Phy 4A 12/7

Wednesday, December 7, 2016 10:04 AM

Goals for the Lecture:

1) Understand that cyclical motion can be described by sin and cos trig functions
2) Understand how energy is conserved in SHM and use it to solve problems

   Understand how these concepts relate to the pendulum and use them to solve problems

SHM

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

A = amplitude

ω = angular frequency = $2\pi f$ $\left(\frac{rad}{sec}\right)$

ϕ = phase angle (sets initial conditions)

f = frequency $\left(\frac{cycles}{second}\right)$ units: s^{-1} or Hz

T = period $\left(\frac{seconds}{cycle}\right)$ units: s

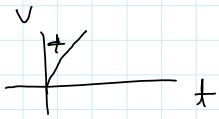
$$T = \frac{1}{f}$$

Worksheet P. 226

a) $T = 8$ sec

b) $f = \frac{1}{T} = \frac{1}{8}$ Hz

c) to the left (← direction)



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

find: A, ω, ϕ $\qquad \omega = 2\pi f = \frac{\pi}{4}\ \frac{rad}{s}$

$$v(t) = -\underbrace{\omega A}_{4}\sin(\omega t + \phi)$$

$$\omega A = 4$$

$\omega A = 4$

$A = \frac{4}{\omega} = \frac{4}{\frac{\pi}{4}} = \frac{16}{\pi}$

at $t = 0$ $\quad x(0) = -A = A\cos(\omega(0) + \phi)$

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

$-1 = \cos\phi$

$\phi = \pi$

$\phi = 0$ or ~~π~~

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p. 229

a) D, E, F

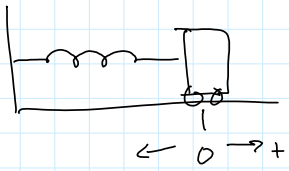
b) A, E

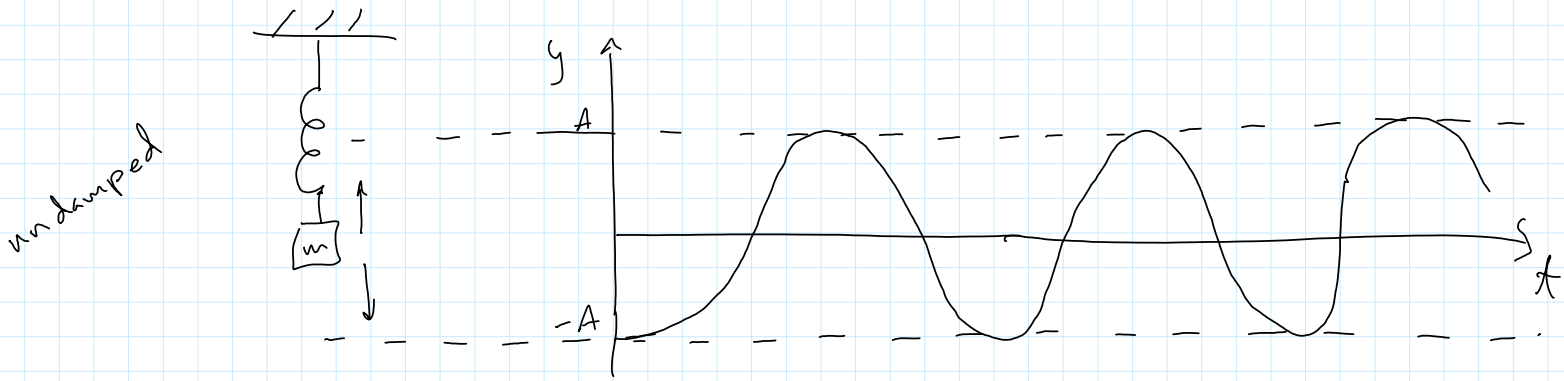
c) C, G

d) None

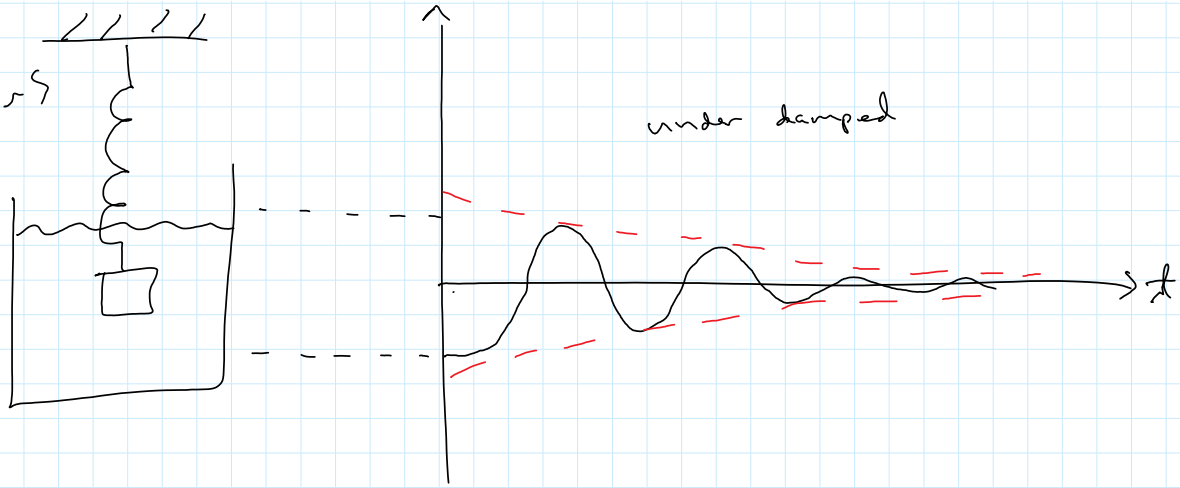
e) A, B, D, E, F, H

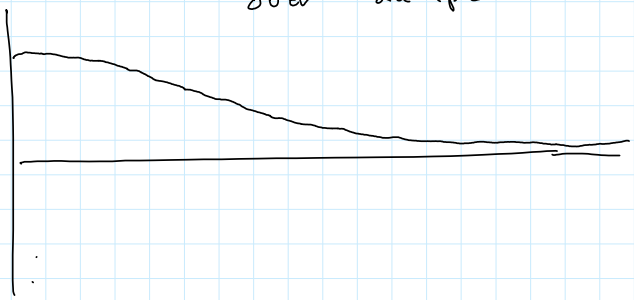
f) D, H

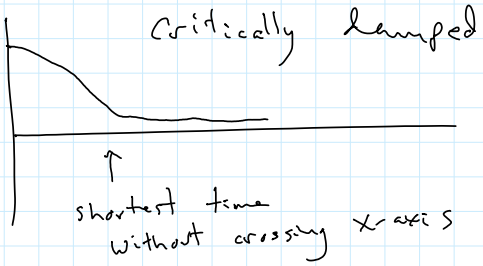




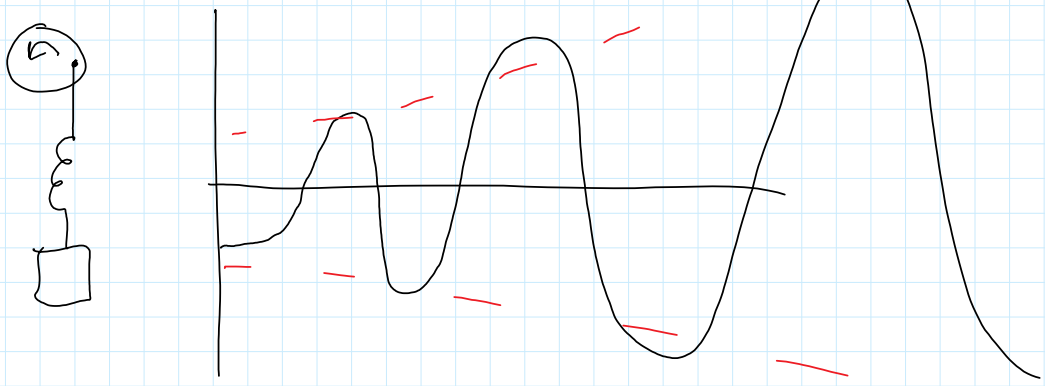
Damped oscillations







driven oscillations



Worksheet p.233

a) None

b) A, E

b) A, E

c) all the same

d) None (Never Negative)

e) B, C, D, F, G, H (all Non-Zero KE, Never Negative)

f) C, G

g) A, E

P. 231

point	a	V	x	F_{Net}
A	−	0	+	−
B	−	−	+	−
C	0	−	0	0
D	+	−	−	+
E	+	0	−	+
F	+	+	−	+
G	0	+	0	0
H	−	+	+	−

