

AP Chemistry
Practice Test

Name Key
Date _____ Period

Chapter 8 - Basic Concepts of Chemical Bonding

I. Directions: Answer each of the following questions. No calculators are allowed unless specified.

Target 1: I can differentiate between an ionic bond, covalent bond or metallic bond.

For # 1-8, identify which statements below is a characteristic of an ionic bond(I), covalent bond(C) or a metallic bond(M).

- | | |
|--|---|
| <u>I</u> 1. Potassium iodide. | <u>M</u> 5. Conducts electricity in the solid state |
| <u>M</u> 2. Aluminum. | <u>C</u> 6. More sharing of electrons. |
| <u>I</u> 3. More transfer of electrons | <u>M</u> 7. Have mobile electrons. |
| <u>C</u> 4. Water | <u>C</u> 8. Carbon disulfide |

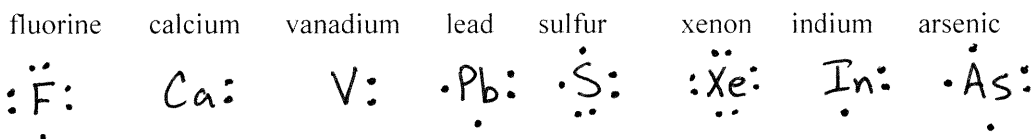
9. Which one of the following element combinations is likely to produce ionic bonds in a compound?

A

- a) Li and F b) B and O c) N and O d) P and S e) Cl and Br

Target 2: I can draw the Lewis symbols for any element on the periodic table.

10. Below each element, draw its Lewis dot structures



11. Which is most closely associated with the Lewis dot diagrams for molecules that contain atoms of elements from the boron family, Group 13 (Group IIIA)?

C

- a. elements shown as 3^+ ions
b. expanded octets of electrons
 c. incomplete octets of electrons
d. odd number of valence electrons
e. kernel electrons promoted to the valance shell

12. Which one of the following has eight valence electrons?

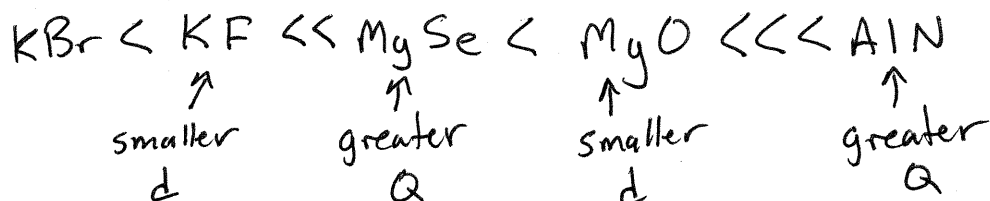
E

- a) Ti^{4+} b) Kr c) Cl^- d) Na^+ e) All of these!

$$LE = k \frac{Q_1 Q_2}{d}$$

Target 3: I can define Lattice Energy and its relationship to ionic compounds and their melting points. I will also be able to describe the factors which affect lattice energy.

13. Explain, using the factors that affect lattice energy why the following compounds increase in lattice energy: $KBr < KF < MgSe < MgO < AlN$



14. Which of the following compounds would you expect to have the lowest melting point? *smaller L.E.*

- D* a) NaF b) Na₂O c) NaBr d) NaI e) CaO *highest melting point*

15. Calcium oxide has a lower melting point than magnesium oxide due to the

- C* a. greater charge on the Mg²⁺ than of Ca²⁺.
 b. greater charge on the Ca²⁺ than of Mg²⁺.
 c. the greater distance between the charges in CaO.
 d. the greater distance between the charges in MgO.
 e. equal charges on the Mg²⁺ than of Ca²⁺.

16. In ionic bond formation, the lattice energy of ions _____ as the magnitude of the ion charges _____ and the radii _____.

