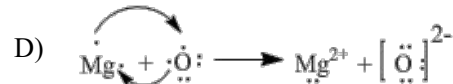
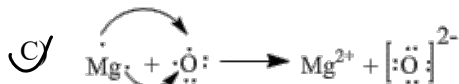
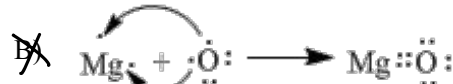
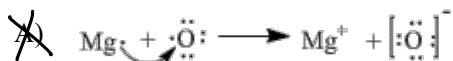


## Chapter 08 Homework

### Part A multiple choice (select the one that is best in each case. 1point/question)

- C. 1. Using Lewis symbols, diagram the reaction between magnesium and oxygen atoms to give the ionic substance MgO.



- A. 2. Energy is required to remove two electrons from Ca to form  $\text{Ca}^{2+}$ , and energy is required to add two electrons to O to form  $\text{O}^{2-}$ . Yet CaO is stable relative to the free elements. Which statement is the best explanation?

☒ A) The lattice energy of CaO is large enough to overcome these processes.

~~B~~ CaO is a covalent compound, and these processes are irrelevant.

~~C~~ CaO has a higher molar mass than either Ca or O.

~~D~~ The enthalpy of formation of CaO is small.

~~E~~ CaO is stable to atmospheric conditions.

- C. 3. Indicate which statement is true.

~~A~~ An element's number of valence electrons is the same as its atomic number.

~~B~~ The hydrogen atom is most stable when it has a full octet of electrons.

☒ C) The octet rule is based on the fact that filling in all *s* and *p* valence electrons in a shell gives eight electrons.

~~D~~ Compounds in which nitrogen is the central atom are frequent exceptions to the octet rule because they have too many electrons surrounding the nitrogen. odd #

E) The Si in  $\text{SiH}_4$  does not follow the octet rule because hydrogen is in an unusual oxidation state. X

- B. 4. State which compounds are likely to be covalent bonding?

~~SnCl<sub>4</sub>, SiF<sub>4</sub>, LaF<sub>3</sub>, RbCl, ReCl<sub>6</sub>, Mn<sub>2</sub>O<sub>7</sub>~~

A)  $\text{SnCl}_4$ ,  $\text{SiF}_4$ ,  $\text{LaF}_3$

B)  $\text{SnCl}_4$ ,  $\text{SiF}_4$ ,  $\text{ReCl}_6$ ,  $\text{Mn}_2\text{O}_7$ ,

C)  $\text{SiF}_4$ ,  $\text{LaF}_3$ ,  $\text{RbCl}$

D)  $\text{LaF}_3$ ,  $\text{RbCl}$ ,  $\text{ReCl}_6$

E)  $\text{LaF}_3$ ,  $\text{RbCl}$ ,  $\text{ReCl}_6$ ,  $\text{Mn}_2\text{O}_7$

- A. 5. Predict which one of the following orderings of lattice energy is correct for these ionic compounds.

☒ A)  $\text{ScN} > \text{MgO} > \text{NaCl} > \text{CsI}$

B)  $\text{NaCl} > \text{CsI} > \text{MgO} > \text{ScN}$

C)  $\text{ScN} > \text{MgO} > \text{CsI} > \text{NaCl}$

D)  $\text{CsI} > \text{NaCl} > \text{ScN} > \text{CaO}$

E)  $\text{MgO} > \text{NaCl} > \text{ScN} > \text{CsI}$

$$\propto \frac{Q_1 Q_2}{r}$$

- C. 6. Which one of the following ions has a noble-gas electron configuration?

~~A~~  $\text{Zn}^{2+}$

~~B~~  $\text{Cu}^{2+}$

☒ C)  $\text{Se}^{2-}$

~~D~~  $\text{Cr}^{3+}$

~~E~~  $\text{Fe}^{3+}$

- C. 7. To convert from one resonance structure to another, \_\_\_\_\_.

