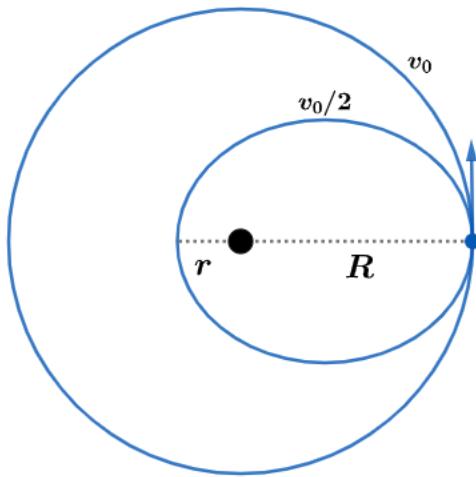


## 2008 F=ma Exam: Problem 25

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Recall for the circular orbit, we have

$$v_0 = \sqrt{\frac{GM}{R}}$$

For the elliptical orbit, the starting point is the apogee so

$$R = a + c$$

$$\frac{1}{2}v_0 = v_{\text{apogee}} = \frac{a - c}{b} \sqrt{\frac{GM}{a}} = \sqrt{\frac{a - c}{a + c}} \sqrt{\frac{GM}{a}}$$

using our results from elliptical orbits (note  $a^2 = b^2 + c^2$ ). Substituting these into the first equation,

$$2\sqrt{\frac{a - c}{a + c}} \sqrt{\frac{GM}{a}} = \sqrt{\frac{GM}{a + c}}$$

$$2\sqrt{1 - \frac{c}{a}} = 1$$

$$\frac{c}{a} = \frac{3}{4}$$

We have

$$\frac{r}{R} = \frac{a - c}{a + c} = \frac{1 - (c/a)}{1 + (c/a)} = \frac{1/4}{7/4} = \frac{1}{7}$$

so the answer is E.