Physics 201

Lab X

2 activities:

I. - Specific Heat

II. - Diffraction

I. Boil your metals. $T_{o(metal)} \simeq 100^\circ C$

Carefully measure some H_2O in calorimeter. $= m_w$

Find mass of each metal m_m

Heat energy $= c \cdot m \cdot \Delta T$

c ↑ specific heat

m ↑ mass

ΔT ↑ $(T_f - T_o)$

cool water ✓ metal

$$0 = c_w m_w \Delta T_w + c_m m_m \Delta T_m$$

c_w = $4.184 \frac{J}{g^\circ C}$

m_w ✓

ΔT_w = $(T_f - T_{o_w})$ ↑ measure before adding hot metal.

c_m ⊛

m_m ↑ measure this

ΔT_m = $(T_f - T_{o_m})$ ↑ $100^\circ C$

$$* \quad c_m m_m (T_{0_m} - T_f) = c_w m_w (T_f - T_{0_w})$$

$T_{0_m} = 100°C - T_f$

$$c_m = c_w \frac{m_w}{m_m} \frac{(T_f - T_{0_w})}{(T_{0_m} - T_f)}$$

$T_{0_m} = 100°C$

theory $c_m = 3R$ (per mol of metal)

$$R = 8.315 \frac{J}{mol \cdot °C}$$

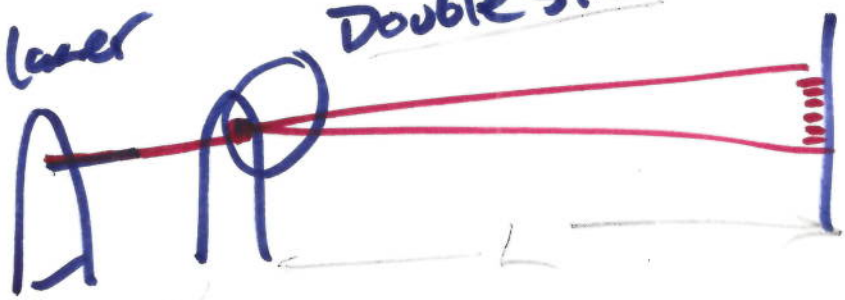
our c_m is per gram.

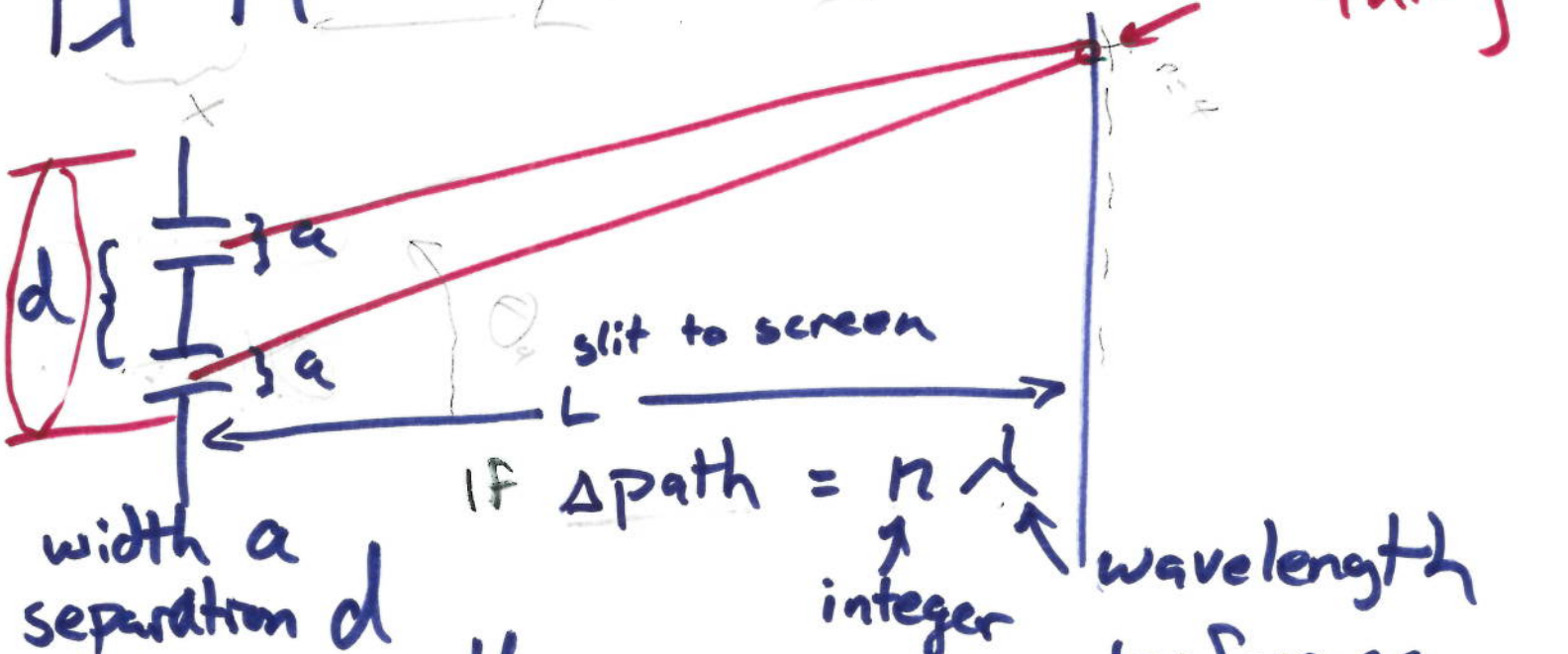
$$\frac{J}{g\,°C} \times \frac{g}{1\,mol} = \frac{J}{mol \cdot °C}$$

