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Problem 15, HW 2, Phys 416

From Euler Method wht.

(1) $$\omega_{n+1} = \omega_n + \tau a_n$$
$$\theta_{n+1} = \theta_n + \tau \omega_n$$

$$E_{n+1} = \frac{1}{2} m L^2 \omega_{n+1}^2 + \frac{1}{2} mgL\theta_{n+1}^2 - mgL$$

Substitute with (1)

$$\Rightarrow E_{n+1} = \frac{1}{2} mL^2 (\omega_n + \tau a_n)^2 + \frac{1}{2} mgL(\theta_n + \tau \omega_n)^2 - mgL$$

$$= \frac{1}{2} mL^2 \omega_n^2 + \left(mL^2 \omega_n \tau a_n + \frac{1}{2} mL^2 \tau^2 a_n^2\right)$$
$$+ \frac{1}{2} mgL\theta_n^2 + \left(mgL\theta_n \tau \omega_n + \frac{1}{2} mgL\tau^2 \omega_n^2\right)$$
$$- mgL$$

$$\Rightarrow E_{n+1} = E_n + \left(mL^2 \omega_n \tau a_n + \frac{1}{2} mL^2 \tau^2 a_n^2\right)$$
$$+ \left(mgL\theta_n \tau \omega_n + \frac{1}{2} mgL\tau^2 \omega_n^2\right)$$

$$\Rightarrow E_{n+1} > E_n$$

□