...You may use calculators for all parts of the examination.

R= 0.0821 lit.atm/mol K = 62.4 lit.torr/mol K = 8.31 J/mol K

1. A sample of 1.00 mole of hydrogen gas is mixed with 5.00 mole of helium gas. If the total pressure of the system is 3.00 atmospheres, the partial pressure of the **helium** gas is

A) 0.500 atm B) 1.00 atm C) 1.50 atm D) 2.00 atm E) 2.50 atm

2. The density of a certain gas was measured to be 2.68 grams per liter at 3.00 atm. and 27oC. What is the molecular mass of the gas? A) 16.0 B) 20.0 C) 22.0 D) 60.0 E) 132

3. Deviations from the gas laws in which PV > nRT are generally produced when

A) there are significant intermolecular attractions B) the particles occupy a significant

fraction of the space in the container C) the pressure is significantly decreased

D) there are significant chemical interactions between the gas particles

4. At the same temperature, the RMS speed of O2 gas is how many times that of SO2 gas ?

A) 1.4 B) 2 C) 4 D) .5 E) .25

5. The density of oxygen gas at 25oC and 4.0 atmospheres pressure is approximately

A) 1.3 gram/liter B) 2.6 gram/liter C) 3.2 gram/liter D) 5.2 gram/liter E) 7.3 gram/liter

6. A sample of 0.0100 mole of oxygen gas is confined at 37oC and 0.216 atmosphere. What would be the pressure of this sample at 7.0oC and the same volume?

A) 0.041 atm. B) 0.195 atm C) 0.201 atm D) 0.239 atm E) 1.14 atm

7. A hydrocarbon with an empirical formula CH2 is found to have a mass of 5.01 grams at a pressure of 1.00 atm, a temperature of 0oC., and a volume of 2.00 liters. A possible formula

for this hydrocarbon is A) CH2 B) C2H4 C) C3H6 D) C4H8 E) C5H10

8. Samples of F2 gas and Xe gas are mixed in a container of fixed volume. The initial partial pressure of the F2 gas is 8.0 atm. and that of the Xe gas is 1.7 atm. When all of the Xe gas reacted, forming a solid compound, the pressure of the unreacted F2 gas was 6.3 atm. The temperature remained constant. What is the formula of the compound?

A) XeF B) XeF2 C) XeF3 D) XeF4 E) XeF6

9. A sample of an ideal gas is cooled from 50.0o C to 25.0o C in a sealed container of constant volume. Which of the following values for the gas will decrease?

I. The density of the gas.

II. The average distance between the molecules

III. The average speed of the molecules.

A) I only B) II only III ) III only D) I and III E) II and III

10. Collisions between gas particles and container walls result in a measurable force per unit

area. This force per unit area varies

I. Directly with Kelvin temperature

II. Inversely with the volume of the container

III. Directly with the concentration of gas particles.

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

11. A 66.0g sample of solid CO2( MM=44) vaporizes completely to fill an empty plastic bag to a final volume of 22.4 L at 0̊ C. What is the final pressure in the sealed bag? (Note: this was on an AP test, and had to be done WITHOUT calculators! ̊)

A) 380 mm Hg B) 507 mm Hg C) 760 mm Hg D) 1140 mm Hg E) 1520 mm Hg

12. A mixture of nitrogen and helium gases containing 4.00 grams of helium, exerts a total pressure of 800. mm Hg. If the partial pressure of the nitrogen gas is 480 mm of Hg, what is the mass of the nitrogen gas in the mixture? A) 21.0 g B) 42.0 g C) 56.0 g D) 28.0 g

E) 6.00 g

(13 to 14) Hydrogen is often prepared through the reaction of dilute HCl with Zinc.

Zn(s) + 2 HCl(aq) → H2(g) + ZnCl2(aq)

In one such experiment, 6.54 grams of Zn are reacted with 2.00 molar HCl. The zinc is completely consumed in the reaction.

13. What is the minimum amount of 2.00 molar HCl needed to react with the entire quantity of zinc? A) 50.0 mL B) 100. mL C) 25.0 mL D) 200. mL

14. At STP, what volume of hydrogen gas would be produced in this reaction?

A) 1.12 liters B) 2.24 liters C) 4.48 liters D) 6.54 liters

( 15 to 16) An experiment is done to measure the heat of neutralization of an acid and a base in water. 50.0 mL of 2.00 M HNO3 is mixed with 50.0 mL of 2.00 M KOH. The initial temperature of both reactants is 22.0°C. The final temperature of the mixture is 31.0 °C.

15. Assuming that the specific heat of the mixture is 4.00 J/g°, and that the mass of the mixture is 100.0 grams, calculate the heat of neutralization in joules per mole of water formed.

A) -36000 J/mol B) -3600 J/mol C) -72000 J/mol D) - 12400 J/mol

16. The experiment is repeated using 50.0 mL samples of 2.00 M HC2C3O2 and 2.00 M NaOH. Compared with the amount of heat released per mole as in question 15, the amount of heat per mole in this new experiment would most likely be

A) the same, because it is the same net reaction.

B) greater, because the molar mass of NaOH is smaller than that of KOH

C)less, because acetic acid is only slightly ionized in water, while nitric acid is nearly completely ionized

D) greater, because the formation of sodium acetate is more exothermic than the formation

of potassium nitrate.

17 - 19. The molar mass of the soluble salt CaCl2 is 111 g/mol. 11.1 grams of calcium chloride are dissolved in 50.0 mL of solution.

17.What is the resulting concentration of Cl− ion?