$\frac{g}{1\,mol}$ = molar mass of your metal!

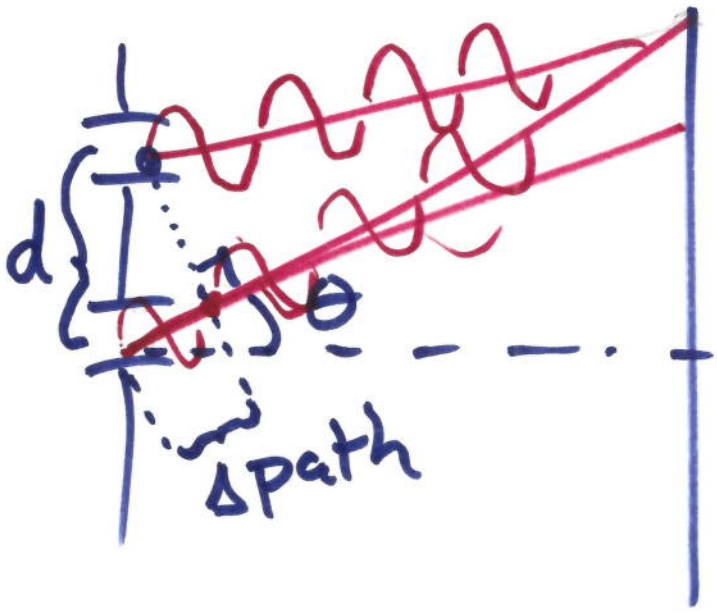
II. Diffraction

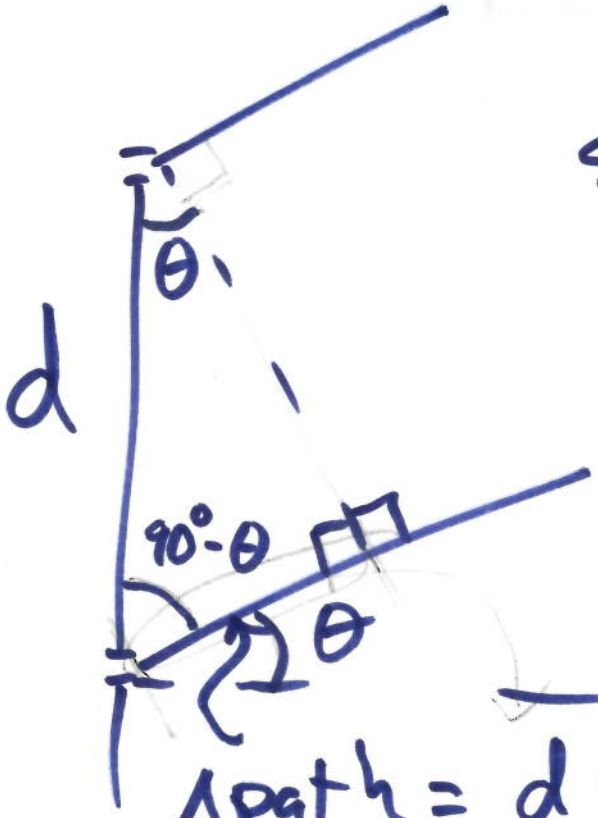
Double Slits





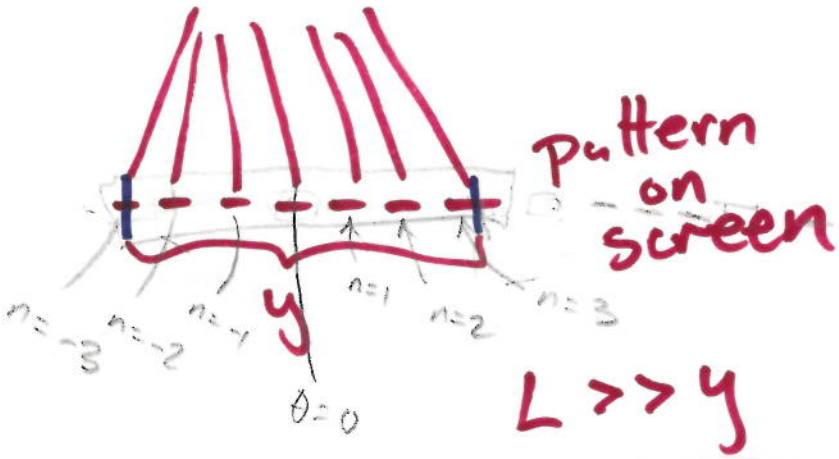
then: constructive interference
→ bright spot





$$\sin\theta = \frac{opp}{hyp} = \frac{\Delta path}{d}$$

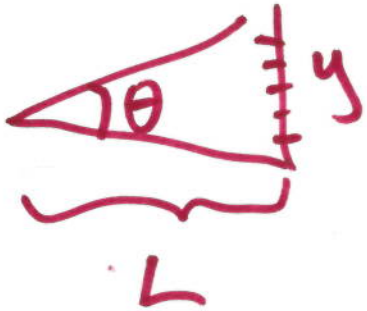
