Form Code B CHEM 1025 Exam # 4 6 April 2010

Instructions: On your scantron sheet enter your name, UF ID number, and Form Code (start with the first space and leave the last space blank). This exam consists of 25 multiple choice questions each worth 8.0 points for a total maximum of 200 pts. Keep your exam sheet (mark your answers on it and on the scantron sheet). Turn in only the scantron. *Any bubbling error will count as an incorrect response, including wrong form code and answers*.

1. Arrange the following bands in order of decreasing bond polarity: P-S, C-O, F-F, C-F, Na-F
   (1) Na-F > C-F > C-O > P-S > F-F
   (2) F-F > C-O > C-F > P-S > Na-F
   (3) F-F > P-S > C-O > C-F > Na-F
   (4) Na-F > C-O > P-S > C-F > F-F
   (5) P-S > Na-F > C-O > C-F > F-F

2. Determine the bond energy of a H-Cl bond given the following information.

   $H_3C\text{-}H(g) + Cl\text{-}Cl(g) \rightarrow H_3C\text{-}Cl(g) + H\text{-}Cl(g)$ $\Delta H_{rxn}^{o} = -113$ kJ

Bond	Bond Energy (kJ/mol)
Cl-Cl	243
C-Cl	339
H-C	414

   (1) -1109 kJ/mol (2) 883 kJ/mol (3) -623 kJ/mol (4) 55 kJ/mol (5) 431 kJ/mol

3. Which of the following is True?
   (1) A double covalent bond has 2 electrons
   (2) As bonds get longer, they also get stronger
   (3) Molecules can not exist with an odd number of electrons
   (4) All metals are solid at room temperature
   (5) Resonance structures must have the same total formal charge

4. Calculate the ΔH_{rxn} for this reaction using the given bond energies: $CH_4(g) + 2\ H_2O(g) \rightarrow 4H_2(g) + CO_2(g)$

Bond	Bond Energy (kJ/mol)
H-H	436
O-H	464
H-C	414
C=O	799

   (1) -357 kJ (2) +170 kJ (3) -170 kJ (4) +357 kJ (5) -2110 kJ

5. How many total electrons surround the central atom in XeF_2?
   (1) 6 (2) 8 (3) 10 (4) 12 (5) 14

6. The potential energy of two charged particles depends on:
   I. Magnitude of the charges II. Sign of the charges III. Distance between the charges
   (1) I only (2) II only (3) III only (4) I and III only (5) I, II, and III

7. Breaking bonds _____, while forming bonds _____.
   (1) requires no energy; requires no energy
   (2) releases energy; requires energy
   (3) releases energy; releases energy
   (4) requires energy; releases energy
   (5) requires energy; requires energy

8. Which of the following has the stronger carbon-carbon bond: HCCH H_2CCH_2 H_3CCH_3
   (1) HCCH (2) H_2CCH_2 (3) H_3CCH_3 (4) All of their carbon-carbon bonds are of equal strength
   (5) Not enough information

9. Arrange the following atoms in order of increasing electronegativity: P, F, Cs, Ga, K
   (1) Cs < P < K < Ga < F
   (2) F < K < P < Ga < Cs
   (3) Cs < Ga < P < K < F
   (4) F < P < Ga < K < Cs
   (5) Cs < K < Ga < P < F

10. Which of the following is False?
    (1) Ionic bonds have an electrostatic attraction
    (2) Chemical bonds form because the resulting molecule is at higher potential energy
    (3) Noble gases are the least reactive group of elements
    (4) Ionic bonds form by the interaction of a nonmetal and a metal
    (5) Covalent molecules have low melting and boiling points

11. To which of the following does the octet rule apply?
    (1) SF_4 (2) Helium (3) BCl_3 (4) CN^- (5) Lithium

12. What concentration of a 15.0 mL $Ba(OH)_2$ solution is required to titrate 25.3 mL of 0.2 M HI to the equivalence point?

(1) 0.34 M (2) 4.22 M (3) 0.17 M (4) 0.67 M (5) 0.00095 M

13. What is the name for the compound $IrBr_3$.

(1) Monoiridium tribromide (2) Iridium(I) bromide (3) Iridium bromide
(4) Iridium(III) bromide (5) Iridium tribromide

14. What volume of a 12.0 M $HClO_4$ solution is required to completely react with 50.0 mL of a 14.9 M Li_2CO_3solution according to the following balanced chemical equation?

$$2\ HClO_4(aq) + Li_2CO_3(aq) \rightarrow 2\ LiClO_4(aq) + CO_2(g) + H_2O(l)$$

(1) 80.5 mL (2) 31.0 mL (3) 62.1 mL (4) 4.47 mL (5) 124 mL

15. What mass (kg) of $AlCl_3$ will be formed when 7.5 kg of Al and 24.8 kg of Cl_2 are added according to the following balanced chemical equation? $2\ Al(s) + 3\ Cl_2(g) \rightarrow 2\ AlCl_3(s)$

