MULTIPLE CHOICE (2 pts each): Write the ONE letter corresponding to the correct answer on the line next to each question. The LETTER ASSOCIATED WITH THE CORRECT ANSWER MUST BE WRITTEN ON THE LINE NEXT TO THE QUESTION in order to receive full credit.

1) Which of the following would form an ionic bond? 1) D

a) Co & Cl (3.0 - 1.8 = 1.2) b) Ni & I (2.5 - 1.8 = 0.7) c) Ru & Br (2.8 - 2.2 = 0.6) (d) Cr & O (3.5 - 1.6 = 1.9)

2) What color of light corresponds to a frequency of 5.86×10^{14} Hz? 2) C

a) yellow b) red (c) green d) violet

$\lambda = \frac{c}{\upsilon} = \frac{3.0 \times 10^8 \text{ m/s}}{5.86 \times 10^{14} \text{ /s}} = 5.12 \times 10^{-7} \text{ m} \left(\frac{1 \times 10^9 \text{ nm}}{\text{m}}\right) = 512 \text{ nm}$ (look at chart on cover sheet)

3) Which of the following elements cannot have an expanded octet? 3) A

(a) N b) Fe c) Cl d) As

must be in row 3 or higher

4) Which of the following elements is the most reactive? 4) D

a) calcium b) fluorine c) arsenic (d) cesium

alkali metal - one ve-

5) What is the formal charge on the sulfer atom in SO_2? 5) D

a) +2 b) -1 c) 0 (d) +1

example from class: $:\ddot{O}=\overset{+1}{S}-\ddot{O}:^{-1}$

6) How many dots would you have in the Lewis Dot Symbol of phosphorus 6) C

a) 3 b) 6 (c) 5 d) 2

7) How many resonance structures would you draw for SO_2? 7) B

a) 0 (b) 2 c) 3 d) 1

8) Which of the following is most likely to form a coordinate covalent bond? 8) C

a) carbon b) potassium (c) cobalt d) silicon

transition metal

9) The energy level occupied by an electron is given by which quantum number? 9) C

a) angular momentum b) spin

(c) principle d) magnetic

10) The least reactive elements on the Periodic Table are the 10) D

a) alkaline earth metals b) alkali metals

c) halogens (d) noble gases

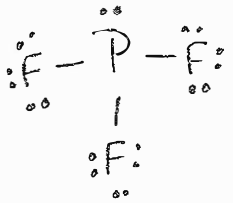
Old exam from spring 2018

SHORT ANSWER (10 pts each): Completely answer all of the following questions. Read all questions carefully!!! ~~Show all work.~~ Make sure to include units and report all mathematical answers to the correct number of significant figures. Write final answers in designated locations when indicated.

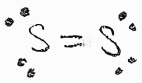
1) Draw a Lewis structures for each of the following molecules. Include all lone pairs.

a.) PF_3

P: 5ve⁻ x 1 = 5ve⁻
F: 7ve⁻ x 3 = 21ve⁻
26ve⁻

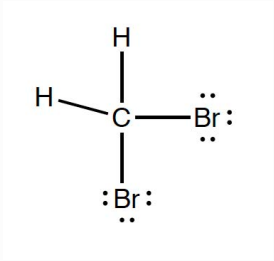


b.) S_2 6ve⁻ x 2 = 12ve⁻



c.) CBr_2H_2

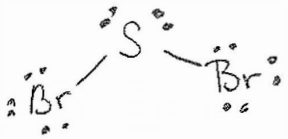
C = 4ve⁻ x 1 = 4ve⁻
Br = 7ve⁻ x 2 = 14ve⁻
H = 1ve⁻ x 2 = 2ve⁻
20 ve-



(arrangement of H's & Br's can vary)

d.) SBr_2

S: 6ve⁻ x 1 = 6ve⁻
Br: 7ve⁻ x 2 = 14ve⁻
20ve⁻



2) Use the table of bond energies on the cover sheet to calculate the enthalpy of the following reaction:

