CHM151 Name: _____KEY_____

Sample Exam 3 – Chapters 8, 9, 10

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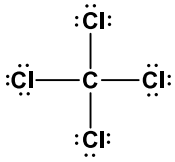
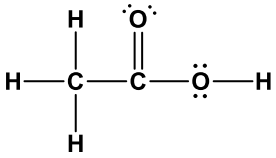
1. Which of the following substances crystallizes as a molecular solid?
   a. NaCl
   b. CO_2
   c. Au
   d. K_2CO_3
   e. CaO

2. Circle **ALL** of the IMF's present for each of the following substances:



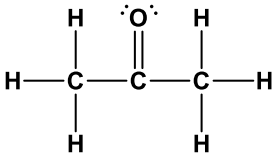
A.

LDF DDF HBF



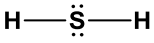
B.

LDF DDF HBF



C.

LDF DDF HBF



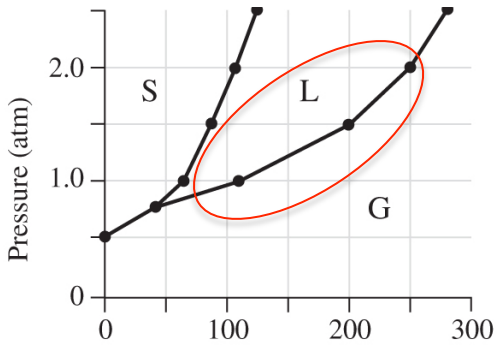
D.

LDF DDF HBF

3. Which of the following properties indicates the presence of *weak* intermolecular forces in a liquid?
   a. a high boiling point
   b. a high vapor pressure
   c. a high viscosity
   d. a high surface tension

4. Which of the following should have the highest boiling point at a given temperature?
   a. methane, CH_4
   b. carbon tetrafluoride, CF_4
   c. carbon tetrachloride, CCl_4
   d. carbon tetrabromide, CBr_4
   e. carbon tetraiodide, CI_4

5. Refer to the phase diagram provided to answer the following questions:
   a. What is the normal boiling point for this substance? 105ºC
   b. What is the physical state for this substance at 1.5 atm and 150°C? liquid
   c. Circle the vaporization curve on the phase diagram below.



6. Calculate the heat of reaction, ΔH°, for the reaction:

$3\ NO_{2\ (g)} + H_2O_{\ (l)} \rightarrow 2\ HNO_{3\ (aq)} + NO_{\ (g)}$

Substance:	$NO_{2(g)}$	$H_2O_{\ (l)}$	$HNO_{3\ (aq)}$	$NO_{\ (g)}$
$\Delta H°_f$(kJ/mol)	33.2	-285.5	-119.0	91.3

$\Delta H°_{rxn}$ = 39.2 kJ

7. Determine the amount of heat released when 26.9 mL methanol, CH_3OH (density = 0.792 g/mL), reacts according to the following combustion equation:

$2\ CH_3OH_{\ (l)} + 3\ O_{2\ (g)} \rightarrow 2\ CO_{2\ (g)} + 4\ H_2O_{\ (l)}$ $\Delta H°_{rxn}$ = -1452.8 kJ/mol

$\Delta H°_{rxn}$ = -483 kJ

8. Use the given average bond dissociation energies to estimate ΔH for the reaction of methane, CH_4 (g), with fluorine:

____ CH_4 (g) + __2__ F_2 (g) → ____ CF_4 (g) + __2__ H_2 (g)

$\Delta H°_{rxn}$ = -716 kJ

Bond	E_{BDE}, kJ/mol
H-H	436
C-F	450
C-H	410
F-F	158

9. List the following ionic compounds in order of ***increasing*** lattice energy:

Li_3P, Sr_3P_2, Mg_3P_2, AlP,

Lowest LE _Li_3P__ > __Sr_3P_2_ > __Mg_3P_2__ > __AlP__ > Highest LE

10. Which of the following equations represents a heat of formation equation?
    a. $C\ (s) + O_2\ (g) \rightarrow CO_2\ (g)$
    b. $2\ Au\ (s) + 3\ Cl_2\ (g) \rightarrow 2\ AuCl_3\ (s)$
    c. $Cl\ (g) + Na\ (s) \rightarrow NaCl\ (s)$
    d. $CaO\ (s) + CO_2\ (g) \rightarrow CaCO_3\ (s)$

11. What type of bond typically has the highest bond enthalpy value?
    a. single
    b. double
    c. triple
    d. all three have the same value for bond enthalpy

12. Which of the following has a standard enthalpy of a formation value ($\Delta H_f°$) of zero?

H_2O (l) O_3 (g) Br_2 (l) O (g) CO_2 (s)

13. Which ionic compound is the most stable?
    a. CaO b. K_2O c. SrO d. Rb_2O

14. When bonds are broken in a chemical reaction, this process is considered _____.
    a. exothermic b. endothermic

15. Find ΔH for **$BaCO_{3\,(s)} \rightarrow BaO_{(s)} + CO_{2\,(g)}$**
    given $2\ Ba_{(s)} + O_{2\,(g)} \rightarrow 2\ BaO_{(s)}$ ΔH = -1107.0 kJ
    $Ba_{(s)} + CO_{2\,(g)} + \frac{1}{2}\ O_{2\,(g)} \rightarrow BaCO_{3\,(g)}$ ΔH = -822.5 kJ
    ΔH = 269.0 kJ

