

1.) Metallic gold crystallizes in the face-centered cubic lattice with an edge length of 407 pm. From this information, estimate the density of gold in g/cm^3 .

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?

$\Delta_{\text{vap}}H^\circ = 33.9 \text{ kJ/mol}$	$C_{P,\text{liq}} = 1.73 \text{ J/g}^\circ\text{C}$	$C_{P,s} = 1.51 \text{ J/g}^\circ\text{C}$	Normal $T_{\text{melting}} = 5.5^\circ\text{C}$
$\Delta_{\text{fus}}H^\circ = 9.8 \text{ kJ/mol}$	$C_{P,\text{gas}} = 1.06 \text{ J/g}^\circ\text{C}$	$\rho = 0.879 \text{ g/cm}^3$	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 N_2) 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: SF_6 , SiH_4 , SF_4

(1) $\text{SF}_6 < \text{SF}_4 < \text{SiH}_4$ (2) $\text{SF}_6 < \text{SiH}_4 < \text{SF}_4$ (3) $\text{SiH}_4 < \text{SF}_6 < \text{SF}_4$
(4) $\text{SiH}_4 < \text{SF}_4 < \text{SF}_6$ (5) $\text{SF}_4 < \text{SF}_6 < \text{SiH}_4$

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

$\text{IE}_1 = 520;$ $\text{IE}_2 = 7298;$ $\text{IE}_3 = 11,815;$ $\text{IE}_4 = 16,000;$
 $\text{IE}_5 = 22,831;$ $\text{IE}_6 = 27,277;$ $\text{IE}_7 = 32,987;$ $\text{IE}_8 = 38,235$

(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 $NH_2CH_2CHCOOH$?

- (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 $25.00^\circ C$. 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 $[O_2CCO_2]^{2-}$ have?

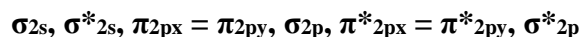
10.) Compare the ionic sizes of Cl^- and K^+ . (Z_{eff} = effective nuclear charge)

- (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 Xe(g) and O₂(g), formed by the complete decomposition of XeO₄(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 O₂?

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:



14.) When 50.0 ml of 0.200 M AgNO₃ and 50.0 ml of 0.100 M CaCl₂, 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 J/g°C.

15.) Rate data have been determined at a particular temperature for the reaction

$2 \text{NO(g)} + \text{Cl}_2\text{(g)} \rightarrow 2 \text{NOCl(g)}$. What is the numerical value for the rate constant?

Experiment	[NO] (M)	[Cl ₂] (M)	Rate (M/s)
1	0.0300	0.0100	3.4×10^{-4}
2	0.0150	0.0100	8.5×10^{-5}
3	0.0150	0.0400	3.4×10^{-4}