MOMENT OF INERTIA LAB			
SEE EXAMPLE 10.3 OF TEXTBOOK			
FROM EXAMPLE REFERENCED ABOVE AND FROM CHAPTER 2, IT CAN BE SHOWN $I = m\left(\frac{gt^2}{2h}-1\right)\bullet r^2$. We will use this formula to find the moment of inertia I of a disk and ring and then compare with the theoretical values. Here h is the vertical distance fallen by hanging mass m in time t, and r = radius of axle and I is the moment of inertia for horizontally spinning disk and/or ring of demonstration equipment used in class for the past few weeks. You will measure r with vernier calipers, t with a digital timer, and m is from the weight sets and sits on a 50 g hanger. The data sheet below suggests we must eliminate I for the spindle (SP) to find the ring (RING) and disk (DISK) I's. We will get these I's by subtracting various results given below in data sheet.			
DATA SHEET:			
r =	m =	h =	
SPINDLE + RING			
TIME t		$I_{SP} + I_{RING}$	
1 time1		BLank	
2 time2		BLank	
3 time3		BLank	
4 time4		BLank	
Average t t_{AV}		average $I_{SP} + I_{RING}$ $= m\left[\frac{g t_{AV}^2}{2h} - 1\right] r^2$	
SPINDLE + DISK			
TIME t		$I_{SP} + I_{DISK}$	
1 time1		Blank	
2 time2		BLank	
3 time3		BLank	
4 time4		BLank	
Average t t_{AV}		average $I_{SP} + I_{DISK}$ $= m\left[\frac{g t_{AV}^2}{2h} - 1\right] r^2$	

SPINDLE + DISK +RING	
TIME t	$I_{SP} + I_{DISK} + I_{RING}$
1 time 1	Blank
2 t2	Blank
3 t3	Blank
4 t4	Blank
Average t t_{AV}	average $I_{SP} + I_{DISK} + I_{RING} = M\left[\frac{g t_{AV}^2}{2h} - 1\right] \cdot r^2$
1. COMPUTE I_{DISK} USING APPROPRIATE SUBTRACTION.	
2. COMPUTE I_{RING} USING APPROPRIATE SUBTRACTION.	
COMPARE DYNAMIC MEASUREMENTS WITH THEORETICAL I-VALUES.	
RING MASS M_{RING} =	
RING RADIUS R_{RING} =	
THEORETICAL I_{RING} =	
PERCENT DIFFERENCE	
DISK MASS M_{DISK} =	
DISK RADIUS R_{DISK} =	
THEORETICAL I_{DISK} =	
PERCENT DIFFERENCE	

ENTER RAW DATA IN THE ABOVE TABLE. SHOW CALCULATIONAL WORK IN SPACE BELOW AND ATTACHED WHITE SHEETS.

