Exam

Name_____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Which metal will produce the most hydrogen per gram of metal?
   A) $Mg + 2\ HCl \rightarrow MgCl_2 + H_2$
   B) $Sn + 4\ HCl \rightarrow SnCl_4 + 2\ H_2$
   C) $2\ Cr + 6\ HCl \rightarrow 2\ CrCl_3 + 3H_2$
   D) $2\ Li + 2\ HCl \rightarrow 2\ LiCl + H_2$
   E) $2\ Fe + 6\ HCl \rightarrow 2\ FeCl_3 + 3\ H_2$

   Answer: D

2) Potassium superoxide (KO_2) can simulate a plant-type action by consuming carbon dioxide gas and releasing oxygen gas. The other product is potassium carbonate. When the equation for this process is balanced, it shows that:
   A) 3 g of oxygen is produced per 2 g CO_2 consumed
   B) 3 mol oxygen is produced per mol KO_2 consumed
   C) moles of products exceed moles of reactants
   D) 2 mol KO_2 is consumed per mol carbon dioxide
   E) moles of reactants equals moles of product

   Answer: D

3) You have 10.00 L of a 0.350 M KCl solution, but you need a solution that is 0.450 M. What volume of water, in L, would you evaporate from the solution?
   A) 2.85 L B) 4.38 L C) 2.22 L D) 3.50 L E) 7.77 L

   Answer: C

4) The chemical reaction during low current discharge of a simple "dry cell" involves:
   (unbalanced) $Zn + MnO_2 + NH_4Cl \rightarrow ZnCl_2 + Mn_2O_3 + NH_3 + H_2O$
   What is the coefficient for zinc in the balanced equation, and what is the limiting reagent for a process in which equal masses of reactants are mixed?
   A) $2/MnO_2$ B) 1/Zn C) $2NH_4Cl$ D) 2/Zn E) $1/MnO_2$

   Answer: E

5) In which of the following cases is the gas most likely to behave as an ideal gas?
   A) Ne(g), 375 °C, 0.75 atm
   B) He(g), 37.5 K, 7500 torr
   C) SF_6, -37.5 °C, 0.75 atm
   D) H_2O(g), 375 K, 750 torr
   E) CH_4(g), 37.5 °C, 7.5 atm

   Answer: A

6) A gaseous mixture consists of 50.0% O_2, 25.0% N_2, and 25.0% Cl_2, by mass. At standard temperature and pressure, the partial pressure of:

A) $Cl_2(g)$ is less than 0.25 atm
B) $O_2(g)$ is equal to 1.6 atm
C) $O_2(g)$ is equal to 380 torr
D) $Cl_2(g)$ is greater than 0.25 atm
E) $N_2(g)$ is equal to 0.20 atm

Answer: A

7) Using the heat of combustion of methanol as -726.6 kJ and the following data:

$C(graph) + 1/2O_2 \rightarrow CO(g)$ $\Delta H° = -110.5$ kJ
$C(graph) + O_2(g) \rightarrow CO_2(g)$ $\Delta H° = -393.5$ kJ
$H_2(g) + 1/2O_2(g) \rightarrow H_2O(l)$ $\Delta H° = -285.8$ kJ

Determine $\Delta H°$ for the following reaction:

$CO(g) + 2\ H_2(g) \rightarrow CH_3OH(l)$

A) 157.8 kJ B) 128 kJ C) -128 kJ D) -349 kJ E) -157.8 kJ

Answer: C

8) For the reaction $H_2(g) + 1/2\ O_2(g) \rightarrow H_2O(g)$ $\Delta H° = -241.8$ kJ/mol, what quantity of heat is liberated by the reaction of 10.0 L of O_2 measured at 22.0 °C and 742 mmHg?

