TODAY'S LAB

10-23-13
4C

LAB TODAY

Measure grooves on CD!

compare with industry standard.

(1

Review CH17 # 7, 15, 20, 22,
26, 30, 45, 33, 39,
38, 48*, 55, 57*, 64, 68*, 58*

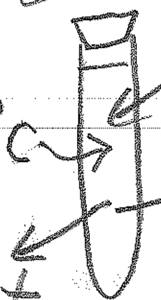
Big sections
(A) Sec. 17.5 — Exercises
WHAT IS Heat?
(B) 17.6 — Exercises
CALORIMETRY.
(C) 17.7 Heat transfer Exercises
+ problems after that ...

58 glass vial

AIR

ice bath
(ice + water @ 0°C)
$m_i = 0.120\,kg$
i = ice mass.

16.0g of enzyme



$T_i = 19.5°C$

Heat

Heat

$\boxed{\text{Heat flows until enzyme temp.} = 0}$

$$\left|\underset{\text{ENZYME}}{\text{Heat LOST}}\right| = \left|\underset{\text{ICE}}{\text{Heat gained}}\right|$$

$$\left| m_g \cdot c_g \cdot \Delta T + m_\varepsilon \cdot c_\varepsilon \cdot \Delta T \right| = \left| m_{ice} \cdot L_f \right|$$

NOTE: $|\Delta T| = 19.5 - 0 = 19.5\,^{\circ}C$

$\Delta T = 0 - 19.5 = -19.5\,^{\circ}C$

$$\left|(m_g c_g + m_\varepsilon c_\varepsilon)\Delta T\right| = m_{ice} L_f$$

$$m_{ice} = \frac{(m_g c_g + m_\varepsilon c_\varepsilon)\cdot|\Delta T|}{L_f}$$

$$m_{ice} = \frac{[(0.006)(2800) + (0.016)(2250)](19.5)}{334\times10^3}$$

$= 3.082\ kg = 3.08\ g$

NOTE: $L_f = 334\times10^3\ \frac{J}{kg}$

What could I do on test 2?
What is mass of remaining ice?

INITIAL ice mass $\rightarrow$ $120g - 3.082 = 116.92g = 0.11692kg$

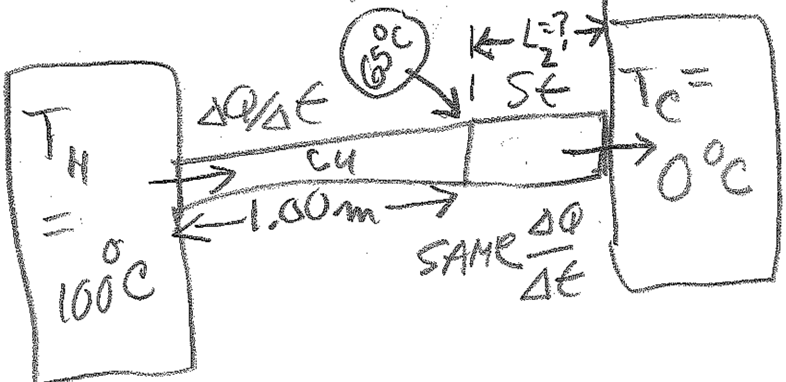
(3

series connection TO reduce heat flow rate $\frac{\Delta Q}{\Delta t}$

ch17 (68.)

(a) $\left(\frac{\Delta Q}{\Delta t}\right)_{cu} = \frac{K_{cu} \cdot A\,(100-65)^\circ C}{1.00\,m}$

= heat RATE of entire system.