CH10
$$\begin{cases} ma = mg - T \\ T = I\frac{a}{r^2} \end{cases}$$

$$\begin{cases} ma = mg - T \\ I\frac{a}{r^2} = T \end{cases}$$

$$a\left(m + \frac{I}{r^2}\right) = mg$$

$$\frac{mg}{a} = m + \frac{I}{r^2}$$

$$m\left(\frac{g}{a} - 1\right)r^2 = I$$

$$\frac{1}{2}at^2 = h$$

$$a = \frac{2h}{t^2}$$

$$m\left(\frac{g}{2h/t^2} - 1\right)\cdot r^2 = I$$

$$\boxed{I = m\left(\frac{gt^2}{2h} - 1\right)\cdot r^2}$$

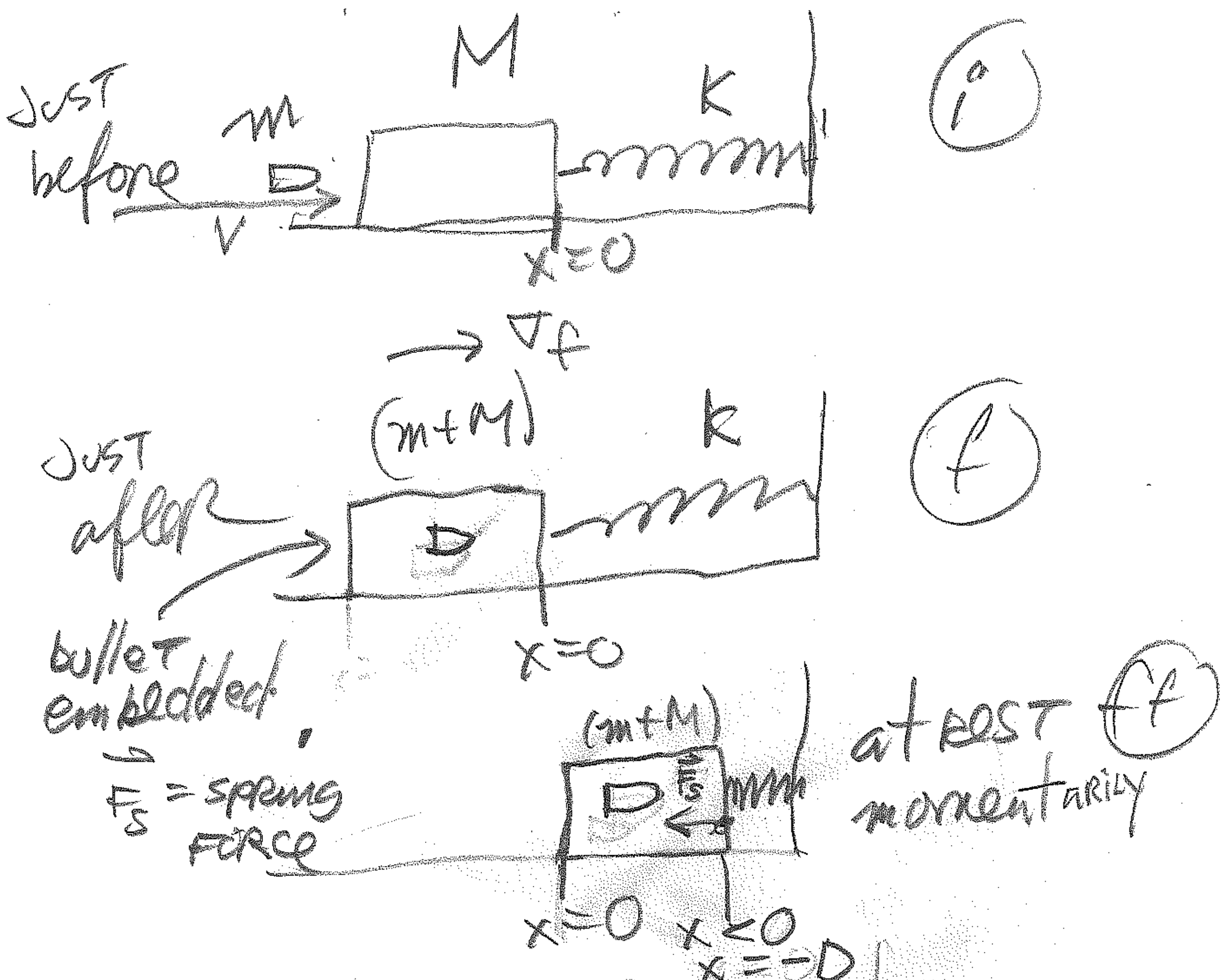
$T \quad + I_{ring}$

5-1-13

Class: Ch 8 review

(43) see Example 8.8

(83) → 86, 43, 85, 24



(i) → (f)	(f) → (ff)	
momentum	energy	conservation LAW USED.

