CH301 Practice Questions

1. A radio station broadcasts at a frequency of 105 MHz. What is the energy of a photon with this frequency?

2. How many d electrons does I (atomic number 53) possess?

3. The 3d sublevel has enhanced stability when it contains how many electrons?

4. An electron in a 3d orbital could have which of the following quantum numbers?

   1. $n = 3; l = 2; m_l = 0$
   2. $n = 3; l = 1; m_l = -1$
   3. $n = 3; l = 2; m_l = -3$
   4. $n = 3; l = 0; m_l = 0$
   5. $n = 2; l = 2; m_l = 2$
   6. $n = 2; l = 3; m_l = 0$
   7. $n = 3; l = 3; m_l = 1$

5. Vapor obtained by evaporating 0.495 grams of an unknown liquid is collected in a 127 mL flask. At 371 K, the pressure of the vapor in the flask is 754 torr. What is the molar mass in g/mol?

6. What is the density of nitrogen gas at STP?

7. Consider two equal-sized containers, one filled with H_2 gas and one with O_2 gas at the same temperature and pressure. The average velocity of the O_2 molecules is (equal to, greater than, less than) that of the H_2 molecules.

8. Which of the statements below are true?

   1. Real gases act more like ideal gases as the temperature increases.
   2. When n and T are constant, a decrease in P results in a decrease in V.
   3. At 1 atm and 273 K, every molecule in a sample of a gas has the same speed.
   4. At constant T, CO_2 molecules at 1 atm and H_2 molecules at 5 atm have the same average kinetic energy.

9. How many sigma and pi bonds are in $CH_3CH_2CHCHCH_3$?

10. How many lone pairs are in the structure for IO_3^{1-}?

11. The molecular geometry of SF_5 is _____.

12. What is the hybridization of the central atom in XeF_4?

13. The molecule PBr_3 is a (polar/nonpolar) molecule with (polar/nonpolar) bonds.

14. What would be the bond order of C_2?

15. Estimate ΔH for the gas-phase reaction

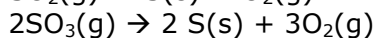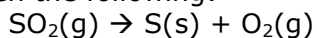$NCl_3 + 3H_2O \rightarrow NH_3 + 3$ HOCl,
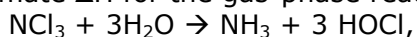
based on the bond energies N-Cl : 190 kJ/mol; O-H : 464 kJ/mol; N-H : 391 kJ/mol; O-Cl : 206 kJ/mol.

16. Calculate the enthalpy change for the reaction

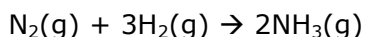$SO_2(g) + \frac{1}{2} O_2(g) \rightarrow SO_3(g)$
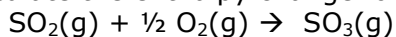
given the following:	ΔH°$_f$ (kJ/mol rxn)
$SO_2(g) \rightarrow S(s) + O_2(g)$	+296.8
$2SO_3(g) \rightarrow 2 S(s) + 3O_2(g)$	+791.4

17. Which physical state, solid, liquid, or gas, has the lowest entropy?

18. What is the entropy change of the reaction

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
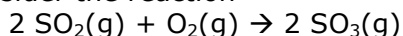191.5   130.6   192.3

at 298 K and 1 atm pressure? The number below each substance is the absolute entropy of the substance at 298 K, 1 atm, in units of J/(mol•K).

19. What is the molarity of a HCl solution if 2.50 L is needed to react with 12.7 g of Al according to the reaction

2 Al + 6 HCl $\rightarrow$ 2 AlCl$_3$ + 3H$_2$?
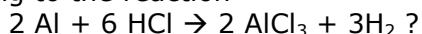
20. Consider the reaction

2 SO$_2$(g) + O$_2$(g) $\rightarrow$ 2 SO$_3$(g)

with a reaction enthalpy of -10.0 kJ/mole rxn. Which response predicts the thermodynamic spontaneity of the reaction?

1. The reaction is spontaneous at all temperatures.
2. The reaction is spontaneous only at low temperatures.
3. The reaction is spontaneous only at high temperatures.
4. The reaction is not spontaneous at any temperature.
5. We cannot predict the spontaneity for this reaction.

21. Which would you expect to have the largest atomic radius: Ca, K, Rb, or Sr?

22. What type of intermolecular forces would you expect in a liquid sample of H$_2$S?

23. Order these molecules in order of increasing melting point: C$_2$H$_6$, H$_2$S, H$_2$O, and NaI.

CH301 Practice Question Answers

1. 6.96 x 1026 J
2. 20
3. 5 or 10
4. A
5. 1.20 g/mol
6. 1.25 g/L
7. less than
8. I and IV
9. 14 sigma, 1 pi
10. 10
11. square pyramidal
12. sp^3d^2
13. polar; polar
14. 2
15. +171 kJ/mol rxn
16. -98.9 kJ/mol rxn
17. solid
18. -198.7 J/mol•K
19. 0.564
20. B
21. Rb
22. dipole-dipole forces
23. C_2H_6, H_2S, H_2O, NaI