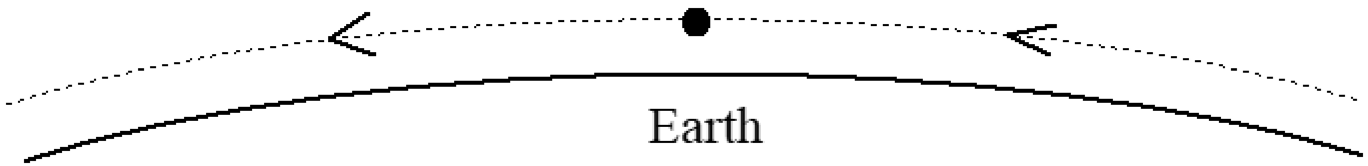
Discuss and Answer:

A satellite is in circular orbit at an altitude of 100 miles above the surface of the Earth.



The satellite's pre-launch weight is its weight measured on the ground. The magnitude of the force of gravity on the satellite while it is in orbit is..

A) slightly greater than its pre-launch weight.
B) the same as its pre-launch weight.
C) slightly less than its pre-launch weight.
D) much less than its pre-launch weight, but not zero.
E) zero.

Notes

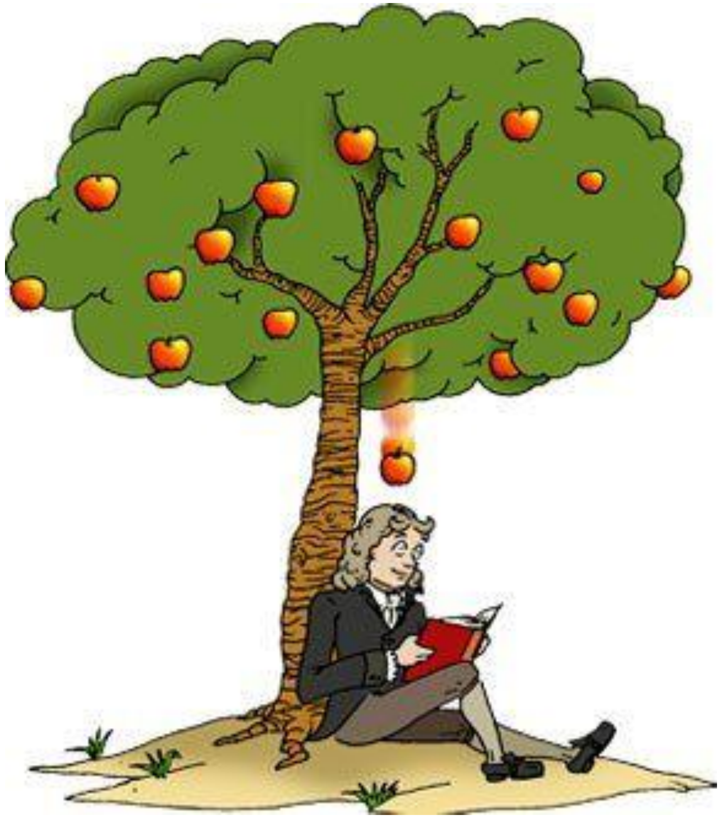
Thanks for filling out the midsemester survey – 98+ responses! Will discuss feedback today in discussion and Friday here in lecture.

