2009 F=ma Exam: Problem 5

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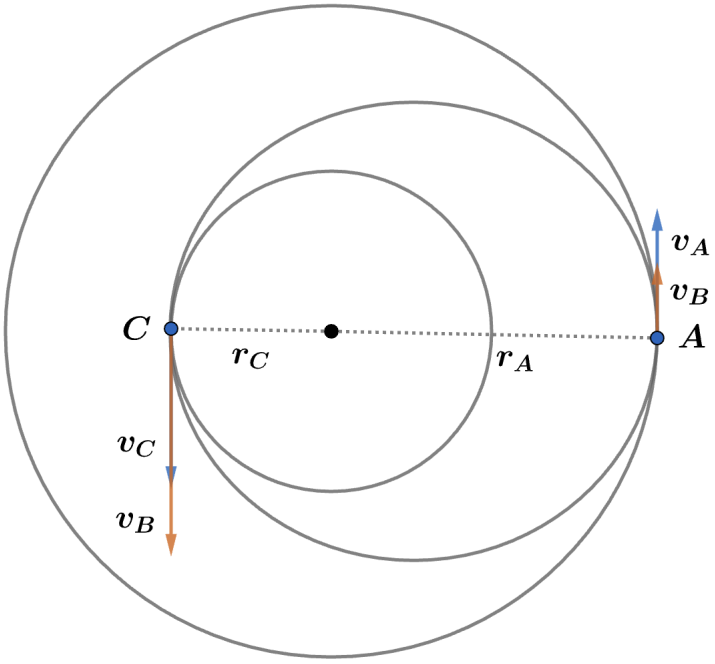
By conservation of angular momentum, each satellite has the same angular momentum at any point along its orbit. Thus, we can shift point A to coincide with the apogee of the ellipse and point C to coincide with the perigee of the ellipse.



Recall the velocity of a circular orbit is

$$v = \sqrt{\frac{GM}{r}}$$

The angular momentum is then

$$L = mvr = m\sqrt{GMr}$$

Since $r_A > r_C$, we have $L_A > L_C$. At the apogee, the velocity v_B of satellite B is smaller than the velocity v_A of satellite A since the ellipse is contained in the A circle. Thus, we have $L_B < L_A$. Similarly, we find $v_B > v_C$ at the perigee since the ellipse contains the C circle. Thus, $L_B > L_C$. Finally, we obtain $L_A > L_B > L_C$ so the answer is $\boxed{\text{A}}$.