1. Calculate EMR Classic Phys and Chem (1)

Involves

$E = h\nu$ $\quad h = 6.626 \times 10^{-34}$ J s

$\nu = c/\lambda$ $\quad c = 3.00 \times 10^{8}$ m/s

find an unknown

- make units cancel
- know your metric system

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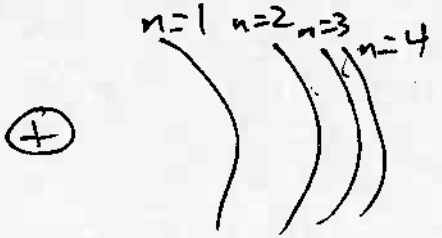
2. Theory: Balmer, Rydberg

According to Balmer there are discrete lines in emission spectra of H atom

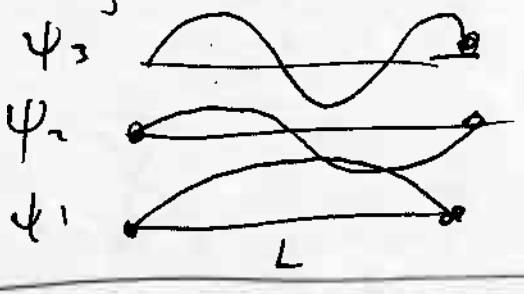
Rydberg created an empirical relationship

$E \propto \left(\frac{1}{n^2}\right)$ where n was an integer representing a quantum number

Bohr said that n corresponded to a discrete energy level for an e^- in H atom

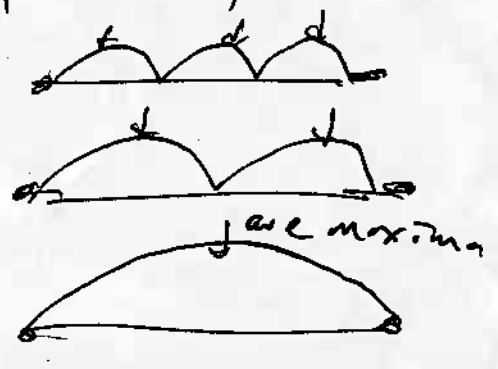


Theory: particle in a box - this is the first effort ②
to apply quantum mechanics to a physical system.
Particle in a box is simplest because there is no V. ie.
$V(x) = 0$ I can create a series of $n = 1, 2 \cdots \infty$
quantum levels w. th ψ solutions.



note the nodes and note where ψ is large

ψ^2 is where particle is in the box



Calculate: uncertainty This is a plug and chug.

$$\frac{\hbar}{2} \leq \Delta x \Delta p \leq m \Delta v \Delta x$$

I will give you some data, you stick it in, make units cancel and solve

$m \equiv$ is mass and is for an object and is kg
$\Delta v \equiv$ velocity in m/s
$\Delta x \equiv$ displacement in m
$\hbar \equiv$ constant given to you

make units. make them cancel

5. Calculate: de Broglie wavelength of a plane + chug

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

$h \equiv$ constant

$m \equiv$ mass in kg

$v \equiv$ velocity in m/s

$\lambda \equiv$ wavelength in reciprocal cm

mks units you need to convert into these and solve

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6. Theory: Schrödinger + Ψ equations

I will give you a collection of true and false statement about schrödinger eqn. you need to spot which are which

Don't kill yourself on this one. It is probably the only thing you do know about Schrödinger.

7. Applying quantum rules

I want you to make a decision about the number and kind of e^- quantum numbers given

$n = 1, 2 \cdots \infty$

$\ell = 0, 1, 2 \cdots n-1$

$m_\ell = -\ell, \cdots 0, \cdots +\ell$

$m_s = +\frac{1}{2}, -\frac{1}{2}$

Be able to identify when a series of quantum #s is invalid and be able to count # of e^- that meet certain condition.

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8. Rules: Aufbau, Hund, Pauli:

Aufbau says fill from bottom up

Hund says that need to spread out over degenerate levels

Pauli says no more than two e^- in same orbit

I will give you some examples of e^- conf. (quantum), find the one that violates one of these.

Hint. This is the first kind of tricky one.

