VERSION 2

CHM151 Exam 2 100 Pts Fall 2004 Name: Key

Multiple Choice

1. For the equation: $2NO(g) + O_2(g) \longrightarrow N_2O_4(g)$, determine its enthalpy of reaction, given the chemical equations and their respective enthalpy changes;

#1 $N_2O_4(g) \longrightarrow 2NO_2(g)$ $\Delta H = 57.20$ kJ

#2 $2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$ $\Delta H = -114.14$ kJ

A. -171.34 kJ B. -85.67 kJ C. -56.94 kJ D. +56.94 kJ

NO : #2 as is
O_2 : used in #2
N_2O_4 : reverse #1

$2NO + O_2 \rightarrow 2NO_2$ kJ: -114.14

$2NO_2 \rightarrow N_2O_4$ $+57.20$

$2NO + O_2 \rightarrow N_2O_4$ -171.34 kJ

2. Determine the oxidation number of sulfur in $Na_2S_2O_3$.

A. -2 B. +1 C. +2 D. +4

$\frac{2(+1)}{Na} + \frac{2x}{S} + \frac{3(-2)}{O} = 0$ $x = +2$

3. What volume of 3.00 M HCl solution is needed to supply 0.125 mole of HCl?

A. 41.7 mL B. 125 mL C. 375 mL D. 1480 mL

$$\frac{0.125 \text{ mol HCl}}{3.00 \text{ mol HCl}} \left| \frac{1000 \text{ mL}}{} \right. = 41.7 \text{ mL}$$

4. The addition of a sodium fluoride solution to one of lead nitrate results in a net ionic equation of:

$$Pb^{2+}(aq) + 2F^-(aq) \longrightarrow PbF_2(s)$$

10 mL, 0.150 mol/L Pb^{2+}; 25.0 mL, 0.200 mol/L F^-; ? g

If 25.0 mL of 0.200 M NaF solution are mixed with 10.0 mL of 0.150 M $Pb(NO_3)_2$ solution, how many grams of the precipitate would be formed?

A. 0.368 g B. 1.23 g C. 1.59 g D. 368 g

Based on Pb^{2+}: $\frac{10.0 \text{ mL}}{} \left| \frac{0.150 \text{ mol } Pb^{2+}}{1000} \right| \frac{1 \text{ mol } PbF_2}{1 \text{ mol } Pb^{2+}} \left| \frac{245.2 \text{ g } PbF_2}{1 \text{ mol } PbF_2} \right. = 0.3678 \text{ g } PbF_2$

Based on F^-: $\frac{25.0 \text{ mL}}{} \left| \frac{0.200 \text{ mol } F^-}{1000} \right| \frac{1 \text{ mol } PbF_2}{2 \text{ mol } F^-} \left| \frac{245.2 \text{ g } PbF_2}{1 \text{ mol } PbF_2} \right. = 0.613 \text{ g } PbF_2$

5. The specific heat of aluminum is 0.900 J/g°C. Calculate the heat needed to raise the temperature of a 45.0 g block of aluminum from 20.5°C to 86.8°C.

A. 1.63 kJ B. 2.69 kJ C. 3.32 kJ D. 13.7 kJ

$$\frac{0.900 \text{ J}}{\text{g °C}} \left| \frac{45.0 \text{ g}}{} \right| \frac{66.3 \text{ °C}}{} = 2685 \text{ J} \left| \frac{\text{kJ}}{10^3} \right. = \text{kJ}$$

6. Determine the molarity of a solution prepared by dissolving 15.82 g Na_2SO_4 in enough water to prepare 250.0 mL of solution.

A. 0.0045 M B. 0.02784 M C. 0.06328 M D. 0.4455 M

$$\frac{15.82 \text{ g}}{250.0 \times 10^{-3} \text{ L}} \left| \frac{\text{mol}}{142.06 \text{ g}} \right. = 0.4454 \frac{\text{mol}}{\text{L}}$$

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7. The enthalpy change for the combustion of one mole of methane, CH_4, is -891 kJ. Determine the enthalpy change when 1.5 kg of methane are burned.

