Quiz #2 PH306

13 February 2007

Break up into groups of about 6 each.
Use the book, notes, friends, internet – just not anyone in another group.
Take 15min. We will have the groups try to convince the rest of the class about the answers.
I will assign each group one problem.

1. All the planets (except Uranus), the Sun, the Moon, and most large asteroids revolve around the Sun in the same direction. They also rotate on their axes in the same sense. Give us a theory for why this is.

2. Galileo used the existence of craters on the Moon as an important argument against the Ptolemaic theory. What was his argument? Are mountains on the Moon taller, the same, or smaller than on the Earth? Given that gravity is weaker on the Moon, does that mean that mountains can be taller or smaller than the Earth?

3. Kepler's third law says that $P^2 = a^3$ in units of years and Astronomical Units. In the centers of galaxies, the mass is concentrated in the nucleus. The rotation of stars around the galaxy center is seen to be constant as a function of radius. Why does this imply there is "dark matter" – matter which cannot be seen? Remember, the mass of a spherical distribution of matter can be considered to be concentrated at the center of the mass. Give three examples of matter which could appear dark.

4. The escape velocity from an object is $v_{esc} = (2GM/r)^{1/2}$. For the Earth, this is 1.1×10^4 m/s. Note that as r gets smaller v_{esc} gets larger. Use this formula to describe a black hole – an object where light cannot escape. Calculate the size the Earth would have to be if we were to turn it into a black hole. What would happen to the Earth if a black hole with the mass of the Earth hit the Earth? If light can't escape, what happens to the light as it leaves the Earth?

5. Einstein showed that $E=mc^2$. (actually he was not the first to show this). This means a mass at rest has a large total energy. It also means

that light, which has energy (that's why the sun feels warm) also can be considered to have mass. What happens to light as it passes by the sun? Consider two stars on the same side of the Sun (but light years behind the Sun) – one which appears very close to the Sun and one which is far away. From the Earth, does the Sun make the 2 stars seem closer together or farther away? Draw a diagram showing the path of light to prove your point.