Form Code ☺ **NAME**_____

CHM 2045 Spring 2020 Exam 3 (UF Teaching Center) (Chapters 8, 9, 10, 11)

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1. **Arrange the following elements in order of decreasing electronegativities:**

   Al, Cs, Mg, Na, P

   (1) P > Al > Mg > Na > Cs
   (2) Cs > Na > Mg > Al > P
   (3) Al > Mg > Na > Cs > P
   (4) P > Al > Mg > Cs > Na
   (5) P > Cs > Na > Mg > Al

2. **Identify the element in period 3 which has the following successive ionization energies in kJ/mol.**
   IE_1: 1,012; IE_2: 1,903; IE_3: 2,910; IE_4: 4,956; IE_5: 6,278; IE_6: 22,230; IE_7: 25,236; IE_8: 28,658
   (1) Na (2) Al (3) P (4) S (5) Cl

3. **Select the true statement.**
   (1) N_2O_5 is a more basic oxide than P_4O_{10}
   (2) Cl_2O_7 is a more acidic oxide than P_4O_{10}
   (3) Al_2O_3 is a more basic oxide than MgO
   (4) Bi_2O_3 is a more acidic oxide than As_2O_5
   (5) BeO is a more basic oxide than CaO

4. **Which one of the following statements regarding ground-state atoms or ions is false?**
   (1) the Zn atom and the Zn^{2+} ion are both diamagnetic
   (2) there are two filled 4p orbitals in a bromine atom
   (3) the element with electron configuration of $[Ne]3s^23p^3$ has a valence of three
   (4) the C atom has 2 unpaired electrons
   (5) the Ti^{2+} ion is paramagnetic

5. **Which of the following compounds will have the largest (most negative) lattice energy?**
   (1) Li_2O (2) $MgCl_2$ (3) Na_2S (4) NaCl (5) LiF

6. Arrange the following bonds in order of increasing bond strength:

I: H–F, H–Cl, H–Br II: C–O, C=O, C≡O

(1) H–F < H–Br < H–Cl; C–O < C=O < C≡O

(2) H–Br < H–Cl < H–F; C≡O < C=O < C–O

(3) H–Cl < H–F < H–Br; C–O < C=O < C≡O

(4) H–F < H–Cl < H–Br; C≡O < C=O < C–O

(5) H–Br < H–Cl < H–F; C–O < C=O < C≡O

7. Experiments show that it takes 1,656 kJ/mol to break all of the bonds in methane (CH_4) and 4,006 kJ/mol to break all of the bonds in propane ($CH_3CH_2CH_3$). Based on these data, calculate the average bond enthalpy of the C–C bond.

(1) 174 kJ/mol (2) 296 kJ/mol (3) 347 kJ/mol (4) 521 kJ/mol (5) 694 kJ/mol

8. Which choice gives, in order, the correct molecular geometries for: BF_3, SCO, ClF_3, BrF_5

(1) trigonal planar, linear, T-shaped, square pyramidal

(2) trigonal planar, linear, T-shaped, square planar

(3) trigonal planar, linear, seesaw, T-shaped

(4) tetrahedral, linear, T-shaped, square pyramidal

(5) trigonal planar, linear, tetrahedral, octahedral

9. Consider CH_4 and CF_4. Electronegativities: C = 2.5, H = 2.1, F = 4.0. Which statement is false?

(1) Both are sp^3 hybridized at carbon.

(2) Both molecules are nonpolar.

(3) The bond angles in CF_4 are smaller than those in CH_4.

(4) The C-F bonds are more polar than the C-H bonds.

(5) The bond dipoles in CF_4 are directed toward the fluorine, but those in CH_4 are directed toward the carbon atom.

10. Which of the following require(s) a resonance hybrid for its Lewis structure(s):

NO_2, N_3^-, SF_6, O_3, XeF_2

(1) NO_2 and N_3^-

(2) N_3^- and O_3

(3) NO_2, N_2^-, O_3

(4) N_3^-, SF_6, XeF_2

(5) NO_2, N_3^-, SF_6, O_3

11. Which one of the following is a nonpolar molecule with polar bonds?

(1) H_2O (2) NH_3 (3) SF_2 (4) H_2O_2 (5) XeF_4

12. Which of the following statements about the valence bond theory is false?

(1) The number of hybrid orbitals formed equals the number of high electron density regions.

(2) To make 4 single bonds with no lone pairs on the central atom, an atom will make 4 sp^3 hybrid orbitals.

(3) For an atom to share more than 8 electrons it must hybridize d orbitals.

(4) Atoms that do not complete their octet use either sp^3d or sp^3d^2 hybrid orbitals.

(5) Trigonal planar molecules use sp^2 hybrid orbitals.

13. How many sigma (σ) and pi (π) bonds are found in CH_2CHCHO?

(1) 5 σ and 2 π (2) 5 σ and 4 π (3) 6 σ and 2 π (4) 7 σ and 1 π (5) 7 σ and 2 π

14. In the Haber process of making ammonia $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, what is the hybridization change for the nitrogen atom?

(1) sp to sp^2 (2) sp to sp^3 (3) sp^2 to sp (4) sp^2 to sp (5) sp to sp^3d

15. Which species is incorrectly matched with the hybridization at the central atom?

(1) SO_2, sp^2 (2) CF_4, sp^3 (3) HCN, sp (4) PF_5, sp^3d^2 (5) SeF_4, sp^3d

16. Based on Molecular Orbital Theory, rank C_2^-, C_2, and C_2^+ in order of increasing bond order given that C_2 has the valence MO energy sequence: $\sigma_{2s} < \sigma^*_{2s} < \pi_{2py} = \pi_{2pz} < \sigma_{2px} < \pi^*_{2py} = \pi^*_{2pz} < \sigma^*_{2px}$

(1) $C_2^- < C_2 < C_2^+$

(2) $C_2^- < C_2^+ < C_2$

(3) $C_2^+ < C_2 < C_2^-$

(4) $C_2 < C_2^+ < C_2^-$

(5) $C_2^+ < C_2^- < C_2$