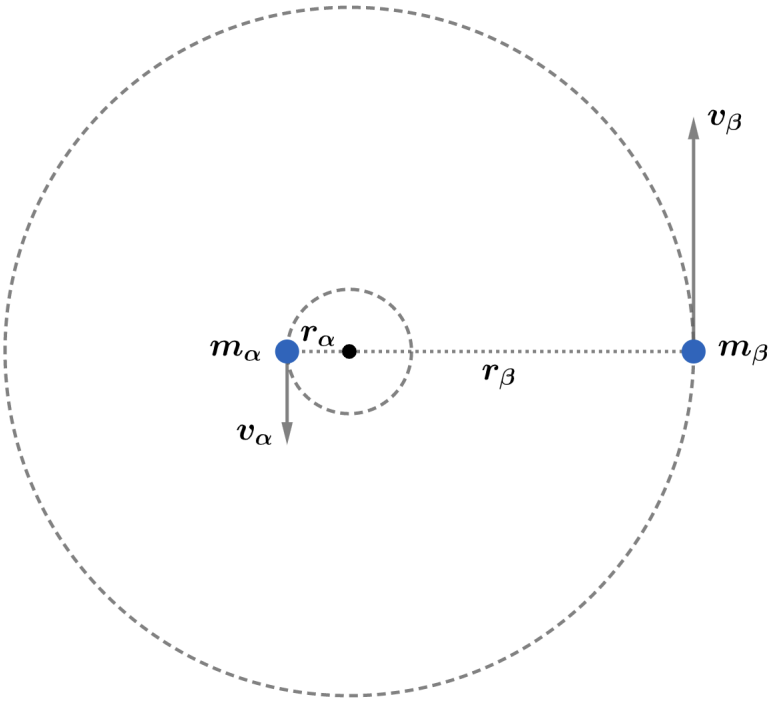
2023 F=ma Exam: Problem 8

Kevin S. Huang



The force of gravity provides the centripetal acceleration so we have

$$F_g = \frac{m_\alpha v_\alpha^2}{r_\alpha} = \frac{m_\beta v_\beta^2}{r_\beta}$$

$$\frac{v_\alpha}{v_\beta} = \sqrt{\frac{m_\beta}{m_\alpha}\frac{r_\alpha}{r_\beta}}$$

Since we are in the CM frame, $m_\alpha r_\alpha = m_\beta r_\beta$ so

$$\frac{v_\alpha}{v_\beta} = \frac{m_\beta}{m_\alpha} = \frac{1}{10}$$

We could have also gotten this by noting that the total momentum is zero in the CM frame so $m_\alpha v_\alpha = m_\beta v_\beta$. Thus, the answer is $\boxed{\text{B}}$.