Bonds Broken: (endothermic → +)

4 C-H 414 kJ/mol x 4 = 1656 kJ/mol
1 C=C 620 kJ/mol x 1 = 620 kJ/mol
1 F-F 157 kJ/mol x 1 = 157 kJ/mol
+ 2433 kJ/mol

Answer: -470 kJ/mol

Bonds Formed: (exothermic → −)

4 C-H -414 kJ/mol x 4 = -1656 kJ/mol
1 C-C -347 kJ/mol x 1 = -347 kJ/mol
2 C-F -450 kJ/mol x 2 = -900 kJ/mol
-2903 kJ/mol

2433 kJ/mol
−2903 kJ/mol
-470 kJ/mol

3) Write electron configurations for the following:

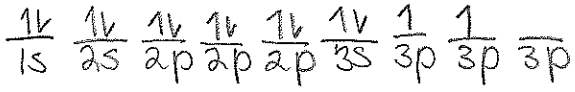
27 e⁻

a.) Cobalt (Co) using electron configuration notation (superscripts)

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^7$

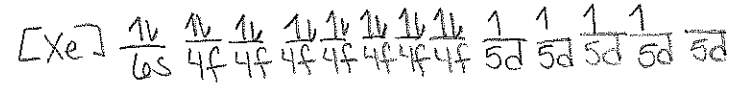
14e⁻

b.) Silicon (Si) using orbital notation (arrows)



c.) Tungsten (W) using the noble gas short form - you can use either of the two notations

74e⁻ - 54e⁻ = 20e⁻

$[Xe]\ 6s^2\ 4f^{14}\ 5d^4$ or $[Xe]$ 

d.) Sulfur **ion** - you can use either notation but NOT noble gas short form.

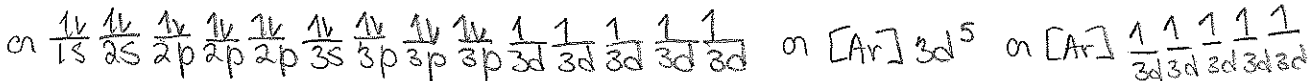
S^{2-} 16+2 = 18e⁻

$1s^2 2s^2 2p^6 3s^2 3p^6$ or 

e.) Iron (III) (Fe^{3+}) - you can use any notation

26 - 3 = 23e⁻ 3+ = -3e⁻

atom not ion → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{6-1-5}$ → $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$

or 

or $[Ar]\ 3d^5$ or

4) Use the following information to calculate the **lattice energy** for Lithium Oxide (Li_2O).

$$2\ Li^+ + O^{2-} \rightarrow Li_2O$$

All values are in kJ/mol.

Li (s) → Li (g): 162

1st Ionization energy of lithium: 520

Total formation enthalpy: $2Li^+(g) + O^{2-}$: -167

O_2 (g) → 2 O (g): 499

1st Electron affinity for oxygen: -141

2nd Electron affinity for oxygen: 593

not covered this semester. will not be on your exam 3.

Answer : n/a

5) a.) Calculate the energy associated with a transition from the 3rd to the 6th energy level.

$E = -R_H \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$

Answer a: 1.82×10^{-19} J

$= -2.18 \times 10^{-18}\text{J} \left(\frac{1}{6^2} - \frac{1}{3^2} \right)$

$= -2.18 \times 10^{-18}\text{J} \, (0.027778 - 0.11111) = 1.817 \times 10^{-19}\text{J}$

b.) Is the energy from part a released or absorbed?

Answer b: absorbed (energy is +)

c.) What wavelength of light would be associated with this transition?

