SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.(每題5分)

1) **A 100. mL sample of 0.200 M aqueous hydrochloric acid is added to 100. mL of 0.200 M aqueous ammonia in a calorimeter whose heat capacity (excluding any water) is 480. J/K. The following reaction occurs when the two solutions are mixed.**
$HCl(aq) + NH_3(aq) \rightarrow NH_4Cl(aq)$
The temperature increase is 2.34°C. Calculate ΔH per mole of HCl and NH_3 reacted.

2) **Ethanol undergoes combustion in oxygen to produce carbon dioxide gas and liquid water. The standard heat of combustion of ethanol, $C_2H_5OH(l)$, is –1366.8 kJ/mol. Given that $\Delta H°_f[CO_2(g)] = -393.5$ kJ/mol and $\Delta H°_f[H_2O(l)] = -285.8$ kJ/mol, what is the standard enthalpy of formation of ethanol?**

3) **Acetylene (C_2H_2) undergoes combustion in excess oxygen to generate gaseous carbon dioxide and water. Given $\Delta H°_f[CO_2(g)] = -393.5$ kJ/mol, $\Delta H°_f[H_2O(g)] = -241.8$ kJ/mol, and $\Delta H°_f[C_2H_2(g)] = 226.6$ kJ/mol, how much energy is released (kJ) when 10.5 moles of acetylene is burned?**

4) **Pentaborane $B_5H_9(s)$ burns vigorously in O_2 to give $B_2O_3(s)$ and $H_2O(l)$. Calculate ΔH_{rxn} for the combustion of 5.00 mol of B_5H_9.**
$\Delta H°_f[B_2O_3(s)] = -1{,}273.5$ kJ/mol
$\Delta H°_f[B_5H_9(s)] = 73.2$ kJ/mol
$\Delta H°_f[H_2O(l)] = -285.8$ kJ/mol

5) **The enthalpy change when a strong acid is neutralized by strong base is –56.1 kJ/mol. If 12.0 mL of 6.00 M HBr at 21.30°C is mixed with 300. mL of 0.250 M NaOH, also at 21.30°C, what is the maximum temperature reached by the resulting solution? (Assume that there is no heat loss to the container, that the specific heat of the final solution is 4.18 J/g·°C, and that the density of the final solution is that of water.)**

6) **Calcium carbonate decomposes at high temperatures to give calcium oxide and carbon dioxide as shown below. $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ The K_P for this reaction is 1.16 at 800°C. A 5.00 L vessel containing 10.0 g of $CaCO_3(s)$ was evacuated to remove the air, sealed, and then heated to 800°C. Ignoring the volume occupied by the solid, what will be the overall mass percent of carbon in the solid once equilibrium is reached?**

7) **Sodium carbonate, $Na_2CO_3(s)$, can be prepared by heating sodium bicarbonate, $NaHCO_3(s)$ as shown below.$2NaHCO_3(s) \rightleftharpoons Na_2CO_3(s) + CO_2(g) + H_2O(g)$ $K_p = 0.23$ at 100°C If a sample of $NaHCO_3$ is placed in an evacuated flask and allowed to achieve equilibrium at 100°C, what will the total gas pressure be?**

8) **A solution was prepared such that the initial concentrations of $Cu^{2+}(aq)$ and $CN^-(aq)$ were 0.0120 M and 0.0400 M, respectively. These ions react according to the following chemical equation:**
$Cu^{2+}(aq) + 4CN^-(aq) \rightleftharpoons Cd(CN)_4^{2-}(aq)$ $K_c = 1.0 \times 10^{25}$
What will be the concentration of $CN^-(aq)$ at equilibrium?

9) 25.0 g of HI(g) is injected into a 4.00 L reaction vessel that contains 20.0 g of I_2(g). When the system comes to equilibrium at 400°C, what will be the total pressure inside the reaction vessel?
$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$, $K_c = 0.0156$ at 400°C

10) For the reaction $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$, $K_c = 8.0$ at a certain temperature. What concentration of NOCl must be put into an empty 4.00 L reaction vessel in order that the equilibrium concentration of NOCl be 1.00 M?

11) A sample of mercury(II) oxide is placed in a 5.00 L evacuated container and heated until it decomposes entirely to mercury metal and oxygen gas. The container is then cooled to 25°C. One now finds that the gas pressure inside the container is 1.73 atm. What mass of mercury(II) oxide was originally placed into the container?

12) The mole fraction of oxygen molecules in dry air is 0.2095. What volume of dry air at 1.00 atm and 25°C is required for burning 1.00 L of octane (C_8H_{18}, density = 0.7025 g/mL) completely, yielding carbon dioxide and water?

13) 9.45 g of liquid hexane (C_6H_{14}) is introduced into a 10.0 L vessel containing 13.15 atm of oxygen gas at 21°C and ignited, yielding carbon dioxide and water. If the vessel is then cooled to –10.°C, what will be the gas pressure inside the vessel?

14) 5.00 g of hydrogen gas and 50.0 g of oxygen gas are introduced into an otherwise empty 9.00 L steel cylinder, and the hydrogen is ignited by an electric spark. If the reaction product is gaseous water and the temperature of the cylinder is maintained at 35°C, what is the final gas pressure inside the cylinder?

15) 10.0 g of gaseous ammonia and 6.50 g of oxygen gas are introduced into a previously evacuated 5.50 L vessel. If the ammonia and oxygen then react to yield NO gas and water vapor, what is the final density of the gas mixture inside the vessel at 23°C?

16) One method of determining the concentration of hydrogen peroxide (H_2O_2) in a solution is through titration with the iodide ion. The net ionic equation for this reaction is
$H_2O_2 + 2I^- + 2H^+ \rightarrow I_2 + 2H_2O$
A 50.00 mL sample of a hydrogen peroxide solution is found to react completely with 37.12 mL of a 0.1500 M KI solution. What is the concentration of hydrogen peroxide in the sample?

17) A 4.691 g sample of $MgCl_2$ is dissolved in enough water to give 750. mL of solution. What is the magnesium ion concentration in this solution?

18) The concentration of oxalate ion ($C_2O_4^{2-}$) in a sample can be determined by titration with a solution of permanganate ion (MnO_4^-) of known concentration. The net ionic equation for this reaction is
$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 10CO_2$
A 30.00 mL sample of an oxalate solution is found to react completely with 21.93 mL of a 0.1725 M solution of MnO_4^-. What is the oxalate ion concentration in the sample?

19) **Pressurized metal gas cylinders are generally used to store commonly used gases in the laboratory. At times, it can be easier to chemically prepare occasionally used gases. For example, oxygen gas can be prepared by heating $KMnO_4(s)$ according to the following chemical reaction: $2KMnO_4(s) \rightarrow K_2MnO_4(s) + MnO_2(s) + O_2(g)$ The above procedure was carried out starting with 93.2 g of $KMnO_4$, and it was later determined that all of the $KMnO_4$ reacted according to the above equation except 11.7 g. What was the percent yield for the reaction?**

20) **What is the theoretical yield of vanadium, in moles, that can be produced by the reaction of 2.0 moles of V_2O_5 with 6.0 moles of calcium based on the chemical reaction below? $V_2O_5(s) + 5Ca(l) \rightarrow 2V(l) + 5CaO(s)$**