A) 0.00200 molar B) 2.00 molar C) 4.00 molar D) 0.222 molar

18. How many mL of water must be added (assuming volumes are additive) to dilute the **calcium ion** concentration down to 0.500 molar?

A) 150. mL B) 200. mL C) 350. mL D) 500. mL

19. Sufficient AgNO3 solution is added to completely precipitate all of the chloride ion as AgCl(s). (molar mass = 143) What is the mass of the silver chloride precipitate?

A) 14.3 g B) 28.6 g C) 286 g D) 7.15 g

20) Which one of the following conditions would always result in an increase in the internal energy of a system?

A) The system loses heat and does work on the surroundings.

B) The system gains heat and does work on the surroundings.

C) The system loses heat and has work done on it by the surroundings.

D) The system gains heat and has work done on it by the surroundings

21) For which one of the following reactions is ΔH°rxn equal to the heat of formation of the product?

A) N2 (g) + 3H2 (g) → 2NH3 (g)

B) (1/2) N2 (g) + O2 (g) → NO2 (g)

C) 6C (s) + 6H (g) → C6H6 (l)

D) P (g) + 4H (g) + Br (g) → PH4Br (l)

22) The value of ΔH° for the reaction below is -72 kJ. \_\_\_\_\_\_\_\_\_\_ kJ of heat are released when 80.9 grams of HBr is formed in this reaction.

H2 (g) + Br2 (g) → 2HBr (g)

A) 144 B) 72 C) 0.44 D) 36

23) Given the following reactions:

2S (s) + 3O2 (g) → 2SO3 (g) ΔH = -790 kJ

S (s) + O2 (g) → SO2 (g) ΔH = -297 kJ

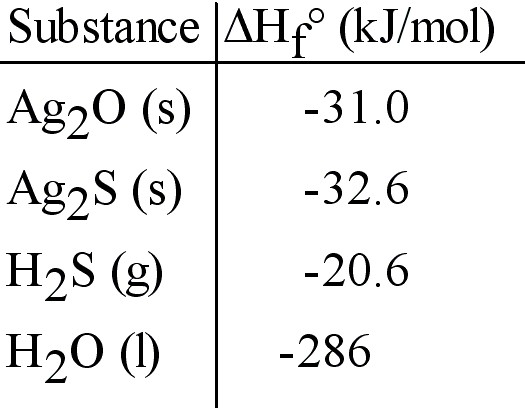
the enthalpy of the reaction in which sulfur dioxide is oxidized to sulfur trioxide

2SO2 (g) + O2 (g) → 2SO3 (g) is \_\_\_\_\_\_\_\_\_\_ kJ.

A) 196 B) -196 C) 1087 D) -1384

24) Given the data in the table below, ΔH°rxn for the reaction

2 Ag2S (s) + O2 (g) → 2 Ag2O (s) + 2S (s) is \_\_\_\_\_\_\_\_\_\_ kJ.



A) -1.6 B) +1.6 C) -3.2 D) +3.2

I. Observations about real gases can be explained at the molecular level according to the kinetic molecular theory of gases. Explain how each of the following observations can be interpreted according to these concepts. (Note: Do NOT answer the question by simply citing a gas law. Explanations MUST be on a molecular level)

A. When a gas filled balloon is cooled it shrinks in volume; this occurs no matter what gas is originally placed in the balloon.

B. Three identical balloons are inflated to equal size. One contains He, one CO2 , and

one O2 . After 12 hours, all the balloons have decreased in size. Predict which balloon

is smallest, and explain your reasoning.

C. When a balloon with a gas in it is cooled its volume never becomes zero.

D. At STP, while the volumes of 1.00 mole of O2 , Ne, and N2 are nearly identical to each other, the volume of 1.00 mole of SO2 gas is somewhat smaller.

II. A. The vapor pressure of water at 25o C is 23.8 torr. In order to collect 50.0. mL of hydrogen gas over water, at a temperature of 25o, and an external pressure of 763.8 torr, what is the minimum mass of magnesium needed to react with excess HCl ?

( Mg(s) + 2 HCl(aq) ➞ MgCl2 (aq) + H2 (g)

B. Write the net ionic equation for the reaction shown in part A.

III. 2 CO + O2 ➞ 2 CO2 (all gases)

A. At 400 K sufficient CO is added to a metal tank to produce a pressure of 2.00 atm.

If the mass of the CO is 17.0 grams, what is the volume of the tank?

B. Sufficient O2 is now added to increase the total pressure to 7.00 atm before any

reaction occurs. The reaction is then initiated, and proceeds until one of the reactants

is used up. The temperature is brought back to 400 K, and the volume of the tank

is constant. Find the partial pressures of all gases now remaining in the tank.

IV. An unknown compound contains only the three elements C, H, and O. A pure sample of the compound is analyzed and found to be 53.30 % C and 11.11 % H by mass.

A. Determine the empirical formula of the compound.

B. When 1.570 grams of the compound is vaporized at 400.o C and 1.00 atm. the gas occupies a volume of 964 milliliters. What is the molar mass of the compound?

C. What is the molecular formula for the compound?

D. What partial pressure of carbon dioxide would result from the complete combustion of

1.500 mole of this substance at 300.o C in a tank with a volume of 4.000 liters?

V. In theory, the reaction of graphite, C(s) with ozone gas, O3(g) to form carbon dioxide,

3C(s ) + 2 O3(g) → 3 CO2(g) has a ΔH° of -1465 kJ.

Given that the heat of formation of CO2(g) is -393.5 kJ/mol,

A. Find the standard heat of formation of ozone gas.

B. Would the production of 3 moles of CO2 gas using O2 instead of O3 produce more energy, less energy, or the same amount of energy? Justify your answer.