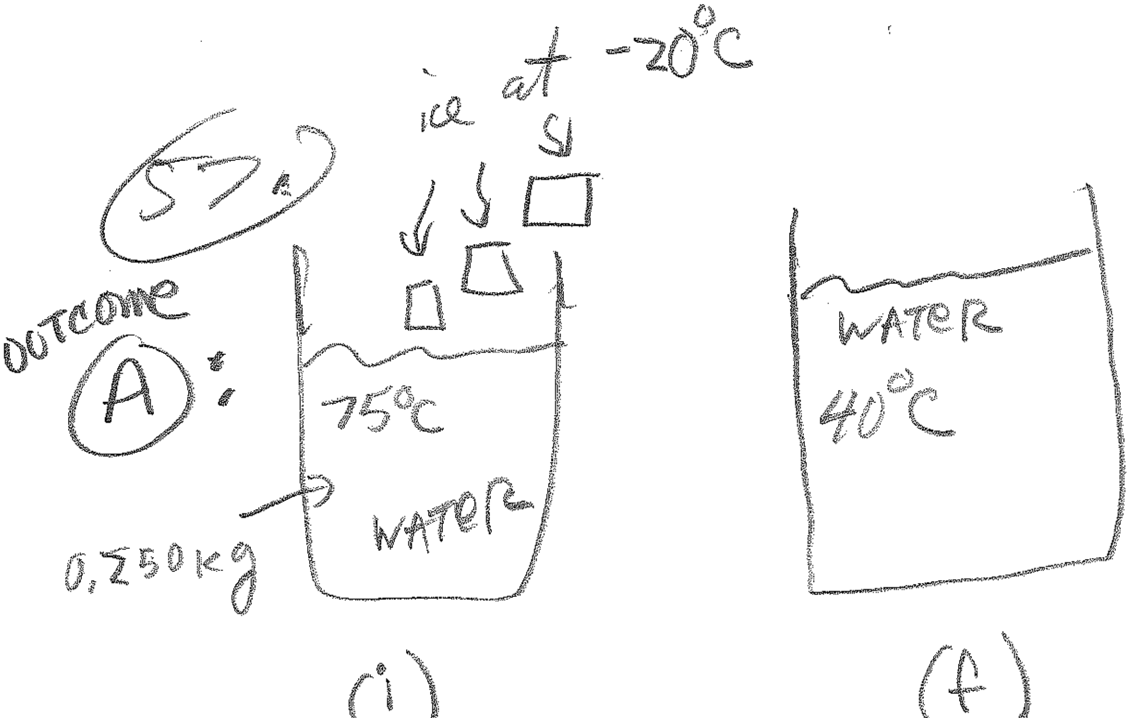
$$\frac{\Delta Q}{\Delta t} = \frac{(385.0)(4\times 10^{-4})(35)}{(1)} = 5.39\ \frac{J}{S}$$

(b) $$\left(\frac{\Delta Q}{\Delta t}\right)_{cu} = 21.56 = \frac{K_{st} \cdot A(65-0)^\circ C}{L_2} = \left(\frac{\Delta Q}{\Delta t}\right)_{st}$$

$$A = 4\times 10^{-4}\,m^2 ;\ K_{st} = 50.2\ \frac{W}{m \cdot {}^\circ C}$$

$$5.39 = \frac{(50.2)(4\times 10^{-4})(65)}{L_2}$$

$$L_2 = \frac{(50.2)(4\times 10^{-4})(65)}{5.39} = \boxed{0.24\ m = 24\ cm}$$



$$\left|\underbrace{\text{Heat LOST}}_{\text{WATER}}\right| = \left|\underbrace{\text{Heat gained}}_{\text{ice}}\right|$$

$$\left| m_W C_W \cdot \Delta T_W \right| = \left| m_i C_i \Delta T_i + m_i L_f + m_i C_w \Delta T_i' \right|$$

NOTE: m_i = MASS of ice after melting

NOTE! $\left|\Delta T_W\right| = (75-40)^\circ C$
$= 35^\circ C$

$\Delta T_i = 0-(-20) = 20^\circ C$: Heating ice

$\Delta T_i' = 40-0 = 40^\circ C$: Rise of ice WATER After ice melts.

15

want $m_i = ?$

$m_w = 0.250 \text{ kg}$

$C_w = 4190 \text{ J/kg}\cdot{}^\circ C$

$$\underbrace{(0.250)(4190)\cdot 35}_{} = m_i \underbrace{(2100)}_{}\cdot 20 + m_i L_f + m_i C_w \cdot \Delta T_i'$$

