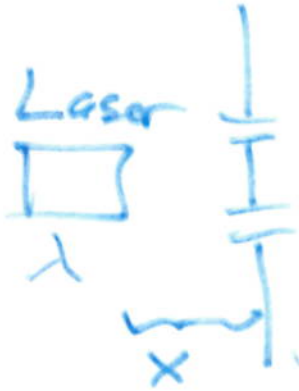
Physics 201

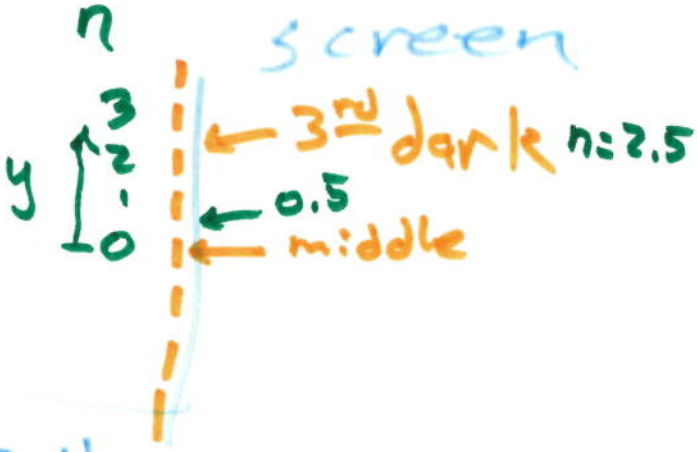
Day 30

Exam 3 Review

See updated equation sheet.

2 x Slit





$L = 3.11\,m$

$x = 51\,cm$

width = 0.155mm = a

separation = 0.617mm = d

$\lambda = 650nm$

Find dist (on screen) from center to 3rd dark spot on one side.

$d \sin\theta = m\lambda$ $\quad m = 0, \pm1, \pm2 \ldots$ Bright

$a \sin\theta = p\lambda$ $\quad p = \pm1, \pm2, \pm3 \ldots$ Dark

$d \sin\theta = n\lambda$ double slit bright spots

$0.617mm \; \frac{y}{L} = 2.5(650nm)$

$$y = \frac{2.5\,(650\,nm) \times 3.11\,m}{0.617\,mm}$$

10^{-9} 10^{-3}

$$= 8.19\,mm$$

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2 states: (A) $E = 3.2 \frac{Kcal}{mol}$ $S = 0$

(B) $E = 0$ $S = -0.015 \frac{Kcal}{mol \cdot K}$

at $T = 300K$, find P_A.

2 state systems

$$P_A = \frac{1}{1 + e^{-\Delta G / K_B T}}$$

$$\Delta G = G_B - G_A$$

$$= E_B - TS_B - E_A + TS_A$$

$$= 0 - 300K\left(-0.015 \frac{Kcal}{mol \cdot K}\right) - 3.2 \frac{Kcal}{mol} + T \cdot 0$$

$$= 4.5 \frac{Kcal}{mol} - 3.2 \frac{Kcal}{mol} = 1.3 \frac{Kcal}{mol}$$

$$P_A = \frac{1}{1 + e^{-1.3 \frac{Kcal}{mol} / \left(0.002 \frac{Kcal}{mol \cdot K} \cdot 300K\right)}} = 0.897$$

$$P_B = 1 - P_A = 0.102$$

Check: $E(x,t) = E_0(Ax^3 - Bt^3)$

is a soln of $c^2\frac{d^2E}{dx^2} = \frac{d^2E}{dt^2}$

If yes, find c
If no, why no?

$\frac{dE}{dx} = E_0 A 3x^2$

$\frac{d^2E}{dx^2} = E_0 A 6x$

$\frac{dE}{dt} = -E_0 B 3t^2$

$\frac{d^2E}{dt^2} = -E_0 B 6t$

$c^2 \cancel{E_0} A \cancel{6} x \stackrel{?}{=} -\cancel{E_0} B \cancel{6} t$

$c^2 A x \stackrel{?}{=} -Bt$

$c^2 = -\frac{Bt}{Ax}$ ✗ No $c^2 \neq$ const not a fun(x,t)

$Q = cm\Delta T$ yes. Know this

$Q = Lm$ No. Not on equ. sheet.

You have 300g unknown liquid. at 17°C. Add 45g hot (100°C) copper $c = 0.385 \frac{J}{g°C}$. If final T of mixture is 20.9°C, find c of unknown liquid.

$$Q = cm\Delta T$$

Assume no heat loss (meaning all heat from copper goes into liquid).

$$0 = c_1 m_1 \Delta T_1 + c_c m_c \Delta T_c$$

$$\Delta T = T_f - T_{init}$$

$$0 = c_1\, 300g\,(20.9°C - 17°C) + 0.385 \frac{J}{g°C}\, 45g\,(20.9°C - 100°C)$$

$$0 = C_1\,(1170\ g°C) + -1370.4\ J$$

$$\frac{1170}{1370.4} = C_1 = \frac{1370\ J}{1170\ g°C} =$$

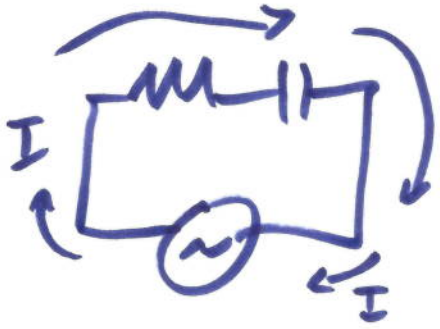
$$C_1 = 1.2 J/g°C$$

AC: $V = 9.17\,V$ $f = 546\,Hz$

$R = 123\,\Omega$ ___ $C = 8.76 \times 10^{-7}\,F$
series

find I, V across each element.

$X_R = R$ $X_C = \frac{1}{\omega C}$



$\omega = 2\pi f = 3430\ \frac{1}{s}$

$X_C = 3330\,\Omega$ $X_L = L\omega$

$V = XI$ $V = ZI$

$$Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{(123\,\Omega)^2 + (333\,\Omega)^2}$$

$Z = 355\,\Omega$

$$I = \frac{V}{Z} = \frac{9.17\,V}{355\,\Omega} = 2.58 \times 10^{-2}\,A$$
$$= 25.8\,mA$$

$V = XI$

$V_R = RI = 123\,\Omega\,(2.58 \times 10^{-2}\,A) = 3.17\,V$

$V_C = X_C I = 333\,\Omega\,(2.58 \times 10^{-2}\,A) = 8.59\,V$