- C, D* a. increases, decrease, increase.
 b. increases, increase, increase.
 c. decreases, decrease, increase.
 d. increases, increase, decrease.
 e. decreases, increase, decrease.

Target 4: I can differentiate between a single, double, and a triple covalent bond in terms of number of shared electrons, length and strength.

17. Which of the following elements is **most** likely to participate in the formation of multiple bonds?

- D* a) H b) Na c) Cl d) S e) F

18. Which molecule has the weakest bond?

- C* a) CO b) O₂ c) Cl₂ d) NO e) N₂

Cl-Cl single

- B 19. As the number of covalent bonds between two atoms increases, the distance between the atoms _____ and the strength of the bond between them _____.
- increases, increases.
 - decreases, increases.
 - increases, decreases.
 - decreases, decreases.
 - is unpredictable

Target 5: I am able to define electronegativity and apply the electronegativity trends to the periodic table.

- A 20. In which of the following are the elements listed in order of increasing electronegativity?
- Ba, Zn, C, Cl
 - O, N, S, Cl
 - N, P, As, Sb
 - K, Ba, Si, Ga
 - Li, K, Na, Ca

- C 21. $N < O$ $Cs < Mg$ $O < N$ $Cl < P$ $Au < Cu$
- How many pairs above shows the correct relationship of electronegativity?
- 1
 - 2
 - 3
 - 4
 - 5

Target 6: I am able to predict the relative polarities of bonds using either the periodic table or electronegativity values. I can also describe the factors which affect bond polarity and dipole moment.

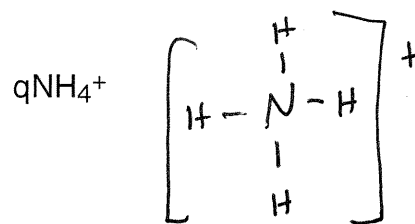
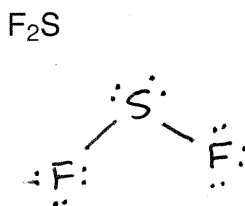
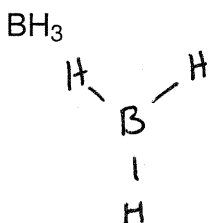
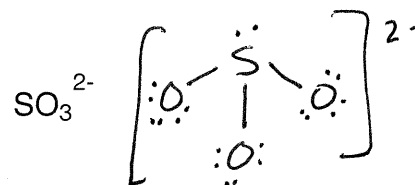
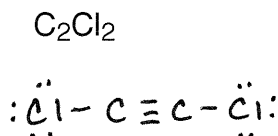
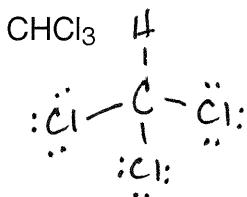
- C 22. Which of the following bonds is expected to be the most polar? *need to look up values*
- C - Si
 - C - N
 - O - C
 - S - C
 - H - C

- C 23. A nonpolar bond will form between two _____ atoms of _____ electronegativity.
- different, opposite
 - identical, different
 - identical, equal
 - similar, different
 - different, different

- D 24. C, O C, F N, O K, Br S, O Rb, Cl
- The bond above that is the most polar is _____ and the least polar is _____.
- C, O K, Br
 - Rb, Cl C, F
 - C, F, S, O
 - Rb, Cl S, O
 - N, O C, F

Target 7: Write the Lewis structures for molecules and ions containing covalent bonds using the periodic table.

25. Draw Lewis dot structures for the following molecules:



26. Which of the following species would have a Lewis structure(s) most like that of carbon disulfide?

- a) NO₂ b) NO₂⁻ c) ¹⁶NO₂⁺ d) HCN e) ICl₂⁻

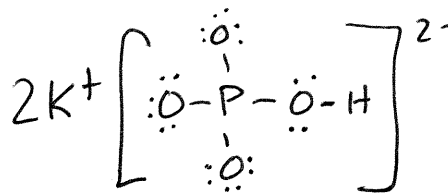
Target 8: Explain the concept of resonance and draw resonance structures for molecules or polyatomic ions.

