PHYC303 Quiz 7 Name SOLUTIONS

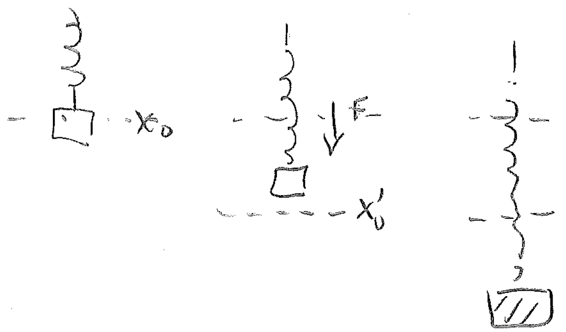
Assume ideal springs. $\omega = \sqrt{\frac{k}{m}}$.

1. A mass m hangs (in the Earth's gravity) from a spring. The system has an angular frequency of 2 rad/sec. The mass is initially at rest.

a) A constant downward force F is applied for a time Δt. What should Δt be if you want the largest possible subsequent oscillation of the mass?

Natural frequency is unchanged, only rest point shifts. (down).

Want ½ cycle $T = \frac{2\pi}{\omega}$ = period, so $t = \frac{\pi}{\omega} = \frac{\pi}{2}$ s.



release here for max amplitude

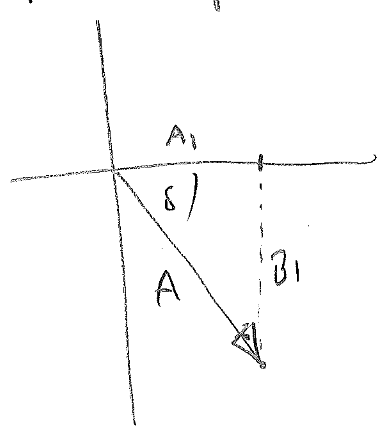
b) Instead, the mass is set into motion so that, at t=0, the position of the mass is +4 m from its resting position, and the speed of the mass is +12 m/s (+ measured downward.)

If the position of the mass is written as x=Acos(ωt -δ), (measured from the rest position)what are A and δ?

$x = A_1 \cos\omega t + B_1 \sin\omega t = +4$ @ $t=0$ $A_1 = +4$ (m)

$\dot{x} = -\omega A_1 \sin\omega t + \omega B_1 \cos\omega t = +12$ @ $t=0$ $B_1 = \frac{+12}{2} = +6$ (m)

phasor diagram



$A = \sqrt{16+36} = \sqrt{52} = 7.21$ m

$\delta = \arctan\frac{6}{4} = 56.3^\circ = 0.98$ rad

-OVER-

2. The amplitude of a mass-spring system is 2 m. When the mass is at 1 m from the resting position, its speed is 1 m/s.

What is the angular frequency of the motion, ω?

$U = \frac{1}{2}kx^2$ $\quad E = \frac{1}{2}\cdot k\cdot 2^2$

when mass is at $x = 1$, $U = \frac{1}{2}k\cdot 1^2$ so $T = \frac{3}{2}k = \frac{1}{2}mv^2$

$$3\frac{k}{m} = v^2$$

$$\sqrt{\frac{k}{M}} = \frac{v}{\sqrt{3}}$$

$$\omega = \frac{1}{\sqrt{3}} \cdot s^{-1}$$

OR

$x = A\sin\omega t$

$1 = 2\sin\omega t$

$\sin\omega t = \frac{1}{2}$ $\quad \omega t = 30°$

$\dot{x} = \omega A\cos\omega t = 1\ m/s$

$$\omega = \frac{1\ m/s}{2m\cdot\cos 30°} = \frac{1}{\sqrt{3}}s^{-1}$$