Energy Problems – Set 4

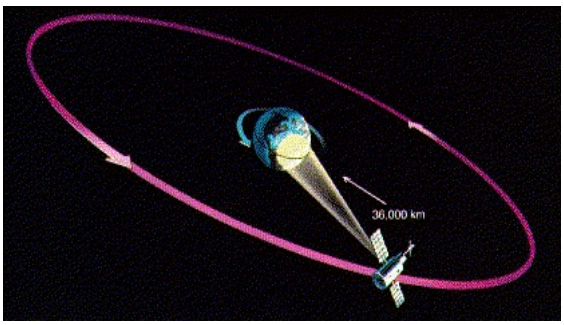
The Zeronians live on a planet with a mass of 5.0×10^{23} kg, a radius of 3.0×10^{6} m. Their planet is rapidly running out of atmosphere (so there's no wind resistance) and, because they enjoy skydiving AND breathing, they have built a space-craft to leave.

a) Their space-craft, which weighs 10 kg (the zeronians are tiny), launched with an initial velocity of 3000 m/s. What will be its velocity at when it is 4.0×10^{6} m from the center of the planet?

b) What maximum altitude will it achieve?

b) What initial velocity does it need to get to escape the planet's gravity completely?
HINT: To “escape” means to get to a distance of infinity from the center of the planet.

Satellites in geosynchronous orbit always remain above the same geographic spot on the Earth's surface, making them extremely handy for communications.
Using what you know about Newton's Universal Law of Gravity and the rotation of the Earth:



a) Use $\vec{F}=m\vec{a}$ to calculate the radius of the geosynchronous orbit.

b) What's the orbital velocity of the geosynchronous satellites?

c) Calculate the amount of energy required to put a 1000kg communications satellite into geosynchronous orbit.

The radius of the Earth is: $R_{Earth} = 6.37 \times 10^{6}$ m.
The mass of the Earth is : MEarth = 5.97×10^{24} kg
The gravitaional constant: G = 6.67×10^{-11} $m^3/(kg\ s^2)$