27. Which molecule below possesses resonance?

- a) BCl₃ b) SO₂ c) CO₂ d) BeF₂ e) SO₄²⁻

Questions 28-30: Consider the chemical bonds found in the white solid, potassium hydrogen phosphate, K₂HPO₄. For each bond specified, choose the best description from the list of bond types below.

- a. ionic bond
b. hydrogen bond
c. single covalent bond
d. double covalent bond
e. covalent bond with resonance



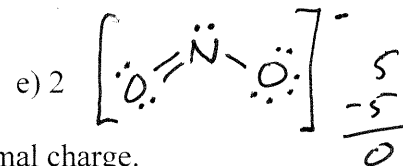
28. phosphorus/oxygen bond

29. potassium/hydrogen phosphate bond

30. oxygen/hydrogen bond

Target 9: Use the concept of formal charge to predict the most stable resonance structure.

- C 31. The formal charge on the nitrogen in a nitrite ion (NO_2^-) is
 a) -2 b) -1 c) 0 d) 1



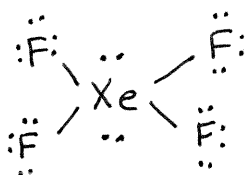
- A 32. Identify all the following statements that are TRUE about formal charge.
 T a) The formal charge on an atom is determined by taking the valence electrons minus the electrons assigned to that atom.
 F b. A Lewis structure is valid if a negative formal charge is on the least electronegative element.
 F c. The formal charge on the oxygen in a water molecule is -2.
 F d. For neutral compounds, the formal charges add up to various numbers and for ions the formal charges add up to equal the charge on the ion.
 F e. Lewis structures with large formal charges are most likely to exist.

Target 10: Describe the 3 common exceptions to the octet rule and provide examples of each.

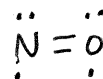
The three common exceptions are:

- A. Molecules that have an odd number of electrons.
 B. Molecules in which there is less than an octet of electrons.
 C. Molecules in which there is more than an octet of electrons.
 Knowing this, identify the exception that each molecule best fits.

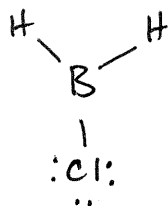
- C 33. XeF_4



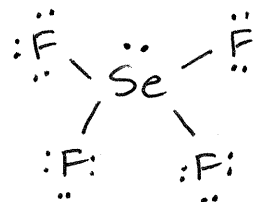
- A 34. NO



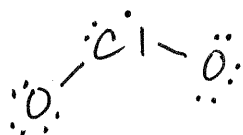
- B 35. BH_2Cl



- C 36. SeF_4



- A 37. ClO_2

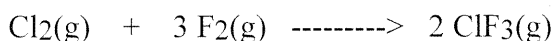


- E 38. Which of the following is most likely to form compounds involving an expanded octet?
 a) Li b) N c) F d) Ne e) S

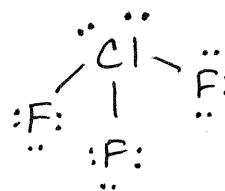
Target 11: Relate bond enthalpies to bond strengths and use bond enthalpies to estimate ΔH for reactions.

