1) $NaHCO_3$

| lightest | | Heaviest | |
|---|---|---|---|
| 1 x 23 | 23 | 1 x 23 = 23 | |
| 1 x 1 | 1 | 1 x 2 = 2 | |
| 1 x 12 | 12 | 1 x 13 = 13 | |
| 3 x 16 = 48 | | 3 x 18 = 54 | |
| | 84 g/mol | | 92 g/mol |

2) Ionic compounds require stabilization by the very large coulomb attraction between cations and anions in the solid phase.

Covalent molecules do not have a complete transfer of electrons between atoms and so the interaction between molecules is generally weak.

3) $V_{coul}(r) = \frac{q_1 q_2 e^2}{4\pi\epsilon_0 r}$ $\quad F_{coul}(r) = -\frac{d}{dr} V(r) = \frac{q_1 q_2 e^2}{4\pi\epsilon_0 r^2}$

Ionic radii from notes $Ca^{2+} = 100$ pm, $O^{2-} = 140$ pm

$$V_{coul}(r) = \frac{(2+)(2-)(1.602 \times 10^{-19} C)^2}{4\pi\ 8.854 \times 10^{-12} \frac{C^2}{J\,m}\left(3 \times 240 \times 10^{-12} m\right)} = 1.28 \times 10^{-18} J \quad (\sim 8 eV)$$

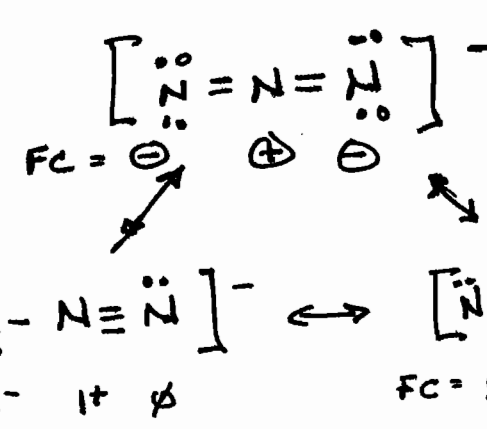
Notice:

$$F_{coul}(r) = \frac{V_{coul}}{r} = \frac{1.28 \times 10^{-18} J}{(3 \times 240 \times 10^{-12} m)} = 1.78 \times 10^{-9} J/m \quad (\sim 11 eV/\text{Å})$$

[ should get some number if you do this the long way

$$F_{coul}(r) = \frac{q_1 q_2 e^2}{4\pi\epsilon_0 r^2} \ ]$$

4) $N_3^-$ (16 e⁻)




5) need a) heat of formation of $CaBr_{2(s)}$ from $Ca_{(s)}$ & $Br_{2(l)}$

b) heat of sublimation $Ca_{(s)} \rightarrow Ca_{(g)}$

c) FIP od SIP of $Ca_{(g)}$

d) EA of $Br_{(g)}$ (atoms)

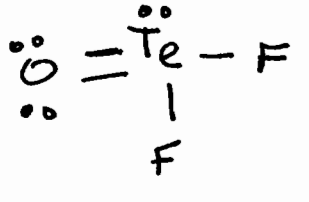
e) BDE of $Br_{2(g)}$

f) heat of vaporization $Br_{2(l)} \rightarrow Br_{2(g)}$

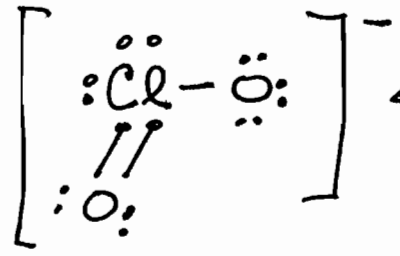
6) (a)