9. Configure atm + Ions: use Aufbau and exceptions to create e⁻ configuration.

step 1 : count up total electrons

step 2 : fill according to Aufbau $1s^2 2s^2 2p^6 3s^2 3p^6 \ldots$

step 3 : consider famous exceptions

$5_2 d_4 \rightarrow 5_1 d_5$ $\quad$ $5_2 d_9 \rightarrow 5_1 d_{10}$

$In^{+3} \rightarrow d^{10}$ etc

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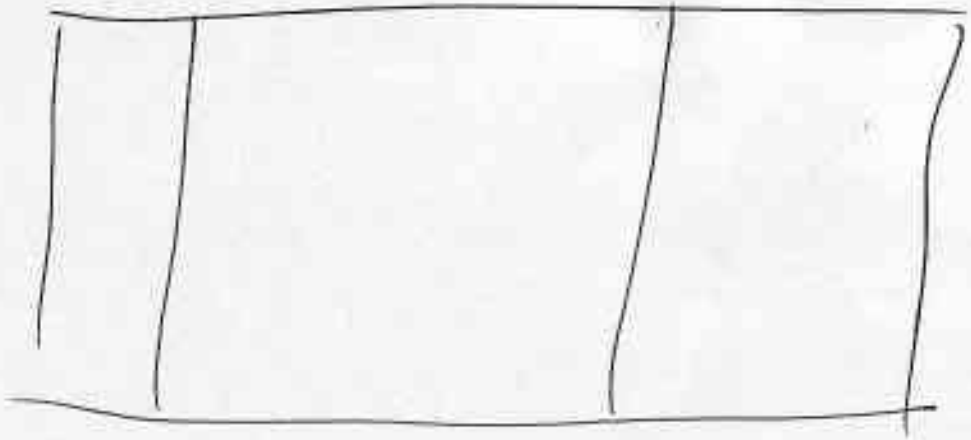
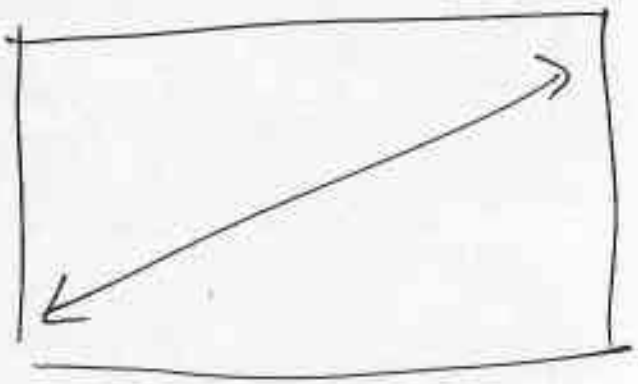
10 Def.n: Periodic Table



know the words for describing periodic table. for example group, row, family period, halogen, alkali metal, noble gas, lanthanide main group etc etc

these aren't all of them

11. Theory: trends IE, EA, AR, IR



In general as you move from lower left to upper right, ENC increases. ∴ IE↑ EA↑ AR↓ IR↓

Know the exceptions involving isoelectronic series for I.R.

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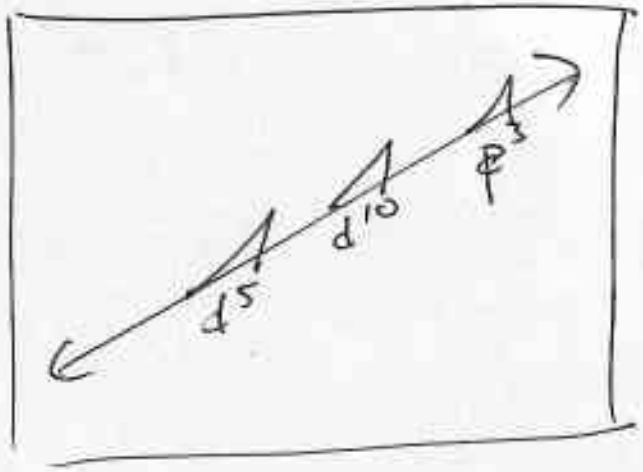
12 Ranking IE EA AR IR



I give you a collection of ions or atoms. You rank them most to least or least to most from lower left to upper right following ENC.

I will want you to know the exceptions at d^5, d^{10}, p^3 stabil

13. Ranking: crystal lattice Energy

I will give a series of salts. Based on the charge density which is directly proportional to C.L.E. rank them. ie. ↑ charge density the C.L.E ↑

(1) The charge on an ion is first ranking $+3 > +2 > +1$

(2) for same charge, the smaller the atom the greater the charge density. NaF > NaCl because F is smaller than Cl

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14. Lewis structure: Ionic

I want you to be able to draw the Lewis structure of a salt

ie. $NaCl \longrightarrow Na^+ , :\ddot{\underset{\cdot\cdot}{Cl}}:^-$

or $CaCl_2 \longrightarrow Ca^{++} , 2:\ddot{\underset{\cdot\cdot}{Cl}}:^-$

Be able to do this for salts of form

AB, AB_2, A_2B

A_3B, AB_3

A_2B_3, A_3B_2

15. Lewis structure: covalent

Step 1: spread out the atoms

step 2: add up the valence e^-

step 3: assign 8 or 2 to perimeter

step 4: stick rest in middle

step 5: if hypervalent then create II or III or I:

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16. Lewis structure: covalent

→ I will give you two examples, one is a multiple-centred atom case i.e. $CH_3CH_2NH_2$ and the other is a standard single centred atom case using steps 1 → 5.