A) 120 kJ B) 2610 kJ C) 195 kJ D) 97.5 kJ E) 1310 kJ

Answer: C

9) A 12.8 g sample of ethanol (C_2H_5OH) is burned in a bomb calorimeter with a heat capacity of 5.65 kJ/°C. Using the information below, determine the final temperature of the calorimeter if the initial temperature is 25.0°C. The molar mass of ethanol is 46.07 g/mol.

$$C_2H_5OH(l) + 3\ O_2(g) \rightarrow 2\ CO_2(g) + 3\ H_2O(g) \qquad \Delta H°_{rxn} = -1235 \text{ kJ}$$

A) 85.7°C B) 53.4°C C) 28.1°C D) 74.2°C E) 111°C

Answer: A

10) How many moles of oxygen are formed when 58.6 g of KNO_3 decomposes according to the following reaction? The molar mass of KNO_3 is 101.11 g/mol.

$$4\ KNO_3(s) \rightarrow 2\ K_2O(s) + 2\ N_2(g) + 5\ O_2(g)$$

A) 0.580 mol O_2 B) 0.290 mol O_2 C) 18.5 mol O_2 D) 0.724 mol O_2 E) 1.73 mol O_2

Answer: D

11) Consider the following reaction. How many moles of oxygen are required to produce 2.33 moles of water? Assume that there is excess C_3H_7SH present.

$$C_3H_7SH(l) + 6\ O_2(g) \rightarrow 3\ CO_2(g) + SO_2(g) + 4\ H_2O(g)$$

A) 3.50 moles O_2
B) 1.55 moles O_2
C) 6.21 moles O_2
D) 4.14 moles O_2
E) 2.33 moles O_2

Answer: A

12) Determine the limiting reactant (LR) and the mass (in g) of nitrogen that can be formed from 50.0 g N_2O_4 and 45.0 g N_2H_4. Some possibly useful molar masses are as follows: N_2O_4 = 92.02 g/mol, N_2H_4 = 32.05 g/mol.

$$N_2O_4(l) + 2\ N_2H_4(l) \rightarrow 3\ N_2(g) + 4\ H_2O(g)$$

A) LR = N_2H_4, 59.0 g N_2 formed
B) LR = N_2O_4, 45.7 g N_2 formed
C) LR = N_2O_4, 105 g N_2 formed
D) No LR, 45.0 g N_2 formed
E) LR = N_2H_4, 13.3 g N_2 formed

Answer: B

13) Determine the percent yield of a reaction that produces 28.65 g of Fe when 50.00 g of Fe_2O_3 react with excess Al according to the following reaction.

$$Fe_2O_3(s) + 2\ Al(s) \rightarrow Al_2O_3(s) + 2\ Fe(s)$$

A) 61.03 % B) 20.02 % C) 28.65 % D) 81.93 % E) 57.30 %

Answer: D

14) Determine the number of grams H_2 formed when 250.0 mL of 0.743 M HCl solution reacts with 3.41×10^{23} atoms of Fe according to the following reaction.

$$2\ HCl(aq) + Fe(s) \rightarrow H_2(g) + FeCl_2(aq)$$

A) 1.14 g B) 0.187 g C) 1.51 g D) 0.374 g E) 1.33 g

Answer: B

15) What mass (in g) of AgCl is formed from the reaction of 75.0 mL of a 0.078 M $AgC_2H_3O_2$ solution with 55.0 mL of 0.109 M $MgCl_2$ solution?

$$2\ AgC_2H_3O_2(aq) + MgCl_2(aq) \rightarrow 2\ AgCl(s) + Mg(C_2H_3O_2)_2(aq)$$

A) 1.70 g B) 0.838 g C) 0.859 g D) 2.56 g E) 1.72 g

Answer: B

16) The titration of 80.0 mL of an unknown concentration H_3PO_4 solution requires 126 mL of 0.218 M KOH solution. What is the concentration of the H_3PO_4 solution (in M)?

A) 0.343 M B) 1.03 M C) 0.114 M D) 0.138 M E) 0.0461 M

Answer: C

17) A large balloon is initially filled to a volume of 25.0 L at 353 K and a pressure of 2575 mm Hg. What volume of gas will the balloon contain at 1.35 atm and 253 K?

