

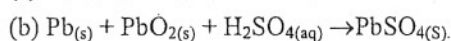
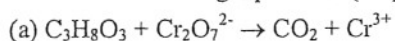
1. Consider the isothermal expansion of 1.00 mole of ideal gas at 27°C. the volume increases from 30.0 to 40.0 L. calculate q , w , ΔE , ΔH , ΔS , and ΔG for two situations. (a) a free expansion (b) a reversible expansion. (10 points)

[Note: $\ln 2 = 0.693$, $\ln 3 = 1.099$, $R = 8.314 \text{ J/K mol}$.]

2. Given the K_a and K_b values of 5.6×10^{-10} and 1.6×10^{-5} for NH_4^+ and CN^- , respectively, calculate the pH of a 0.100 M NH_4CN solution. (10 points)

3. Calculate the concentration of Ag^+ , $\text{Ag}(\text{S}_2\text{O}_3)^-$, and $\text{Ag}(\text{S}_2\text{O}_3)_2^{3-}$ in a solution prepared by mixing 150 mL of 0.001 M AgNO_3 with 200 mL of 5.00 M $\text{Na}_2\text{S}_2\text{O}_3$. The stepwise formation equilibrium constants for $\text{Ag}(\text{S}_2\text{O}_3)^-$ and $\text{Ag}(\text{S}_2\text{O}_3)_2^{3-}$ are 7.4×10^8 and 3.9×10^4 , respectively. (10 points)

4. Balance the following equations. (10 points, 5 points each)



[Note that you might need to add H_2O or H^+ to balance these equations.]

5. (a) At a given temperature, what is the ratio of the root-mean-square (rms) speed of the atoms of Ar gas to the rms speed of H_2 gas? (the atomic weights of Ar and H are 39.95 and 1, respectively.) (b) how does the rms speed and kinetic energy of these gaseous atoms and molecules vary quantitatively with temperature? (c) Draw a diagram to show the distribution of speed of Ar and H_2 gas at a given temperature (300 K, for example). (10 points)

6. Name 5 types of chemical bonding and describe their characteristic properties briefly. (10 points)

7. Draw the shape of the five d orbitals (5 points) and explain how we know the shape of the d orbitals. (5 points)

8. Titanium metal has a body-centered cubic unit cell. The density of titanium is 4.5 g/cm^3 . Calculate the edge length of the unit cell and a value for the atomic radius of titanium. (10 points)

[Hint: in a body-centered arrangement of spheres, the spheres touch along the body diagonal.]

注意：背面有試題

- 9 When an aqueous solution of KCN is added to a solution containing Ni^{+2} ions, a precipitate forms, which redissolves upon addition of more KCN solution. No precipitate forms when H_2S is bubbled into this solution. Write reactions describing what happens in this solution. (10 points)

[Hint: CN^- is a Bronsted-Lowry base ($K_b \sim 10^{-5}$) and a Lewis base.]

- 10 Complete the following reactions. (10 points, 2 points each)

