Test 3 Review

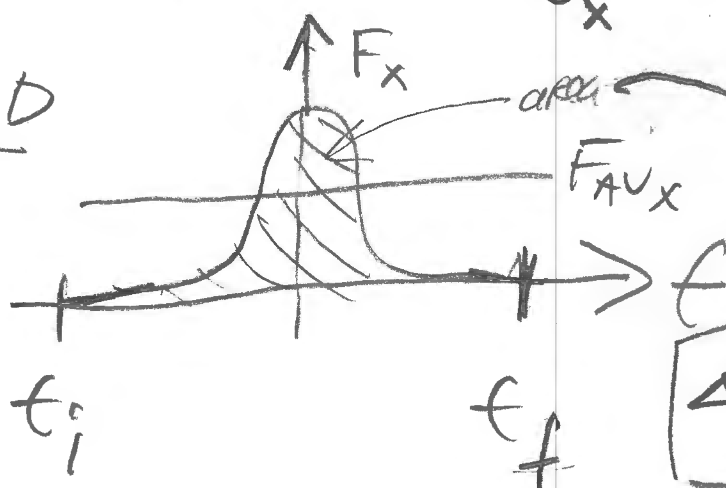
4-29-13

Ch. 8

Basic ch8 cheat sheet:

$\vec{p} = m\cdot\vec{v}$. $\quad J_x = \Delta p_x = \int_{t_i}^{t_f} F_x\,dt$

1-D



$$\boxed{\Delta p_x = F_{AV_x}\cdot\Delta t}$$

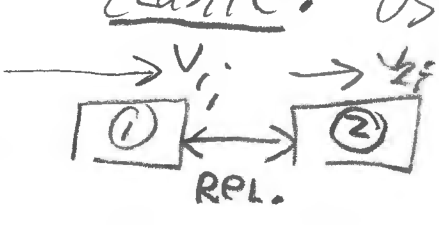
$J_x = mv_{f_x} - mv_{i}$

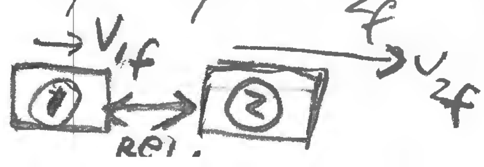
$\Delta t = t_f - t_i$

$\sum p_x$ before $= \sum p_x$ after ; $\sum p_y$ before $= \sum p_y$ after

$\rightarrow$ x(pos) $m_1 v_{1_i} + m_2 v_{2_i} = m_1 v_{1f} + m_2 v_{2f}$

Elastic: use also $v_{1_i} - v_{2_i} = v_{2f} - v_{1f}$ = relative speed.





Inelastic: just use,

$\longrightarrow x$(pos) (1D) $m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$

$0 < v_i \rightarrow$ }
$0 > v_f \leftarrow$ } conventions

PROBLEM CLASS	CONCEPT
CLASS 1	$\vec{p}$ = constant; ALSO Energy = constant (CH 7)
Class 2	cm: center of MASS $x_{cm} = \dfrac{\sum m_i x_i}{\sum m_i}$, ETC. IF $\vec{p}$ = constant, $\vec{V}_{cm}$ = CONSTANT
Class 3	Elastic collisions $\vec{p}$ = constant and $\lvert \vec{v}_{rel} \rvert$ = constant
CLASS 4	2D problems

NOTE: inelastic EQUATIONS ARE ALSO REQUIRED for Test 3.