A) 58.6 L B) 87.5 L C) 11.4 L D) 45.0 L E) 22.2 L

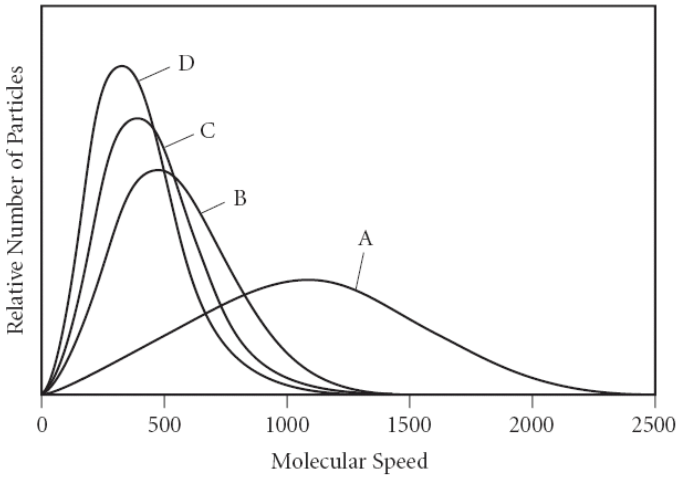
Answer: D

18) What mass of NO_2 is contained in a 13.0 L tank at 4.58 atm and 385 K?

A) 69.2 g B) 18.8 g C) 86.7 g D) 24.4 g E) 53.1 g

Answer: C

19) Using the graph below, determine the gas that has the highest density at STP.



A) C
B) B
C) A
D) D
E) All of the gases have the same density at STP.

Answer: D

20) Determine the density of NH_3 gas at 435 K and 1.00 atm.

A) 2.24 g/L B) 2.10 g/L C) 0.477 g/L D) 0.321 g/L E) 0.851 g/L

Answer: C

21) A compound is found to be 30.45% N and 69.55 % O by mass. If 1.63 g of this compound occupy 389 mL at 0.00°C and 775 mm Hg, what is the molecular formula of the compound?

A) N_2O_5 B) N_2O C) NO_2 D) N_4O_2 E) N_2O_4

Answer: E

22) The following reaction is used to generate hydrogen gas in the laboratory. If 243 mL of gas is collected at 25°C and has a total pressure of 745 mm Hg, what mass of hydrogen is produced? A possibly useful table of water vapor pressures is provided below.

$$Mg(s) + 2\ HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

T (°C)	P (mm Hg)
20	17.55
25	23.78
30	31.86

A) 0.0449 g H_2 B) 0.0196 g H_2 C) 0.0144 g H_2 D) 0.0717 g H_2 E) 0.0190 g H_2

Answer: E

23) What pressure would a gas mixture in a 10.0 L tank exert if it were composed of 48.5 g He and 94.6 g CO_2 at 398 K?

A) 58.7 atm B) 39.6 atm C) 32.6 atm D) 7.02 atm E) 46.6 atm

Answer: E

24) Determine the volume of SO_2 (at STP) formed from the reaction of 96.7 g of FeS_2 and 55.0 L of O_2 (at 398 K and 1.20 atm). The molar mass of FeS_2 is 119.99 g/mol.