$C_i = \frac{2100 \text{ J}}{\text{kg}^\circ C}$

$$3.66625\times10^4 = m_i\left[(2100)(20) + (3.34\times10^5) + (4190)(40)\right]$$

$$3.666\times10^4 = m_i\left[42000 + 334000 + 167600\right]$$

$$3.666\times10^4 = [543600]\cdot m_i$$

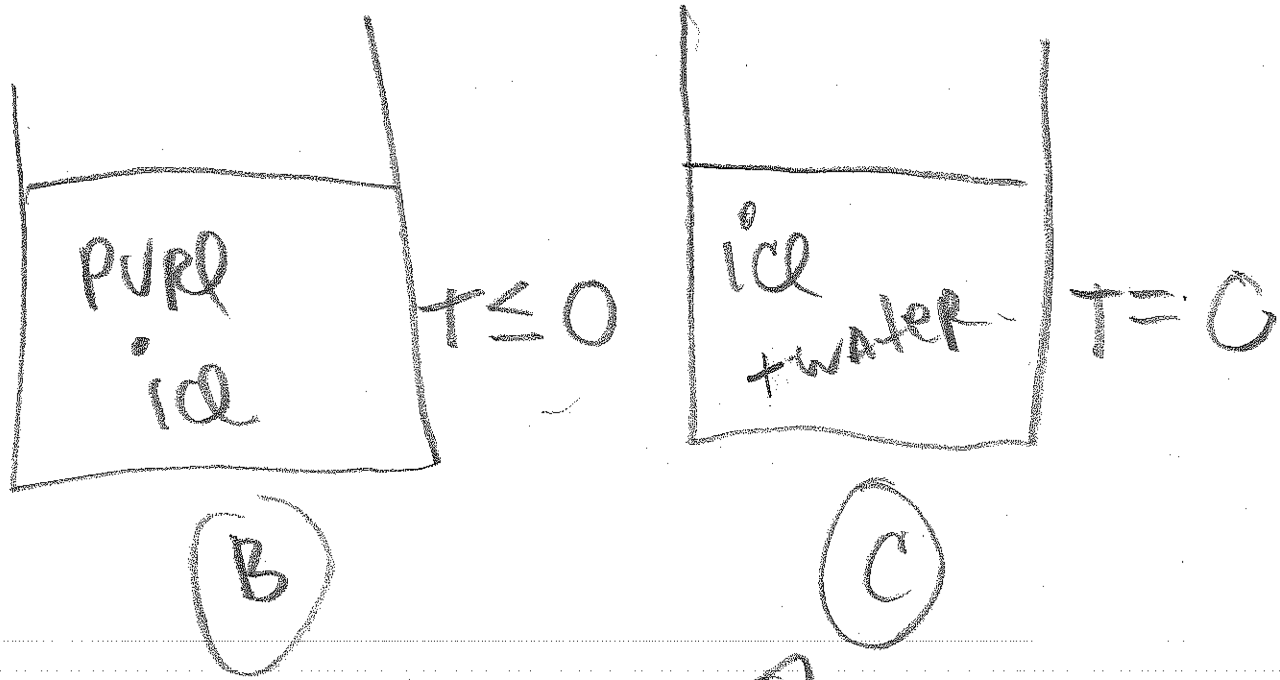
$$\frac{36662.5}{543600} = m_i = 0.067 \text{ kg}$$

$$= 67 \text{ g}$$

We $\underline{\text{ADD}}$ $\underbrace{0.067 \text{ kg}}_{\text{ice}}$ TO 0.250 kg water.

Test2 what if #57 :

2 other possible outcomes depending on initial ice parameters like mass or initial ice temperature.



other possible outcomes

(48)

$$\left|\text{Heat lost}\right| = m_w c_w \cdot |\Delta T| + m_w \cdot L_f$$

$$= m_w \cdot (c_w \cdot |\Delta T| + L_f)$$

$$= (0.350)(4190 \cdot 18 + 334000)$$

$$= (0.350)(75420 + 334000)$$

$$= (0.350)(409420)$$

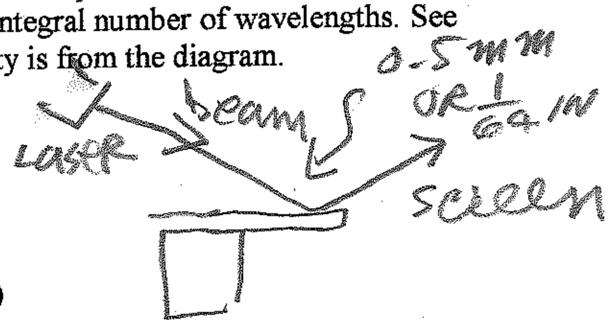
$$= 1.4 \times 10^5 \text{ J}$$

Realistic?

