

## STEP III, 2008 Q11 MS

11. If the resistance couple (constant) is  $L$ , then using  $L = I\alpha$  for the second phase of the motion,  $L = \frac{I\omega_0}{T}$  and rotational kinetic energy used up doing work against the couple in the second phase gives

$$\frac{1}{2}I\omega_0^2 = L \times n_2 \times 2\pi$$

Hence, eliminating  $L$  and simplifying gives the first result.

If the particle descends a distance  $h$  in the first phase of motion, then  $h = 2\pi n_1$ . If the particle has speed  $v$  at the end of the first phase, then  $v = r\omega_0$  and using the work-energy principle,

$$mgh - L \times n_1 \times 2\pi = \frac{1}{2}I\omega_0^2 + \frac{1}{2}mv^2$$

Hence, eliminating  $h$ ,  $v$  and  $\omega_0^2$  obtains the second result.



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