(1): $\omega_0 = \sqrt{\frac{s}{m}} = \left[\frac{16\ N/m}{0.01\ kg}\right]^{1/2} = 40\ sec^{-1}$

$f = \frac{\omega_0}{2\pi} = 6.37\ Hz$ $T = \frac{1}{f} = 0.157\ s$

(2) (a) INITIAL CONDITIONS $\psi(0) = 0$ $\dot{\psi}(0) = 0.2\ m/s$ $\omega_0 = 1\ s^{-1}$

ASSUMING $\psi(t) = A\cos(\omega_0 t + \phi)$

$\psi(0) = A\cos\phi$

$\dot{\psi}(t) = -\omega_0 A \sin(\omega_0 t + \phi)$

$\dot{\psi}(0) = -\omega_0 A \sin\phi$

SOLVE FOR $A = \sqrt{(\psi(0))^2 + \left(-\frac{\dot{\psi}(0)}{\omega_0}\right)^2} = 0.2\ m$

$\tan\phi = -\frac{\dot{\psi}(0)}{\omega_0 \psi(0)} = \infty$ SO $\phi = \pm\pi/2$

SINCE $\dot{\psi}(0) = 0.2\ m/s > 0 = -\omega_0 A \sin\phi$

$\sin\phi$ MUST BE NEGATIVE, $\phi = -\pi/2$

FINALLY $\psi(t) = 0.2\cos(\omega_0 t - \pi/2)$

YOU WILL GET A DIFFERENT ϕ IF YOU CHOOSE $\psi(t) = A\sin(\omega_0 t + \phi)$

(2) (b) $\omega_0 = 0.3\ s^{-1}$

$\psi(0) = -1.2\ m$ $\dot{\psi}(0) = 0$

AGAIN ASSUMING $\psi(t) = A\cos(\omega_0 t + \phi)$

② ⓑ $A = \left[(\psi(0))^2 + \left(-\frac{\dot\psi(0)}{\omega_0} \right)^2 \right]^{\frac{1}{2}} = 1.2 \text{ m}$

$\tan\phi = -\frac{\dot\psi(0)}{\omega_0 \psi(0)} = 0$ SO $\phi = 0$ OR π

SINCE $\psi(0) = A \cos\phi < 0$ AND $A > 0$

WE MUST CHOOSE $\phi = \pi$

$$\psi(t) = 1.2 \cos(\omega_0 t + \pi)$$

③ THE WORDING OF THIS PROBLEM IS AMBIGUOUS

ⓐ IF WE CHOOSE TO READ IT AS $A = 0.01$ m

$x(t) = A \sin(\omega t + \delta)$

$E = \frac{1}{2} S A^2$ IS INDEPENDENT OF δ

FROM PROBLEM ① $S = 16$ N/m

$E = \frac{1}{2}\left(16 \frac{N}{m}\right)(0.01 \text{ m})^2 = $ <u>8×10^{-4} JOULES</u>

ⓑ OTHERWISE COULD INTERPRET TO MEAN:

$x(0) = 0.01$ m $\quad \delta = 0.367$

THEN $x(0) = A \sin\delta \rightarrow A = \frac{x(0)}{\sin\delta} = \frac{0.01 \text{ m}}{\sin(0.367)}$

$A = 0.028$ m

$E = \frac{1}{2} S A^2 = $ <u>6.2×10^{-3} J</u>

$\delta = 1.263$

$A = \frac{x(0)}{\sin\delta} = 1.05 \times 10^{-2}$ m

$E = 8.8 \times 10^{-4}$ J

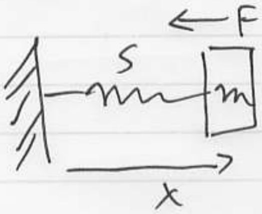
PH 351 HW 1 (3)

PROBLEM 1-5, PAIN.

- IGNORE GRAVITY AND FRICTION
- ASSUMING REST LENGTH OF SPRING = 0

*

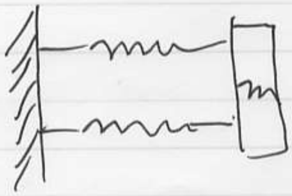
(A)



$F = -sx$

$m\ddot{x} = -sx \rightarrow \omega_A^2 = \frac{s}{m}$

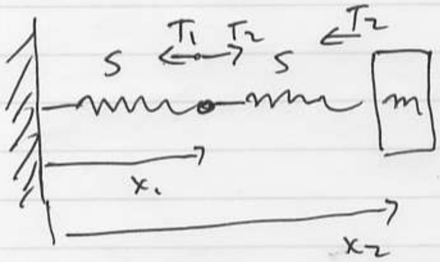
(B)



OBVIOUSLY $F = -2sx$

$m\ddot{x} = -2sx \qquad \omega_B^2 = \frac{2s}{m}$

(C)



T_1 = TENSION IN SPRING 1

$= -sx_1$

T_2 = TENSION IN SPRING 2

$= -s(x_2 - x_1)$

FORCE ON MASS $= T_2$ SO

$m\ddot{x}_2 = -s(x_2 - x_1)$

NEED TO SOLVE FOR x_1

USE: $T_1 = T_2$ OTHERWISE SPRING AT x_1 WOULD ACCELERATE,

SO: $-sx_1 = -s(x_2 - x_1) \Rightarrow x_1 = \frac{x_2}{2}$

THEN: $m\ddot{x}_2 = -s\left(x_2 - \frac{x_2}{2}\right) = -\frac{s}{2}x_2$

$\omega_C^2 = \frac{s}{2m}$

$$\boxed{\omega_B^2 : \omega_A^2 : \omega_C^2 = 1 ; 2 ; 4}$$