

Name KEY

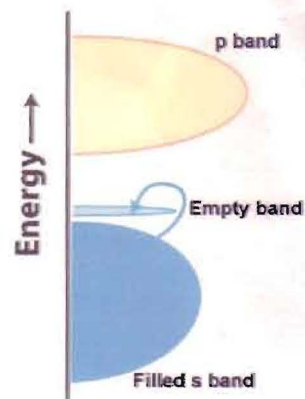
1) {6 pts}

- a. Examine the diagram on the right. Does it describe an insulator, a metallic conductor an intrinsic semiconductor, a p-type extrinsic semiconductor or an n-type extrinsic semiconductor?

a p-type semiconductor

- b. Suppose that the bulk material were Si. Would you dope the Si with As or Ga to produce this material?

Ga - one less valence electron
adding a "positive"



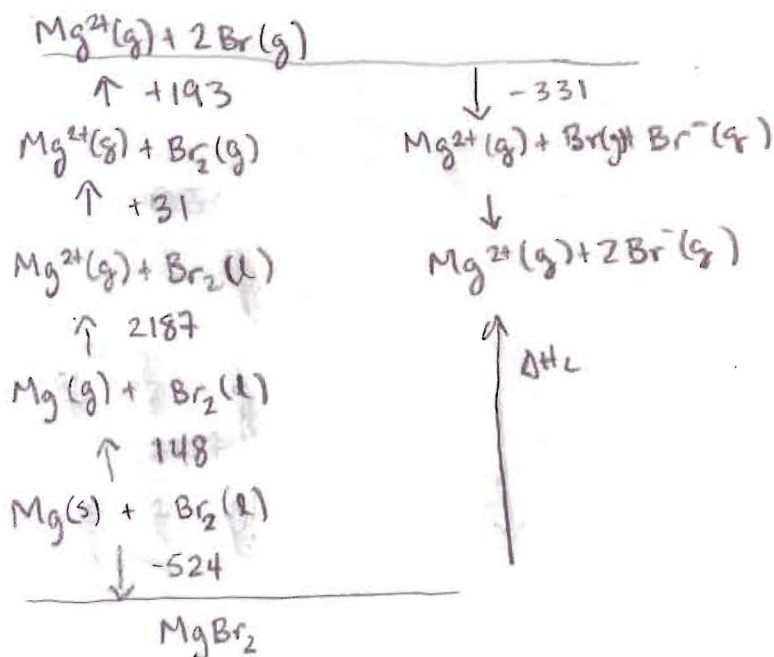
- 2) {6 pts} On the basis of the factors that contribute to lattice enthalpies place LiF, CaO, RbCl, AlN, NiO and CsI, all of which adopt the rock-salt structure, in order of increasing lattice energy.

$$\Delta H_L \propto \frac{|Z_1 Z_2|}{d}$$

do LiF = +1, -1
CaO = +2, -2
med RbCl = +1, -1
AlN = +3, -3
NiO = +2, -2
big CsI = +1, -1

$$\text{CsI} < \text{RbCl} < \text{LiF} < \text{CaO} < \text{NiO} < \text{AlN}$$

- 3) {8 pts} Calculate the lattice enthalpy of magnesium bromide using a Born-Haber cycle. **SHOW YOUR WORK.**

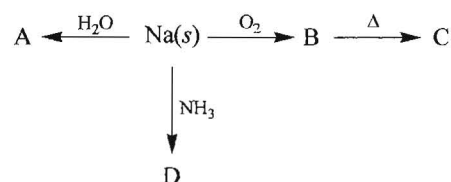


$$\Delta H_L = 148 + 2187 + 31 + 193 - 331 - 331 + 524$$

$$\Delta H_L = 2421 \text{ kJ/mol}$$

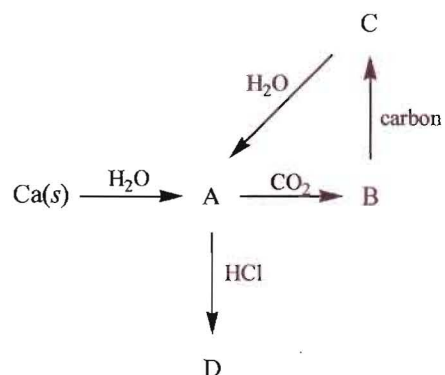
- 4) {4 pts} Identify the reaction that is most likely to give the highest proportion of HD and give your reasoning: (a) $H_2 + D_2$ equilibrated over a platinum surface, (b) $D_2O + NaH$, (c) electrolysis of HDO.
 a & c will give statistical distribution. $H^+/H^-/H\cdot$ are all indiscriminate
 b. is H^+ reacting with $D^- \rightarrow 100\%$ formation of HD

- 5) {4 pts} Using the reaction scheme, identify the Na containing products.



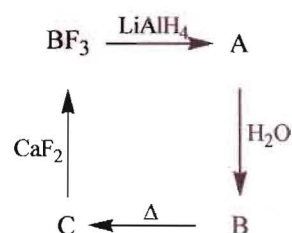
- a. NaOH b. Na_2O_2 c. Na_2O d. NaNH₂

- 6) {4 pts} Using the reaction scheme, identify the Ca containing products.



- a. $Ca(OH)_2$ b. $CaCO_3$ c. CaC_2 d. $CaCl_2$

- 7) {3 pts} Using the reaction scheme, identify the B containing products.



