

1.) Palladium crystallizes in the face-centered cubic lattice with a density of 12.0 g/cm^3 . From this information, estimate the edge length of the cubic lattice in pm.

2.) Starting with a 70.8 g sample of benzene (C_6H_6 , 78.11 g/mol) at 48.6°C and 1.00 atm of pressure, how much energy should be removed in order to lower its temperature to -68.5°C , at constant pressure?

$$\Delta H_{\text{vap}}^\circ = 33.9 \text{ kJ/mol} \quad C_{\text{P,liq}} = 1.73 \text{ J/g}^\circ\text{C} \quad C_{\text{P,s}} = 1.51 \text{ J/g}^\circ\text{C} \quad \text{Normal } T_{\text{melting}} = 5.5^\circ\text{C}$$

$$\Delta H_{\text{fus}}^\circ = 9.8 \text{ kJ/mol} \quad C_{\text{P,gas}} = 1.06 \text{ J/g}^\circ\text{C} \quad \rho = 0.879 \text{ g/cm}^3 \quad \text{Normal } T_{\text{boiling}} = 80.1^\circ\text{C}$$

3.) Which of the following will decrease the equilibrium concentration of an inert gas (such as N₂) in a beaker of water assuming that equilibrium is re-achieved?

I. Decreasing the temperature of the water

II. Increasing the volume of the water

III. Decreasing the pressure of the gas above the liquid

(1) I only (2) II only (III) III only (IV) I and III (V) I, II, and III

4.) Place the following substances in order of increasing normal boiling point: SF₆, SiH₄, SF₄

(1) SF₆ < SF₄ < SiH₄ (2) SF₆ < SiH₄ < SF₄ (3) SiH₄ < SF₆ < SF₄

(4) SiH₄ < SF₄ < SF₆ (5) SF₄ < SF₆ < SiH₄

5.) Identify the Period 2 element which has the following successive ionization energies, in kJ/mol

$IE_1 = 520$; $IE_2 = 7298$; $IE_3 = 11,815$; $IE_4 = 16,000$;

$IE_5 = 22,831$; $IE_6 = 27,277$; $IE_7 = 32,987$; $IE_8 = 38,235$

(1) Beryllium (2) Lithium (3) Nitrogen (4) Oxygen (5) Neon

6.) When the chlorite ion is oxidized to form the chlorate ion, which of the following occurs?

(1) The Cl-O bond order changes from 1.50 to 1.33

(2) The formal charge on the chlorine atom changes from 0 to +1

(3) The oxidation state of the chlorine atom changes from +4 to +6

(4) The hybridization of the chlorine atom remains as sp^3

(5) The geometry of the anion changes from linear to trigonal planar

7.) How many sigma and pi bonds, respectively, are in $\text{NH}_2\text{CH}_2\text{CHCHCOOH}$?

(1) 13, 2 (2) 12, 1 (3) 11, 4 (4) 10, 2 (5) 9, 1

8.) In an experiment, 25.0 ml of a gas with a pressure of 1.00 atm is contained in a balloon at 25.00°C. The balloon's temperature is adjusted until the pressure is 0.75 atm at a volume of 31.1 ml. What is the final temperature of the gas under the new conditions?

9.) How many resonance structures does the oxalate dianion $[\text{O}_2\text{CCO}_2]^{2-}$ have?

10.) Compare the ionic sizes of Cl^- and K^+ . (Z_{eff} = effective nuclear charge)

- (1) K^+ will have a larger ionic size because its outer electrons experience a higher Z_{eff}**
- (2) K^+ will have a larger ionic size because its outer electrons experience a smaller Z_{eff}**
- (3) K^+ will have a smaller ionic size because its outer electrons experience a higher Z_{eff}**
- (4) K^+ will have a smaller ionic size because its outer electrons experience a smaller Z_{eff}**
- (5) K^+ will have the same ionic size because it and Cl^- experience the same Z_{eff}**

11.) A sample of a hydrocarbon produced 3.14 grams of CO_2 and 1.28 grams of H_2O during combustion analysis. If the hydrocarbon has a molar mass between 50 and 60 g/mol, what is its molecular formula?

12.) A mixture of $\text{Xe}(\text{g})$ and $\text{O}_2(\text{g})$, formed by the complete decomposition of $\text{XeO}_4(\text{g})$, is collected over water at 34°C at a total pressure of 760 mmHg. If the vapor pressure of water is 40 mmHg at 34°C , what is the partial pressure of O_2 ?

13.) According to molecular orbital theory, what are the bond order and the number of unpaired electrons in CN, respectively? The valence molecular orbital sequence for CN is:

$\sigma_{2s}, \sigma^*_{2s}, \pi_{2px} = \pi_{2py}, \sigma_{2p}, \pi^*_{2px} = \pi^*_{2py}, \sigma^*_{2p}$

14.) When 50.0 ml of 0.200 M AgNO_3 and 50.0 ml of 0.100 M CaCl_2 , both at 25.0°C , are reacted in a coffee-cup calorimeter, the temperature of the reacting mixture increases to 26.0°C . Calculate ΔH in kJ/mol of AgCl produced. Assume the density of the solution is 1.05 g/ml and the specific heat capacity of the solution is $4.20 \text{ J/g}^\circ\text{C}$.

15.) A 150.0 ml sample of an aqueous solution at 25.0°C contains 15.2 mg of an unknown nonelectrolyte compound. The solution has an osmotic pressure of 8.44 torr, what is the molar mass of the unknown compound?

16.) Benzene (C_6H_6 , 78.11 g/mol) is a liquid at room temperature with a normal boiling point of 80°C, and its molal boiling point elevation constant K_b is 2.65 °C kg/mol. Anthracene ($C_{14}H_{10}$, 178.23 g/mol) is a solid at room temperature but is quite soluble in liquid benzene. Predict the boiling point of a solution that is 25%-by-mass anthracene dissolved in benzene.