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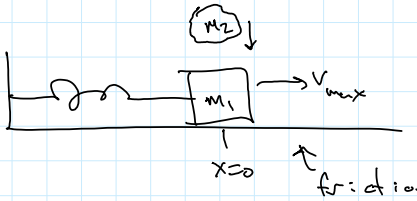
ch 13: 15, 39, 61

ch 15: ~~71~~, ~~85~~

Ch 15 # 71



$m_1 = 4$ kg

$k = 100 \frac{N}{m}$

$A = 2$ m

$m_2 = 6$ kg

← max velocity prior to collision

Find V_1

use momentum:

$$(P_i)_x = (P_f)_x$$

$$(P_{1x})_i + (P_{2x})_i = (P_{1+2_x})_f$$

$$\frac{1}{2} k A^2 = \frac{1}{2} m_1 V_1^2$$

$$V_1 = A\sqrt{\frac{k}{m}}$$

$$m_1 v_1 + 0 = (m_1 + m_2) v_f$$

$$v_f = \left(\frac{m_1}{m_1 + m_2}\right) v_1 = \frac{4}{10} A \sqrt{\frac{k}{m_1}} = 4$$

with both stuck together

$$v_{max} = 4 \ \frac{m}{s}$$

$$m = 10 \ kg$$

$$\frac{1}{2} m v_{max}^2 = \frac{1}{2} k A^2$$

$$(10)(4)^2 = 100 A^2$$

$$A = 1.26 \ m$$

$$\omega = \sqrt{\frac{k}{m}} = \sqrt{\frac{100}{10}} = \sqrt{10}$$

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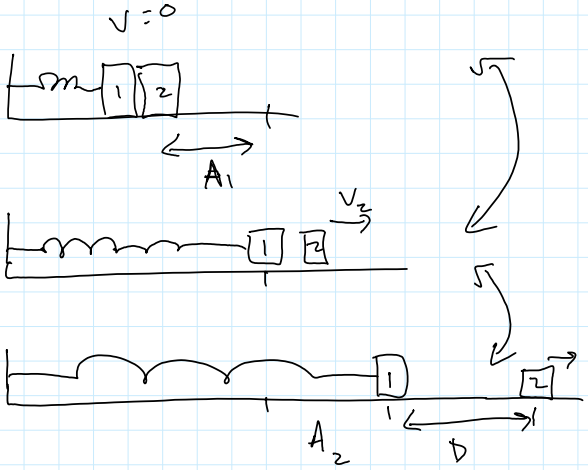
ch 15 - 85



$$\frac{1}{2} k A_1^2 = \frac{1}{2} (m_1 + m_2) v_2^2$$

$$v_2 = \_\_\_$$

$$\frac{1}{2} m_1 v_2^2 = \frac{1}{2} k A_2^2$$

$$A_2 = \_\_\_$$

m_1 only

$$\omega = \sqrt{\frac{k}{m_1}} \qquad f = \frac{1}{2\pi} \sqrt{\frac{k}{m_1}}$$

$$T = \frac{1}{f} = 2\pi \sqrt{\frac{m_1}{k}}$$

time $t = \frac{T}{4}$

$$D + A_2 = v_2 t$$

$$D = v_2 t - A_2$$

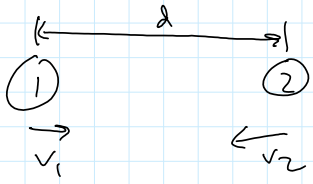
Ch 13-61

initial

(1) $v_1 = 0$

(2) $v_2 = 0$

final



$$E_i = E_f$$

$$K_i + U_{g_i} = K_f + U_{g_f}$$

$$0 = \frac{1}{2} m_1 v_1^2 + \frac{1}{2} m_2 v_2^2 - \frac{G m_1 m_2}{d}$$

2 unknowns

$$P_i = P_f$$

$$0 = m_1 v_1 - m_2 v_2$$