

## Answer on Question #65499 – Physics – Mechanics | Relativity

### Question:

A satellite going around Earth in an elliptic orbit has a speed of  $10 \text{ km s}^{-1}$  at the perigee which is at a distance of  $227 \text{ km}$  from the surface of the earth. Calculate the apogee distance and its speed at that point.

### Solution:

We need to know a distance from the center of the earth to satellite (perigee distance):

$$r_p = h + R_{\text{Earth}} = 227 + 6371 = 6598 \text{ km};$$

We can find semi-major axis of orbit:

$$v_p = \sqrt{GM \left( \frac{2}{r_p} - \frac{1}{a} \right)} \Rightarrow \frac{GM}{a} = \frac{2GM}{r_p} - v_p^2 \Rightarrow a = \frac{GM r_p}{2GM - r_p v_p^2} = 18724 \text{ km};$$

Now we will find apogee distance and apogee speed:

$$r_a = 2a - r_p = \frac{2GM r_p}{2GM - r_p v_p^2} - r_p = 30850 \text{ km};$$

$$v_a = \sqrt{GM \left( \frac{2}{r_a} - \frac{1}{a} \right)} = 2.138 \frac{\text{km}}{\text{s}};$$

### Answer:

$$r_a = 30850 \text{ km};$$

$$v_a = 2.138 \frac{\text{km}}{\text{s}};$$