5 structural pairs
trigonal bipyramidal arrangement
→ T-shape

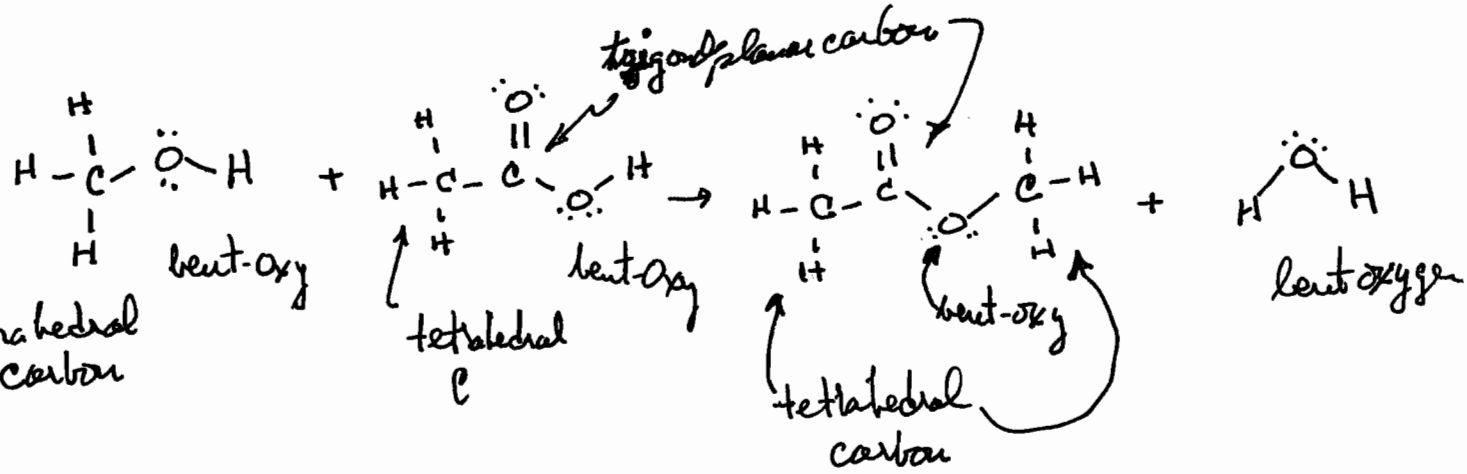
(b)



4 structural pairs
tetrahedral arrangement
→ trigonal pyramid shape

6) (c)  ↔ resonator

4 structural pairs
tetrahedral arrangement
→ bent molecule

7) 


8) $\lambda = \frac{c}{\nu} = \frac{3 \times 10^8 \ m/s}{2450 \times 10^6 \ /s} = 0.122 \ m$ "micro waves"

↳ rotational motion of water molecule as a whole

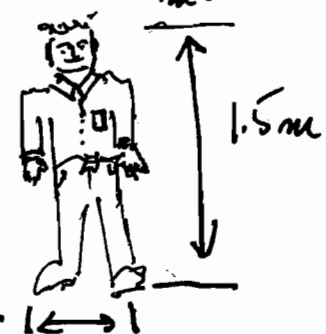
9) $\lambda_{max} \sim 1 \mu m$ $\quad T = \frac{c}{5\lambda_{max}} = \frac{1.44 \ cm \ K}{5(1 \times 10^{-6} \ m) \times 10^2 \frac{cm}{m}}$

$T = 2880 \ K$

10) $P/A = 56.705 \times 10^{-9} \frac{W}{m^2 K^4} T^4 = 56.705 \times 10^{-9} (310 \ K)^4 \frac{W}{m^2} = 524 \frac{W}{m^2}$

→ need estimate of area of student
- if flat student then $A \sim 1.5 \times 0.4 \ m^2$

$P = 524 \times 1.5 \times 0.4 = 630 W$



11) Blmer Series in Hydrogen $N_1 = 3, 4, 5 \ldots \infty \rightarrow N_2 = 2$

maximum energy when $N_1 = \infty$, $N_2 = 2$

$He^+$ ion (1 electron) $\Delta E = hcR_H Z^2 \left(\frac{1}{N_2} - \frac{1}{N_1}\right)$ for hydrogenic Ions

$$\Delta E = hcR_H (2)^2 \left(\frac{1}{2^2} - \frac{1}{\infty^2}\right) = hcR_H \quad !$$

$\Delta E = 13.6\ eV$ or $2.18 \times 10^{-18}\ J$