(1) 57.63 kg (2) 31.09 kg (3) 24.71 kg (4) 37.06 kg (5) 46.64 kg

16. If 0.123 L of a 1.6 M fructose solution is diluted to 428.0 mL, what is the molarity of the diluted solution?

(1) 0.46 M 2) 5570.0 M (3) 5.57 M (4) 3.92 M (5) 0.00046 M

17. The combustion of toluene has a ΔE_{rxn} of -3.91×10^3 kJ/mol. When 2.36 g of toluene (C_7H_8) undergoes combustion in a bomb calorimeter, the temperature rises from 25.17 to 38.92 °C. Find the heat capacity of the bomb calorimeter.

(1) 5.47 kJ/°C (2) 13.08 kJ/°C (3) 3.09 kJ/°C (4) 7.28 kJ/°C (5) 12.05 kJ/°C

18. If the surroundings emit 100 kJ of energy during a process, what is the change in energy for the system (ΔE_{sys})? Is this process endo- or exothermic for the surroundings?

(1) +100 kJ; endothermic (2) -100 kJ; endothermic (3) +100 kJ; exothermic
(4) -100 kJ; exothermic (5) not enough information

19. Use Hess' Law and the following data to determine the value of ΔH_{rxn} for the following reaction:

$$CH_4(g) + 4\ Cl_2(g) \rightarrow CCl_4(g) + 4\ HCl(g)$$

$C(s) + 2\ H_2(g) \rightarrow CH_4(g)$ $\Delta H_1 = -74.6$ kJ
$C(s) + 2\ Cl_2(g) \rightarrow CCl_4(g)$ $\Delta H_2 = -95.7$ kJ
$H_2(g) + Cl_2(g) \rightarrow 2\ HCl(g)$ $\Delta H_3 = -92.3$ kJ

(1) -209.1 kJ (2) -205.7 kJ (3) -354.9 kJ (4) -113.4 kJ (5) -262.6 kJ

20. Top fuel dragsters and funny cars burn nitromethane as fuel according to the following combustion equation:

$$2\ CH_3NO_2(l) + 3/2\ O_2(g) \rightarrow 2\ CO_2(g) + 3\ H_2O(g) + N_2(g) \qquad \Delta H_{rxn} = -709.2\ kJ$$

Calculate the standard enthalpy of formation (ΔH_f) for nitromethane. For $CO_2(g)$, $\Delta H_f = -393.5$ kJ/mol. For $H_2O(g)$, $\Delta H_f = -241.82$ kJ/mol.

(1) -94.06 kJ/mol (2) -803.26 kJ/mol (3) -401.63 kJ/mol (4) -1110.83 kJ/mol (5) 257.92 kJ/mol

21. Determine whether a bond between each of the following pairs of atoms would be pure covalent, polar covalent, or ionic: C and O Ca and O N and N P and Cl K and Br

(1) Pure, Ionic, Pure, Ionic, Ionic (2) Polar, Polar, Pure, Ionic, Ionic (3) Polar, Ionic, Pure, Polar, Ionic
(4) Polar, Polar, Ionic, Pure, Ionic (5) Pure, Ionic, Pure, Polar, Polar

22. What is the formal charge of the central atom in IF_3?

(1) -2 (2) -1 (3) 0 (4) +1 (5) +2

23. Formic acid is responsible for the sting in biting ants. By mass, formic acid is 26.10% C, 4.38% H, and 69.52% O. The molar mass for formic acid is 46 g/mol. Find the molecular formula of formic acid and determine how many total lone pairs (l.p.) exist in this molecule.

(1) C_2H_6O; 2 lone pairs (2) C_2H_6O; 1 lone pair (3) $CH_{18}O$; 2 lone pairs
(4) CH_2O_2; 2 lone pairs (5) CH_2O_2; 4 lone pairs

24. How many resonance structures are possible for the formate ion, HCO_2^-?

(1) 0 (2) 1 (3) 2 (4) 3 (5) 4

25. Use the Born-Haber cycle and the following reactions to calculate the ionization energy of sodium.

$Na(s) + ½\ Cl_2(g) \rightarrow NaCl(s)$ $\Delta H_f^o = -411$ kJ/mol
$Na(g) \rightarrow Na(s)$ $\Delta H_f^o = -108$ kJ/mol
$½\ Cl_2(g) \rightarrow Cl(g)$ $\Delta H_f^o = +122$ kJ/mol
$Cl^-(g) \rightarrow Cl(g) + e^-$ $\Delta H_f^o = +349$ kJ/mol
$Na^+(g) + Cl^-(g) \rightarrow NaCl(s)$ $\Delta H_f^o = -788$ kJ/mol

(1) +496 kJ/mol (2) -836 kJ/mol (3) 14 kJ/mol (4) -14 kJ/mol (5) +836 kJ/mol