$\Delta path = d\sin\theta \overset{if}{=} n\lambda \Rightarrow$ Constructive



$L >> y$

$\lambda = 650nm$

$d \Rightarrow$ unit is milimeter



$$\sin\theta \simeq \frac{y}{L}$$

theory:

$$d\sin\theta = n\lambda \qquad \sin\theta \simeq \frac{y}{L}$$

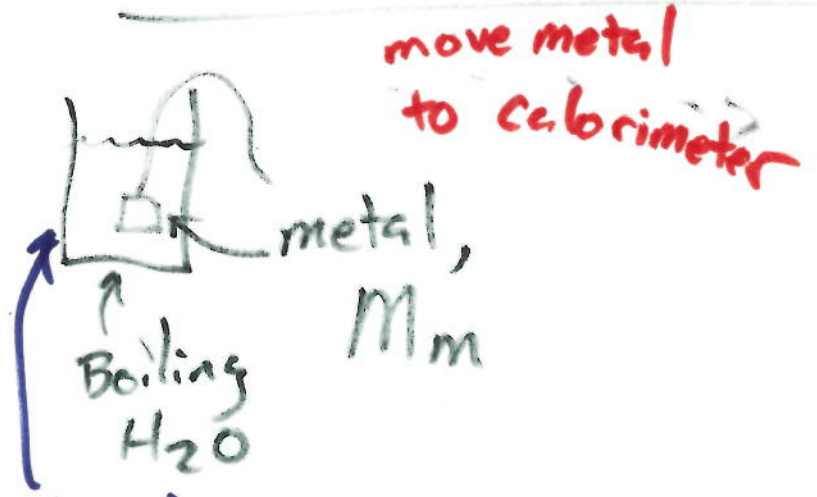
$$\sin\theta = \frac{n\lambda}{d} \overset{?}{=} \frac{y_n}{L}$$ check

$n =$ # gaps between spots measured.