Objective:
The purpose of this experiment is to verify the law of interference between light rays reflected from a metal ruler.

Equipment:
Small metal ruler
Laser

Introduction:
Light rays on two adjacent diffracting centers ruled on a metal surface will reflect off the surface and interfere. The diffracted rays will combine to produce maximum intensity if the path difference between the adjacent rays is an integral number of wavelengths. See figure 1 below. The condition for maximum intensity is from the diagram.



$$CB - AD = n\lambda\,;\ n = 0, 1, 2, 3, \ldots \qquad (1)$$

It is clear that
$$CB = d\cos\phi_0 \qquad (2)$$
$$AD = d\cos\phi_n \qquad (3)$$

Thus, equation (1) can be written,

$$d\cos\phi_0 - d\cos\phi_n = n\lambda \qquad (4)$$

It can be shown that
$$d\left(\frac{(y_n)^2 - (y_o)^2}{2x^2}\right) = n\lambda \qquad (5)$$

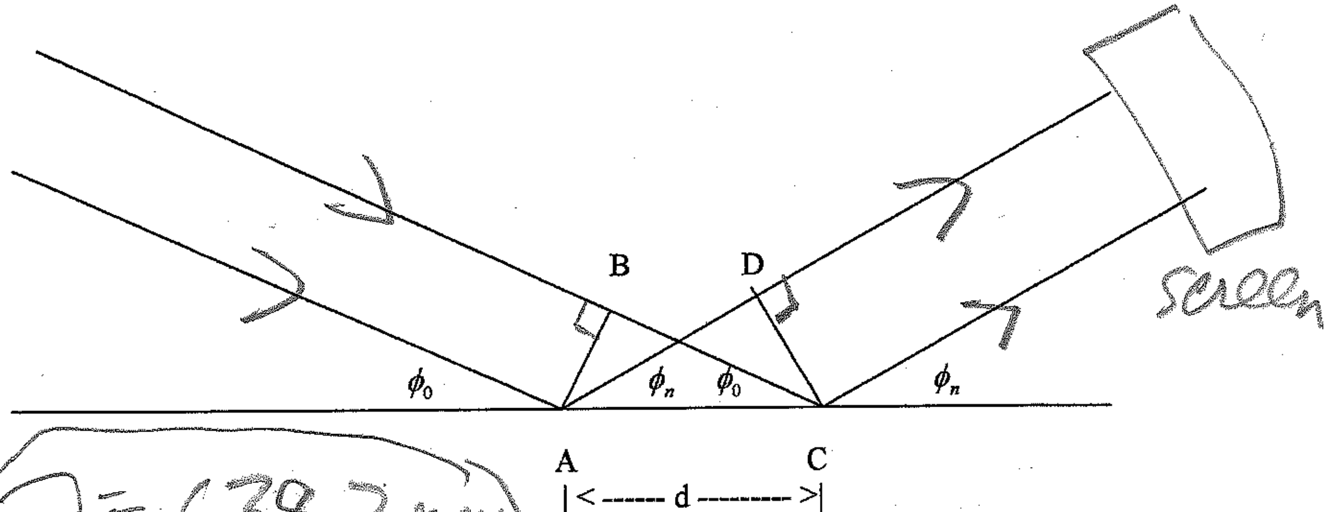
Where y_n = distance to the n^{th} maximum on the screen and y_o = distance to the o^{th} maximum on the screen ($n = 0$) and x = distance from the ruler to the screen.

$$\text{Thus, } \lambda = \frac{d}{n}\left(\frac{(y_n)^2 - (y_o)^2}{2x^2}\right) \qquad (6)$$

Procedure:
(Q-1) The wavelength of the laser light is 638.2 nm. Measure x.

(Q-2) Measure y_o, y_1, and y_2. From these measurements calculate *d*, the distance between the markings on the ruler. Use markings that are 1/64 inches, and compare your calculations with the expected value of *d*.