~~A~~ only atoms can be moved

~~B~~ electrons and atoms can both be moved

☒ C) only electrons can be moved

## Chapter 08 Homework

- D) neither electrons nor atoms can be moved  
E) electrons must be added

B. 8. The bond length in an HI molecule is 1.61 Å and the measured dipole moment is 0.44 D. What is the magnitude (in units of  $e$ ) of the negative charge on I in HI?

(1 debye =  $3.34 \times 10^{-30}$  coulomb-meters;  $1 e = 1.6 \times 10^{-19}$  coulombs)

- A)  $1.6 \times 10^{-19}$  B) 0.057 C) 9.1 D) 1 E) 0.22

B. 9. A valid Lewis structure of \_\_\_\_\_ cannot be drawn without violating the octet rule.

- A) NF<sub>3</sub> B) IF<sub>3</sub> C) PF<sub>3</sub> D) SbF<sub>3</sub> E) SO<sub>4</sub><sup>2-</sup>

E. 10. Consider the collection of nonmetallic/metallic elements and electronegativity.

Elements	O	Mg	Be	N	F
electronegativity	3.5	1.2	1.5	3.0	4.0

Which of the following has the bonds correctly arranged in order of decreasing polarity?

- A) Be—F, Mg—F, N—F, O—F  
B) O—F, N—F, Be—F, Mg—F  
C) O—F, Be—F, Mg—F, N—F  
D) N—F, Be—F, Mg—F, O—F  
E) Mg—F, Be—F, N—F, O—F

C. 11. The central atom in \_\_\_\_\_ does not violate the octet rule.

- A) SF<sub>4</sub>  
B) KrF<sub>2</sub>  
C) CF<sub>4</sub>  
D) XeF<sub>4</sub>  
E) ICl<sub>4</sub><sup>-</sup>

A. 12. Which of the following statements about electronegativity is false?

- A) The most easily ionizable elements are the most electronegative.  
B) The greater the difference in electronegativity between two atoms, the more polar their bond.  
C) There is generally an increase in electronegativity from left to right across a period (except exceptions), electronegativity decreases with increasing atomic number in a group.  
D) Electronegativity is the ability of an atom in a molecule to attract electron density toward itself.  
E) The numerical values for electronegativity have no units.

A. 13. In covalent bonding as the number of bonds increases, the bond length decreases and the bond enthalpy increases.

- A) increases; decreases; increases  
B) increases; increases; increases  
C) increases; decreases; decreases  
D) decreases; decreases; increases  
E) decreases; decreases; decreases

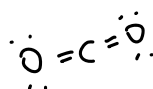
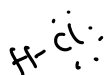
A. 14. In the nitrite ion (NO<sub>2</sub><sup>-</sup>), \_\_\_\_\_.

- A) both bonds are the same  
B) one bond is a double bond and the other is a single bond  
C) there are 20 valence electrons  
D) both bonds are single bonds  
E) both bonds are double bonds

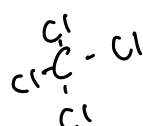
C. 15. Which of these molecules has the same number of shared electron pairs as unshared electron pairs?

HCl, CO<sub>2</sub>, PF<sub>3</sub>, CCl<sub>4</sub>, Br<sub>2</sub>.

- A) HCl B) PF<sub>3</sub> C) CO<sub>2</sub> D) CCl<sub>4</sub> E) Br<sub>2</sub>

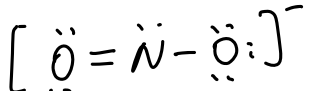
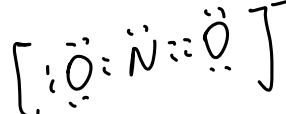
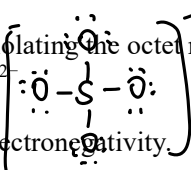