P201

Lab X
10?

Calorimetry, Simple:



initial temperature:

T_{om} = metal ~ 100°C (boiling water)

water in calorimeter T_{ow}

$$\Delta Heat = c\,m\,\Delta T$$

c: specific heat; m: mass; ΔT: change in temperature

$$0 = \Delta Heat_{water} + \Delta Heat_{metal}$$

Try to compute C_{metal}.

$$0 = C_w m_w (T_f - T_{ow}) + C_m m_m (T_f - T_{om})$$

C_m ★ ; T_{om} ↑ 100°C

$$C_m m_m (T_{om} - T_f) = C_w m_w (T_f - T_{ow})$$

$$C_m = C_w \cdot \frac{m_w}{m_m} \frac{(T_f - T_{ow})}{(T_{om} - T_f)}$$

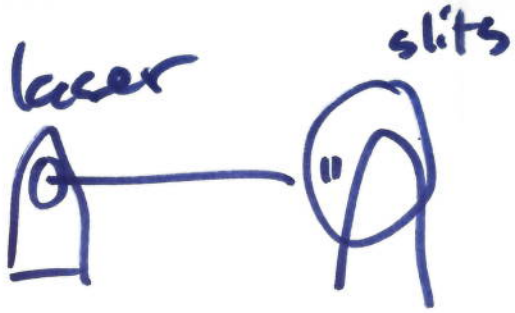