CLASS TABLE: CH8

CLASS1: 24, 43, 83*, 86, 85, 82 (Momentum and Energy)

CLASS2: 51, 54, 55, 51, 54, 107 (CM)

CLASS3: 46, 48, 49 (ELASTIC)

CLASS4: 41, 43, 86 and other 20 problems

*CLASSIC!

we did this! class 1

C.M. class 2 use calculus or other methods to find CM

QUIZ 10 - CH 8 - MOMENTUM AND ENERGY ((SAMPLE TEST 3, FOR ENERGY) AND (SAMPLE TEST 4 SPRING '11, FOR MOMENTUM) (ANSWERS)

class 4 — BACKWARDS

8, 13, 22, 24, 28 (TRY 95), 31, 36, 41, 43 (TRY 82), 46, 48, 49, 51, 54, 55 (TRY 51 AND 54), 57(TRY 107), 82 (TRY 43), 86. class 3 , 83 , 85

TRICKY

DISCUSSIONS POSTED BELOW:

Same class! If you know 86 and 95, you should know 83, 85

8. (a) IMPULSE = CHANGE IN MOMENTUM. See Example 8.2 and also note this problem is related to the last lab-- A VERNIER LAB WILL HAVE A MINI LAB ON THIS SUBJECT.

Note: $m*v_f - m*v_i$ = change in momentum where v_i and v_f represent velocity components along the x - axis. Let rightward be positive. For example the pitched ball initially moves to the right, so v_i is positive and equals +45.0 m/s. After impact with the bat, the ball moves left in the negative direction; thus $v_f <$ 0 and equals - 55.0 m/s .

(b) Clearly the x-component of force F_x is negative. We have $m*v_f - m*v_i = F_x$ *change in time. Note F_x is the average force. Normally, Impulse = $m*v_f - m*v_i$ = area under the force curve, obtained via integration. But it can be shown that the area under the curve = average force *(change in time) from the MEAN VALUE THEOREM FOR INTEGRALS (Review Math 1) .

13.

(a) IMPULSE = CHANGE IN MOMENTUM. The problem seems to have been plucked from EXP 20 VERNIER where you had to analyze the shape of the force curve. In the experiment, clearly the shape was not a perfect rectangle like this idealization , but the main concepts apply: The area under the curve represents the change in momentum resulting from the force. $| m*v_f - m*v_i |$ = area under the force curve. Note we have given you the magnitude of the change in momentum or impulse since the force curve plots the force magnitude.

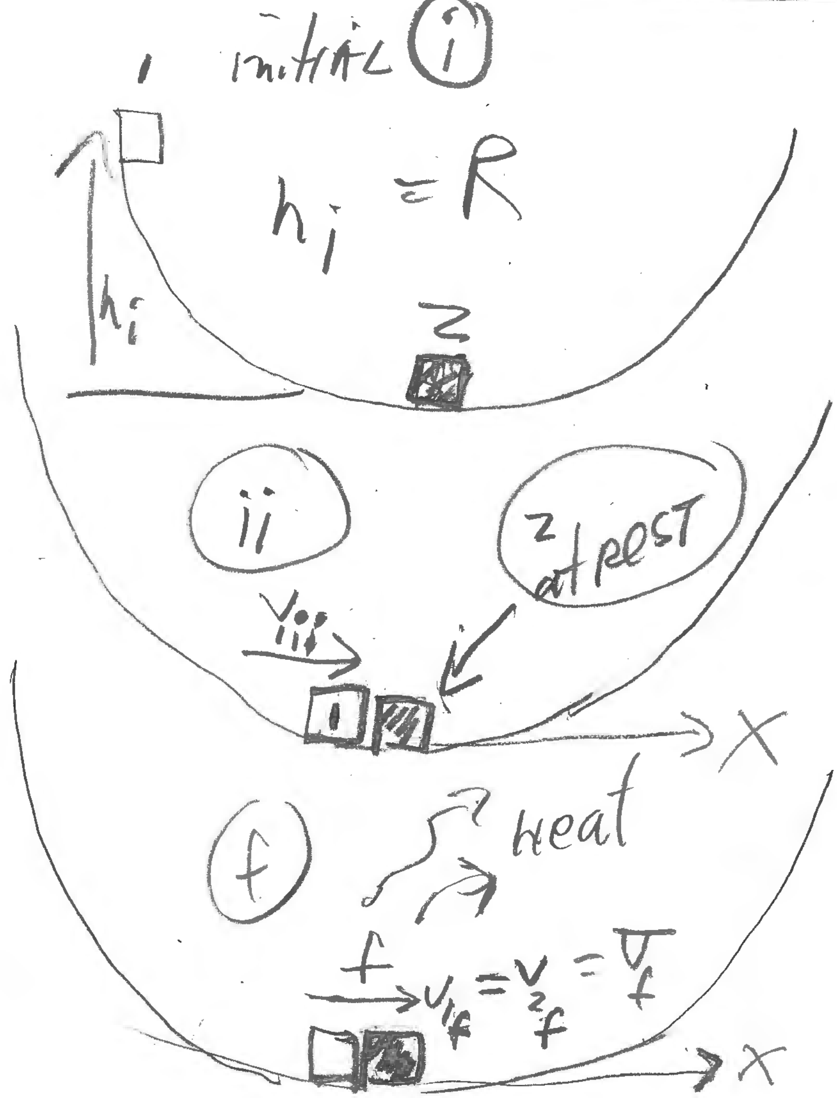
(b) Assume the rightward direction is positive. You are given v_i = +5.00 m/s. To get the exact signed component of impulse you would write:
$m*v_f - m*v_i$ = area under the force curve.