83. $i \longrightarrow f$

$$\sum_i P_x = \sum_f P_x$$

$$mV + 0 = (m+M) \cdot V_f$$

WOODEN BLOCK @ REST

$f_1 \longrightarrow ff_1$

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

$$\frac{1}{2}(m+M)V_f^2 + 0 = 0 + \frac{1}{2}KD^2$$

2 EQUATIONS!

(1.) $mV = (m+M) \cdot V_f$ OR $\boxed{V_f = \frac{mV}{(m+M)}}$

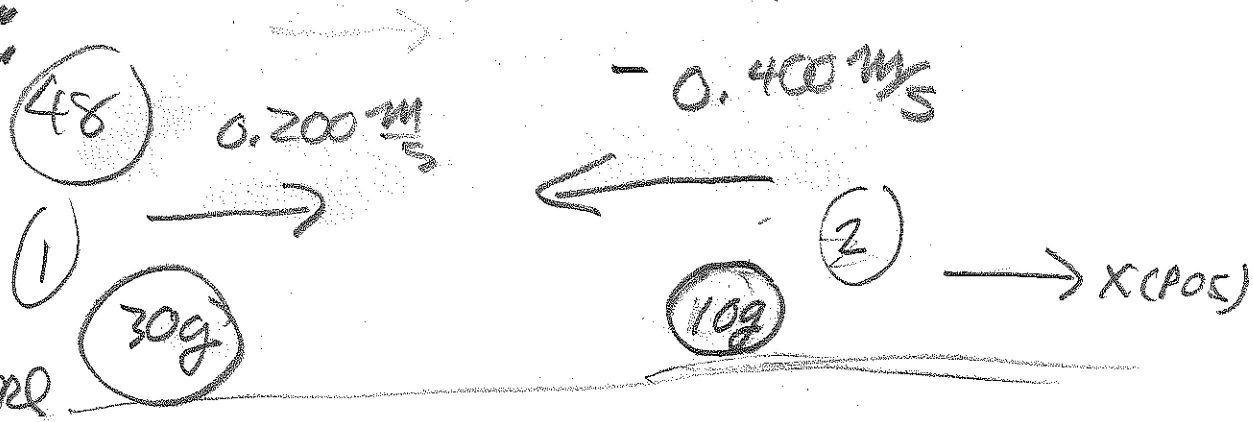
(2.) $\boxed{\frac{1}{2}(m+M)V_f^2 = \frac{1}{2}KD^2}$

#83 Options:

(i) given V and find D.

(ii) given D and find V

CLASS 3: ELASTIC COLLISIONS



before

$$m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f}$$

$$(30)(0.2) + (10)(-0.4) = (30)v_{1f} + (10)v_{2f}$$

$$v_{1i} - v_{2i} = v_{2f} - v_{1f}$$

$$0.20 - (-0.4) = v_{2f} - v_{1f}$$

$$0.60 = v_{2f} - v_{1f}$$

$$6 - 4 = 30V_{1f} + 10V_{2f}$$

$$2 = 30V_{1f} + 10V_{2f}$$

$$0.60 = V_{2f} - V_{1f}$$

$$\Rightarrow V_{2f} = 0.60 + V_{1f}$$

$$2 = 30V_{1f} + 10(0.60 + V_{1f})$$

$$2 = 30V_{1f} + 6 + 10V_{1f}$$

$$-4 = 40V_{1f}$$

$$-0.100\,\frac{m}{s} = V_{1f}$$

$$\Rightarrow V_{2f} = 0.60 + (-0.10) = 0.500\,\frac{m}{s}$$

AFTER COLLISION

CH 14

we did: 12 and by implication 11.

12. review:

$$\frac{1}{2}(2)(-4)^2 + \frac{1}{2}(300)(0.2)^2 = \frac{1}{2}(300)A^2$$

$$16J + 6J = 150A^2$$

$$A = \sqrt{\frac{22}{150}} = 0.383(m)$$

check $A > x_0 = 0.200(m)$

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

$x(0) = A\cos\phi = x_0 \rightarrow A\cos\phi = 0.2$

$\frac{dx}{dt}(0) = v_x(0) = -\omega A\sin\phi = v_0 \rightarrow -\omega A\sin\phi = -4$

$\cos\phi > 0$ and $\sin\phi > 0$

$\rightarrow \phi = \cos^{-1}\left(\frac{0.200}{0.383}\right) = 58.5^0$

(12) CH14

$$X = 0.383 \cdot \cos(\omega t + 58.5^\circ)$$

CONVERT TO RAD*

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

$$= \sqrt{\frac{300}{2}} = \sqrt{150} = 12.25 \ \frac{\text{RAD}}{s} \ **$$

$$X = 0.383 \cdot \cos(12.25t + 58.4^*)$$

$$** \ \frac{\text{RAD}}{s} = s^{-1}$$

CH14:

11. comparison

#11 $x = A\cos(\omega t + \phi)$

$x_0 = A\cos\phi$

$v_0 = -\omega A\sin\phi$

at $t = 0$: $v_0 = -12.0 \frac{m}{s}$

$x_0 = 0$

GOOD GUESS: $x = -A\sin\omega t$

$\frac{1}{2}mv_0^2 + \frac{1}{2}kx_0^2 = \frac{1}{2}kA^2$

$\frac{1}{2}(2)(-12)^2 + 0 = \frac{1}{2}(300)A^2$

$144 = 150A^2$

$A = \sqrt{\frac{144}{150}} = 0.98 (m)$

#12 — CH14

$$A\cos\phi = x_0$$

$$-\omega A\sin\phi = v_0$$

$$0.98\cos\phi = 0$$

$$-\omega(0.98)\sin\phi = -12$$

$$\left.\begin{array}{l}\cos\phi = 0 \\ \text{and } \sin\phi > 0\end{array}\right\} \phi = \frac{\pi}{2}$$