Interference from a diffraction Ruler:



$\lambda = 638.2$ nm He-Neon

$$\cos\phi_n = \frac{AD}{d},$$

$d\cdot(\cos\phi_0 - \cos\phi_1) = \lambda$

$d\cdot(\cos\phi_0 - \cos\phi_2) = 2\lambda$

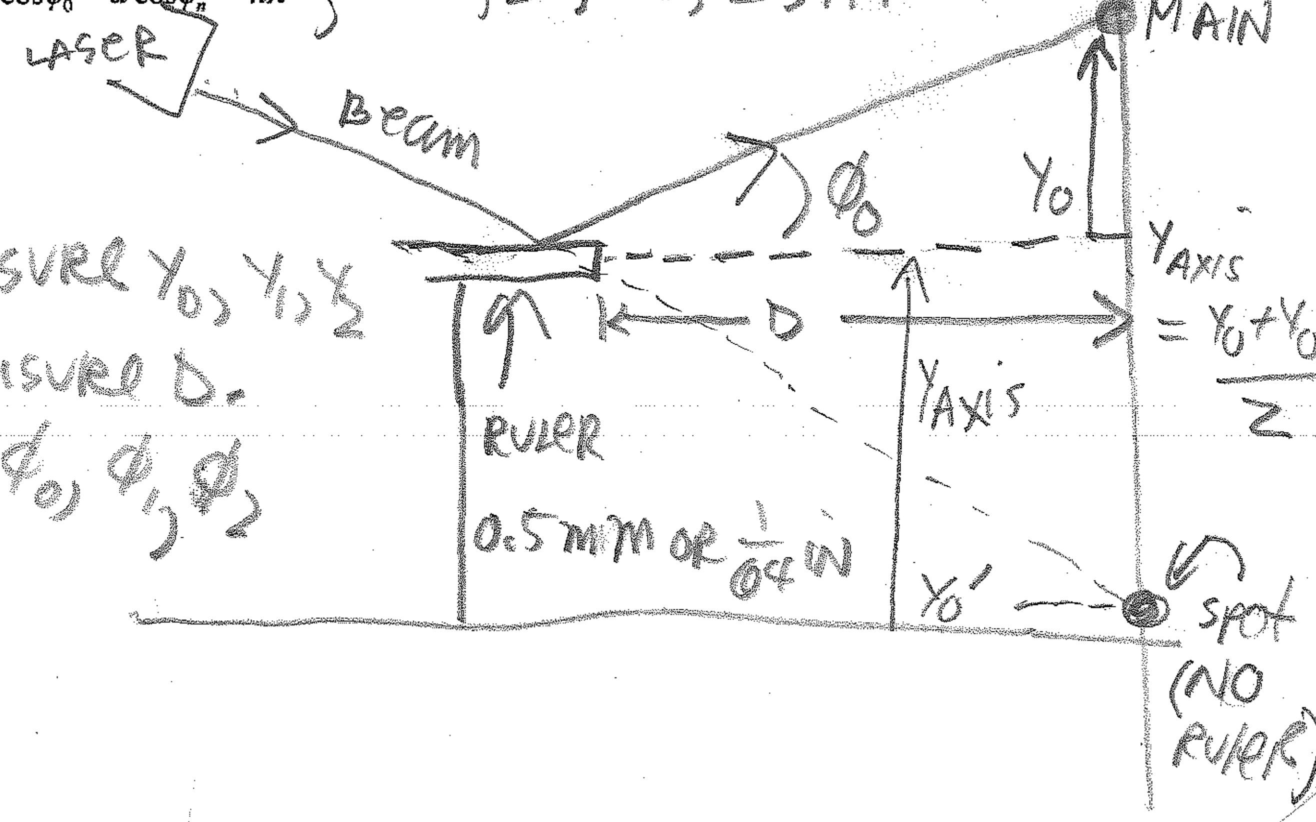
$$\cos\phi_o = \frac{CB}{d},$$

ALSO: FIND d for $n = -1, -2$.

