PROBLEM 2.12

From Problem 2.11, $KE = \frac{1}{2} I \omega^2 \Rightarrow \omega = \left(\frac{2KE}{I}\right)^{1/2}$ where $I = 200\,lb \cdot ft^2$.

The change in potential energy of a 100 lb mass raised 30 ft is

$$\Delta PE = mg(z_2 - z_1) = (100\,lb)\left(32.2\,\frac{ft}{s^2}\right)(30\,ft)\left|\frac{1\,lbf}{32.2\,lb \cdot ft/s^2}\right| = 3000\,ft\,lbf.$$

Thus, with $KE = 3000\,ft \cdot lbf$,

$$\omega = \left(\frac{2(3000\,ft \cdot lbf)}{200\,lb \cdot ft^2}\left|\frac{32.2\,lb \cdot ft/s^2}{1\,lbf}\right|\right)^{1/2} = 31.08\,\frac{1}{s}$$

In terms of RPM

$$\omega = \left(31.08\,\frac{1}{s}\right)\left|\frac{1\,rev}{2\pi}\right|\left|\frac{60\,s}{1\,min}\right| = 297\,rev/min$$