

## The JETS Challenge

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### Challenge 94 – The Sputnik Challenge

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#### Problem:

The space race was launched more than 50 years ago on October 4, 1957, when the former Soviet Union successfully launched Sputnik I as the first manmade satellite to orbit the earth every 96.2 minutes. The satellite was a 58.0 cm-diameter aluminum sphere that weighed about 83 kg. The equation for orbital mechanics is given as

$$T = \frac{2\pi}{\sqrt{\mu}} r^{\frac{3}{2}}$$

where  $T$  = to complete one orbit in seconds  
 $r$  = radius of circular orbit in kilometers  
 $\mu = M \cdot g$  in kg-km/s<sup>2</sup> (= 398,600 for the earth)

Find the radius of Sputnik's orbit in km.

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#### Solution:

96.2 minutes  
58 cm diameter  
83 kg

$$T = \frac{2\pi}{\sqrt{\mu}} r^{\frac{3}{2}}$$

$$T = 96.2 \text{ minutes} \times \frac{60 \text{ sec.}}{1 \text{ min.}} = 5,772 \text{ seconds}$$

$$\mu = 398,600$$

$$5,772 = \frac{2\pi}{\sqrt{398,600}} r^{3/2}$$

$$579,982.7826 = r^{3/2}$$

$$(579,982.7826)^{2/3} = r$$

$$6954.67331 \text{ km} = r$$

$$6,955 \text{ km} = r$$