$E = \frac{hc}{\lambda} \qquad \lambda = \frac{hc}{E} = \frac{(6.626 \times 10^{-34}\text{J}\cdot\text{s})(3.00 \times 10^{8}\text{ m s}^{-1})}{1.817 \times 10^{-19}\text{J}}$

$= 1.094 \times 10^{-6}$ m

Answer c: 1.09×10^{-6} m
or
1.09 μm
or
1094 nm

6) a.) What is the energy associated with light that has a wavelength of 356 nm? $\left(\frac{1\text{m}}{1\times10^{9}\text{nm}}\right) = 3.56 \times 10^{-7}$ m

$E = \frac{hc}{\lambda} = \frac{(6.626 \times 10^{-34}\text{J}\cdot\text{s})(3.00 \times 10^{8}\text{ m/s})}{3.56 \times 10^{-7}\text{ m}}$

Answer : 5.58×10^{-19} J

$= 5.5837 \times 10^{-19}$ J

b.) What would be the energy of half a mole of photons with a wavelength of 356 nm?

Answer : 1.68×10^{5} J

$5.5837 \times 10^{-19}\frac{\text{J}}{\text{photon}} \left(\frac{6.022 \times 10^{23}\text{ photon}}{\text{mol}} \right) \left(\frac{1}{2}\text{mol} \right) = 1.68125 \times 10^{5}\text{J}$

7) a.) Which of the following elements has the smallest atomic radius?

Calcium, Titanium, Iron, Zinc, or Arsenic Answer a: Arsenic

b.) Which of the following has the highest ionization energy?

Carbon, Silicon, Germanium, Tin, or Lead Answer b: carbon

c.) Which of the following has the lowest electron affinity?

Strontium, Molybdenum, Silver, Tin, or Iodine Answer c: strontium

d.) Which of the following elements is the largest?

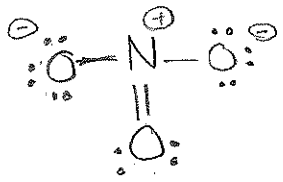
Magnesium, Calcium, Strontium, Barium, or Radium? Answer d: radium

e.) Which of the following ions is larger, calcium or bromine? (+) (−) Answer e: bromine

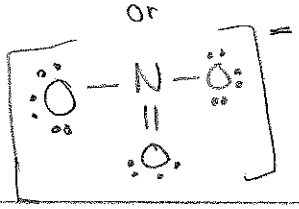
8) Draw a Lewis structure for each of the following. Include all lone pairs.

a.) NO_3^{-1}

N: 5ve⁻ x1 = 5ve⁻
O: 6ve⁻ x3 = 18ve⁻
23ve⁻
+ 1ve⁻
24ve⁻



or

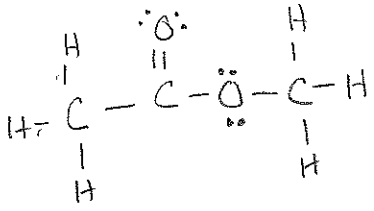


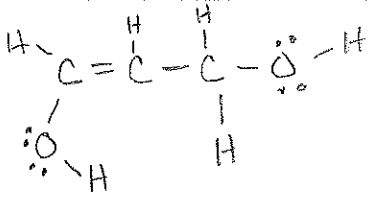
b.) C_2Br_2

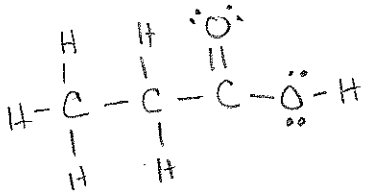
C: 4ve⁻ x2 = 8ve⁻
Br: 7ve⁻ x2 = 14ve⁻
22ve⁻

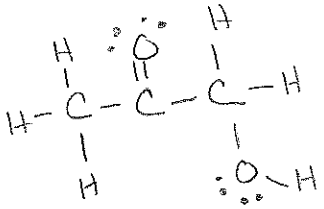
c.) $C_3H_6O_2$

C: 4ve⁻ x3 = 12ve⁻
H: 1ve⁻ x6 = 6ve⁻
O: 6ve⁻ x2 = 12ve⁻
30ve⁻









for part c. there are other correct answers also