(i) If the force acts rightward $m*v_f - m*v_i$ = area under the force curve = positive area of rectangle, in which case the final velocity component will be greater than the initial velocity component.
(ii) If the force acts leftward $m*v_f - m*v_i$ = area under the force curve = negative area of rectangle, in which case the final velocity component will be less

Note: before this.
Review, the solutions are posted
already: mvaphysics.com

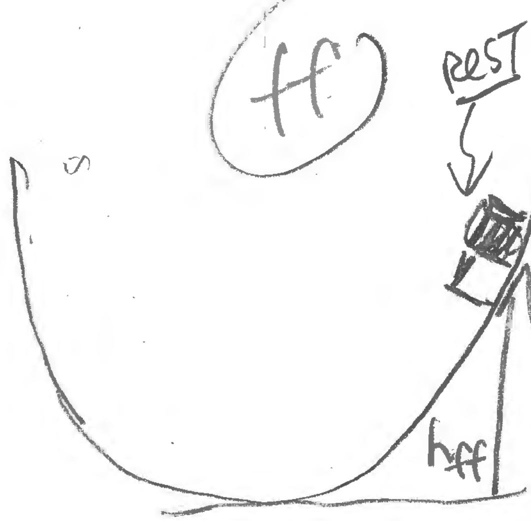
test 3 review

(86) → $\boxed{83, 85, 43}$



freethinking!!

$h_{ff} < h_i$
$v_f < v_{1ii}$



stuck together

inelastic → Heat generated during collision

86.

$h_{ff} = ?$

i. $\rightarrow$ ii to $v_{1_{ii}}$.

Use CMS $\quad KE_i + U_i = KE_{ii} + U_{ii}$

$$0 + mgR = \frac{1}{2}mv_{1_{ii}}^2 + 0$$

$$v_{1_{ii}} = \sqrt{2gR}$$

ii $\rightarrow$ f.

$$\underset{ii}{\sum P_x} = \underset{f}{\sum P_x}$$

$$m_1 v_{1_{ii}} = m_1 v_{1_f} + m_2 v_{2_f}$$

$(v_{2_i} = 0)$ $\quad (v_{1_f} = v_{2_f} = v_f)$

note:

$m_1 = m_2 = m$

$$0 < v_f < v_{1_{ii}}$$

$$m_1 v_{1_{ii}} = (m_1 + m_2) v_f \Rightarrow v_f = \frac{m_1 v_{1_{ii}}}{(m_1 + m_2)}$$

