_____ AP Chem ____/____/____

Chapters 5 & 6 Homework Answer Sheet – Write the correct letter (neatly printed) on the line for the appropriate question. (31 Homework points)

Chapter 5

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Chapter 6

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AP Multiple-Choice Review Questions

1. On a cold day near the ocean, it was found that 8 g of an unknown gas occupies a volume that is a little less than 6 L. Based on this information, what is the most likely identity of the unknown gas?
   (A) CO_2
   (B) Ne
   (C) O_2
   (D) CH_4
2. Which of the following gases is expected to behave most ideally at a given temperature and pressure?
   (A) H_2O
   (B) NH_3
   (C) Xe
   (D) He

The following information is used to answer questions 3 and 4.

Nitroglycerine, $C_3H_5N_3O_9$, explodes with tremendous force due to the numerous gaseous products. The equation for the explosion of nitroglycerine is:

$$4C_3H_5N_3O_9(l) \rightarrow 12CO_2(g) + O_2(g) + 6N_2(g) + 10H_2O(g)$$

A scientist conducts an experiment to characterize a bomb containing nitroglycerine. She uses a steel, rigid container for the test.

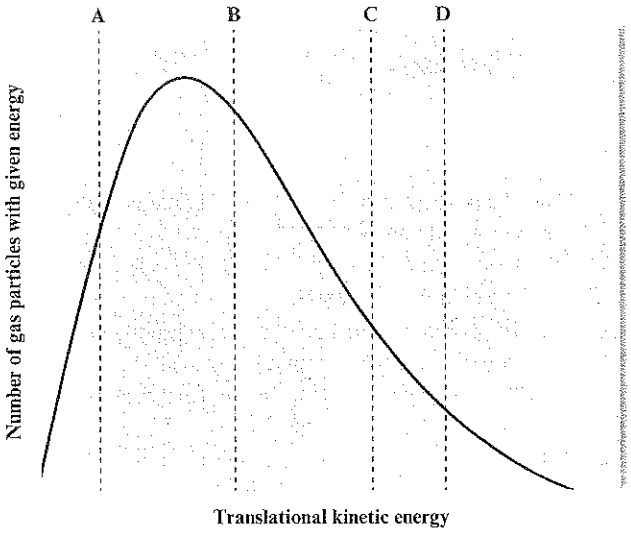
Volume of rigid steel container	1.00 L
Molar mass of nitroglycerine	227 g/mol
Temperature	300. K
Amount of nitroglycerine tested	227 g
Value for ideal gas constant, R	$0.0821 \frac{\text{L atm}}{\text{mol K}}$

3. What is the total pressure produced in this explosion?
   (A) 25.0 atm
   (B) 52.0 atm
   (C) 179 atm
   (D) 435 atm
4. In a second experiment, the total pressure is observed to be 58 atm. What is the partial pressure of the water vapor produced?
   (A) 10. atm
   (B) 20. atm
   (C) 30. atm
   (D) 40. atm
5. There are two equations of state commonly used for gas law problems in chemistry: the ideal gas law and the van der Waals equation, both shown in the table below. A sample of 6.00 moles of chlorine gas has a volume of 2.00 L at 273 K. A student is asked to determine the pressure using these two equations.

	Ideal Gas Law	van der Waals Equation
Equation	$PV = nRT$	$\left(P + \frac{n^2a}{V^2}\right)(V - nb) = nRT$
Calculated pressure	67.2 atm	22.5 atm

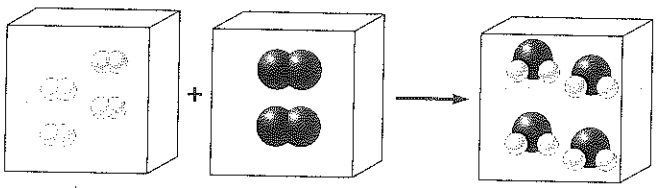
   What is the major factor that accounts for most of the difference in the two values?
   (A) chlorine is a halogen
   (B) diatomic nature of chlorine
   (C) volume of the chlorine particles
   (D) forces of attraction between chlorine molecules
6. A sample of gas is heated from 35°C to 70.°C. Which statement correctly describes what happens to the volume?
   (A) The volume increases by a factor of less than 2.
   (B) The volume increases by a factor of 2.
   (C) The volume decreases by a factor of less than 2.
   (D) The volume decreases by a factor of 2.
7. The Maxwell-Boltzmann distribution for unknown gas is shown. At which point on the graph is the average temperature of the gas most directly related to its translational kinetic energy?

