Chem 111

Review

Announcement

Review Schedule - ISB 135

Weds 4-6 PM C. Joseph

Weds 7-9 PM J. Tyson and M. Johnson

Thurs 4-6 PM B.Botch

General Tips

Relax

Practice:
http://people.chem.umass.edu/cjoseph/chem111/
http://courses.umass.edu/chem111-bbotch/

Do problems you know and not frustrate you.

Eliminate answers

Tentative - Tyson

Avogadro's number is 6.022×10^{23}

$q = mC_{sp}\,\Delta T$

C_{sp} (water) = 4.184 J/g °C

1 ml water weighs 1 g

$h =$ 6.626×10^{-34} J s/photon

$c =$ 2.998×10^{8} m/s

$R =$ $1.097 \times 10^{7}\ m^{-1}$ (Rydberg constant)

1 m = 10^{9} nm

1 Hz = $1\ s^{-1}$

1 cal = 4.184 J

$\lambda =$ h/mv (De Broglie)

$\Delta U = q + w$

$w = -P\Delta V$

$\Delta H = \Delta U + P\Delta V$ reactions at constant pressure

$\Delta H^0_{rxn} = \Sigma\Delta H^0_f\,(\text{products}) - \Sigma\Delta H^0_f\,(\text{reactants})$

$E_n = \dfrac{-Rhc}{n^2}$ $\quad Rhc = 2.180 \times 10^{-18}$ J

$\Delta E = -Rhc(1/n_f^2 - 1/n_i^2)$

$c = \lambda\nu$

$E = h\nu$

T(°F) = (180/100) T(°C) + 32

T(K) = T(°C) + 273

$\text{Force} = q_1q_2/r_{12}^2$

R = 0.0821 L atm/mol K = 8.314 J/mol K (gas constant)

1 atm = 760 mm Hg

1 mile = 5280 ft

1 foot = 12 inches

1 inch = 0.0254 meters

Tentative - Vachet

USEFUL INFORMATION

1 mole = 6.022×10^{23}		$\Delta U =$	$q + w$		
$q = mC_{sp}\,\Delta T$		$w =$	$-P\Delta V$		
Csp (water) = 4.184 J/g^0		$\Delta H =$	$\Delta U + \Delta PV$		
1 ml water = 1 g		ΔH^0_{rxn}	$= \Sigma\ \Delta H^0_f$ (products) - $\Sigma\ \Delta H^0_f$ (reactants)		
		$E_n =$	$\dfrac{-Rhc}{n^2}$		
$h =$	6.626×10^{-34} J sec/photon	$\Delta E =$	$-Rhc(1/n_f^2 - 1/n_i^2)$		
$c =$	2.998×10^8 m/sec	$c =$	$\lambda\nu$	1 atm =	760 mm Hg
$R =$	$1.097 \times 10^7\ m^{-1}$	$E =$	$h\nu$	1 mile =	5280 ft
1 m =	10^9 nm	T(°F) =	(180/100) T(°C) + 32	1 foot =	12 inches
1 Hz =	1 sec^{-1}	T(K) =	T(°C) + 273	1 inch =	0.0254 meters
1 cal =	4.184 J	Force =	$q_1q_2/\ r_{12}^2$		
		R =	0.0821 L atm/mol K = 8.314 J/mol K		
			FC = group # - [# lone pair e + ½(bonding pair e)]		

Tentative - Joseph

$N_A = 6.022 \times 10^{23}$

$q = mC_{sp}\Delta T$

$C_{sp}(\text{water}) = 4.184 \frac{J}{g\ {}^{o}C}$

1 ml water weighs 1 g

$h = 6.626 \times 10^{-34}$ Js

$c = 2.998 \times 10^{8} \frac{m}{s}$

$R_H = 1.097 \times 10^{7}\ m^{-1}$

1 Hz = 1 s^{-1}

1 cal = 4.184 J

$A = \varepsilon \ell c$

$\Delta U = q + w$

$w = -P\Delta V$

$\Delta H = \Delta U + P\Delta V$ reactions at constant pressure

$\Delta H^{0}_{rxn} = \Sigma \Delta H^{0}_{f}(\text{products}) - \Sigma \Delta H^{0}_{f}(\text{reactants})$

