CHM 2045 Exam 2 Review - Spring 2024 - Academic Resources

1. Consider the following reaction in a closed reaction flask: 2 A(g) + 3 B(g) -> A2B3 (g) If 1.20 atm of gas A is allowed to react with 1.20 atm of gas B, and the reaction goes to completion at constant temperature and volume, what is the total pressure (in atm) in the reaction flask at the end of the reaction?

    a 0.4 atm

    b 0.8 atm

    c 1.2 atm

    d 2.4 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 34ºC at a total pressure of 760 mmHg. If the vapor pressure of water is 40 mmHg at 34ºC, what is the partial pressure of O_2(g)? If O_2(g) is isolated in a 250 mL container at the same temperature, how many grams of O_2(g) is produced? = PO2 = 480 mm Hg ; m = 0.2 g O2

3. In an experiment, 25.0 ml of a gas with a pressure of 1.00 atm is contained in a balloon at 25.00°C. The balloon's temperature is adjusted until the pressure is 0.75 atm at a volume of 31.1 ml. What is the final temperature of the gas under the new conditions? = 5.02ºC

4. 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. =0.443 J/gºC

5. 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 $\Delta\{U, E\}$ 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 $\Delta\{U, E\}$ for the system must be negative.

E) When its $\Delta\{U,E\}$ increases, then the system must gain heat or have work performed on it, or both.

6. 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 $Fe_2O_3(s)$? = 3440 kJ

7. 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
= -44.1 kJ/mol

8. 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 (ρ= 1.00 g/mL and C = 4.184 J/gºC) at 20.9ºC. When equilibrium is reached, the temperature of the water is 22.9°C. What was the mass of the gold ring?

=7.5g

9. Find the heat of formation of gaseous HCl

(I) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ ΔH = -91.8 kJ

(II) $N_2(g) + 4H_2(g) + Cl_2(g) \rightarrow 2NH_4Cl(s)$ ΔH = -628.8 kJ

(III) $NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$ ΔH = -176.2 kJ

= -92.3 kJ

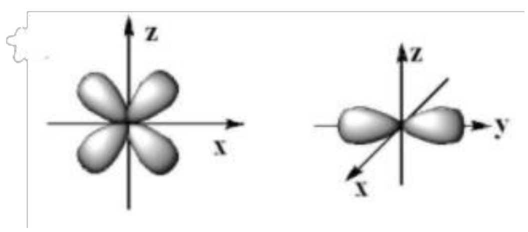
10. Consider the reaction

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

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/°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?

= -5650 kJ/mol

11. For each of the following orbital shapes below, give the maximum number of electrons that can be accommodated in the orbitals that share the same principal quantum number, *n*, and angular quantum number, *l*.



A) 4, 2 B) 6, 2 C) 5, 3 D) 10, 6 E) 14, 10

12. Which of the following full sets of quantum numbers is incorrect?

a) The e^- gained from Br → Br^-; n=4, l=1, m_l=+1, m_s=-1⁄2
b) The outermost e- in Rb; n=5, l=0, m_l=0, m_s=+1⁄2
c) The 6th e^- in O; n=2, l=0, m_l=0, m_s=+1⁄2
d) The 3rd e^- in F; n=2, l=0, m_l=0, m_s=+1⁄2
e) The 8th e^- in O; n=2, l=1, m_l=-1, m_s=-1⁄2

13. Which of the following electron configurations are correct?

I. Mo: [Kr] $5s^1 4d^5$

II. Cr: [Ar] $4s^2 3d^4$

III. Cu: [Ar] $4s^1 3d^{10}$

IV. Ca^{2+}: [Ar] $4s^2$

V. V^{3+}: [Ar] $3d^2$

VI. S^-: [Ne] 3s23p6

a) I, III, V
b) II, IV
c) I, II, V, VI
d) II, III, IV, V
e) None

14. What one correct set of quantum numbers for the third electron removed to form a cation of nickel? If there are multiple, give a range for each quantum number.

N= 3; l = 2; m_l = -2, or -1, or 0, or 1, or 2; m_s = + ½, or - 1/2

15. Which of these are in the correct increasing atomic size order?

a) Sr < Ca < Mg

b) Rb < Br < Kr

c) Se < Br < Cl

d) Xe < I < Ba

e) K < P < F

16. Which of these are in the correct order for increasing IE_1.

a) Cs < Xe < I

b) Kr < Ar < He

c) Rb < Ca < K

d) Sn < Sb < I

e) A and C

f) B and D

17. If a light bulb consumes 218 J per second, and all of its energy is converted to 560 nm light, how many photons are produced per second?

$=6.14 \times 10^{20}$ photons/ sec

18. Label the following ions paramagnetic or diamagnetic.

I. Hg^{2+} diamagnetic

II. V^{3+} paramagnetic

III. Zn^{2+} diamagnetic

19. Which ions are ranked correctly by decreasing size?

I. $Sr^{2+} > Ca^{2+} > Mg^{2+}$ II. $S^{2-} > Cl^- > K^+$ III. $Mg^{2+} > Na^+ > F^-$ IV. $Ba^{2+} > Cs^+ >$ I-

V. $P^{3-} > S^{2-} > Cl^-$

a) I, III, V
b) II, IV

c) I, II, V

d) I, IV, V

e) II, III, IV, V