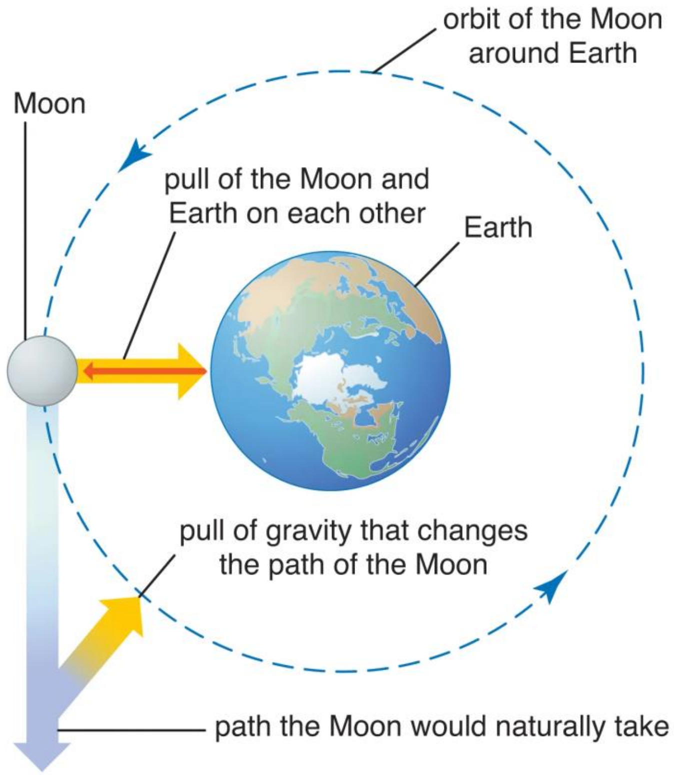
- Homework on Rotational Dynamics due Friday

- Exam II will be Nov 20 (Momentum, Rotational Motion - Dynamics, and Gravity)

Recap: Universal Gravitation

- The stipulation is that $F = -\frac{GMm}{r^2}$ accounts for the falling apples and the orbit of the moon?
- We can measure $g \approx 9.81\frac{m}{s}$, we have $R_{earth} = 6{,}378km$, $d_{moon} = 384{,}400\ km$
- If the same force is responsible, we should be able to predict the orbital period!





New Idea: Universal Gravitation

- All matter exerts a force on all other matter in the universe:

$$F = -\frac{GMm}{r^2}\ \hat{r}$$

- How does this happen, mechanically? Newton did not know. You may learn: there is an entity called the gravitational field, and this field represents the geometry of space itself.

Discuss and Answer:

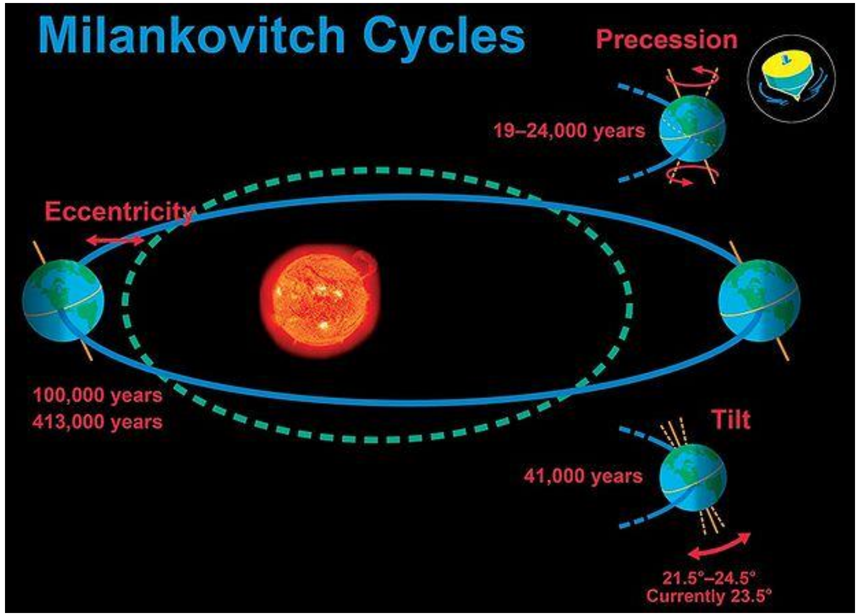
Kepler's third law states that the ratio $\frac{T^2}{r^3}$ is a constant for all the planets. The period T of the Earth is 1 year. An astronomical unit (1 A.U.) is defined as the mean distance from the Earth to the Sun, therefore the mean Earth-Sun distance is 1A.U.