$$E_n = -\frac{R_H hc}{n^2}$$

$$\Delta E = -R_H hc\left(\frac{1}{n_f^2} - \frac{1}{n_i^2}\right)$$

$c = \lambda\nu$

$E = h\nu$

$$\lambda = \frac{h}{mv}$$

$$\frac{c}{\lambda} = \nu$$

$$E = \frac{hc}{\lambda}$$

Tentative - Solubility

1.	All sodium, potassium, and ammonium salts are SOLUBLE.
2.	All nitrate, acetate, chlorate and perchlorate salts are SOLUBLE.
3.	All chloride, bromide and iodide salts are SOLUBLE - EXCEPT those also containing: silver(I), lead(II), or mercury(I), Hg_2^{2+} ions, which are not soluble.
4.	All sulfate salts are SOLUBLE - EXCEPT those also containing: calcium, silver(I), mercury(I), strontium, barium, or lead(II) ions, which are NOT soluble.
5.	All hydroxide and oxide compounds are NOT SOLUBLE - EXCEPT those also containing: sodium, potassium, or barium ions which are soluble.
6.	All sulfide salts are NOT SOLUBLE - EXCEPT those also containing: sodium, potassium, ammonium or barium ions which are soluble.
7.	All carbonate and phosphate salts are NOT SOLUBLE - EXCEPT those also containing: sodium, potassium, or ammonium ions, which are soluble.

Let's practice

45.7 mL of 0.500 M H_2SO_4 is required to react completely with a 20.0 mL sample of NaOH solution. What is the concentration of the NaOH solution?

$$H_2SO_4 + 2NaOH \rightarrow 2H_2O + Na_2SO_4$$

$$0.5M = \frac{0.5\ mol\ H_2SO_4}{1\ L} = \frac{0.5\ mol\ H_2SO_4}{1000\ mL} \times \frac{45.7\ mL}{1} = 0.02285\ mol\ H_2SO_4$$

$$\frac{.00285\ mol\ H_2SO_4}{} \cdot \frac{2\ mol\ NaOH}{1\ mol\ H_2SO_4} = 0.0457\ mol\ NaOH$$

$$\frac{0.0457\ mol\ NaOH}{.020\ L} = 2.285\ M\ NaOH$$

Let's practice

$P\% = \frac{actual}{theo} \times 100\%$

#4

Adipic acid, $H_2C_6H_8O_4$, is a material used for the production of nylon. It is made commercially reaction between cyclohexane, C_6H_{12} and O_2:

$$2\ C_6H_{12} + 5\ O_2 \rightarrow 2\ H_2C_6H_8O_4 + 2\ H_2O$$

Assume you that you carry out this reaction with 25.0 g cyclohexane and it is the limiting reactant. If you obtain33.5 g of adipic acid, what is the percent yield.

$25\text{ g cyclo} \times \frac{1\text{ mol}}{(6\times12+12)\text{ g cyclo}} = 0.298\text{ mol cyclo}$

84 g

$.298\text{ mol cyclo} \times \frac{2\text{ mol AA}}{2\text{ mol cyclo}} = .298\text{ mol AA}$

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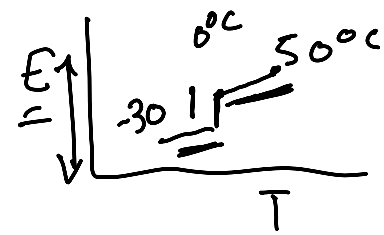
$.298\text{ mol AA} \times \frac{(2+12\times6+8+16\times4)\text{ g}}{\text{mol}} = 43.51\text{ g AA}$

$\frac{33.5}{43.51} \times 100\% = 77.0\%$

Let's practice

What is the enthalpy change during the process in which 100.0g of water 50.0 ºC is cooled to ice at -30.0 ºC? The specific heats of ice and water 2.09 and 4.18 J/g-K, respectively. For H_2O, ΔH_{fus} = 6.01 kJ/mol.