$$v_f = \frac{m\cdot\sqrt{2gR}}{2m}$$

$$v_f = \frac{\sqrt{2gR}}{2}$$

$$v_f = \sqrt{\frac{gR}{2}}$$

$f \longrightarrow ff$

$$KE_f + U_f = KE_{ff} + U_{ff}$$

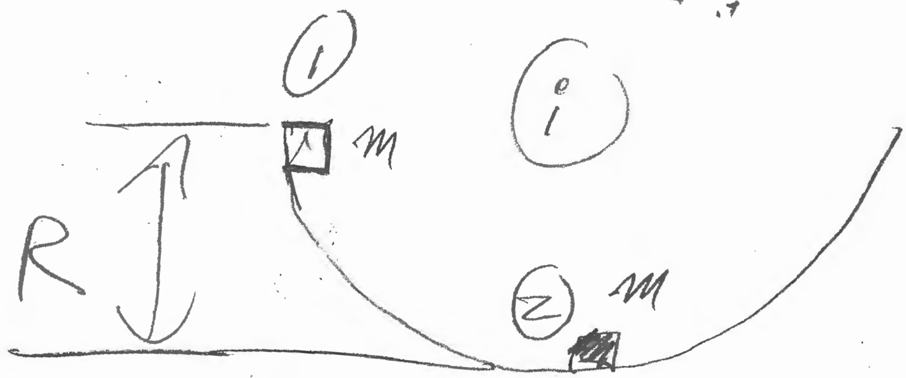
$$\frac{1}{2}(2m)v_f^2 + 0 = 0 + (2m)g\,h_{ff}$$

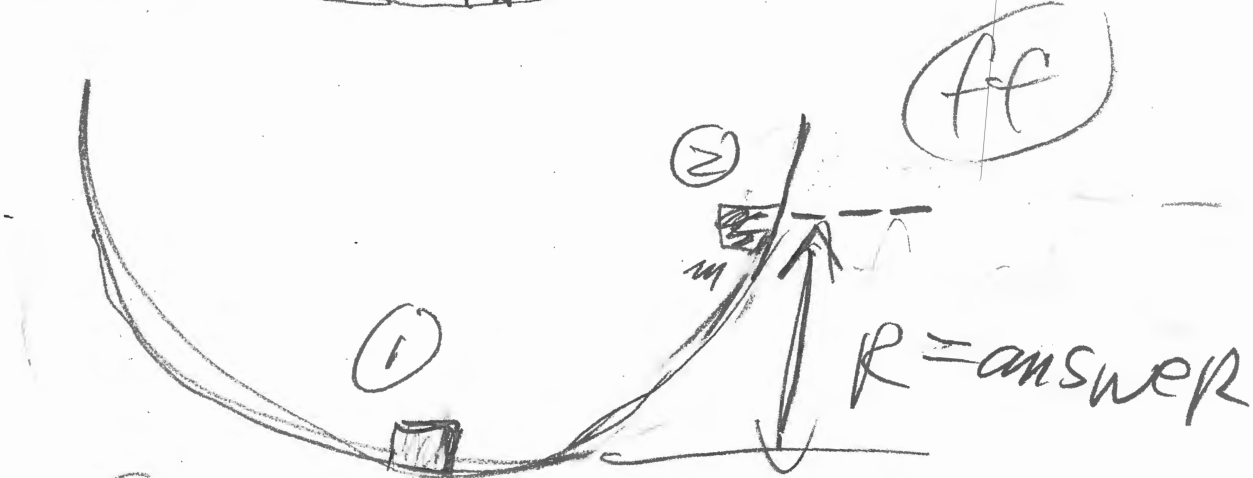
$$\frac{1}{2}\cancel{(2m)}\left(\frac{\cancel{g}R}{2}\right) = \cancel{(2m)}\cancel{g}\,h_{ff}$$

$$\frac{R}{4} = h_{ff}$$

"WHATIF" on # 86

WHAT IF the collision WAS ELASTIC ?