$$4\ FeS_2(s) + 11\ O_2(g) \rightarrow 2\ Fe_2O_3(s) + 8\ SO_2(g)$$

A) 18.1 L B) 36.1 L C) 27.6 L D) 32.9 L E) 45.3 L

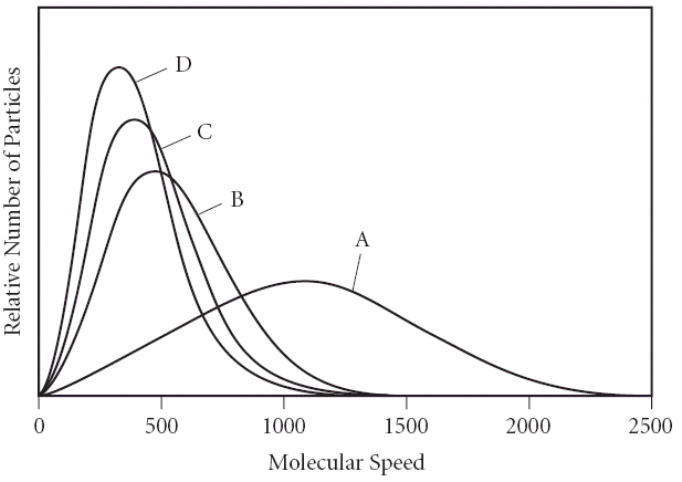
Answer: D

25) A mixture of 1.0 mol He and 1.0 mol Ne are at STP in a rigid container. Which of the following statements is TRUE?

A) The mixture has a volume of 22.4 L
B) Both gases contribute equally to the density of the mixture under these conditions.
C) Both gases have the same molecular speed.
D) Both gases have the same average kinetic energy.
E) All of the above are TRUE.

Answer: D

26) Which of the gases in the graph below has the largest molar mass?



A) A
B) B
C) C
D) D
E) There is not enough information to determine.

Answer: D

27) Which of the following compounds will behave LEAST like an ideal gas at low temperatures?
A) N_2 B) He C) SO_2 D) H_2 E) F_2

Answer: C

28) This equation is used to calculate the properties of a gas under nonideal conditions.
A) Dalton's Law
B) Avogadro's Law
C) Charles's Law
D) van der Waals equation
E) Boyle's Law

Answer: D

29) The law of _____ states that energy that can be neither created or destroyed.
A) the consecration of energy
B) thermochemistry
C) potential energy
D) the conservation of energy
E) kinetic energy

Answer: D

30) A 21.8 g sample of ethanol (C_2H_5OH) is burned in a bomb calorimeter, according to the following reaction. If the temperature rises from 25.0 to 62.3°C, determine the heat capacity of the calorimeter. The molar mass of ethanol is 46.07 g/mol.

$$C_2H_5OH(l) + 3\ O_2(g) \rightarrow 2\ CO_2(g) + 3\ H_2O(g) \qquad \Delta H°_{rxn} = -1235\ kJ$$

A) 4.99 kJ/°C B) 5.65 kJ/°C C) 15.7 kJ/°C D) 63.7 kJ/°C E) 33.1 kJ/°C

Answer: C

31) A 35.6 g sample of ethanol (C_2H_5OH) is burned in a bomb calorimeter, according to the following reaction. If the temperature rose from 35.0 to 76.0°C and the heat capacity of the calorimeter is 23.3 kJ/°C, what is the value of $\Delta H°_{rxn}$? The molar mass of ethanol is 46.07 g/mol.

$$C_2H_5OH(l) + 3\ O_2(g) \rightarrow 2\ CO_2(g) + 3\ H_2O(g) \qquad \Delta H°_{rxn} = ?$$

A) -8.09×10^3 kJ/mol
B) -1.24×10^3 kJ/mol
C) $+9.55 \times 10^3$ kJ/mol
D) -9.55×10^3 kJ/mol
E) $+1.24 \times 10^3$ kJ/mol

Answer: B

32) Given w = 0, an endothermic reaction has the following.