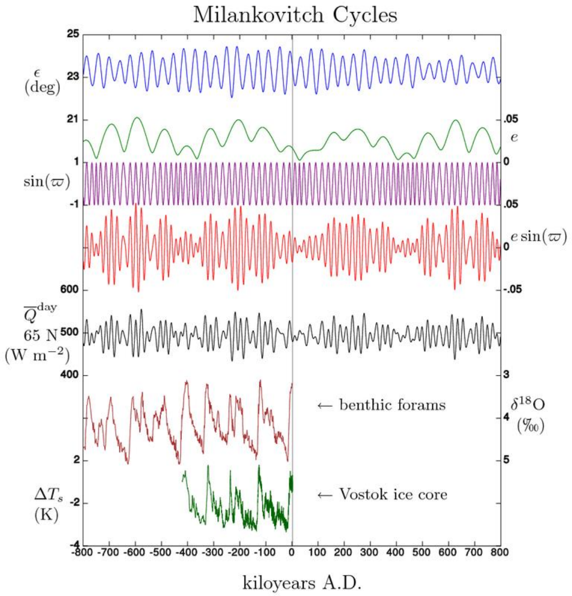
Consider an asteroid in circular orbit around the Sun with radius r = 2A.U. The period of the asteroid is..

A): 2 years. B) 3 years C) $2^{3/2} \cong 2.83$ years.
D) $2^{2/3} \cong 1.59$ years E) None of these.

Recap: Comments and Questions

- If the areas are swept out in equal times according to Kepler's Second Law, doesn't that mean the tangential velocity of the terrestrial body orbiting around the sun have a higher velocity at some point compared to others? Also, the circumference distance that the terrestrial body has to cover as it rotates around the sun changes per equal allotted area based on its location in relation to the sun.
- Another question I have is if it's true that the tangential velocity of Earth changes as it rotates around the sun based on the Earth's location along its orbit, how does this affect life on Earth?





Recap: My Comments and Questions

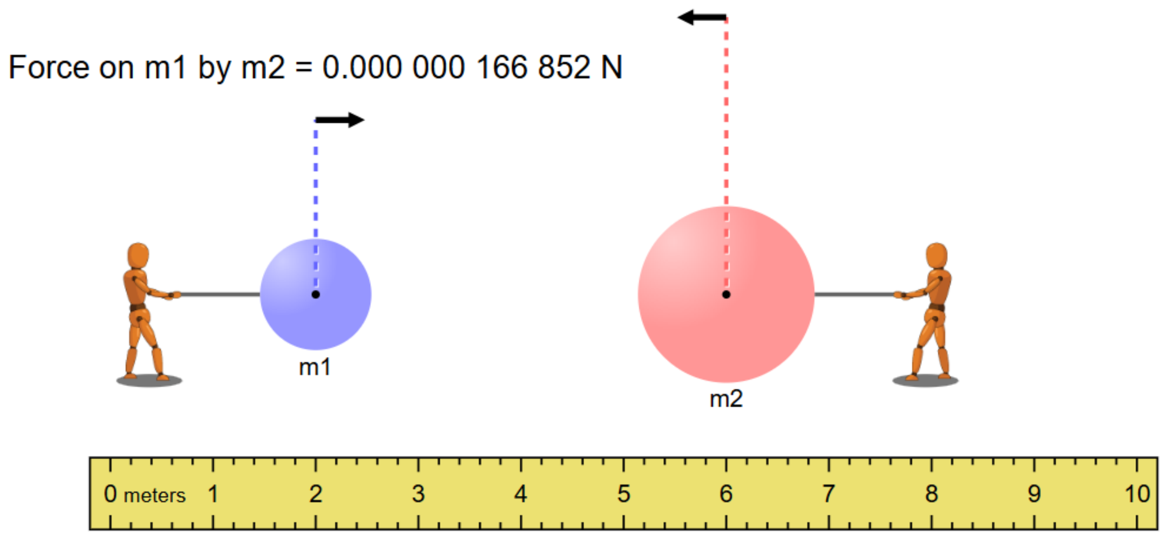
- In ancient times it was thought that there was a division between motion on Earth, and motion in “the heavens”.