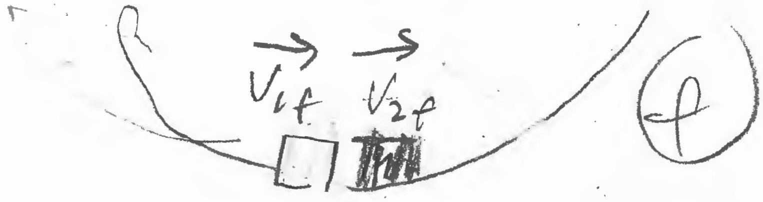




(i) → (ii)

$v_i = \sqrt{2gR}$

(ii) → (f)



(ii) $\rightarrow$ (f):

(ii) $\rightarrow$ (f) $m_1 v_{1ii} = m_1 v_{1f} + m_2 v_{2f}$

AND $v_{1ii} - v_{2ii} = v_{2f} - v_{1f}$

$$\cancel{m}\cdot\sqrt{2gR} = \cancel{m} v_{1f} + \cancel{m}\cdot v_{2f}$$

AND $\sqrt{2gR} - 0 = v_{2f} - v_{1f}$

$$\sqrt{2gR} = v_{1f} + v_{2f}$$

$$\sqrt{2gR} = v_{2f} - v_{1f}$$

$$2\cdot\sqrt{2gR} = 2\cdot v_{2f}$$

$$v_{1ii} = \sqrt{2gR} = v_{2f}$$

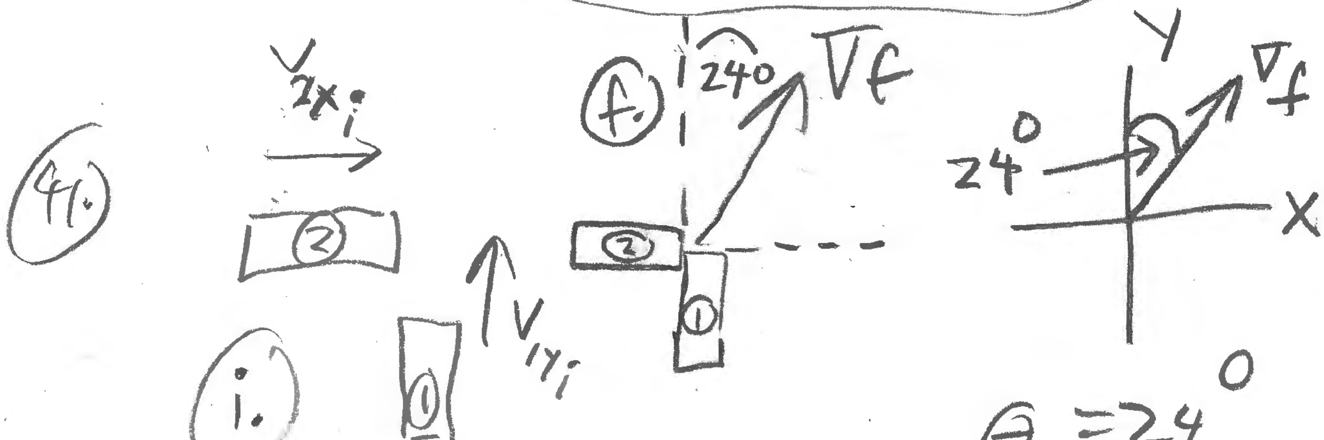
THUS: $\sqrt{2gR} = v_{1f} + \sqrt{2gR} \rightarrow v_{1f} = 0$

FINISH THE rest AT HOME:

$$KE_f + U_f = KE_{ff} + U_{ff}$$

$$\frac{1}{2}m(2gR) + 0 = 0 + mgh_{ff}$$

ANSWER: $\boxed{R = h_{ff}}$



$\theta_f = 24^\circ$ relative to y.

(41.) before after

$$\sum p_x = \sum p_x$$

$$\sum p_y = \sum p_y$$

NOTE: 24° relative to y.

$$m_2 v_{2x_i} = (m_1 + m_2) v_f \sin 24^\circ$$

$$m_1 v_{1y_i} = (m_1 + m_2) v_f \cos 24^\circ$$

2 equations and 2 unknowns.

