Introduction to Astronomy, Gravity, and Planetary Laws Name:_____

PowerPoint Notes

I. Essential Questions:

- What were the accomplishments of early astronomers?
- How does the geocentric model differ from the heliocentric model of the solar system?
- What are Kepler's Laws of Planetary Motion?
- What are astronomical units?
- What is gravity?
- What is the difference between mass and weight?
- What is Newton's Law of Universal Gravitation?

Astronomy is the _____

- Properties of objects in space
- Laws that predicts the way the universe operates

II. Early Astronomers

Aristotle was the first to conclude that the Earth is shaped like a _____.

- His evidence was that _____on the moon when it passes between the sun and the moon.

Ancient Greeks believed in the _____ model of the solar system.

- In the geocentric model, the moon, sun, and known planets revolve around Earth in a_____ _____ orbit.

Egyptian-Greek Astronomer _____ published the first idea of the geocentric model called the Ptolemaic System in the 2nd century, and the model persisted as the accepted view for the next _____

Aristarchus was the first Greek to propose that the solar system is _____.

- In the heliocentric model, the _____
- Although there was evidence to support this model, the geocentric model prevailed for nearly 2000 years.

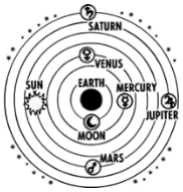
Ptolemy though it was odd that planets appeared to move slightly eastward among the stars, then stop, and reverse motion, and then resume an eastward movement.

- The apparent westward drift is called _____ movement.
- Results from combination of Earth and the planet's own motion around the sun.

Ptolemy explained retrograde motion by saying the planets moved along smaller circles, which in turn moved along orbits around the Earth. He called these smaller circles _____.

Copernicus created the first _____ of the solar system.
He was the first to propose that:

- Earth is a _____
- Earth orbits the sun _____
- Earth _____ daily on its own _____



Brahe built many instruments (before the invention of the telescope) that accurately studied and _____

_____

- Brahe's observations, especially of Mars, were more precise than another other scientists before him.
- Tycho Brahe hired Johannes Kepler as an _____ and Kepler kept most of Brahe's work and put it to exceptional use.

III. Kepler's Laws of Planetary Motion

Kepler Discovered the _____

In 1596, Kepler publicly wrote of support for Copernicus's heliocentric model.

- This was risky because the Lutheran and Catholic churches did not support this idea and even put Galileo under house arrest in 1615 for his publication of support of this sun-centered model.

Kepler's First Law of Planetary Motion

_____

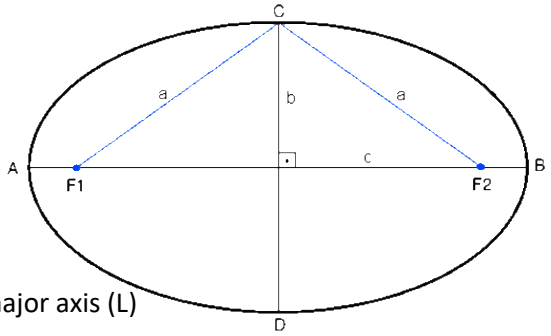
- The path of each planet around the sun is not perfectly circular, but instead an _____ shape called an ellipse.
- The ellipse contains two foci, or points.
- The sun is at one focus and the other focus is symmetrically located at the opposite end of the ellipse.
- The distance between the 2 foci determines the shape of the ellipse. The _____ apart the foci, the more elongated, or _____ the ellipse is.
- _____
- Eccentricity is the measurement of how _____ a closed circle is and is measured from the foci to the length of the major (longer) axis.
- Eccentricity is measured in values of _____
- A _____has only a single focus and an eccentricity of _____
- Ellipses can have a value of 0.1 to 1. The _____

The value of eccentricity is easy to find using the formula E = d / L

E = _____

d = _____

L = _____



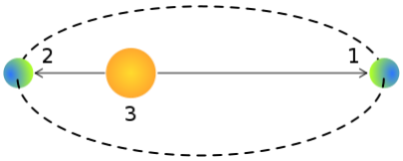
To find the eccentricity, follow these steps:

1) Measure the distance between the foci
2) Measure the distance of the long major axis
3) Divide the distance between the two foci (d) by the length of the major axis (L)

Kepler's 2nd Law of Planetary Motion

Kepler noticed that the speed of Mars in its orbit changes in predictable ways.

- As Mars approaches _____.
- As it approaches _____.
- Perihelion: the point in a planet's orbit _____
  - On Earth: _____
  - Occurs annually on _____
- Aphelion: the point in a planet's orbit _____from the sun
  - On Earth: _____
  - Occurs annually on _____



Each planet revolves so that an imaginary line connecting it to the sun sweeps over _____ _____.

- If a planet is to sweep equal areas in the same amount of time, it must move more _____ _____and _____.
  - The sun's _____ pulls stronger on the planet when it is closest to it, causing it to move faster.
  - As _____between two objects, the force of _____ _____, causing a planet to move slower at aphelion.

Kepler's 3rd Law of Planetary Motion

The _____ a planet is to the sun, the _____ is.

- An orbital period is the time it takes for a planet to complete one orbit around the sun in Earth years.
- _____

The orbital period squared is equal to its mean solar distance cubed or _____

- T stands for orbital period in Earth years
- d stands for distance from the sun in astronomical units

The distance from the Earth to the Sun is 93 million miles or 1 Astronomical Unit

- _____are used to measure distances in our solar system.
- 1 Astronomical Unit (AU) = _____

IV. Galileo Galilei

Galileo was a groundbreaking astronomer whose inventions included the _____ _____.

- Using his telescope, he was able to view the universe in a new way and made many discoveries that supported the ideas of Copernicus and Kepler.

Galileo's discoveries include:

1. Four _____, or moons, orbit Jupiter.
2. Planets in the distance are circular disks, _____.
3. Earth's moon's surface is _____, it contained mountains, craters, and plains.
4. The sun had _____, or dark regions and the sun had a rotational period of just _____

V. Mass Versus Weight

Mass:

- The total _____(think atoms) in an object.
- Mass is _____ and does not change with location
- Measured in _____ (kg)

Weight:

- The _____acting on an object.
- Weight _____ depending where you are in the universe
- Measured in _____ (N)

VI. Gravity

- Gravity is from the Latin word *gravitas*, meaning _____
- Gravity is a _____ by which all things with mass or energy, including planets, stars, and galaxies are brought toward one another.
- Gravity _____
- Earth's gravitational acceleration is _____
- The gravitational attraction of the matter present in the universe cause it to _____ into stars, galaxies, and even planets.
- Without gravity, planets would not move in an elliptical orbit. Instead, planets would move in a straight line out into space.
- The _____of an object, the _____
- The _____ two objects are together, the _____ the gravitational force.

VII. Isaac Newton

- Newton was the first person to formulate and test the Law of _____
- The Law of Universal Gravitation states:
- _____with a force that is directly proportional to their masses and inversely proportional to the square of the distance between their centers of mass.
- Newton believed _____are two factors that keep the planets in orbit.
    - F= gravitational force between 2 objects
    - m_1 & m_2 = masses of the objects
    - r = distance between the centers of the masses of the objects squared
    - G = gravitational constant 6.67 x 10^{-11}