MULTIPLE CHOICE (3pts each): Write the ONE letter corresponding to the correct answer on the line next to each question. The LETTER ASSOCIATED WITH THE CORRECT ANSWER MUST BE WRITTEN ON THE LINE NEXT TO THE QUESTION in order to receive full credit.

1.) Two aqueous solutions were mixed in a beaker and the beaker became very cold. Which response best describes the reaction that occurred? 1.) A

a.) endothermic b.) endomeric c.) exothermic d.) exomeric

2.) Which of the following would have the lowest boiling point? 2.) D

a.) NaCl b.) CH_3OH c.) Fe d.) CH_2O

ionic crystal H-bond metallic crystal dipole-dipole

3.) If the enthalpy of the reaction A + 2B --> AB_2 is 59.7 kJ/mol, what is the enthalpy change when 0.3 moles of AB_2 decomposes? 3.) B

opposite so negative

a.) +17.9 kJ b.) -17.9 kJ c.) +59.7 kJ/mol d.) -59.7 kJ/mol

$0.3\,mol\left(-59.7\ kJ/mol\right) =$

4.) The attraction for unlike materials is called 4.) A

a.) adhesion b.) cohesion c.) capillary action d.) viscosity

5.) A crystal has a very high melting point, is not a conductor of heat and electricity, and has ions at its lattice points. This crystal is 5.) C

a.) covalent b.) metallic c.) ionic d.) molecular

6.) A 22.5g solid (MM 56.287g/mol) is dissolved in water and then reacted with another compound. The enthalpy of solvation for the solid is +25.8 kJ/mol and the reaction enthalpy is -17.2kJ/mol, with one mole of the solid in the balanced equation What is the overall enthalpy for the combined process? 6.) C

a.)+8.6 kJ b.) -193.5 kJ c.) +3.4 kJ d.) - 43.0 kJ

$22.5g\left(\frac{1mol}{56.287g}\right) = 0.3997mol$ $\times -17.2 = -6.8755\ kJ$ $\times +25.8 = +10.312216\ kJ$ $\rightarrow = +3.4368\ kJ$

7.) What is the v_{rms} for argon at 250.K? 7.) B

$\sqrt{\frac{3RT}{MM}}$ in kg

a.) 1.24 m/s b.) 395 m/s c.) 12.5 m/s d.) 39.3 m/s

8.) If a balloon is inflated in a room and then moved to a chanber where the pressure is twice as high, what will happen to the volume of the balloon? 8.) D

a.) the volume will be twice as big c.) the volume will be doubled

b.) the volume will be unchanged d.) the volume will be half as big

9.) Which of the following gases would be the least ideal? 9.) A

a.) H_2O b.) Ar c.) CH_4 d.) Cl_2

10.) If the total pressure is 2.50atm, what would be the partial pressure of propane in a container filled with 5.36 mol methane, 1.87 mol ethane, and 2.04 mol propane? 10.) B

a.) 0.705 atm b.) 0.550 atm c.) 5.10 atm d.) 1.45 atm

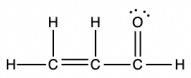
$X = \frac{2.04}{(5.36+1.87+2.04)} = 0.22006\left(2.50\ atm\right)$

$= 0.5502\ atm$

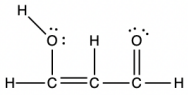
SHORT ANSWER (10 pts each): Completely answer all of the following questions. Read all questions carefully!!! ALL WORK MUST BE SHOWN TO RECEIVE FULL CREDIT. If your work is in a different location, you must make a note of this in the given work area for the problem in order for the work to be considered for partial credit. Make sure to include units and report all mathematical answers to the correct number of significant figures. Write final answers in designated locations when indicated.

1.) List the strongest intermolecular attractive force that can be used by each of the following molecules, then answer the questions provided:

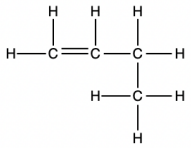
Molecule A



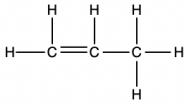
Molecule B



Molecule C



Molecule D



Strongest IMAF Molecule A: dipole-dipole

Strongest IMAF Molecule B: H-bond

Strongest IMAF Molecule C: dispersion

Strongest IMAF Molecule D: dispersion

a.) Which molecule has the highest boiling point? molecule B

b.) Which molecule has the highest viscosity? molecule B

c.) Which molecule has the highest vapor pressure? molecule D

2.) a.) What is the energy change, in kJ, associated with changing 84.62g steam at 150.0°C into water at 20.0°C? Include the sign with your answer. MM H_2O = 18.01528 g/mol; ΔH_{vap} = 40.79 kJ/mol

Answer: −228 kJ

$q = (84.62\,g)(1.99\ J/g^{\circ}C)(100.0^{\circ}C - 150.0^{\circ}C) = -8419.69\,J$ (−50.0°C)

$84.62\,g\left(\frac{1\,mol}{18.01528\,g}\right) = 4.69712\,mol \rightarrow \left(\frac{-40.79\,kJ}{mol}\right) = -191.5957\,kJ = -8.41969\,kJ$

neg cause condensation

$q = (84.62\,g)(4.184\ J/g^{\circ}C)(20.0^{\circ}C - 100.0^{\circ}C) = -28324.0\,J = -28.324\,kJ$ (−80.0°C)

$-28.324\,kJ - 228.34\,kJ$

b.) Is this reaction exothermic or endothermic? Answer: exothermic

c.) Briefly explain your answer to part b:

enthalpy value is negative

3.) What volume, in L, of N_2O would be produced if 55.8g of solid $C_3H_6N_6O_6$ (222.117g/mol) decomposed at 150.0°C and 5.55atm according to the following reaction?