$q = m \Delta T C_{sp}$

$= (100\,g)(0 - 50\,°C)(4.18\ \frac{J}{g\,K})$

$= -20{,}900\ J$ or $-20.9\ kJ$

$q = m \Delta H_{fus}$

$100\,g \ \frac{1\ mol}{18\ g} = 5.556\ mol\ H_2O$

$q = -(5.556\ mol\ H_2O)(6.01\ \frac{kJ}{mol})$

$q = -33.4\ kJ$

$q = m \Delta T C_{sp}$

$= (100\,g)(-30 - 0)\,°C\ (2.09\ \frac{J}{g\,K})$

$= -6270\ J$ or $-6.27\ kJ$

$q = -20.9\ kJ - 33.4\ kJ - 6.27\ kJ$

$q = -60.57\ kJ$

Let's practice

Chapter 3

Suppose you burn 1.500g of benzoic acid, $C_6H_5CO_2H$, in a constant volume calorimeter and find that the temperature increases from 22.50 ºC to 31.69 ºC. The calorimeter contains 775 g of water, and the bomb has a heat capacity of 893 J/K. Calculate the molar heat of combustion of benzoic acid.

$q = q_1 + q_2 + \ldots$

$= q_{cal} + q_{water}$

$= C_{cal}\Delta T + m C_{sp} \Delta T$

$= 893 \frac{J}{K}(31.69 - 22.50) + 775g\,(4.18 \frac{J}{gK})(31.69 - 22.50)$

$= 38{,}000\,J$ or $38\,kJ$

$1.500g \; \frac{1\ mol}{(6\times12 + 5 + 12 + 16\times2 + 1)\,g} = .0122\ mol$

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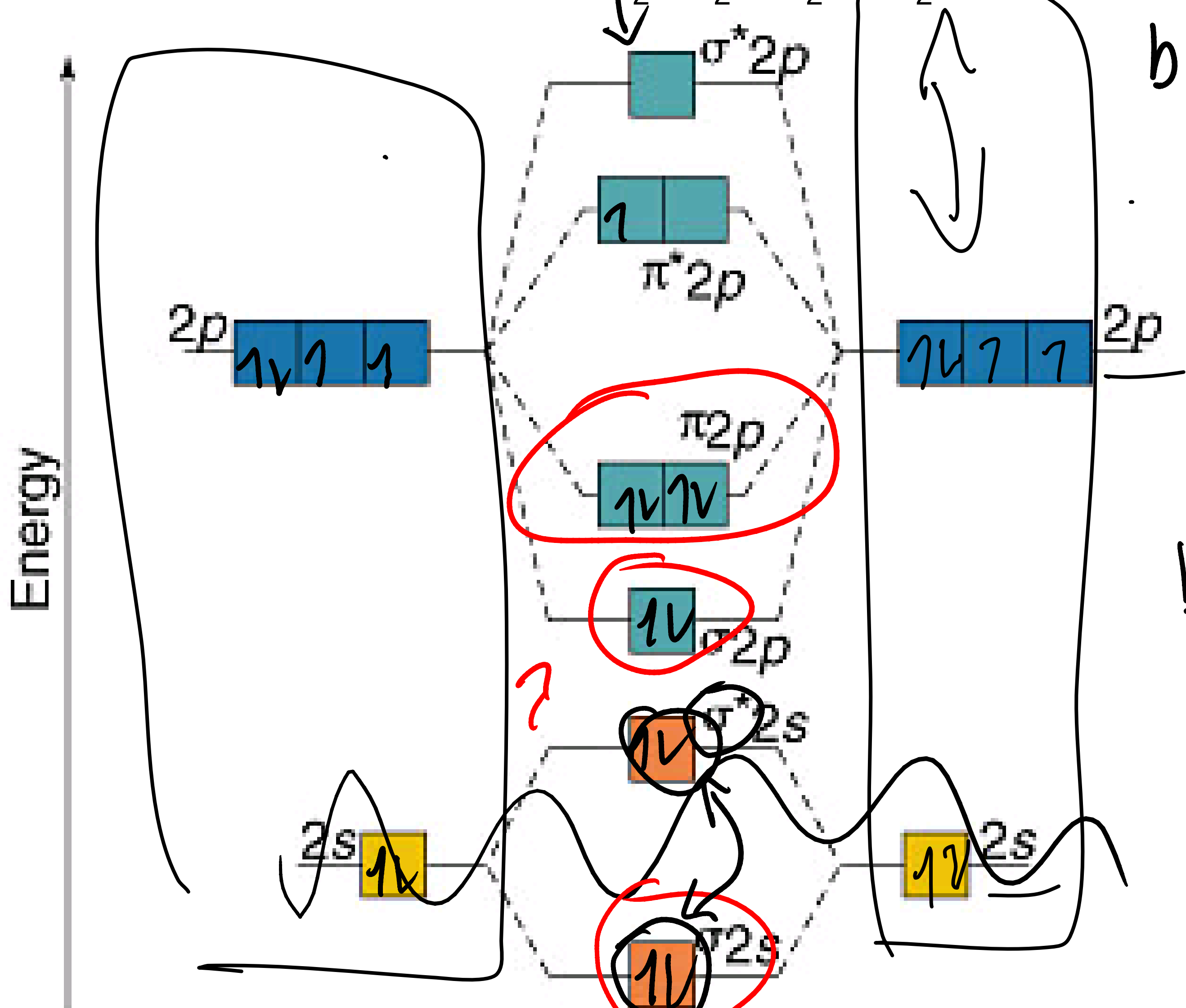
$38\,kJ \div .0122 = 3690\ kJ/mol$

