right and 20N of force pushing from the left?

Use the graph below to answer the following questions:



20. Name the two variables plotted in the graph.
21. Describe the object's motion.
22. What is the distance traveled in three hours?
23. What is the average speed the object traveled during the entire four hours?

24. Label Positive, Negative, and constant acceleration on the graph below:



25. In what direction is the net force acting on the box?
26. What does the head of the arrow indicate?
27. In what direction must a force be applied to balance the forces?
28. If you apply a third force in a downward direction, how will the acceleration change?
29. How are balanced and unbalanced forces effected by the following:
  - Friction
  - Gravity
  - Magnets

