

Physics

Unit 7: Circular Motion, Universal Gravitation, and Satellite Orbits

Satellite Orbits

Satellite Orbits

- How do you put a satellite into orbit around the Earth?
- Isaac Newton understood how to put a satellite into orbit around the Earth almost 400 years ago, but he didn't have the...
 - ...rockets necessary to achieve the necessary propulsion or the...
 - ...computers to do all of the necessary calculations.

--But he did understand how to put a satellite into orbit...

...The Earth may be considered to be flat only for very short distances (a few meters.)

...The Earth curves away from a line tangent to its surface at the rate of 4.9 meters for every 8.0 km. (5 miles)

- ...A projectile that is fired with an initial horizontal velocity will follow a parabolic path until it hits the Earth.
- ...Since its horizontal velocity is constant, and its vertical acceleration is 9.81 m/s^2 , the greater its horizontal velocity, the farther the projectile travels before it hits the ground.

... Since a projectile is accelerated at 9.8 m/s^2 , after 1.0 s it will have fallen 4.9 m :

$$\Delta y = \frac{1}{2} g(\Delta t)^2$$

$$\Delta y = \frac{1}{2} * 9.81 \frac{\text{m}}{\text{s}^2} * (1.0 \text{ s})^2 = 4.9 \text{ m}$$

$$\Delta y = 4.9 \text{ m}$$

... If the satellite travels 8.0 km in one second while it is falling 4.9 m, it will be no closer to the Earth after one second since the Earth has also curved 4.9 m.

...The velocity needed to orbit the Earth near its surface is therefore 8.0 km/s or 8000 m/s; at this velocity the curve of its orbit is the same as the curvature of the Earth.