Let's practice

What is the Bond Order O_2, O_2^-, O_2^{2-}, O_2^+



$b.o. = \frac{1}{2}(be - ae)$

$= \frac{1}{2}(6-2)$

$= \frac{1}{2}(4)$

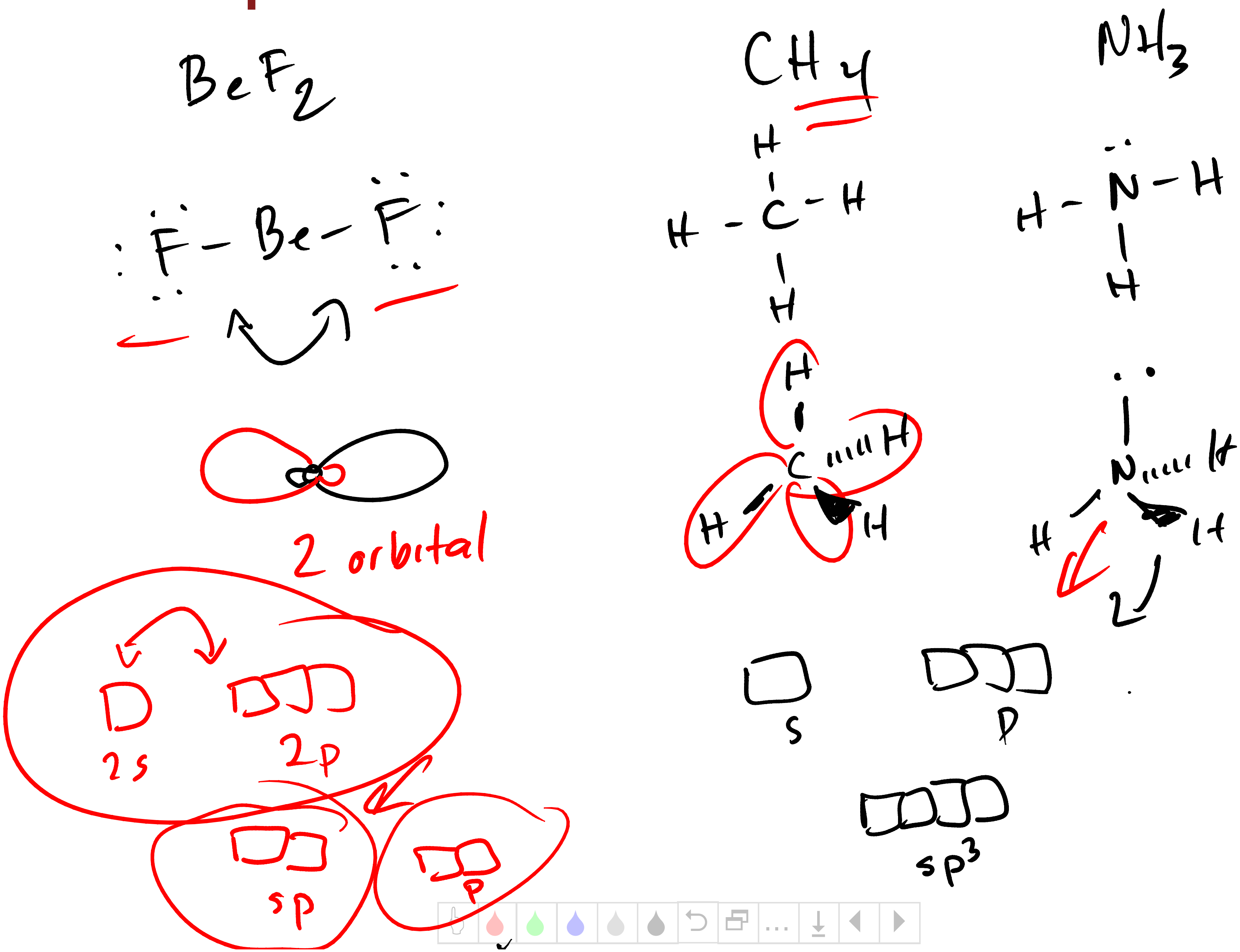
$= 2$

$b.o = \frac{1}{2}(6-1)$

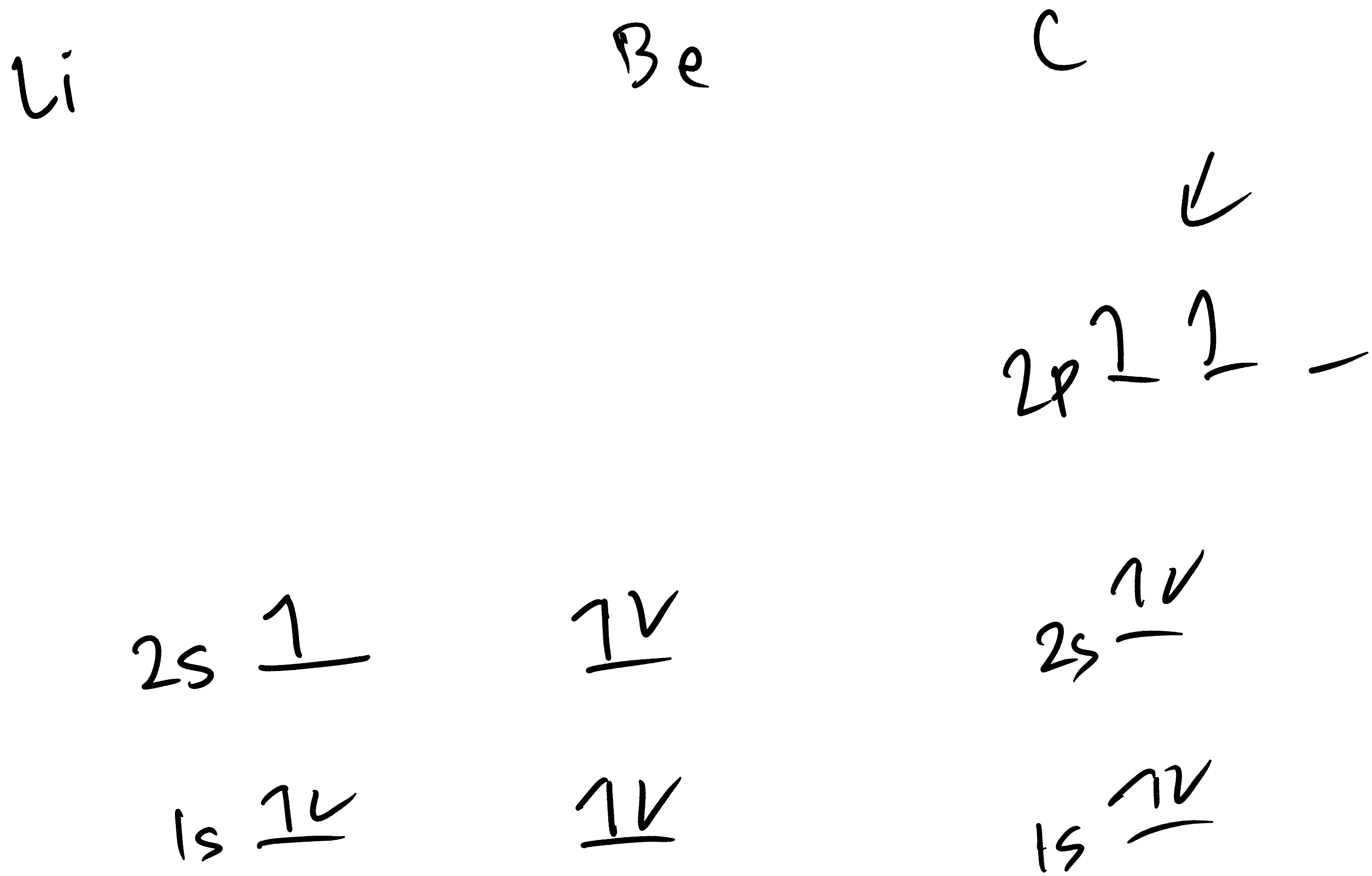
$= \frac{1}{2}(5)$

$= 2.5$

