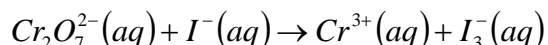


Note: Chemistry 51 is designed for those students who have had at least two years of high school chemistry. Students with the prerequisite background who wish to enroll in Chemistry 51 must also pass the Chemistry 51 Placement Examination that is administered during Freshman Orientation. The examination covers stoichiometry, nomenclature, and the periodic table.

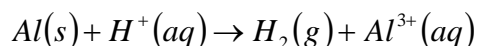
CHEMISTRY 51, SAMPLE PLACEMENT EXAMINATION

You will be given 90 minutes to complete the examination. In problems requiring a derivation or a calculation, you will be expected to show your work to obtain credit. Pay particular attention to significant digits and units. A periodic table of the elements and the values of fundamental constants will be provided. The use of a calculator is permitted on this examination. N.B. Students taking the Advisory Examination for Chem 1a are NOT permitted to use a calculator.

1. Balance the following oxidation-reduction equation. The reaction is carried out in a strongly acidic aqueous medium. Draw a rectangle around the oxidizing agent and a circle around the reducing agent.

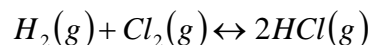


2. Aluminum metal dissolves in aqueous hydrochloric acid to yield gaseous hydrogen and aluminum(III) ions according to the following unbalanced ionic equation:



- (a) Calculate the minimum volume of 0.2000 M HCl required to dissolve 3.00 g of aluminum.
- (b) Calculate the volume of gaseous hydrogen produced at 25.5 °C and 0.985 atm when the 3.00 g of aluminum is dissolved.
3. Short answers.
- (a) Arrange the following elements in order of increasing atomic radius (smallest radius to the left): Rn Ge Li Se He Mg
- (b) Give the formulae of the following compounds:
- (i) perbromic acid
 - (ii) barium sulfate
 - (iii) acetic acid
 - (iv) zinc phosphide
- (c) Give the electronic (orbital) configuration of ground electronic state vanadium.
- (d) What are the dominant species in an aqueous solution of each of the following compounds: HF, H₃PO₄, Na₂O, NH₂NH₂,

4. A reactor is filled with 2.0 atm of gaseous hydrogen and 0.015 atm of gaseous chlorine. At the temperature of the reactor, the equilibrium constant for the reaction



is 5.0×10^5 . Calculate the partial pressure of Cl_2 , H_2 , and HCl when the system reaches equilibrium.

5. An unknown organic compound has the composition 70.6 wgt-% C, 13.7 wgt-% H, and 15.7 wgt-% O. When 0.0500 g of the compound is dissolved in 2.5000 g of benzene, the solution freezes at 4.05 °C. Pure benzene freezes at 5.12 °C. k_f , the freezing-point depression constant, of benzene is 5.48 °C/molal.
- (a) Determine the empirical formula of the compound
 - (b) Determine the molecular weight of the compound.
 - (c) Determine the molecular formula of the compound.