Question 48

A light inextensible string passes over a smooth pulley. Particles of masses m_1 and m_2 are attached to each end of the string as shown in the diagram. If the mass m_2 accelerates downwards at $\frac{g}{5}\ \text{m/s}^2$, then the ratio $\frac{m_2}{m_1}$ is equal to

A. 1

B. $\frac{3}{2}$

C. $\frac{2}{3}$

D. 5

E. $\frac{5}{4}$

ANSWER B

Consider the mass m_2 moving downwards, resolving downwards,

$(1) \qquad m_2 g - T = m_2 a$

Consider the mass m_1 moving upwards, resolving upwards,

$(2) \qquad T - m_1 g = m_1 a$

to solve for *a* add the two equations to eliminate *T*

$m_2 g - m_1 g = m_2 a + m_1 a$

so that $\qquad (m_2 - m_1) g = (m_1 + m_2) a$

$a = \frac{(m_2 - m_1) g}{m_1 + m_2} = \frac{g}{5}$ and

$\frac{m_2 - m_1}{m_1 + m_2} = \frac{1}{5}$

$\frac{\frac{m_2}{m_1} - 1}{1 + \frac{m_2}{m_1}} = \frac{1}{5}$ let $\alpha = \frac{m_2}{m_1}$

$\frac{\alpha - 1}{\alpha + 1} = \frac{1}{5} \qquad 5(\alpha - 1) = 5\alpha - 5 = \alpha + 1 \qquad 4\alpha = 6$

$\alpha = \frac{3}{2}$