39. Given the bond dissociation energies below, calculate the standard molar enthalpy of formation of ClF_3 .

E



Bond	Dissociation Energy (kJ/mol)
Cl-Cl	243
F-F	159
Cl-F	255



- a) 210 kJ/mol b) 147 kJ/mol c) -33 kJ/mol d) -405 kJ/mol e) -810 kJ/mol

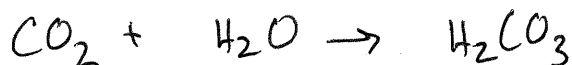
$$\begin{aligned} \Delta H &= \sum \text{Bonds Broken} - \sum \text{Bonds Formed} \\ &= [(\text{Cl-Cl}) + 3(\text{F-F})] - [6(\text{Cl-F})] \\ &= [243 + 3(159)] - [6(255)] \\ &= -810 \text{ kJ/mol} \end{aligned}$$

- A 40. Bond enthalpy is _____ positive and is defined as the energy _____ to break a bond.
- always, required
 - never, required
 - sometimes, produced
 - always, produced
 - never, required

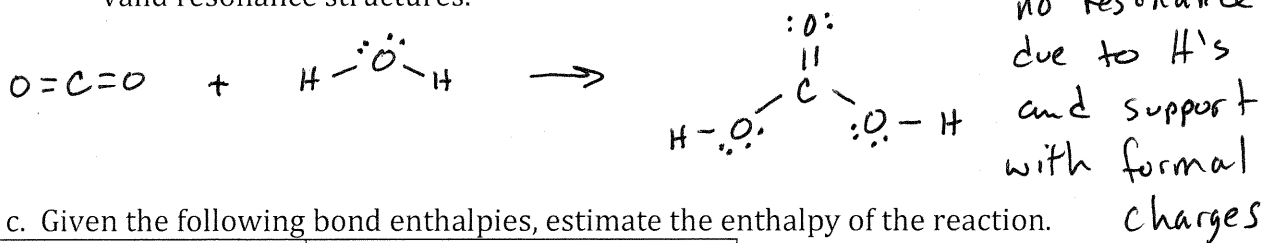
Part II: Free Response - Answer each of the following in the spaces provided.

1. Carbon dioxide is bubbled into water.

a. Write a net ionic equation for this reaction.



b. Draw the Lewis structures of the reactants and products. Include any valid resonance structures.



c. Given the following bond enthalpies, estimate the enthalpy of the reaction.

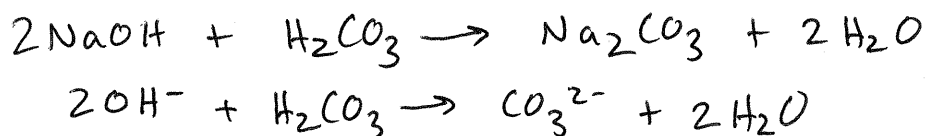
BOND	BOND ENTHALPY (kJ/mol)
H - H	436
H - O	463
O - O	146
C - O	358
C = O	799
C O	1072

$$\begin{aligned} \Delta H &= [2(\text{C}=\text{O}) + 2(\text{H}-\text{O})] - [2(\text{H}-\text{O}) + 2(\text{C}-\text{O}) + \text{C}=\text{O}] \\ &= 799 - [2(358)] \\ &= +83 \text{ kJ/mole} \end{aligned}$$

d. Are the C - O bonds in the reactant stronger or weaker than those in the product? Explain. Is your explanation consistent with the sign of the enthalpy change you estimated? Explain.

There are two C=O bonds to break in CO₂ versus one in H₂CO₃. So, more energy is required and it should be endothermic. It is endo!

e. Excess aqueous sodium hydroxide is added to the solution. Write a balanced net ionic equation for this reaction.



2. Complete the following table below.

Molecule or Ion	Lewis Dot Structure	Formal Charge on Central atom	Obeys Octet Rule Yes or No	Polar Yes or No	Resonance Yes or No
SiO ₃ ²⁻	<p>Si=O rotates to each oxygen in molecules</p>	4-4=0	yes	No	yes
HCO ₃ ⁻	<p>C=O moves to Oxygen on left and top</p>	4-4=0	yes	yes	yes
SeO ₂	<p>Se=O moves from side to side</p>	6-5=+1	yes	yes	yes
COS	<p>NO</p> <p>NO</p>	4-4=0	yes	yes	no formal charge disproves