A. -1.3×10^3 kJ C. -8.3×10^4 kJ

B. -2.1×10^4 kJ D. -1.3×10^6 kJ

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O \quad \Delta H = -891\ kJ$$

$$\frac{1.5 \times 10^3\ g\ CH_4}{1} \left| \frac{mol\ CH_4}{16.04\ g\ CH_4} \right| \frac{-891\ kJ}{1\ mol\ CH_4} = -8.33 \times 10^4\ kJ$$

8. In writing the net ionic equation to describe the reaction of aqueous solutions of sodium hydroxide and acetic acid ($HC_2H_3O_2$, a weak acid), the spectator ion would be,

A. Na^+ B. OH^- C. H^+ C. $C_2H_3O_2^-$

$$Na^+ + OH^- + HC_2H_3O_2 \rightarrow H_2O(l) + Na^+ + C_2H_3O_2^-$$

9. What is the net ionic equation for the acid-base reaction between nitrous acid (weak) and sodium (strong)?

a. $HNO_2(aq) + NaOH(aq) \longrightarrow NaNO_2(aq) + H_2O(l)$

b. $H^+(aq) + OH^-(aq) \longrightarrow H2O(l)$

c. $HNO_2(aq) + OH^-(aq) \longrightarrow NO_2^-(aq) + H_2O(l)$

d. $H^+(aq) + NO_2^-(aq) + Na^+(aq) + OH^-(aq) \longrightarrow NaNO_2(aq) + H_2O(l)$

e. $H^+(aq) + NO_2^-(aq) + Na^+(aq) + OH^-(aq) \longrightarrow Na^+(aq) + NO_2^-(aq) + H_2O(l)$

10. How many grams of $CuSO_4$ are required to make 3.00 L of a 0.150 M solution?

A. 23.9 g B. 45.9 g C. 60.7 g D. 71.8 g

$$\frac{3.00\ L}{1} \left| \frac{0.150\ mol\ CuSO_4}{L} \right| \frac{159.61\ g\ CuSO_4}{mol\ CuSO_4} = 71.8\ g\ CuSO_4$$

11. The specific heat of gold is 0.132 J/g°C. If upon addition of 3.59 kJ of heat a sample of gold increases in temperature from 24.50°C to 100.00°C, how many grams of gold were present?

A. 1.36 g B. 6.28 g C. 78.0 g D. 360. g

$$\frac{g\ Au}{0.132\ J} \left| \frac{3.59 \times 10^3\ J}{75.50\ °C} \right| = 360.\ g\ Au$$

12. In the reaction, (Gained / Lost)

$$\overset{+3}{2BCl_3}(g) + 3\overset{0}{H_2}(g) \longrightarrow 2\overset{0}{B}(s) + 6\overset{+1}{HCl}(g)$$

Oxidized = R.A.

the reducing agent is,

A. B B. Cl C. BCl_3 D. H_2

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13. A 47.00 g sample of iron absorbs 914 J of heat when its temperature rises from 28.34°C to 71.75°C. Determine the specific heat of iron.
A. 0.448 J/g°C B. 1.86 J/g°C C. 6.61 J/g°C D. 49.23 J/g°C

$$\frac{914\ J}{47.00\ g} \left| \frac{1}{(71.75-28.34)^\circ C} \right. = 0.448\ \frac{J}{g^\circ C}$$

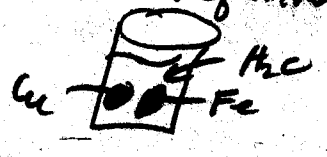
14. How many moles of potassium ions are in 50.0 mL of 0.254 M K_3PO_4 solution?
A. 0.0127 B. 0.0381 C. 0.497 D. 1.49

$$\frac{50.0\ mL}{1000\ mL} \left| \frac{0.254\ mol\ K_3PO_4}{1\ K_3PO_4} \right| \frac{3\ mol\ K^+}{} = 0.0381\ mol\ K^+$$

15. Which of the following statements is not a characteristic of acids?
a. They are proton donors.
b. They neutralize bases.
c. They react with nonmetals to give a salt and oxygen.
d. They react with bases to give a salt and water.
e. They taste sour.

16. The specific heat of iron is greater than that of copper. Suppose equal masses of these two metals, both initially at 25°C, are added to a beaker of boiling water (100.0° C).
A. The final temperature of the iron sample will be greater than that for copper.
B. The final temperature of the copper sample will be greater than that for iron.
C. The final temperatures will depend on the rate of heating.
D. Both iron and copper samples will be at the same final temperature.