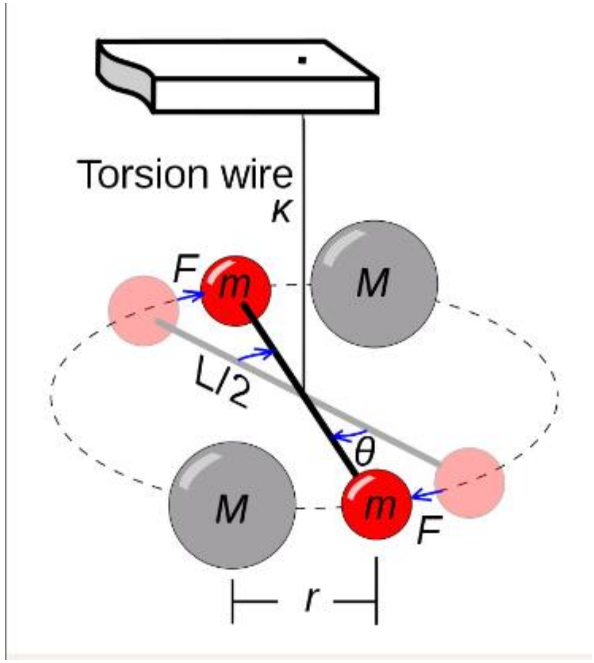
→On Earth, motion was naturally translational, with the radial component special in the sense that things fell towards the center of the Earth.

→In space, motion appeared naturally rotational, with objects rotating around the center of the Earth (or later, the sun).

- What Newton and others accomplished was the break this down and replace it with a framework where *universal laws apply the same way everywhere* – no such division exists!