Maxwell-Boltzmann distribution for an unknown gas



(A) A
(B) B
(C) C
(D) D

8. Two gases are removed from their original container and placed into a third container, where they react with each other. All three containers have identical volumes, and all gasses are at the same temperature.



Which container has the lowest pressure?

(A) container A before the reaction

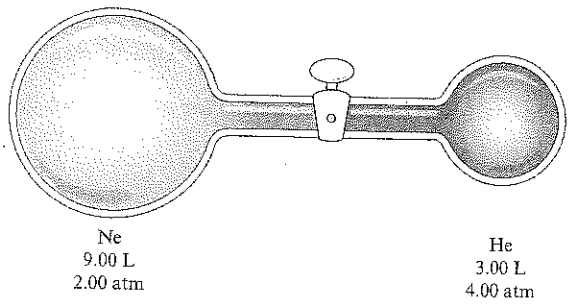
(B) container B before the reaction

(C) container C after the reaction

(D) they all have the same pressure

9. A sample of neon gas is contained in the left-hand bulb and a sample of helium gas is contained in the right-hand bulb of a two-bulb container connected by a valve, as shown in the diagram. Initially the valve is closed.

The left-hand bulb has a volume of 9.00 L, and the Ne gas is at a pressure of 2.00 atm. The right-hand bulb has a volume of 3.00 L, and the He gas is at a pressure of 4.00 atm. After the valve is opened, what is true about the relative partial pressures of helium and neon? Assume constant temperature.



(A) The partial pressure of helium is 1.50 times as great as the partial pressure of neon.

(B) The partial pressure of neon is 2.00 times as great as the partial pressure of helium.

(C) The partial pressure of neon is 1.50 times as great as the partial pressure of helium.

(D) The partial pressure of helium is 2.00 times as great as the partial pressure of neon.

10. Which of the following is a reasonable estimate for the volume of a balloon that has been filled with 300 g of oxygen gas at STP?

(A) 1 L

(B) 10 L

(C) 50 L

(D) 200 L

11. Which of the following most closely estimates the density of air at 1.0 atm and 25°C to one significant figure?

(A) 0.1 g/L

(B) 1 g/L

(C) 10 g/L

(D) 100 g/L

12. A certain mass of neon gas is contained in a rigid steel container. The same mass of helium gas is added to this container. Which of the following best describes what happens? Assume the temperature is constant.

(A) The pressure in the container doubles.

(B) The pressure in the container increases but does not double.

(C) The pressure in the container more than doubles.

(D) The pressure in the container does not change.

13. Which of the following statements is true concerning real gases?

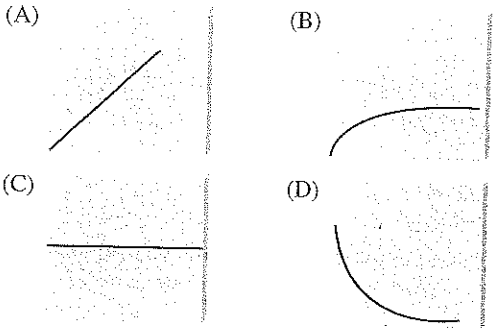
(A) The observed pressure will be less than the ideal pressure, and the volume available for the gas particles is less than the volume of the container.

(B) The observed pressure will be less than the ideal pressure, and the volume available for the gas particles is greater than the volume of the container.

(C) The observed pressure will be greater than the ideal pressure, and the volume available for the gas particles is greater than the volume of the container.

(D) The observed pressure will be greater than the ideal pressure, and the volume available for the gas particles is less than the volume of the container.

Use the following information to answer questions 14–16.



14. Indicate which of the above graphs represents PV (y) vs. V (x) for 1.0 mole of an ideal gas at constant T.

15. Indicate which of the above graphs represents PV (y) vs. n (x) for an ideal gas at constant T.

16. Indicate which of the above graphs represents gas density (y) vs. T (x) for 1.0 mole of an ideal gas at constant P.

AP Multiple-Choice Review Questions

Use the following information to answer questions 1 and 2.