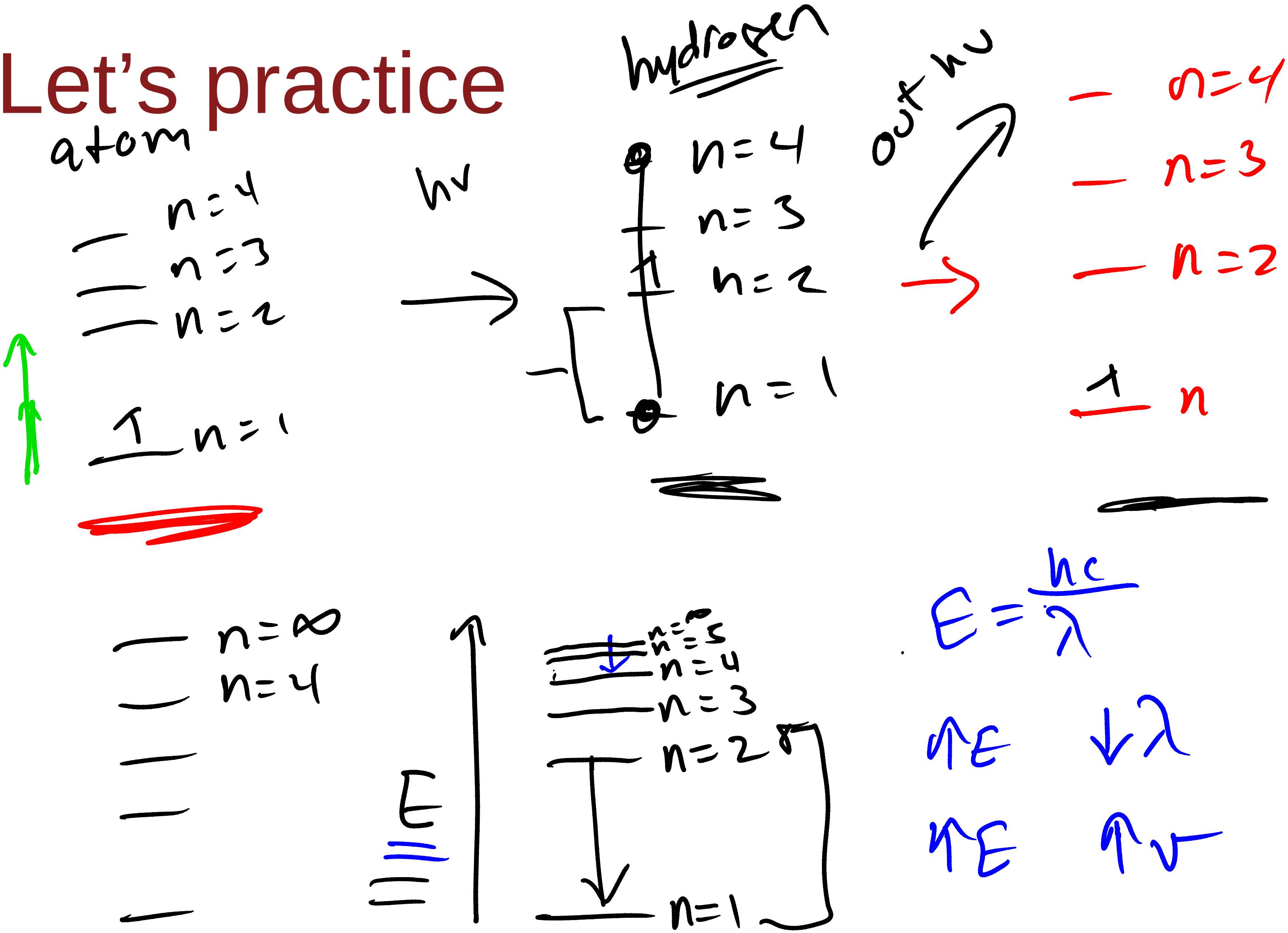
Let’s practice



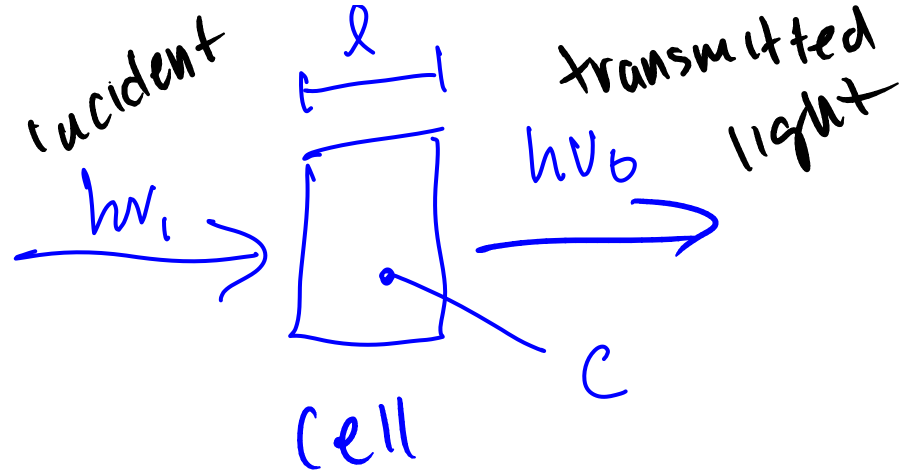
Let’s practice



Let’s practice



Let's practice