$C_3H_6N_6O_6$ (s) → 3 CH_2O (g) + 3 N_2O (g)

+273.15
423.15K

Answer: 4.72L

$$55.8g\left(\frac{1mol}{222.117g}\right) = 0.25122\ mol\ \text{solid } C_3H_6N_6O_6 \left(\frac{3mol\ N_2O}{1mol\ C_3H_6N_6O_6}\right)$$

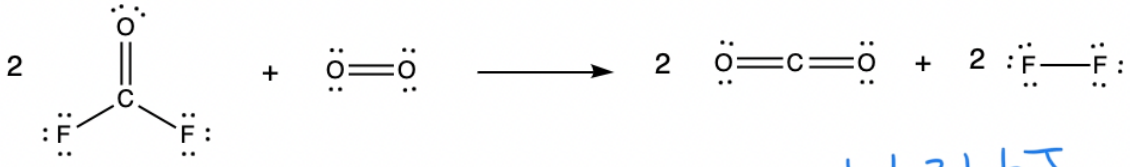
$$= 0.753657\ mol\ N_2O\ gas$$

$PV = nRT$

$$\frac{(5.55\cancel{atm})(V)}{5.55\cancel{atm}} = \frac{(0.753657mol)\left(0.08206\frac{L\,atm}{mol\,K}\right)(423.15K)}{5.55\,atm}$$

$V = 4.71527\ L$

4.) a.) Use the bond enthalpies provided on the cover sheet to calculate the enthalpy of the following reaction per mol of CF_2O. Make sure to include the sign with your answer.



Answer: +631 kJ

+4 (C–F) = 4 mol (536 kJ/mol) = +2144 kJ
+2 (C=O) = 2 mol (749 kJ/mol) = +1498 kJ
+1 (O=O) = 1 mol (499 kJ/mol) = +499 kJ
−4 (C=O) = −4 mol (799 kJ/mol) = −3196 kJ
−2 (F–F) = −2 mol (157 kJ/mol) = −314 kJ
+631 kJ

b.) Is this reaction exothermic or endothermic? Answer: endothermic

c.) Briefly explain your answer to part b.

enthalpy is positive

5.) A gas was burned in a piston inside a calorimeter containing 25.00g of water at 22.4°C. As the reaction occurred, the temperature of the water increased to 58.6°C.

a.) What was the heat of the reaction? Make sure to include the sign in your answer.

$q = m s \Delta T$

$= (25.00\,g)(4.184\,J/g^{\circ}C)(58.6^{\circ}C - 22.4^{\circ}C)$

$= 3786.52\,J$ for water $-3786.52\,J$ for gas

Answer: $-3790\,J$ / $-3.79\,kJ$

b.) If the reaction occurred at 1.00atm and caused the volume of the piston to increase from 0.50L to 2.00L, how much work was done by the reaction? Report your answer in appropriate units for work.

$w = -P\Delta V$

$= -(1.00\,atm)(2.00L - 0.50L)$

$= -1.50\,L\cdot atm \left(\frac{101.32\,J}{L\cdot atm}\right) = -151.98\,J$

Answer: $-152\,J$

c.) What was the internal energy of the system?

$\Delta u = q + w$

$= -3786.52\,J + (-151.98\,J) = -3938.5\,J$

Answer: $-3940\,J$ / $-3.94\,kJ$

6.) Calculate the energy of the following reaction based on the formation enthalpies provided. Make sure to include the sign with your answer. $CH_3COOH(l)$: -484.2kJ/mol; $CO_2(g)$: -393.5 kJ/mol; $H_2O(g)$: -241.8 kJ/mol

$$CH_3COOH\,(l) + 3\,O_2\,(g) \rightarrow 2\,CO_2\,(g) + 2\,H_2O\,(g)$$

Answer: $-786.4\,kJ$

Σ products $-$ Σ reactants

$= [2(CO_2) + 2(H_2O)] - [1(CH_3COOH) + 3(O_2)]$

$= [2\,mol(-393.5\,kJ/mol) + 2\,mol(-241.8\,kJ/mol)]$

$- [1\,mol(-484.2\,kJ/mol) + 3(0)]$

$= [-787.0\,kJ - 483.6\,kJ] - [-484.2\,kJ]$

$= -1270.6\,kJ + 484.2\,kJ$

$= -786.4\,kJ$

7.) A balloon was inflated to 2.50L in a 20.6°C room at 1.04atm. The balloon was then taken outside where the temperature was 15.9°C and the pressure was 658mmHg. What was the volume of the balloon when it was outside?

$20.6°C + 273.15 = 293.75\ K$ $15.9°C + 273.15 = 289.05\ K$

Answer: 2.95L

$$\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2}$$

$$658\ mm\ H_2\left(\frac{1\ atm}{760\ mm\ Hg}\right) = 0.865789\ atm$$

$$\frac{(1.04\ atm)(2.50L)}{293.75K} = \frac{(0.865789\ atm)(V)}{289.05K}$$

$$\frac{0.00885106\ L\ atm/K}{0.0029953\ atm/K} = \frac{0.0029953\ \frac{atm}{K}\ (V)}{0.0029953\ atm/K}$$

$$2.95498\ L = V$$

$$V = 2.95L$$