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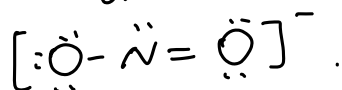


$$\mu = q \cdot r \quad q = \frac{\mu}{r}$$

$$\frac{0.44 \times 3.34 \times 10^{-30} \text{ C}\cdot\text{m}}{1.61 \times 10^{-10} \text{ m}} = 2.7 \times 10^{-21} \text{ C}$$



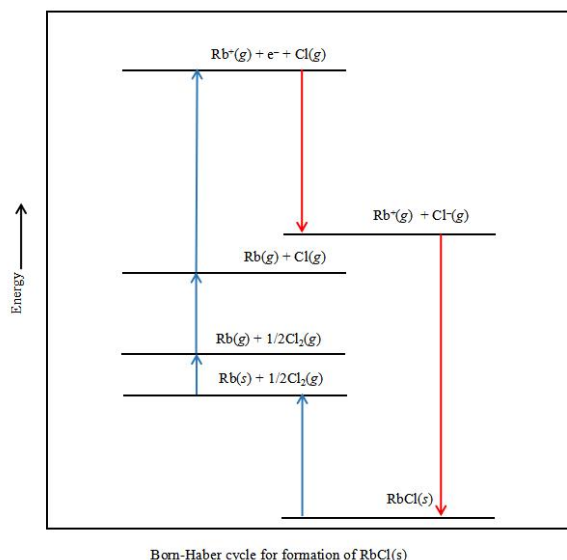
or



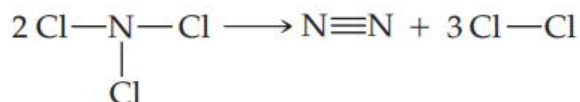
## Chapter 08 Homework

### Part B short question (15 points)

16. (5 points) The Born-Haber cycle for formation of  $\text{RbCl}(s)$  is shown below. (a) Write the chemical equation that represents the process of lattice energy for the case of  $\text{RbCl}$ . (b) Use data from Appendix C, Figure 7.10, and Figure 7.12 to calculate the lattice energy of  $\text{RbCl}$ . (c) Is lattice energy usually endothermic or exothermic? (d) Would you expect salts like  $\text{RbCl}$ , which have singly charged ions, to have larger or smaller lattice energies compared to salts like  $\text{SrO}$  which are composed of doubly-charged ions?



17. (2 points) Using Table 8.4, estimate  $\Delta H_{\text{rxn}}$  for the following gas-phase reactions (note that lone pairs on atoms are not shown):



18. (6 points) (a) Indicate condensed electron configuration of the atoms (i) Fe, (ii) Cd, (iii) Br. (b) Predict the ions generally formed by the atoms in part (a).

19. (2 points) There are many Lewis structures you could draw for sulfuric acid,  $\text{H}_2\text{SO}_4$  (each H is bonded to an O). (a) What Lewis structure(s) would you draw to satisfy the octet rule? (b) What Lewis structure(s) would you draw to minimize formal charge?

## Chapter 08 Homework Answer Sheet

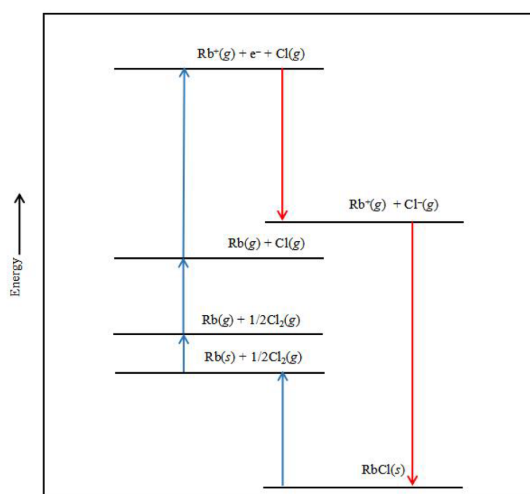
Name: Ph. Ph Student ID: 12311410 Instructor: \_\_\_\_\_ Score: \_\_\_\_\_