FIND UNKNOWNS: v_{2x_i} and v_{1y_i}

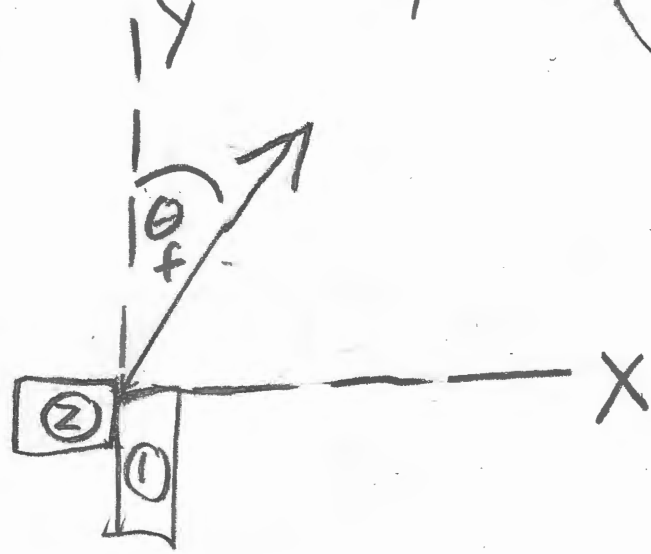
KNOWNS: $v_f = 16$ m/s, final angle $24^\circ = \theta_f$

WHAT IF? KNOWNS: v_{2x_i} and v_{1y_i}, UNKNOWNS: v_f AND θ_f

what if? **Note:** Divide Equations

Given v_{2x_i} and v_{1y_i}:

$$\frac{m_2 v_{2x_i}}{m_1 v_{1y_i}} = \tan\theta_f \Rightarrow \text{Find } \theta_f$$

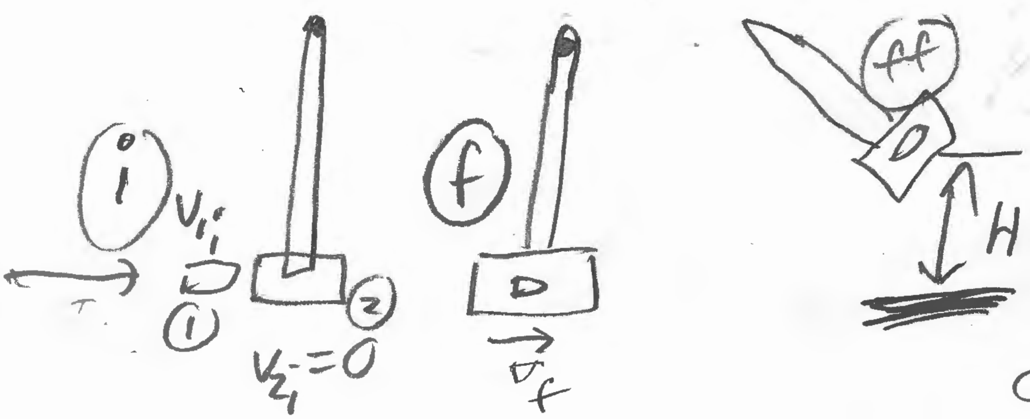


stick together

Find: $$v_f = \frac{v_{2x_i}}{(m_1+m_2)\cdot \sin\theta_f}$$

not elastic = inelastic $\Rightarrow \frac{1}{2} m_2 v_{2x_i}^2 + \frac{1}{2} m_1 v_{1y_i}^2 > \frac{1}{2}(m_1+m_2)v_f^2$

\# 43. → like 86. See Example 8.8, p253



(i) → (f) $\Delta\vec{p}$ = const.

(f) → (ff)

