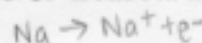


## SECTION 1: PERIODIC TABLE

- 1.) Why does the ionization energy increase when electrons are consecutively removed from an atom?
- A) the outermost electron experiences a higher effective nuclear charge
  - B) the remaining electrons are held more strongly
  - C) atomic radius is decreasing
  - D) all of the above
  - E) none of the above

For the next two questions consider the ionization energy of sodium is 496 kJ/mol and the electron affinity of Cl is -349 kJ/mol.

- 2.) What is the approximate net energy change in producing  $\text{Na}^+$  and  $\text{Cl}^-$  from Na and Cl atoms (kJ/mol)?



- A) 150      B) 0      C) -323      D) -510      E) -1776

- 3.) What is the net energy change in making the NaCl molecule (kJ/mol) from the ions?

- A) -642       B) 0      C) 323      D) 510      E) 1776
- Must be 0. Ions (reactants) more energetic than compd. Releases E.  $\Delta H = 0$*

Continue with the next question:

For the next four questions consider the following atoms Br, Sn, Sb, Te, I.

- 4.) Which has the largest atomic radius?

- A) Br       B) Sn      C) Sb      D) Te      E) I

- 5.) Which is the most paramagnetic?

- A) Br      B) Sn       C) Sb      D) Te       E) I

- 6.) Which has the largest ionization energy?

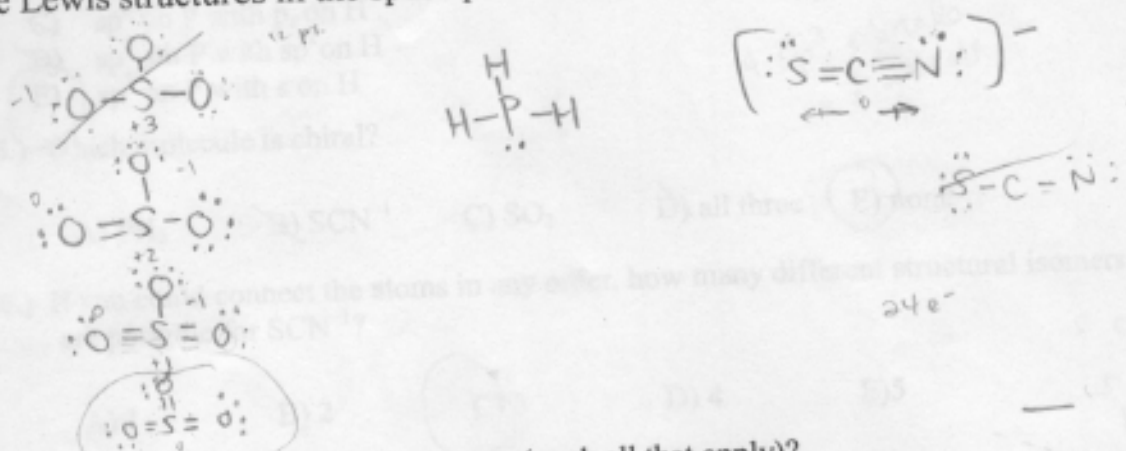
- A) Br      B) Sn      C) Sb      D) Te      E) I

- 7.) Which has the largest electronegativity?

- A) Br      B) Sn      C) Sb      D) Te      E) I

## SECTION 1: CHEMICAL BONDING

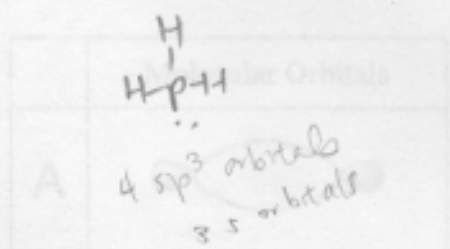
For the following ten questions, consider the lowest energy Lewis structure for the following molecules/ions:  $\text{SO}_3$ ,  $\text{PH}_3$ ,  $\text{SCN}^{-1}$  (you may want to draw the Lewis structures in the space provided, the central atom is highlighted).



- 8.) Which is transparent to microwaves (mark all that apply)?  
 A)  $\text{PH}_3$       B)  $\text{SCN}^{-1}$       C)  $\text{SO}_3$       D) all three      E) none
- 9.) What is the O-S-O bond angle in  $\text{SO}_3$ ?  
 A) 90      B) 108      C) 110      D) 120      E) 180
- 10.) What is the H-P-H bond angle in  $\text{PH}_3$ ?  
 A) 90      B) 108      C) 110      D) 120      E) 180
- 11.) What is the bond angle in  $\text{SCN}^{-1}$ ?  
 A) 90      B) 108      C) 110      D) 120      E) 180
- 12.) What is the oxidation number of S in  $\text{SO}_3$ ?  
 A) -6      B) -2      C) 0      D) +2      E) +6
- 13.) What is the SO bond order in  $\text{SO}_3$ ?  
 A) -2      B) -1      C) 0      D) 1      E) 2

14.) Which is the best description of the orbital overlap in the P-H bond in  $\text{PH}_3$  (the 'z' axis is the internuclear axis)?

- A)  $p_z$  on P with  $sp^2$  on H
- B)  $p_z$  on P with s on H
- C)  $sp^2$  on P with  $p_z$  on H
- D)  $sp^2$  on P with  $sp^2$  on H
- E)  $sp^3$  on P with s on H

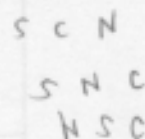


15.) Which molecule is chiral?

- A)  $\text{PH}_3$
- B)  $\text{SCN}^{-1}$
- C)  $\text{SO}_3$
- D) all three
- E) none

16.) If you could connect the atoms in any order, how many different structural isomers are possible for  $\text{SCN}^{-1}$ ?

- A) 1
- B) 2
- C) 3
- D) 4
- E) 5



17.) What is the shape of  $\text{PH}_3$ ?

- A) Linear.
- B) Bent.
- C) Trigonal pyramidal.
- D) Square planar.
- E) Tetrahedral.

Continue with the next question:

23.) Which of the molecular orbitals in the preceding table would have the highest energy?

- A) A
- B) B
- C) C
- D) D
- E) E

24.) If butyric acid (shown right) smells sour, which one of the following compounds is also likely to smell sour?



Butyric Acid