$$A = \varepsilon l c$$

A = absorbance

ε = molar absorbtivity (sp?)

l = path length

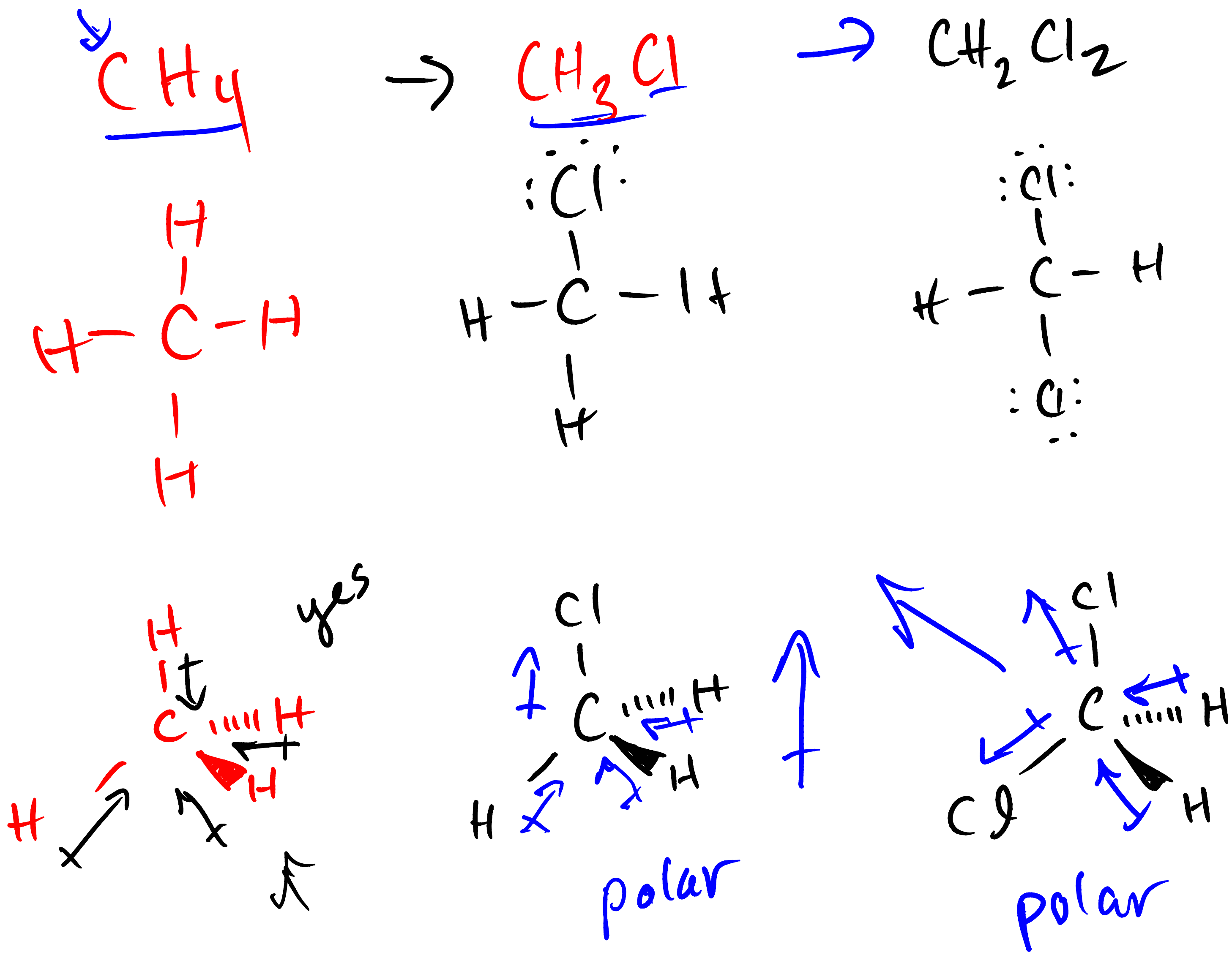
c = conc.

