CHM 2045 Exam 2 – Broward Exam Review

1) A rigid chamber is initially filled with 4.00 atm of N_2 gas and 3.00 atm of O_2 gas. After these react to form $N_2O(g)$ and the chamber returns to its original temperature, the final pressure in the chamber is:
   A) 3.0 atm
   B) 4.0 atm
   C) 5.0 atm
   D) 6.0 atm
   E) 7.0 atm

2) A mixture of Xe(g) and $O_2(g)$, formed by the complete decomposition of $XeO_4(g)$, is collected over water at 34°C at a total pressure of 760 mmHg. If the vapor pressure of water is 40 mmHg at 34°C, what is the partial pressure of O_2?
   A) 360 mmHg
   B) 380 mmHg
   C) 480 mmHg
   D) 510 mmHg
   E) 720 mmHg

3) If 1000. g of boiling water (at 100.°C) was placed in an 1800. g cast iron skillet initially at 25°C, and the final equilibrium temperature of the water and the skillet was 88°C, estimate the specific heat capacity of the skillet. Assume this is a closed system and that the specific heat capacity of water is 4.184 J/°C•g.

   A) 0.247 J/°C•g
   B) 0.443 J/°C•g
   C) 0.833 J/°C•g
   D) 0.452 J/°C•g
   E) 0.185 J/°C•g

4) Which of the following is incorrect?
   I. For n=2 the maximum electron capacity is 8
   II. There are 3 different orbitals with n=2 and l=1
   III. For n=3, the largest value of l is 1
   IV. There can be two electrons in a configuration with quantum numbers n=1 and l=0
   V. There can be one electron in each configuration with n=2 and m_s=+1/2

   A) I and II
   B) I, III, V
   C) II, III, IV
   D) III and V
   E) Only V

5) Which are the correct quantum numbers for the electron removed to form Cu^+?
   A) 3, 0, 0
   B) 4, 0, 0

C) 3, 2, 0
D) 4, 1, 0
E) 4, 2, 0

6) Which of the following statements are true for the electronic configuration of magnesium?
   I. The 2s electrons are more difficult to remove than the 3s
   II. The 2s electrons shield the 3s electrons from nuclear charge
   III. The 2s electrons feel a higher effective nuclear charge than the 3s electrons

   A) Only I
   B) Only II
   C) I and II
   D) II and III
   E) I, II, and III

7) Which statement is incorrect regarding internal energy (U, E) and the first law of thermodynamics?
   A) The first law of thermodynamics states that energy must be conserved.
   B) When the system gains heat and performs work, then Δ{U, E} for the system must be positive.
   C) The first law of thermodynamics does not imply that heat can't be converted to work.
   D) When the system loses heat and performs work, then Δ{U, E} for the system must be negative.
   E) When its Δ{U,E} increases, then the system must gain heat or have work performed on it, or both.

8) Deterioration of buildings, bridges, and other structures through the rusting of iron costs millions of dollars a day. The enthalpy of formation of rust, $Fe_2O_3(s)$, is −826.0 kJ/mol. How much heat is released (in kJ) when 0.500 kg of Fe reacts with 200. g of O_2, forming $Fe_2O_3(s)$?
   A) 3442 kJ
   B) 3696 kJ
   C) 6864 kJ
   D) 7392 kJ
   E) 1650 kJ

9) When 50.0 ml of 0.200 M $AgNO_3$ and 50.0 ml of 0.100 M $CaCl_2$, both at 25.0°C, are reacted in a coffee-cup calorimeter, the temperature of the reacting mixture increases to 26.0°C. Calculate ΔH in kJ per mole of AgCl produced. Assume the density of the solution is 1.05 g/ml and the specific heat capacity of the solution 4.20 J/g°C.
   A) −88 kJ/mol
   B) −42 kJ/mol
   C) −440 kJ/mol
   D) −22 kJ/mol
   E) −44 kJ/mol

10) The rate law for 2 NO(g) + O_2(g) → 2 NO_2(g) was experimentally determined to be rate = k$[NO]^2[O_2]$. Based on this information, which of the following are plausible mechanisms for this reaction?