Aluminum reacts with hydrochloric acid according to the following equation:

$$2Al(s) + 6HCl(aq) \rightarrow 2AlCl_3(aq) + 3H_2(g)$$

1. If a sample of 27.0 g of aluminum metal is added to 333 mL of 3.0 *M* hydrochloric acid, the volume of hydrogen gas produced at standard temperature and pressure is
   (A) 2.80 L.
   (B) 5.60 L.
   (C) 11.2 L.
   (D) 22.4 L.
2. What is the approximate density of the hydrogen gas produced at STP?
   (A) 0.1 g/L
   (B) 0.2 g/L
   (C) 0.3 g/L
   (D) 0.4 g/L
3. Given the following data,

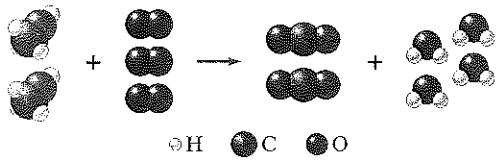
Substance	ΔH_f° (kJ/mol)
$CO_2(g)$	−393.5
$H_2O(g)$	−285.8
$C_4H_{10}(g)$	−124.7

calculate the ΔH_{rxn}° for the following reaction.

$$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(g)$$

(A) −6255.4 kJ
(B) −5756.6 kJ
(C) −40.6 kJ
(D) 539.4 kJ

4. Consider the reaction shown below:

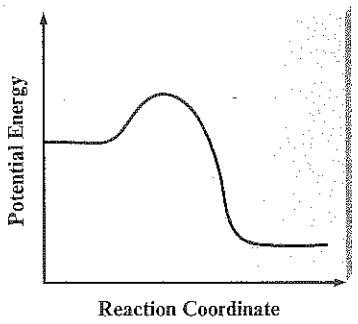


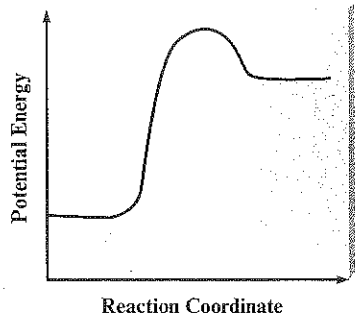
Given the following information, calculate ΔH_{rxn}° for the reaction represented above, where each molecule represents 1 mole of that substance. Assume that all states are those that are listed below.

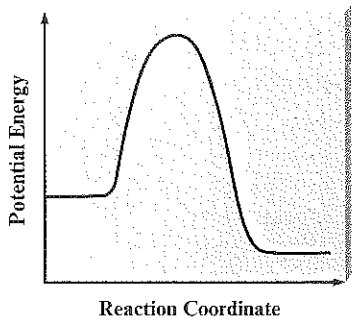
Substance	ΔH_f° (kJ/mol)
$CO_2(g)$	−393.5
$H_2O(g)$	−285.8
$CH_3OH(g)$	−201.0

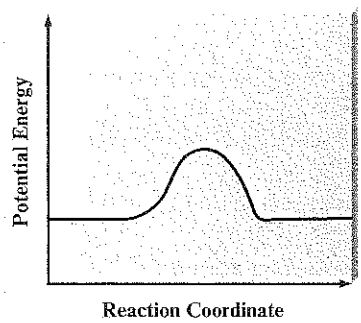
(A) −2332.2 kJ
(B) −1528.2 kJ
(C) −478.3 kJ
(D) [illegible]

5. Which of the following graphs describes a pathway of reaction that is exothermic with a high activation energy?

(A)


(B)


(C)


(D)


6. One cup of ice has a mass of approximately 250 g. The ice is at 0.0°C. How much heat is required to melt the ice and then warm the resulting water to 25.0°C? A table of useful information is provided.

