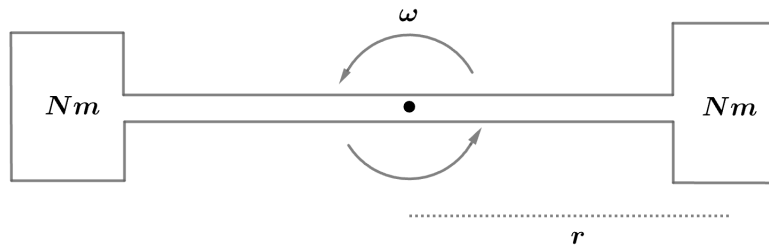# 2007 F=ma Exam: Problem 27

Kevin S. Huang

Let ω be the initial angular velocity of the space station. In the rotating frame, all objects experience a (fictitious) centrifugal force of magnitude $ma_c = m\omega^2 r$ which looks like gravity mg if we have

$$g = \omega^2 r$$

After two astronauts climb into the center, the space station rotates at angular velocity ω' so the artificial gravity becomes $g' = \omega'^2 r$. We can find ω' by conserving angular momentum since no external torque acts on the space station.
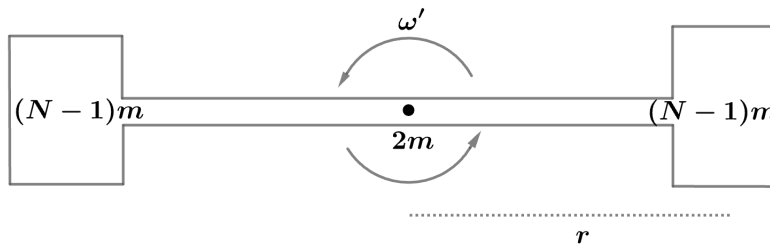
We have

$$L_i = I_i\omega = 2Nmr^2\omega$$
$$L_f = I_f\omega' = 2(N-1)mr^2\omega'$$

Since $L_i = L_f$,

$$\frac{\omega'}{\omega} = \frac{N}{N-1}$$

Finally,

$$\frac{g'}{g} = \frac{\omega'^2}{\omega^2} = \left(\frac{N}{N-1}\right)^2$$

so the answer is $\boxed{\text{E}}$.