The Mass of the Moon

On July 19, 1969 the Apollo-11 Command Service Module and LEM entered lunar orbit. The orbit period was 2.0 hours, at a distance of 1,737 kilometers from the lunar center.

Believe it or not, you can use these two pieces of information to determine the mass of the moon. Here's how it's done!

Problem 1 - Assume that Apollo-11 went into a circular orbit, and that the inward gravitational acceleration by the moon on the capsule, Fg, exactly balances the outward centrifugal acceleration, Fc. Solve Fc = Fg for the mass of the moon, M, in terms of V, R and the constant of gravity, G, given that:

$$F_g = \frac{G\,M\,m}{R^2} \qquad F_c = \frac{m\,V^2}{R}$$

Problem 2 - By using the fact that for circular motion, V = 2 π R / T, re-express your answer to Problem 1 in terms of R, T and M.

Problem 3 - Given that G = 6.67 x 10^{-11} m^3 kg^{-1} sec^{-2}, R = 1,737 kilometers and T = 2 hours, calculate the mass of the moon in kilograms!

Problem 4 – In 1973 a rocket was send to a very distant solar system to collect some kind of information of the planets from that solar system. The obtained information is showed in the following table:

Student (Planet)	G (m^3 kg^{-1} sec^{-2})	At a distance from the planet center (Km.)=Radius of the planet (R)	Orbit period (T) (hours)
Moon	6,67E-11	1737	2
Planet 1	6,67E-11	5800	5
Planet 2	6,67E-11	11500	4
Planet 3	6,67E-11	50500	2
Planet 4	6,67E-11	3500	13

Planet 5	6,67E-11	45000	6
Planet 6	6,67E-11	97000	22
Planet 7	6,67E-11	9500	8
Planet 8	6,67E-11	28000	10
Planet 9	6,67E-11	6450	11
Planet 10	6,67E-11	64000	5
Planet 11	6,67E-11	112000	7
Planet 12	6,67E-11	18000	3
Planet 13	6,67E-11	6400	9
Planet 14	6,67E-11	9000	4
Planet 15	6,67E-11	950	2

Calculate the mass of your planet in <u>kilograms</u>!

Problem 5 – The mass of Earth is 5.97×10^{24} kilograms. What is the ratio of the moon's mass, derived in Problem 3, to Earth's mass? Give your answer in simplest form, and using whole numbers!

Problem 6 – What is the ratio of your planet's mass derived in Problem 4 to Earth's mass?

Problem 7 – Draw a bar chart showing the mass of all the planets of our solar system and include the obtained mass of the planet derived in problem 4 . Look for the data on the internet.

TO REMEMBER:
The whole project must be written on a maximum of 6 sheets, and must include:

1. A title
2. Name and present course
3. Date and Term
4. At the end of your written project you must include a bibliography or references to books, articles, web links, etc. that you have used (e.g. books where you have found solar system distances, or web links where you found them, etc.) In general, all books and web links you have used in the making of **any** part of your project.
5. If you used mathematical references from an outside source, they must be included as well.
6. Your project can be handwritten (It is not compulsory to do it on a computer).

Project deadline: November 25th.