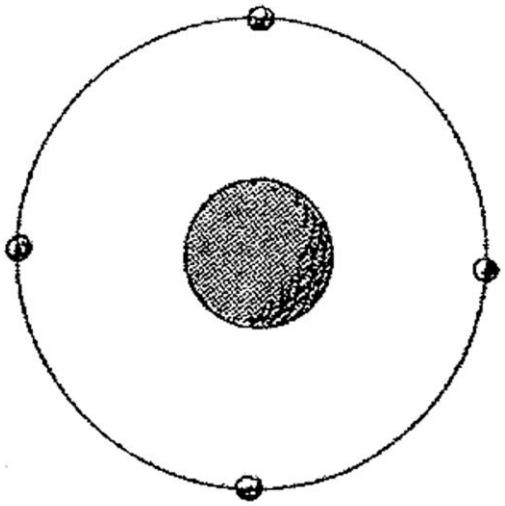
Worksheet 26: Gravity

Newton's gravity formula

$F = G\frac{m_1 m_2}{r^2}$, where $G = 6.6742 \times 10^{-11}$ N·m^2/kg^2, the universal gravitational constant

Gravitational potential energy

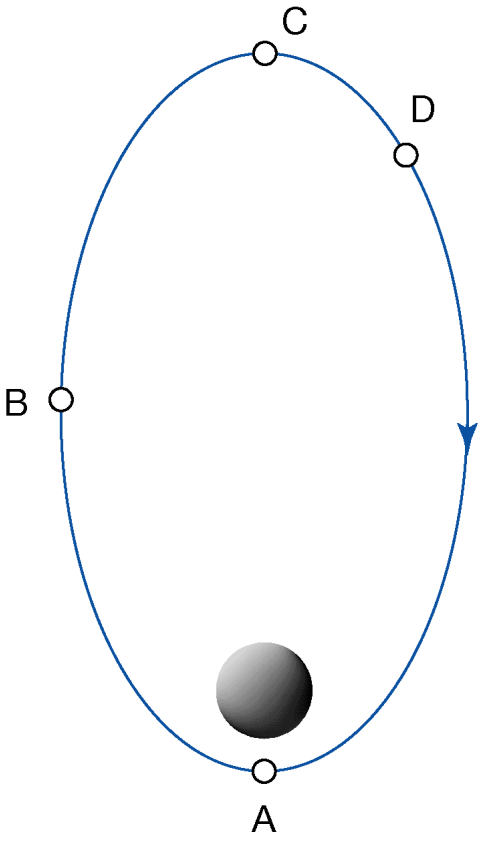
$$U = -G\frac{m_1 m_2}{r}$$



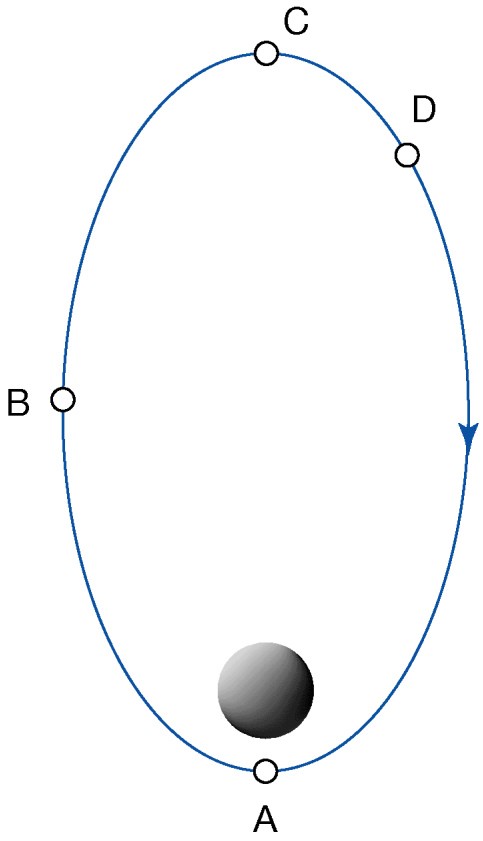
Problems

1. A satellite revolves around its planet in a perfectly circular orbit at a constant speed.
   a. Draw and label force vectors *F*.
   b. Draw and label velocity vectors *v*.
   e. What is the angle between the *F* and *v* vectors? _____
   f. Is there any component of *F* parallel to *v*? _____
   g. Does the satellite's *K* remain constant or vary? _____

2. The picture to the right shows the path of a satellite orbiting a planet.
   a. At which position(s) is the satellite slowing down?
   b. At which position(s) is the satellite speeding up?
   c. At which position(s) is the satellite's direction changing?
   d. At which positions is gravity doing work on the satellite?



3. Rank the positions A, B, C, and D in descending order of the satellite's:



   a. Gravitational force.

   b. Acceleration.

   c. Speed.

   d. Kinetic energy.

   e. Gravitational potential energy.

   f. Total mecuhanical energy ($K + U$).

   g. Angular momentum (about the planet's center).

4. A satellite orbits at a distance r from an attractor of mass M.

   a. What is the tangential speed of the satellite?

   b. What is the orbital period of the satellite?

5 Suppose a satellite orbits the Earth just above the surface (disregard the atmosphere). Earth's mass is 5.97×10^{24} kg, and its radius is 6.38×10^{6} m.

a. What must be the satellite's orbital speed?

b. What is the satellite's orbital period?

6. What distance from the Earth's center would a geosynchronous satellite, with an orbital period of 86,164 s, orbit?