$KE_f + U_f = KE_{ff} + U_{ff}$

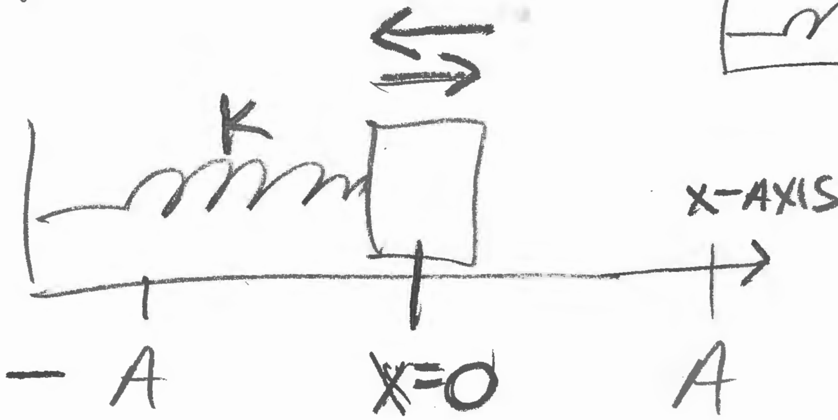
0 0

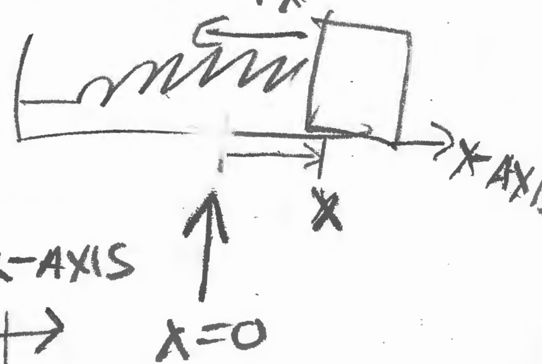
CH14

Sample cheat sheet:

Quiz 11

oscillates





$$x = A\cos(\omega t + \phi) \Leftarrow m\frac{d^2x}{dt^2} = -Kx$$

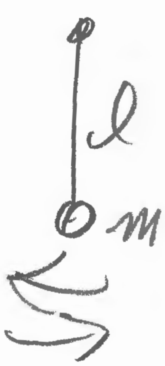
$\omega = \sqrt{\frac{K}{m}}$; 2 unknowns: A, ϕ

$T = 2\pi\sqrt{\frac{m}{K}}$ 2 knowns:

$x(0)$ and $v_x(0)$.

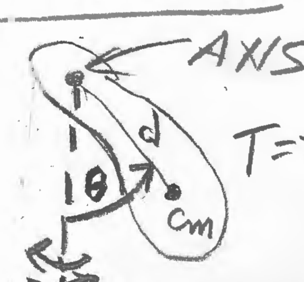
pendulum

$T = 2\pi\sqrt{\frac{l}{g}}$ of oscillation.



PHYSICAL pendulum:

E.C.



$T = 2\pi\sqrt{\frac{I_{Axis}}{Mgd}}$

11

QUIZ ~~15~~ - CH 14 - SIMPLE HARMONIC MOTION

DISCUSSI0N QUESTION 20

Problems: 4*, 5*, 11*, 12* (try 27*) , 26,* (See virtual lab 2) , 27*, 30*, 37*, 45*, 48*, 52* (EC)

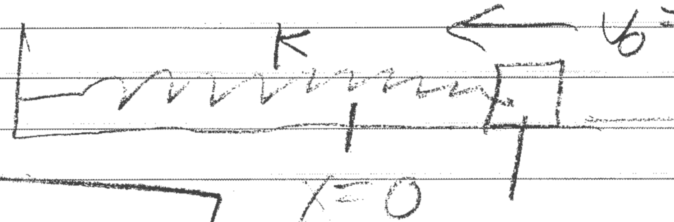
REAL TEST 4.

12.

$t = 0$

$v_0 = v(0) = -4.00\ \frac{m}{s}$

$k = 300\ \frac{N}{m}$



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

$x_0 = x(0) = 0.200\ m$

2 unknowns A, ϕ.

A: $\frac{1}{2} m v_0^2 + \frac{1}{2} k x_0^2 = \frac{1}{2} k A^2$

Find A.

ϕ: $\boxed{x_0 = A\cos\phi = 0.200\ m > 0}$

$v_0 = -\omega A \sin\phi = -4\ \frac{m}{s}$

$\Rightarrow \boxed{\sin\phi > 0}$

$\phi > 0 \Rightarrow \phi = \cos^{-1}\left(\frac{x_0}{A}\right)$