A) $+\Delta H$ and $-\Delta E$ B) $-\Delta H$ and $-\Delta E$ C) $+\Delta H$ and $+\Delta E$ D) $-\Delta H$ and $+\Delta E$

Answer: C

33) How much energy is <u>evolved</u> during the formation of 98.7 g of Fe, according to the reaction below?

$$Fe_2O_3(s) + 2\ Al(s) \rightarrow Al_2O_3(s) + 2\ Fe(s) \qquad \Delta H°_{rxn} = -852\ kJ$$

A) 753 kJ B) 4.20×10^3 kJ C) 482 kJ D) 241 kJ E) 1.51×10^3 kJ

Answer: A

34) Using the following equation for the combustion of octane, calculate the amount of moles of oxygen that reacts with 100.0 g of octane. The molar mass of octane is 114.33 g/mole. The molar mass of carbon dioxide is 44.0095 g/mole.

$$2\ C_8H_{18} + 25\ O_2 \rightarrow 16\ CO_2 + 18\ H_2O \qquad \Delta H°_{rxn} = -11018\ kJ$$

A) 14.00 moles B) 6.997 moles C) 8.000 moles D) 18.18 moles E) 10.93 moles

Answer: E

35) Which of the following statements is TRUE?

A) ΔH_{rxn} can be determined using constant pressure calorimetry.

B) ΔE_{rxn} can be determined using constant volume calorimetry.

C) Energy is neither created nor destroyed, excluding nuclear reactions.

D) State functions do not depend on the path taken to arrive at a particular state.

E) All of the above are true.

Answer: E

36) Two solutions, initially at 24.60°C, are mixed in a coffee cup calorimeter (C_{cal} = 15.5 J/°C). When a 100.0 mL volume of 0.100 M $AgNO_3$ solution is mixed with a 100.0 mL sample of 0.200 M NaCl solution, the temperature in the calorimeter rises to 25.30°C. Determine the $\Delta H°_{rxn}$ for the reaction as written below. Assume that the density and heat capacity of the solutions is the same as that of water.

$$NaCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq) \qquad \Delta H°_{rxn} = ?$$

A) -35 kJ B) -250 kJ C) -69 kJ D) -140 kJ E) -16 kJ

Answer: C

37) Use the standard reaction enthalpies given below to determine $\Delta H°_{rxn}$ for the following reaction:

$$2\ NO(g) + O_2(g) \rightarrow 2\ NO_2(g) \qquad \Delta H°_{rxn} = ?$$

Given:

$$N_2(g) + O_2(g) \rightarrow 2\ NO(g) \qquad \Delta H°_{rxn} = +183\ kJ$$

$$1/2\ N_2(g) + O_2(g) \rightarrow NO_2(g) \qquad \Delta H°_{rxn} = +33\ kJ$$

A) -333 kJ B) -117 kJ C) +238 kJ D) +115 kJ E) -150. kJ

Answer: B

38) Use the information provided to determine $\Delta H°_{rxn}$ for the following reaction:

$$CH_4(g) + 3\ Cl_2(g) \rightarrow CHCl_3(l) + 3\ HCl(g) \qquad \Delta H°_{rxn} = ?$$

	$\Delta H°_f$ (kJ/mol)
$CH_4(g)$	-75
$CHCl_3(l)$	-134
$HCl(g)$	-92

A) +117 kJ B) -151 kJ C) +662 kJ D) -217 kJ E) -335 kJ

Answer: E

39) Which of the following is the major contributor to energy consumption?

A) industrial

B) transportation

C) commercial

D) residential

E) atmospheric

Answer: A

40) A 100.0 mL sample of 0.300 M NaOH is mixed with a 100.0 mL sample of 0.300 M HNO_3 in a coffee cup calorimeter. If both solutions were initially at 35.00°C and the temperature of the resulting solution was recorded as 37.00°C, determine the $\Delta H°_{rxn}$ (in units of kJ/mol NaOH) for the neutralization reaction between aqueous NaOH and HCl. Assume 1) that no heat is lost to the calorimeter or the surroundings, and 2) that the density and the heat capacity of the resulting solution are the same as water.

A) -169 kJ/mol NaOH
B) - 34.4 kJ/mol NaOH
C) -27.9 kJ/mol NaOH
D) -55.7 kJ/mol NaOH
E) -16.7 kJ/mol NaOH

Answer: D