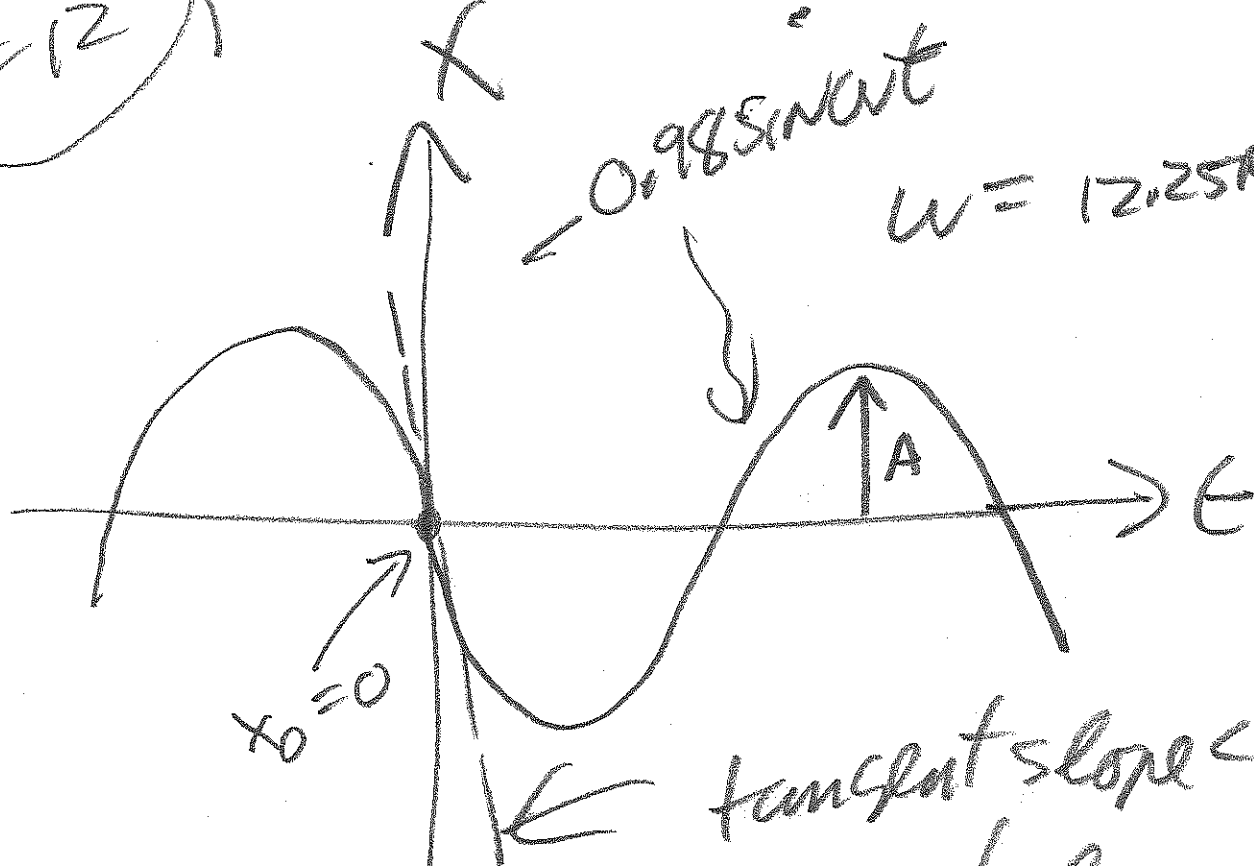
$$x = 0.98 A \underbrace{\cos\left(\omega t + \frac{\pi}{2}\right)}_{\cos\omega t \cdot \cos\frac{\pi}{2} - \sin\omega t \cdot \sin\frac{\pi}{2}}$$

$$= -\sin\omega t$$

$$\boxed{\text{TRUE SOLUTION: } x = -0.98 \cdot \sin\omega t}$$

#12) CH14:

$\omega = 12.25\ \frac{RAD}{s}$



tangent slope < 0

tangent slope $= -12\ \frac{m}{s} = V_0$

$$x = -0.98 \sin 12.25t$$

and $x_0 = 0$