↑ given $4.184 \frac{J}{g°C}$

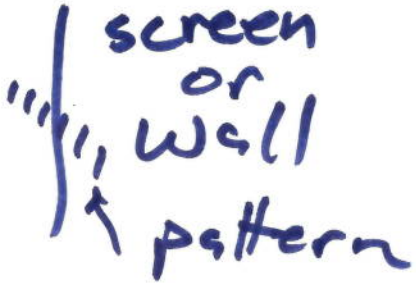
Theory: $C_m \simeq 3R$

$R = 8.315 \frac{J}{mol°C}$

molecular mass

so your C_m is per gram $\times \left(\frac{X \text{ grams}}{mol} \right)$





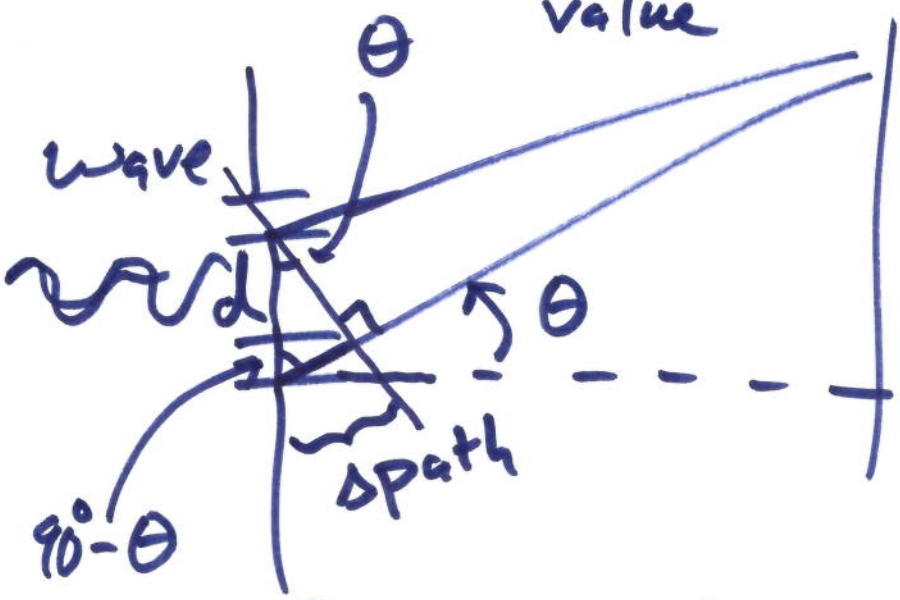
laser $\lambda = 650\,nm$

slits: all units are mm

2 values: a and d

"slit" width
small value

"slit separation"
big value



interference screen

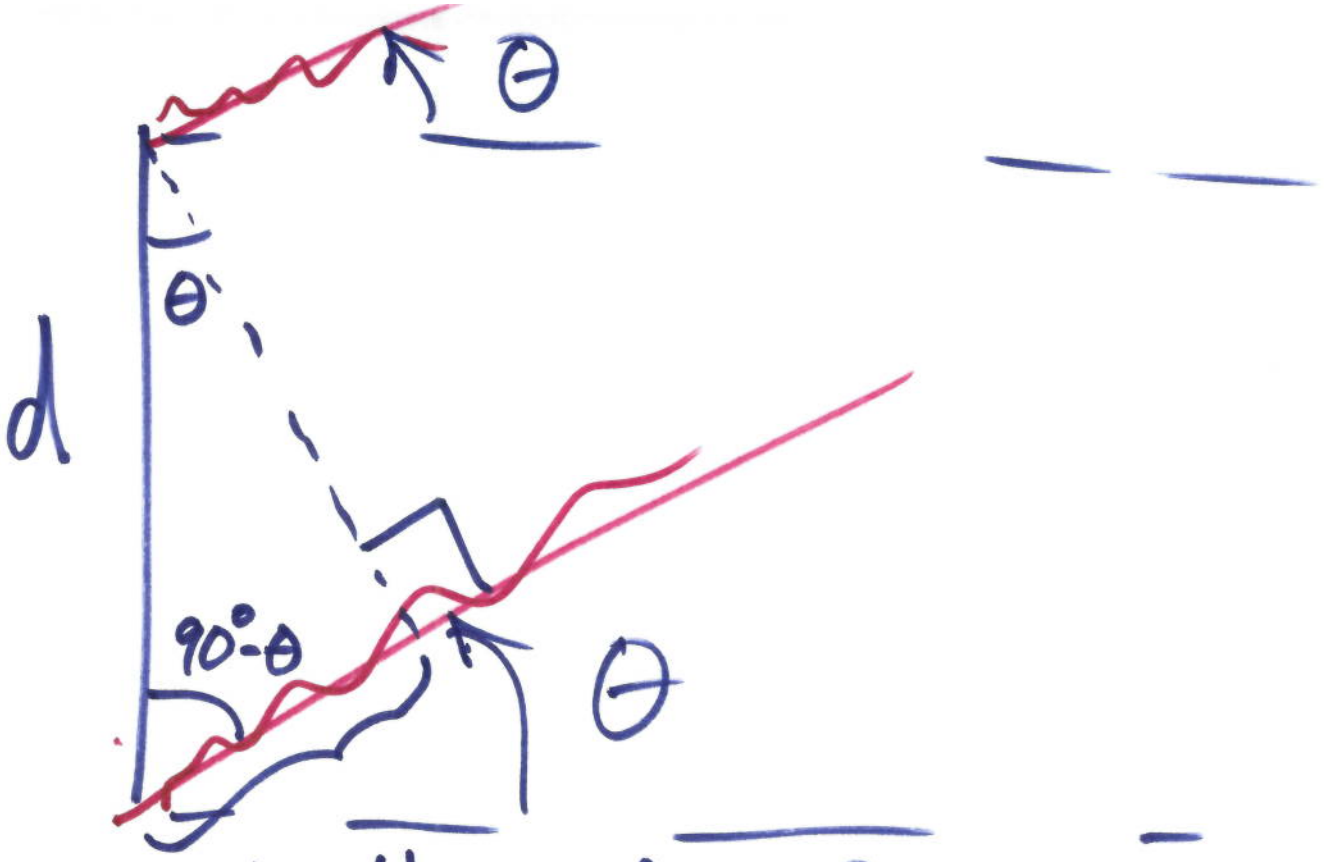
interference patterns

wavelength