$$\begin{matrix} \varepsilon & l & M \\ (cm^{-1} M^{-1}) & (cm) & (M) \end{matrix}$$

$$(cm)(M)$$

$$\varepsilon = (cm^{-1} M^{-1}$$

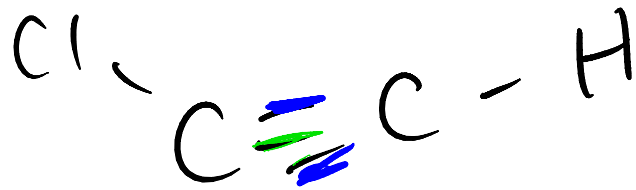
Let’s practice



Let's practice

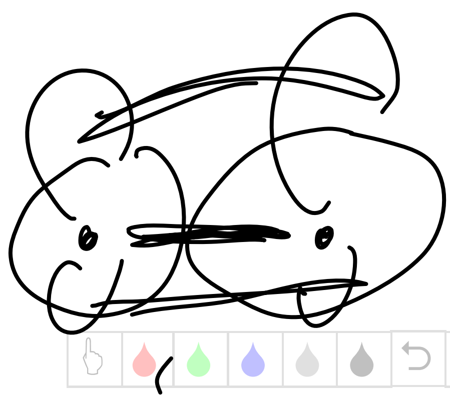
sigma = single
pi = double or triple

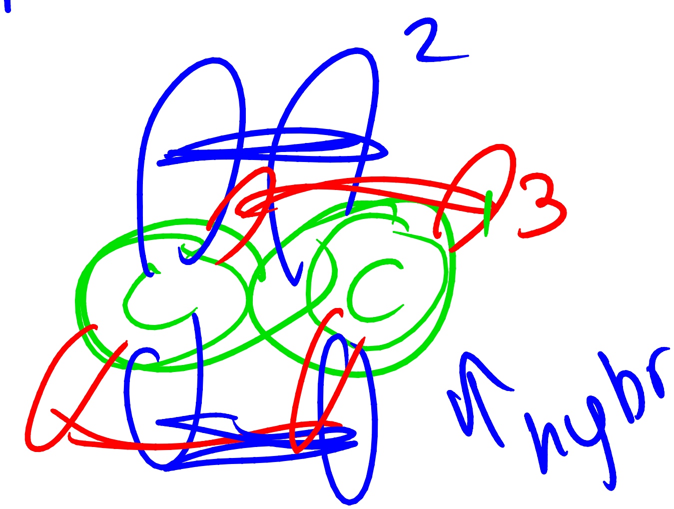
O=O



σ bond
π bond

3 σ
2 π





Let’s practice