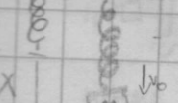
HW 23

1)



$m = 6.4\ kg$ $\quad v_0 = 3.9\ m/s$ $\quad x = 0.29\ m$

a) constant k? $\quad F = -kx = mg \quad -k(0.29\ m) = (6.4\ kg)(9.8\ m/s^2)$

$k = 216.27586\ N/m$

b) f? $\quad T = 2\pi\sqrt{\frac{m}{k}} \quad f = 1/T$

$T = 2\pi\sqrt{\frac{6.4}{216}} = 1.080861\ s \quad f = \frac{1}{T} \approx 0.925\ Hz$

c) $v(0.42\ s)$? $\quad$ Max $v = 3.9\ m/s$ so

$v(t) = 3.9\cos(5.8132t)$ or $3.9\sin(5.8132t + \pi/2)$

$v(0.42s) \approx -2.98\ m/s$

d) a_{max}? $\quad F = ma = -kx$

$a = -22.67\sin(5.8132t) \quad a' = -131.7931\cos(5.8132t) = 0$

$a(0.27) = -22.67\sin(5.8132 \cdot 0.27)$ $\quad 5.8132t = \pi/2$

$= -22.67\sin(1.57)$ $\quad t = 11.626\ s \approx 0.27\ s$

$= -22.67\ m/s$

e) Force @ $t = 0.42\ s$

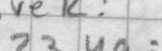
$F = ma = -kx$

$F(0.42) = 6.4(22.67) \approx 145.0971\ N$

2)

$m = 4.8\ kg \quad k_L = 28\ N/m \quad k_R = 53\ N/m$

$x_0 = 0.29\ m$

a) ΣF? 

$F_{SL} = -kx = (28\ N/m)(-0.29\ m) = -8.12\ N$

$F_{SR} = 15.37\ N \quad \Sigma F = -23.49\ N$

b) Effective k? $\quad -23.49 = -k(-0.29) \quad k = 81\ N/m$

c) T?

$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{4.8}{81}} = 1.5295\ s$

d) Reach equil for 1st time?

$\frac{\pi}{2}$, not 2π so $T/4 \approx 0.382385\ s$

e) speed @ equil? $U_s = \frac{1}{2}kx^2$ $\quad K_e = \frac{1}{2}mv^2 \quad kx^2 = mv^2$

$v = \sqrt{\frac{k}{m}x^2} \approx 1.19\ m/s$

f) acceleration? @ equil

$x(t) = -0.29\cos(4.1079t) \quad 0 \to t = 0.3824\ s$

$v(t) = 1.19129\sin(4.1079t)$

$a(t) = 0.345476\cos(4.1079t)$

$a = 0$

g) x at $t = 0.98\ s$? $\quad 0.184\ m$

h) ΣF @ 0.98s? $\quad F = -kx = -81(0.184\ m) = -14.904\ N$