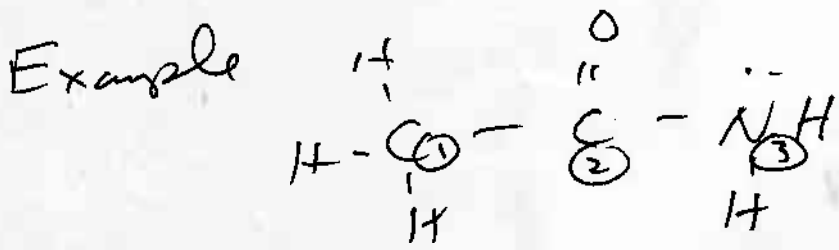
In #15, 16

H.t. I can tell if you get this right by asking, "how many perimeter e^-s?" or "how many unbonded pairs?"

17. Problem: Formal charge I will give you some molecules and ask you to count the formal charge on specific atoms.

F.C. = # of val e^- − 2 for unbnd e^- pairs − 1 for bonded e^- pairs

Example



① 4 − 4 = 0

② 4 − 4 = 0

③ 5 − 3 − 2 = 0

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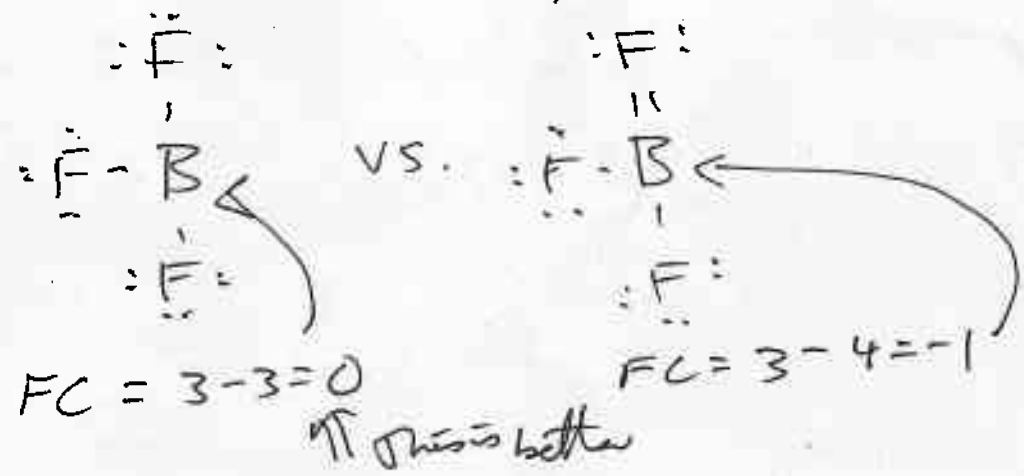
18. formal charge & Lewis structures

you will do #17 a bunch to determine which of two molecules has correct Lewis structure. The smaller the overall FC, the more stable.

Example



Bonding Trend ranking, ~~B.E~~, BE, B.L.

Things to remember: The more covalent the bond, the stronger and shorter

C-C > C-O

HCl > HBr > HI ← The smaller the atoms, the ~~stronger~~ stronger and shorter

stronger stronger
Example $N_2 > O_2$ ← The more bonds there are, the stronger and shorter

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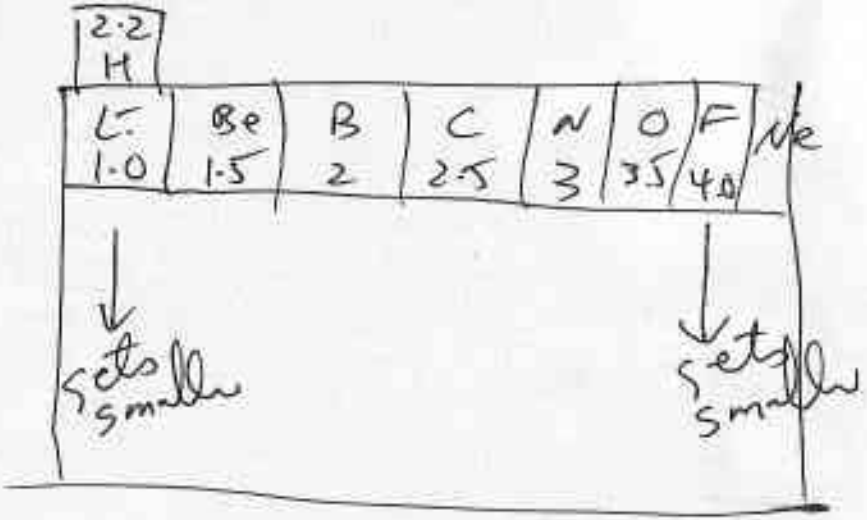
Calculate ΔEN



I will give you ~~a~~ two ~~atoms~~, you tell me if what ΔEN and also if Ionic or covalent

ΔEN < 1.5 covalent

ΔEN > 1.5 Ionic

H.w. It will not be a second row of H ΔEN, but if you know the trend it is easy.