Heat of fusion of $H_2O(s)$	332 kJ/kg
Specific heat of $H_2O(l)$	4.18 J/°C · g

(A) 25 kJ
(B) 58 kJ
(C) 83 kJ
(D) 110 kJ

7. A 20.-g sample of metal at 110.°C is placed into 30. g of kerosene at 35°C. The final temperature of both the kerosene and the metal is 60.°C. If the specific heat of kerosene is 2.0 J/°C · g, what is the specific heat of the metal?
   (A) 1.0 J/°C · g
   (B) 1.5 J/°C · g
   (C) 2.0 J/°C · g
   (D) 2.5 J/°C · g

8. Calculate the enthalpy change for the following reaction given the information below.

$$Al_2(CO_3)_3(s) \rightarrow Al_2O_3(s) + 3CO_2(g)$$

The information available to you is:

$C(graphite) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = W$ kJ
$4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$ $\Delta H = X$ kJ
$2Al(s) + \frac{9}{2}O_2(g) + 3C(graphite) \rightarrow Al_2(CO_3)_3(s)$ $\Delta H = Y$ kJ

   (A) W + X − Y
   (B) 3W + X − Y
   (C) 3W + $\frac{1}{2}$X + Y
   (D) 3W + $\frac{1}{2}$X − Y

9. In which of the following isothermal expansions of an ideal gas is the work done by the system the largest? Assume the temperature is the same for all choices.
   (A) from 1 to 5 L against an opposing pressure of $\frac{1}{2}$ atm
   (B) from 1 to 5 L against an opposing pressure of 1 atm
   (C) from 1 to 5 L against an opposing pressure of 3 atm
   (D) from 1 to 10 L against an opposing pressure of 2 atm

10. Consider four 100.0-g samples of water, each in a separate beaker at 25.0°C. Into each beaker you drop 10.0 g of a different metal that has been heated to 95.0°C. Assuming no heat loss to the surroundings, which water sample will have the lowest final temperature?
   (A) the water to which you have added aluminum (s = 0.89 J/°C · g)
   (B) the water to which you have added iron (s = 0.45 J/°C · g)
   (C) the water to which you have added copper (s = 0.20 J/°C · g)
   (D) the water to which you have added lead (s = 0.14 J/°C · g)

11. A student performs a neutralization reaction involving an acid and a base in an open polystyrene coffee-cup calorimeter. How would the calculated value of ΔH differ from the actual value if there was significant heat loss to the surroundings?
   (A) ΔH_{calc} would be negative, but more negative than the actual value.
   (B) ΔH_{calc} would be negative, but less negative than the actual value.
   (C) ΔH_{calc} would be positive, but more positive than the actual value.
   (D) ΔH_{calc} would be positive, but less positive than the actual value.

12. Which of the following is endothermic?
   (A) Water freezes to form ice.
   (B) Steam condenses on a bathroom mirror.
   (C) Ice cream melts.
   (D) Coffee cools as it sits.

13. At 25°C, the following heats of reaction are known:

$2C_2H_2(g) + 5O_2(g) \rightarrow 4CO_2(g) + 2H_2O(l)$ $\Delta H = -2600.0$ kJ
$C(graphite) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -394$ kJ
$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$ $\Delta H = -574$ kJ

   At the same temperature, calculate ΔH for the reaction $2C(graphite) + H_2(l) \rightarrow C_2H_2(g)$.
   (A) −2422 kJ
   (B) −225 kJ
   (C) 225 kJ
   (D) 2422 kJ

14. Using Hess's law and the equations below find $\Delta H°$ at 25°C for the oxidation of $C_2H_5OH(l)$.

$$C_2H_5OH(l) + 3O_2(g) \rightarrow 3H_2O(l) + 2CO_2(g)$$

$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2\,H_2O(l)$ $\Delta H° = W$ kJ
$2C(graphite) + 3H_2(g) + \frac{1}{2}O_2(g) \rightarrow C_2H_5OH(l)$ $\Delta H° = X$ kJ
$C_2H_4(g) + H_2O(l) \rightarrow C_2H_5OH(l)$ $\Delta H° = Y$ kJ

   (A) W − Y
   (B) X − 2Y
   (C) X + 2W + Y
   (D) 2X − W + Y

15. A popular chemistry demonstration is to drop a piece of sodium metal into water. The products are sodium hydroxide and hydrogen gas. Determine ΔH_{rxn} for this reaction for 1.00 mole of hydrogen gas being produced, given

$\Delta H_f°[H_2O(l)] = -286$ kJ/mol
$\Delta H_f°[NaOH(aq)] = -470$ kJ/mol

   (A) −368 kJ
   (B) −184 kJ
   (C) 184 kJ
   (D) 368 kJ