### Part A multiple choice (15 points)

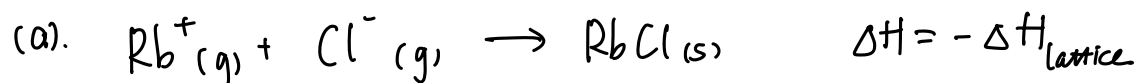
1-5 CACBA  
6-10 CCBBE  
11-15 CAAAC

### Part B short question (15 points)

16. (5 points) The Born-Haber cycle for formation of  $\text{RbCl}(s)$  is shown below. (a) Write the chemical equation that represents the process of lattice energy for the case of  $\text{RbCl}$ . (b) Use data from Appendix C, Figure 7.10, and Figure 7.12 to calculate the lattice energy of  $\text{RbCl}$ . (c) Is lattice energy usually endothermic or exothermic? (d) Would you expect salts like  $\text{RbCl}$ , which have singly charged ions, to have larger or smaller lattice energies compared to salts like  $\text{SrO}$  which are composed of doubly-charged ions?



Born-Haber cycle for formation of  $\text{RbCl}(s)$



(b). 
$$\Delta H_{\text{lattice}} = (430.5 + 85.8 + 121.7 + 40) - 349 \text{ kJ/mol}$$
  

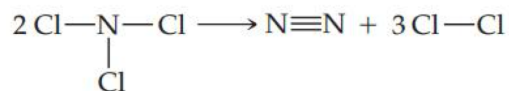
$$= 692 \text{ kJ/mol}$$

(c). endothermic.

(d). larger.

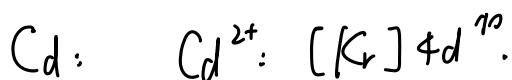
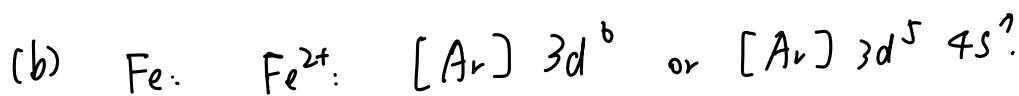
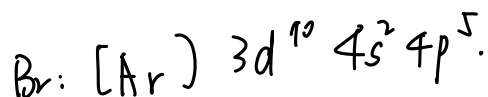
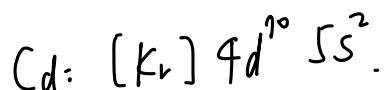
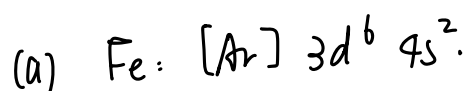
the product of charges is 4 times  
but the distance between the centers of charges is similar  
 $\Rightarrow$  much larger.

17. (2 points) Using Table 8.4, estimate  $\Delta H_{\text{rxn}}$  for the following gas-phase reactions (note that lone pairs on atoms are not shown):



$$\begin{aligned} \Delta H_{\text{rxn}} &= + 6 \times C(\text{N}-\text{Cl}) - 1 \times C(\text{N}\equiv\text{N}) - 3 \times C(\text{Cl}-\text{Cl}) \\ &= 6 \times 200 - 941 - 3 \times 242 \\ &= 1200 - 941 - 726 \\ &= -467 \text{ kJ/mol.} \end{aligned}$$

18. (6 points) (a) Indicate condensed electron configuration of the atoms (i) Fe, (ii) Cd, (iii) Br. (b) Predict the ions generally formed by the atoms in part (a).



19. (2 points) There are many Lewis structures you could draw for sulfuric acid,  $\text{H}_2\text{SO}_4$  (each H is bonded to an O). (a) What Lewis structure(s) would you draw to satisfy the octet rule? (b) What Lewis structure(s) would you draw to minimize formal charge?