16. Which one of the following is **not** used to describe the condition of a gas?
    a. number of moles b. polarity c. temperature d. volume

17. Boyle's Law states that pressure is
    a. directly related to volume
    b. inversely related to volume
    c. directly related to temperature
    d. inversely related to temperature

18. A basketball is inflated to a pressure of 1.50 atm in a 20.0°C garage. What is the pressure of the basketball outside where the temperature is -5.0°C? (Assume V and n are constant)
    a. 1.37 atm b. 1.42 atm c. 1.58 atm d. 1.64 atm

19. Which of the following would have a density of 1.21 g/L at 280.15°C and 0.993 atm?
    a. Ar b. N_2 c. Ne d. O_2

20. What is the total pressure in a 3.00 L container containing 0.310 moles of N_2 and 0.250 mole of O_2 at 303 K?
    a. 4.64 atm b. 4.55×10^{-4} atm c. 0.215 atm d. 1.00 atm

21. Which of the following gases has the **highest** average speed at 400K?
    a. CO_2 b. N_2O_4 c. F_2 d. SF_6

22. A process by which gas molecules escape through a tiny hole in a membrane into a vacuum without collisions is called
    a. Boyle's law. b. diffusion. c. sublimation. d. effusion.

23. Of the following statements, which describes properties of an ideal gas?
    a. Gases are highly compressible.
    b. There are relatively large distances between gas molecules in a container.
    c. Gases form homogeneous mixtures and do not react with other gas molecules.
    d. All of the above.

24. The specific capacity heat of copper is 0.385 J/(g°C). If 34.2 g of copper, initially at 25°C, absorbs 4.689 kJ, what will be the final temperature of the copper?
    a. 356 °C b. 381 °C c. 25.4 °C d. 27.8 °C

25. What mass of chlorine gas occupies a 4.50L container at 55.6ºC and 887 torr?
    PV=nRT solve for n = 0.19468 moles Cl_2 Now use molar mass to get grams = 13.8 gCl_2

26. What volume of hydrogen gas is produced when 6.75 g of aluminum is placed in excess 4.0 M HCl at 33.8 ºC and 956.4 torr according to the equation $2Al(s) + 6HCl(aq) \rightarrow 3H_2(g) + 2AlCl_3(aq)$?

$$6.75\text{ g Al}\left(\frac{1\text{ mol Al}}{26.98\text{ g Al}}\right)\left(\frac{3\text{ mol H}_2}{2\text{ mol Al}}\right) = 0.375\text{ mol H}_2$$

$$PV=nRT \quad V = \frac{nRT}{P} = \frac{(0.375\text{ mol H}_2)(0.08206\text{ L atm mol}^{-1}\text{ K}^{-1})(306.95\text{K})}{(1.2584\text{ atm})} = 7.51\text{ L}$$

27. How much heat is absorbed when 30.00 g of C (s) reacts in the presence of excess SO_2 (g) to produce CS_2 (l) and CO (g) according to the following chemical equation?

$$5\text{ C (s)} + 2\text{ SO}_2\text{ (g)} \rightarrow \text{CS}_2\text{ (l)} + 4\text{ CO (g)} \quad \Delta H° = +239.9\text{ kJ}$$

$$30.00\text{ g C}\left(\frac{1\text{ mol C}}{12.011\text{ g C}}\right)\left(\frac{239.9\text{ kJ}}{5\text{ mol C}}\right) = 119.9\text{ kJ}$$

28. Which of the following would exhibit dipole-dipole forces as the strongest force between molecules?
    a. HCN b. CCl_4 c. CH_3OH d. C_6H_6

29. Which of the following will have the lowest boiling point?
    a. $CH_3CH_2CH_2NH_2$ b. $CH_3CH_2CH_2SH$ c. $CH_3CH_2CH_2OH$

30. Solid carbon dioxide, CO_2 (s), is what type of crystalline solid?
    a. molecular b. ionic c. metallic

31. What type of intermolecular force, IMF, would be present between molecules in a sample of Br_2 (l)?
    a. LDF b. DDF c. HBF d. Ion-Dipole Forces

32. What is the strongest IMF present between like molecules in a sample of H_2S (l)?
    a. LDF b. DDF c. HBF d. Ion-Dipole Forces

33. What type of bond is present between atoms in a sample of CO_2?
    a. nonpolar covalent b. polar covalent c. LDF d. James

34. Hexane, C_6H_{12}, is an organic molecule found in gasoline. Circle the property of liquids that would have a relatively high value for hexane.
    a. vapor pressure b. surface tension c. boiling point d. viscosity

35. Which molecule will have the highest boiling point?
    a. I_2 b. Br_2 c. Cl_2 d. F_2

36. Select the correct molecule with the lowest surface tension.
    a. $CH_3CH_2CH_2Cl$ b. $CH_3CH_2CH_2NH_2$ c. $CH_3CH_2CH_2CH_3$

37. Select the molecule that has HBF as it's strongest IMF between like molecules.
    a. $CH_3CH_2CH_2SH$ b. $CH_3CH_2CH_2OH$ c. $CH_3CH_2OCH_2CH_3$

38. What is the strongest force present between like particles in a sample of liquid mercury, Hg (l)?
    a. London Dispersion Forces
    b. Ionic Bonds
    c. Covalent Bonds
    d. Metallic Bonds