$CB - AD = n\lambda,$

$d\cos\phi_0 - d\cos\phi_n = n\lambda$; $n = 0, \pm 1, \pm 2, \pm 3 \ldots$

Bright spots



measure Y_0, Y_1, Y_2
measure D.
$\rightarrow \phi_0, \phi_1, \phi_2$

(i) $\tan\phi_n = \frac{Y_n}{D}$, $n = 0, \pm 1, \pm 2$

(ii) Find $\cos\phi_n$

use formula:

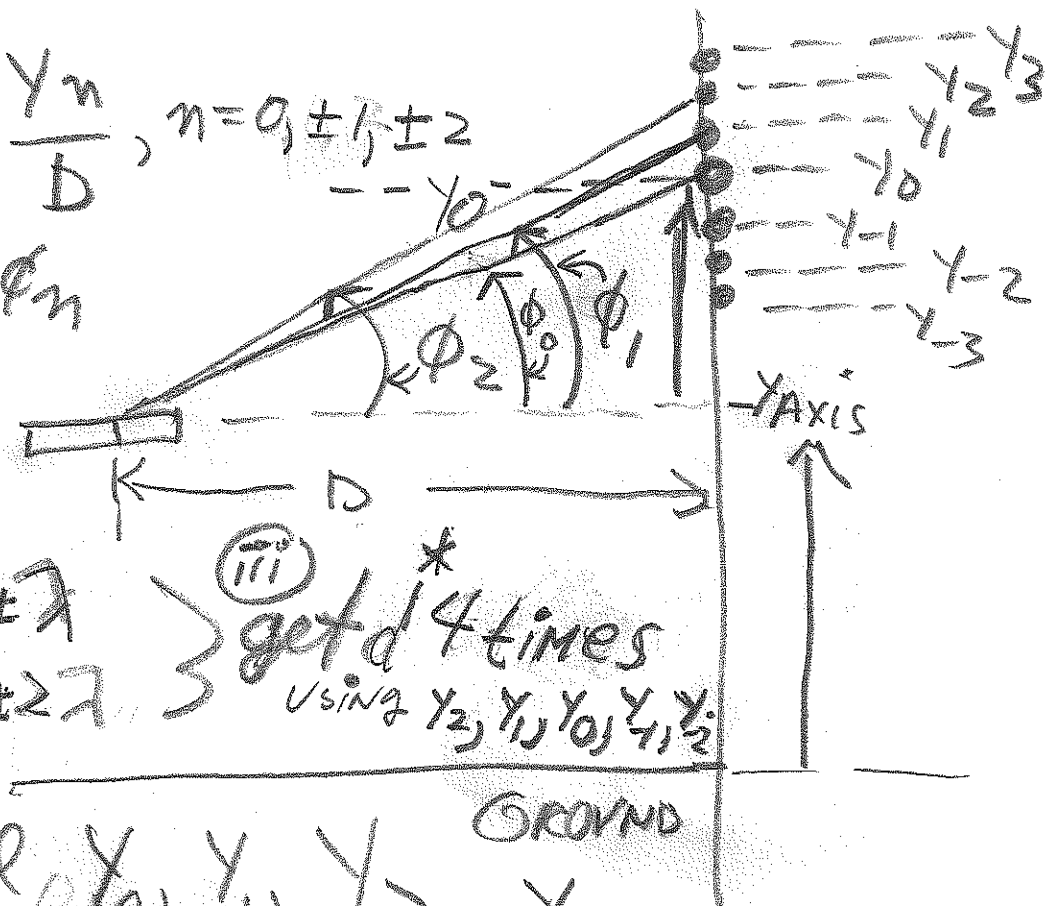
$\lambda = 638.2$ nm

$d(\cos\phi_0 - \cos\phi_{\pm 1}) = \pm\lambda$

$d(\cos\phi_0 - \cos\phi_{\pm 2}) = \pm 2\lambda$

(iii) get d^* 4 times using $Y_2, Y_1, Y_0, Y_{-1}, Y_{-2}$

d = marking distance

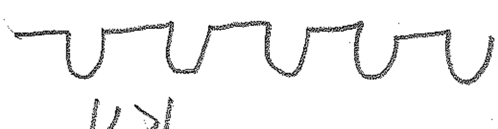


measure $Y_0, Y_1, Y_2, Y_{-1}, Y_{-2}$

d_{acc} = 0.5 mm or $\frac{1}{64}$ in.

* use d_{AV}: $\Rightarrow$ P.E. $= \left|\frac{d_{AV} - d_{acc}}{d_{acc}}\right| \times 100\%$

RULER



$d_{acc} = \frac{1}{64}$ in or 0.5 mm

and check

$$\boxed{d_{AV} - \Delta < d_{acc} < d_{AV} + \Delta}$$

$\Delta = \frac{MAX - MIN}{2}$; MAX = d MAX of 4. MIN = d MIN of 4.