I:	2 NO(g) ⇄ N_2(g) + O_2(g) (slow equilibrium step) N_2(g) + 2 O_2(g) → 2 NO_2(g) (fast second step)
II:	2 NO(g) ⇄ N_2O_2(g) (fast equilibrium step) N_2O_2(g) + O_2(g) → 2 NO_2(g) (slow second step)
III:	2 NO(g) + O_2(g) → 2 NO_2(g) (one step)

A) Only I
B) Only II
C) I and III
D) II and III
E) I, II, and III

11) The growth of Pseudomonas bacteria is a first-order process with rate constant k = 0.035 min^{-1} at 37°C. The time it takes to approximately double the population of these bacteria at 37°C is
A) 5.0 minutes
B) 10. minutes
C) 20. minutes
D) 30. minutes
E) 60. Minutes

12) Select the true statement(s)
I. Photons of green light have greater energy than photons of red light
II. The light emitted from an n=4 to n=2 transition will have greater energy than light from an n=3 to n=1 transition
III. The energy of a photon is directly related to its frequency and inversely related to its wavelength
IV. There are only 2 subshells associated with the n=2 energy level
V. In accordance with Hund's rule, the ground state phosphorous atom contains 3 unpaired electrons in the p sublevel

A) I and II
B) II, III, and IV
C) I and III
D) III only
E) I, III, IV, and V

13) If 150. grams of iron (0.450 J/g°C) at 100°C is combined with 150. grams of water at 20°C in an insulated container, what will be the final temperature of the water?
A) 10.4°C
B) 27.8°C
C) 30.8°C
D) 34.5°C
E) 60.0°C

14) Find the heat of formation of gaseous HCl

$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$ H = -91.8 kJ

$N_{2(g)} + 4H_{2(g)} + Cl_{2(g)} \rightarrow 2NH_4Cl_{(s)}$ H = -628.8 kJ

$NH_{3(g)} + HCl_{(g)} \rightarrow NH_4Cl_{(s)}$ H = -176.2 kJ

A) -92.3 kJ
B) -184.6 kJ
C) -87.6 kJ
D) -445 kJ
E) -574.4 kJ

15) A pure gold ring (C=0.128 J/g°C) and pure silver ring (C=0.235 J/g°C) have a total mass of 15.3g. The two rings are heated to 62.1°C and dropped into a 13.1mL of water at 20.9°C. When equilibrium is reached, the temperature of the water is 22.9°C . What was the mass of the gold ring?

A) 17.6 g
B) 10.3 g
C) 7.5 g
D) 5.2 g
E) 3.4 g

16) Consider the reaction

$$C_{12}H_{22}O_{11}(s)+12O_2(g)\rightarrow 12CO_2(g)+11H_2O(l)$$

in which 10.0 g of sucrose, $C_{12}H_{22}O_{11}$, was burned in a bomb calorimeter with a heat capacity of 7.50 $kJ/\circ C$. The temperature increase inside the calorimeter was found to be 22.0°C . What is the heat of this reaction per mole of sucrose?

A) 5649 kJ/mol
B) 56507 kJ/mol
C) 1650 kJ/mol
D) 4125 kJ/mol
E) 3300 kJ/mol

17) Find the rate law for the following reaction mechanism

$HNO_2 + H^+ \rightarrow H_2O + NO^+$ (fast)

$NH_4^+ \rightarrow NH_3 + H^+$ (fast)

$NO^+ + NH_3 \rightarrow NH_3NO^+$ (slow)

$NH_3NO^+ \rightarrow H_2O + H^+ + N_2$ (fast)

A) Rate = k $[NO^+]$ $[NH_3]$
B) Rate = k $[NO^+]$ $[NH_4^+]$ $[H^+]^{-1}$
C) Rate = k $[NO^+]$ $[NH_4^+]$ $[H^+]$
D) Rate = k $[HNO_2]$ $[NH_4^+]$ $[H_2O]^{-1}$
E) Rate = k $[NH_3]$ $[H^+]$ $[HNO_2]$ $[H_2O]^{-1}$