PHYS M20C: Modern Physics-31376 19 97
Quiz #1 – Thursday, January 17th, 2019

Name: Jared Fowler

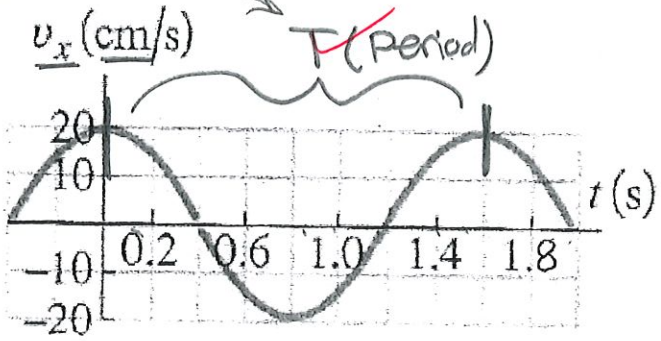
Academic Integrity: I certify that this is my own work. **Signature:** Jared Fowler

Read problems carefully (>twice!), write only on this sheet, show all work, and box your final answers.

1) A mass m is attached to a spring of force constant 75 N/m and allowed to oscillate. The figure below shows its velocity v_x as a function of time t.
Determine

a) the period; [4 points]

$T = \frac{2\pi}{\omega}$ s 1.6 Seconds



b) the angular frequency; [4 points]

$\omega = 2\pi f = ?$

$= 2\pi \frac{1}{T}$

$= 2\pi \frac{1}{1.6} =$ 3.93 rads/s

$x(t) = A\cos(\omega t + \phi)$

$v(t) = \frac{dx}{dt} = -\omega A \sin(\omega t + \phi)$

$v(0) = .2 = -\omega A \sin(\omega t + \phi)$

image at equilibrium v_{max}

$\omega = \sqrt{\frac{k}{m}}$

$v_{max} = .2$ m/s @ $v(0)$

c) the amplitude; [4 points]

Show Algebraic First

$A = ?$

SAF -1

$v(0) = .2 = (-3.93)(A)$

$v = \omega A$

$A = \frac{v}{\omega} = \frac{.2}{3.93}$

$A =$ 0.0509 m

-1

Booo! → Don't worry. @ M.C. 90%+ → A

$x(t) = A\cos(\omega t + \phi)$ $\omega = \sqrt{\frac{k}{m}}$ $\omega = 2\pi f$ $f = \frac{1}{T}$ $\frac{dx^2}{dt^2} = -\frac{k}{m}x$

$K = \frac{1}{2}mv^2$ $U = \frac{1}{2}kx^2$ $E = K + U = \frac{1}{2}kA^2$ $K_i + U_i + W_{NC} = K_f + U_f$

d) the maximum acceleration of the mass; [4 points]

$a_{max} = \omega^2 A$

b/c $x(t) = A\cos(\omega t + \phi)$

$v(t) = \frac{dx}{dt} = \underbrace{-\omega A \sin(\omega t + \phi)}_{v_{max}}$

$a(t) = \frac{d^2x}{dt^2} = \underbrace{-\omega^2 A}_{a_{max}} \cos(\omega t + \phi)$

$a_{max} = (3.93)^2(0.0509)$

$= \boxed{0.786\ m/s^2}$

e) the mass m. [4 points]

$m = ?$

$\omega = \sqrt{\frac{k}{m}}$

$\frac{k}{m} = \omega^2$

$m = \frac{k}{\omega^2} = \frac{75\ N \cdot m}{(3.93\ rad/s)^2} = \boxed{4.86\ kg}$

$x(t) = A\cos(\omega t + \phi)$ $\quad \omega = \sqrt{\frac{k}{m}}$ $\quad \omega = 2\pi f$ $\quad f = \frac{1}{T}$ $\quad \frac{dx^2}{dt^2} = -\frac{k}{m}x$

$K = \frac{1}{2}mv^2$ $\quad U = \frac{1}{2}kx^2$ $\quad E = K + U = \frac{1}{2}kA^2$ $\quad K_i + U_i + W_{NC} = K_f + U_f$