- a. B_2H_6 b. $B(OH)_3$ c. B_2O_3

- 8) {5 pts} What is the diagonal relationship and why does it arise? List two pairs that show this relationship.

Diagonal relationship arises because atomic radii are similar and thus many chemical properties of two elements are similar.



9) {30 pts} Descriptive inorganic chemistry. Identify the element being described.

Na Group 1 element that makes a peroxide upon reaction with O_2 .

Ba Group 2 element used as an x-ray contrast agent for imaging the digestive tract. It makes an insoluble sulfate.

In Its oxides make clear electrodes which are used in solar cells, LCDs and touchscreens.

Li Its carbonate is used to treat bipolar disorders. It is a principle component in rechargeable batteries.

Al Most widely used group 13 "metal", it does not react with water because of an impervious oxide coating.

Cs The "atomic clock" uses this element to officially define the second and the meter.

Ga Element with the largest liquid range of any material known ($\sim 30 - 2400^\circ C$).

K Group 1 element that burns with a purple/lilac flame. Found in nature as potash.

Sr Named after a Scottish village, is prepared either by electrolysis of the molten chloride salt or by reduction of the oxide by aluminum.

Be Group 2 element that is light weight, used for x-ray transparent windows, is toxic and is found in gem stone emeralds.

B Group 13 element known for making pyrophoric organic compounds which burns with a green flame.

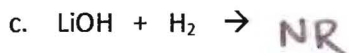
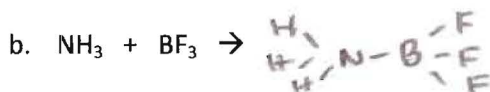
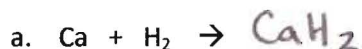
Mg Used in making Grignard reagents.

Tl Group 13 metal whose most common oxidation state is +1.

Ca Group 2 element which is a primary component in bones and teeth.

Rb Group 1 element used in fiber optics. Found by Bunsen to burn with a deep red color.

10) {6 pts} Give the balanced equations (or NR, for no reaction) for

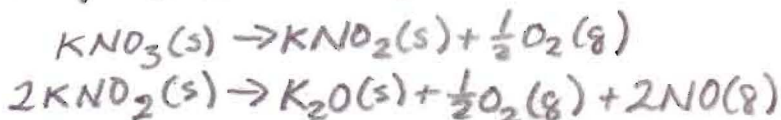


- 11) {8 pts} When heated above 600 °C a sample of potassium nitrate loses mass in two stages, 15.83 percent above 350 °C and 53.46 percent above 450 °C based on the mass of the original sample. Determine the composition of the various products formed in the decompositions. Explain your reasoning. Assume 100g

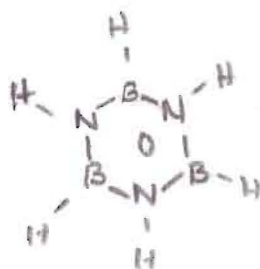
$$\text{KNO}_3 \text{ fw } (39.01 + 14.01 + 16 \times 3) = 101.02 \text{ so } 100\text{g} = 0.99 \text{ mol}$$

$$100\text{g} - 15.83\text{g} = 84.17\text{g} \div 0.99 \text{ mol} = 85.02 \text{ g/mol} - 39.01 = 46.01 \leftarrow \text{NO}_2 \quad (14.01 + 16 \times 2)$$

$$100\text{g} - 53.46 = 46.54\text{g} \div 0.99 \text{ mol} = 47.01 \text{ g/mol} - 39.01 = 8 \leftarrow \text{O}_{0.5}$$



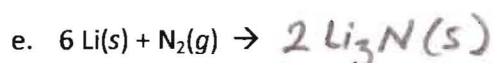
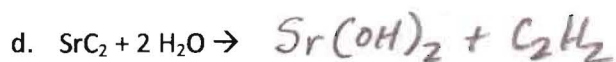
- 12) {2 pts} Draw the structure of borazine.



- 13) {2 pts} Write the equation that describes what happens when you add solid sodium metal to liquid ammonia.



- 14) {14 pts} Predict the products for the following reactions:

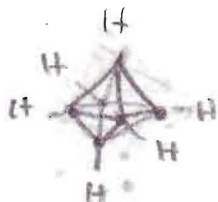


BONUS:

- 1) {2 pts} I begin each class with the phrase...

So it is on the money...

- 2) {4 pts} Draw the structure of $[\text{B}_6\text{H}_6]^{2-}$. How many skeletal electrons does it have? What type of borane cluster is it?



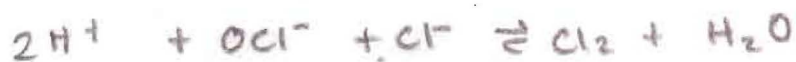
$$\begin{array}{rcl} \text{B-H units} = 6 & \rightarrow & 12 e^- \\ 2- & \rightarrow & 2 e^- \\ \hline & & 14 e^- \text{ are skeletal} \end{array}$$

Closo

- 3) {2 pts} Chlorine is pale yellow-green gas at standard temperature/pressure. However, people add chlorine tablets to their pools to disinfect them. What is the deal here?

Impractical to use gas

Use hypochlorite (and chlorine releasers)



really \nearrow that is the killer.