Prelecture Review: Weighing the earth





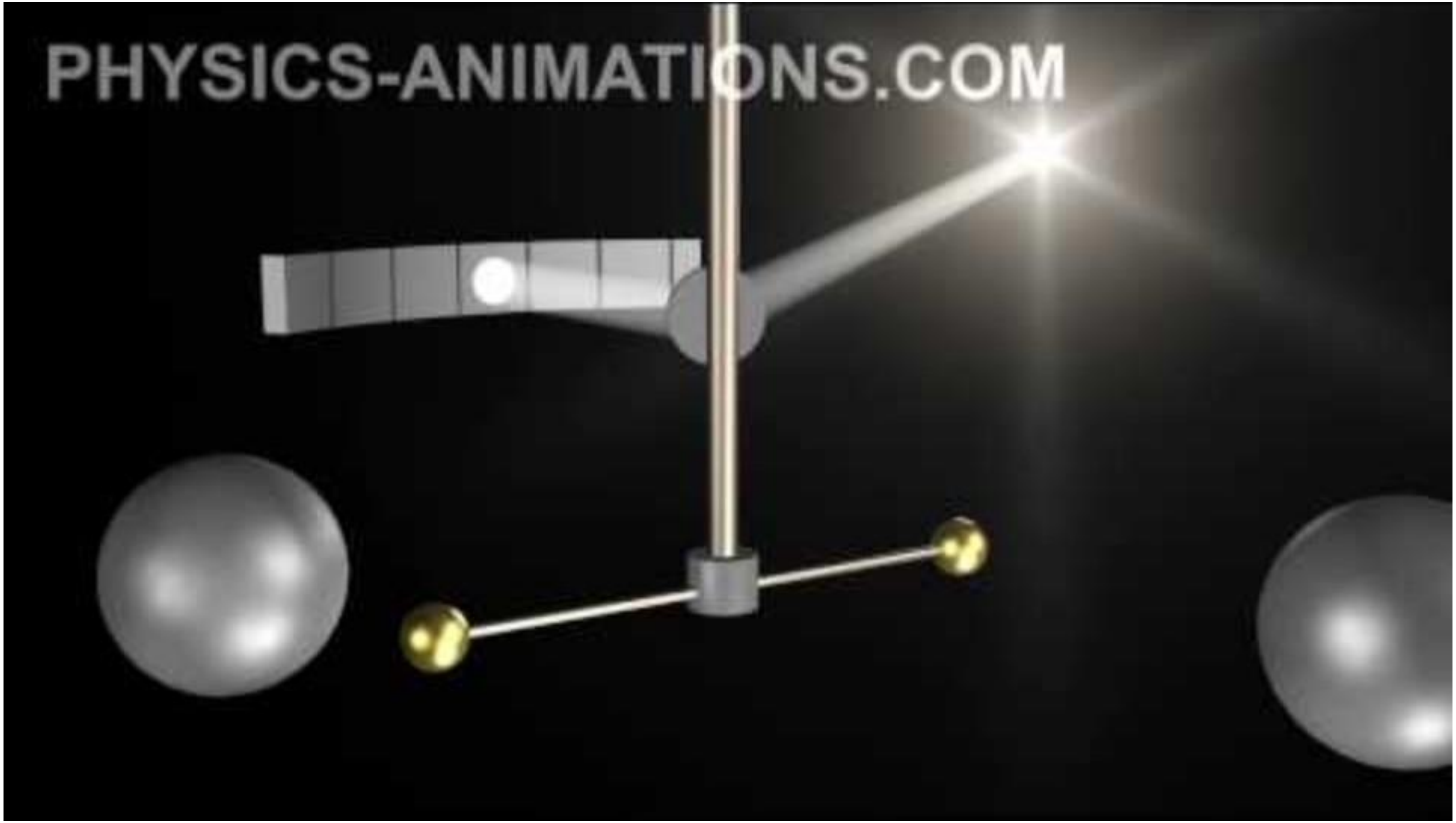
The Law of Universal Gravitation:

$$F = -\frac{GMm}{r^2}$$

$$g = \frac{GM_E}{r_E^2}$$

What are our comments and questions?

Cavendish Experiment



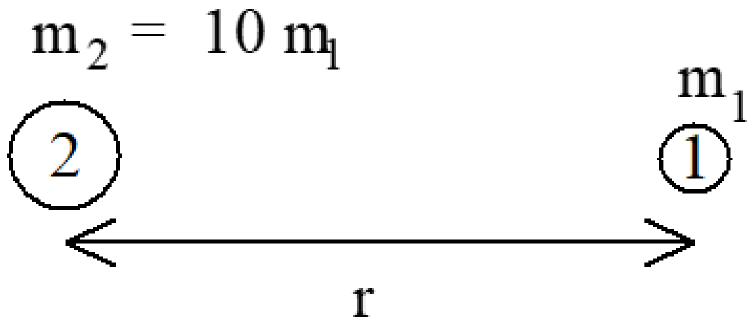
Comments and Questions

- Since all objects have their own gravitational pull, how does this affect magnets if at all?
- Were these methods used for in NASA? Or is there a more complicated formula used?
- I don't understand why when the two balls have different masses why they are exerting the same force on each other. Is this to do with the normal force?
- Is the gravitational force calculated from the center of the mass or from the distance between the two objects? And is it a vector also? Even though it's between two?
- So does this apply to everything? Can I derive the mass of any object by knowing the value of it's gravitational force?

Discuss and Answer:

At a particular instant, two asteroids in inter-galactic space are a distance r = 20 km apart. Asteroid 2 has 10 times the mass of asteroid 1. The magnitudes of the accelerations of asteroids 1 and 2 are a_1 and a_2, respectively.

What is the ratio $\frac{a_1}{a_2}$?



A) 10
B) 1/10
C) 1
D) cannot be determined.

My Comments and Questions

- Comment:

- Question:

Gravitational Energy and Work