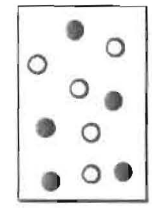
3 each

1. (24) a. In the diagram below to the to the right, helium atoms are represented by unshaded spheres, neon atoms by gray spheres, and argon atoms by black spheres. If the total pressure in the container is 900 mm Hg, what is the partial pressure of helium?



A) 90 mm Hg (B) 180 mm Hg C) 270 mm Hg D) 450 mm Hg

b. Which of the following is not a state function?

A) enthalpy (B) heat C) internal energy D) volume

c. Which one of the following gases will have the **highest** rate of effusion?

A) NO_2 (B) N_2O C) N_2O_4 D) NO_3

SF_6 = 146g/mol Ar= 40g/mol

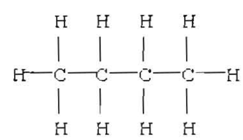
d. At what temperature will sulfur hexafluoride molecules have the same average speed as argon atoms at 20°C?

293K A) -22.0°C B) 73.2°C C) 381°C (D) 799°C

e. Which substance in each of the following pairs is expected to have the larger dispersion forces?

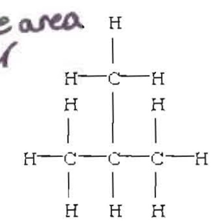
I Br_2 or I_2 ← molar mass bigger

A) Br_2 in set I and n-butane in set II
B) Br_2 in set I and isobutane in set II
(C) I_2 in set I and n-butane in set II
D) I_2 in set I and isobutane in set II

II 

n-butane

or ↓surface area bigger



isobutane

f. The magnitude of the heats of vaporization, fusion and sublimation of a substance reflect the

A) density of the substance.
B) magnitudes of the boiling and melting points of the substance.
C) strength of the covalent bonds between atoms in each molecule of the substance.
(D) strength of the intermolecular forces of the substance.

g. When a substance melts at its normal melting point, the sign of ΔH is __+__ and the sign of ΔS of this phase change is __+__.

A) +, - B) -, + (C) +, + D) -, -

h. Which of the following has the greatest (most negative) lattice energy?

A) CH_4 (B) $CaCO_3$ C) NaCl D) KBr

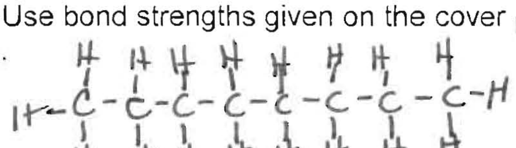
2. (6) Bromine is one of only two elements that is a liquid at room temperature. Bromine has a heat of vaporization of 30.91 kJ/mol and its boiling point is 59°C. What is the entropy of vaporization for bromine?

(3) $\Delta G = 0 = \Delta H - T\Delta S$

$0 = 30.91 - (273+59)K \cdot \Delta S$

(3) $\Delta S = 9.3 \times 10^{-2}$ kJ/molK

3. (10) Use bond strengths given on the cover page to determine the heat of combustion for octane (C_8H_{18}).

(5) 2  + 25 O=O → 16 O=C=O + 18 H-O-H

ΔH = bonds broken - bonds formed

(5) = [14 C-C + 36 C-H + 25 O=O] - [32 O=C + 36 H-O]

= [14 · 350 + 36 · 415 + 25 · 498] - [32 · 745 + 36 · 464] = -8254 kJ / 2 mol

4. (9) The heat of combustion per mole for acetylene, $C_2H_2(g)$, is -1299.5 kJ/mol. Given that the enthalpy of formation is -393.5 kJ/mol for $CO_2(g)$ and -285.8 kJ/mol for $H_2O(l)$, find the enthalpy of formation of $C_2H_2(g)$.

$2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$

$\Delta H^\circ = \sum \Delta H_f^\circ \text{ prod} - \sum \Delta H_f^\circ \text{ react} = -1299.5 \frac{kJ}{mol} \cdot 2 mol$

$-2599 = \left(4 mol \cdot -393.5 \frac{kJ}{mol} + 2 mol \cdot -285.8 \frac{kJ}{mol}\right) - X$

$X = 453.4 \text{ kJ} \therefore \Delta H_f^\circ C_2H_2 = \frac{4534 kJ}{2 mol} = 226.7 \frac{kJ}{mol}$

5. (9) Calculate the total quantity of heat required to convert 25.0 g of liquid $CCl_4(l)$ from 35.0°C to gaseous CCl_4 76.8°C (the normal boiling point for CCl_4)? The specific heat of $CCl_4(l)$ is 0.857 J/(g °C) its heat of fusion is 3.27 kJ/mol and its heat of vaporization is 29.82 k/mol.

(3) heat liquid 35° → 76.8° $s \cdot m \cdot \Delta T = 0.857 \frac{J}{g°C} \cdot 25 g \cdot 41.8°C = 888.25 J$

(3) vaporize liquid $\Delta H_{vap} \cdot \# mol = 29.82 \frac{kJ}{mol} \cdot \left(25 g \cdot \frac{1 mol}{154 g}\right) = 4841 J$

(3) 5729 J

6. (10) 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 -5.00°C?

$\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2}$ $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$1.50 atm = P_2$

7. (11). Rocket fuel, CH_6N_2, has a heat of combustion of -1.30 x 10^3 kJ/mol. When 4.00 g of rocket fuel are combusted in a calorimeter that has a heat capacity of 3.610 kJ/°C when empty, the observed temperature increase is 14.50 °C. Determine the mass of water that was in the calorimeter when the sample was combusted.

$4g \times \frac{1\,mol}{46g} \times \frac{1.30 \times 10^3\,kJ}{mol} = 113\,kJ$ released

heat calorim heat H_2O

-3 kJ

$113\,kJ = 3.610\,\frac{kJ}{°C} \cdot 14.50°C + 4.184\,\frac{J}{g°C} \cdot m_{H_2O} \cdot 14.50°C$

$60.655\,kJ = .06067 \cdot m_{H_2O}$

$m_{H_2O} = 999.79\,g$

8. (11) a. Given the heat of formation of NO is 180.7 kJ/mol, use the following enthalpies of reaction to determine ΔH_{rx} for the formation of NO from dinitrogen oxide and nitrogen dioxide

$2NO + O_2 \rightarrow 2NO_2$ $\Delta H = -113.1$ kJ

$2N_2O \rightarrow 2N_2 + O_2$ $\Delta H = 163.2$ kJ

$N_2 + O_2 \rightarrow 2NO$ $\Delta H = 180.7\,\frac{kJ}{mol} \cdot 2\,mol$

$\frac{1}{2}(2N_2O \rightarrow 2N_2 + O_2)$ $\Delta H = 163.2\,kJ \cdot \frac{1}{2}$

$\frac{1}{2}(2NO_2 \rightarrow 2NO + O_2)$ $\Delta H = 113.1\,kJ \cdot \frac{1}{2}$

$N_2O + NO_2 \rightarrow 3NO$ ΔH 499.55 kJ

Bonus (2 pt): Stae the 1st law of Thermodynamics.