interference: if $\Delta path = n \cdot \lambda$

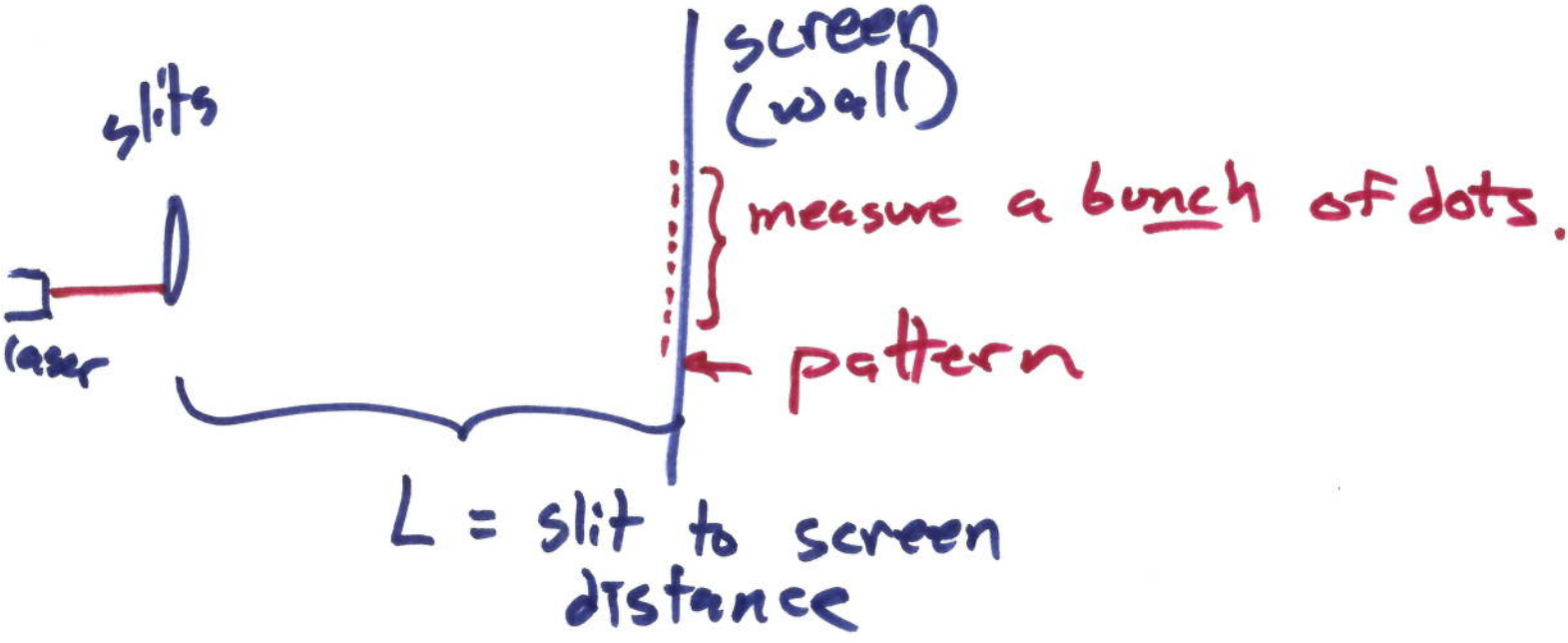
↑ any integer

⇒ constructive interference (bright spot)



$$\Delta path \simeq d \sin\theta$$

$$\sin\theta = \frac{opp}{hyp} = \frac{\Delta path}{d}$$

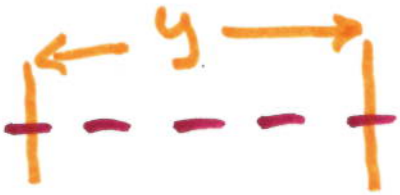


theory: $d \sin\theta = n\lambda$

d = given (read off slit wheel.)

λ = given = 650 nm

n = # of gaps between bright dots you measure.



$n = 4$

$$\frac{y}{L} \simeq \sin\theta = \frac{n\lambda}{d}$$

L

$L >> y$

$$\sin\theta = \frac{\text{opp}}{\text{hyp}}$$