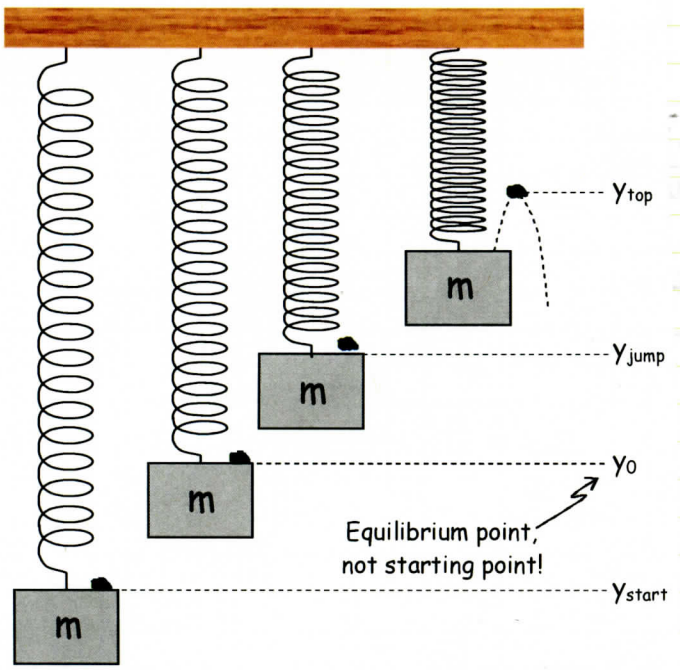
# T3 PR 12.63

T3 12.63 A ROCK RIDES ON A BLOCK OSCILLATING AT 4 Hz AND A = 7 cm AND DOES NOT EFFECT THE OSCILLATION.

a) AT WHAT HEIGHT DOES THE ROCK JUMP?
b) WHAT'S ITS SPEED
c) WHAT'S THE ROCK'S GREATEST HEIGHT?




a) FIND $y_{JUMP}$

$$\Sigma F_{ROCK} = m a_{ROCK}$$

WHERE $a_{ROCK} = a_m$

$$= -\omega_N^2 A \cos(\omega_N t)$$

$\Rightarrow y(t=0) = -A \Rightarrow \delta = 0$

(WHEN $y > 0$, $a < 0$)

$$N - m_R g = -m\omega_N^2 A \cos(\omega_N t)$$

THE ROCK LOSES CONTACT WHEN $N \to 0$

$$\Rightarrow m_R g = m_R \omega_N^2 A \cos(\omega_N t_J)$$

SINCE $y_J = A\cos(\omega_N t_J)$

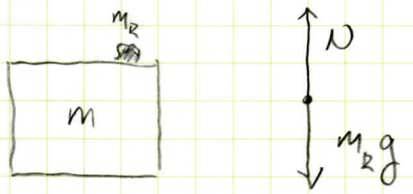
$$g = \omega_N^2 y_J$$

$$y_J = \frac{g}{\omega_N^2} = \frac{9.8}{(8\pi)^2}$$

$$y_J = 0.0155\,m$$

$$\boxed{y_{JUMP} = 1.55\,cm}$$

$\omega_N = 2\pi\nu_N = 8\pi$ RAD/s




b) AT $y_{JUMP}$ THE ROCK HAS THE SPEED OF THE BLOCK

$\Rightarrow$ FIND $v(t_{JUMP})$

$$v_{ROCK} = \omega_N A \sin(\omega_N t_J)$$

TO AVOID SOLVING FOR TIME; MORE ACCURATE

$$v_R^2 = \omega_N^2 \left[A^2 - A^2\cos^2(\omega_N t_J)\right] = \omega_N^2 \left[A^2 - y_{JUMP}^2\right]$$

$$v_R = \omega_N \sqrt{A^2 - y_{JUMP}^2} = 8\pi\sqrt{7^2 - 1.55^2} = \boxed{171.6\ \frac{cm}{s} = v_R}$$

NOTE BOOK

c) WHAT'S $y_{TOP}$?

ABOVE $y_{JUMP}$ IT'S A PROJECTILE

$$\cancel{v_{TOP}^{\,0}} = v_{JUMP}^2 - 2g(y_{TOP} - y_{JUMP})$$

$$y_{TOP} - y_{JUMP} = \frac{v_R^2}{2g} + y_{JUMP}$$

$$y_{TOP} = \frac{(171.6)^2}{2(980)} + 1.55$$

$$\boxed{y_{TOP} = 16.6\,cm}$$