Reach Equilibrium



17. The ΔH for the reaction:

$$C(s) + 2H_2(g) \longrightarrow CH_4(g)$$

is -74.8 kJ. Determine the ΔH for the reaction:

$$3CH_4(g) \longrightarrow 6H_2(g) + 3C(s)$$

A. -224.4 kJ B. -74.8 kJ C. +149.6 kJ D. +224.4 kJ

Reverse × 3 = 3(+74.8) = +224.4 kJ

18. In order to dilute 40.0 mL of 0.60 M HCl to 0.10 M, the volume of water which would need to be added would be
a. 80.0 mL
b. 100.0 mL.
c. 160.0 mL.
d. 200.0 mL.
e. 240.0 mL.

$$M_1V_1 = M_2V_2$$
$$(0.60M)(40.0mL) = (0.10M)(V_{total})$$
$$240mL = V_{total}$$
$$240 - 40.0 = 200\ mL\ H_2O$$

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19. If 40.0 mL of H_2SO_4 solution reacts with 0.212 gram of Na_2CO_3, what is the molarity of the H_2SO_4 solution?

$$Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + CO_2 + H_2O$$

0.212 g, 40.0 mL

a) 0.50 M
b) 0.10 M
c) 0.20 M
d) 0.40 M
e) 0.050 M

$$\frac{0.212\ g\ Na_2CO_3}{} \left| \frac{1\ mol\ Na_2CO_3}{106\ g\ Na_2CO_3} \right| \frac{1\ mol\ H_2SO_4}{1\ mol\ Na_2CO_3} \left| \frac{}{40.0 \times 10^{-3}\ L\ H_2SO_4} \right. = 0.0500 \frac{mol\ H_2SO_4}{L\ H_2SO_4}$$

20. What mass of calcium carbonate, $CaCO_3$, is required to react with 100 mL of 2.00 M HCl solution?

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H2O$$

? g, 100 mL, 2.00 mol/L

a) 5.00 g
b) 10.0 g
c) 15.0 g
d) 20.0 g
e) 23.0 g

$$\frac{100\ mL\ HCl}{} \left| \frac{2.00\ mol\ HCl}{1000\ mL\ HCl} \right| \frac{1\ mol\ CaCO_3}{2\ mol\ HCl} \left| \frac{100.09\ g\ CaCO_3}{1\ mol\ CaCO_3} \right. = 10.0\ g\ CaCO_3$$

21. For the reaction: $2C_2H_2(g) + 5O_2(g) \longrightarrow 4CO_2(g) + 2H_2O(g)$, determine its ΔH if the standard heats of formation, $\Delta H_f°$, in kJ/mole for $C_2H_2(g)$, $H_2O(g)$, and $CO_2(g)$ are +226, -242, and -393 respectively.

A. -2508 kJ B. -1604 kJ C. -802 kJ D. -409 kJ

$$\Delta H = \sum \Delta H_f^\circ_{products} - \sum \Delta H_f^\circ_{reactants}$$

$$\Delta H = \underbrace{\left(4(-393) + 2(-242)\right)}_{CO_2 \quad H_2O} - \underbrace{\left(2(+226) + 0\right)}_{C_2H_2 \quad O_2} = -2508\ kJ$$

22. What volume of a 0.582 M $AgNO_3$ solution contains 85.2 g of $AgNO_3$?

A. 49.6 mL B. 146 mL C. 292 mL D. 862 mL

$$\frac{85.2\ g\ AgNO_3}{} \left| \frac{1\ mol\ AgNO_3}{169.91\ g\ AgNO_3} \right| \frac{1000\ mL}{0.582\ mol\ AgNO_3} = 862\ mL$$

23. The reaction:

$$S(s) + 3F_2(g) \longrightarrow SF_6(g)$$

6.40 g

is studied in a bomb calorimeter. If 6.40 g of sulfur is reacted with excess fluorine gas in a calorimeter whose heat capacity is 32.5 kJ/°C, the temperature inside the calorimeter rises from 21.3°C to 28.7°C. Determine the heat produced if one mole of sulfur would react similarly.

A. 4.8×10^2 kJ C. 1.4×10^3 kJ
B. 1.2×10^3 kJ D. 2.4×10^3 kJ

$$\frac{32.5\ kJ}{°C} \left| \frac{(28.7 - 21.3)\ °C}{} \right| \frac{32.07\ g\ S}{6.40\ g\ S} \left| \frac{}{1\ mol\ S} \right. = 1205\ \frac{kJ}{mol\ S}$$

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24. Each of the following pairs contains one strong acid and one weak acid except
    a. H_2SO_4 and H_2SO_3.
    b. HNO_3 and HNO_2.
    c. HCl and HF.
    d. $HClO_4$ and $HClO_2$.
    e. H_3PO_4 and H_3PO_3.

25. How many moles of sulfate ions are there in a 0.1-liter solution of 0.02-molar $Al_2(SO_4)_3$?
    a. 0.002
    b. 0.004
    c. 0.006
    d. 0.024
    e. 0.06

$$\frac{0.1\ \cancel{L} \mid 0.02\ mol\ \cancel{Al_2(SO_4)_3} \mid 3\ mol\ SO_4^{2-}}{1\ \cancel{L} \mid 1\ mol\ \cancel{Al_2(SO_4)_3}} = mol\ SO_4^{2-}$$