

Name: \_\_\_\_\_  
100 points  
Dr. Jay H. Baltsberger

Test 3  
Chemistry 121A  
November 15, 1993

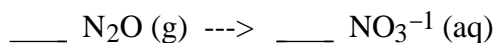
**SHOW ALL CALCULATIONS, CIRCLE YOUR FINAL ANSWERS AND  
USE PROPER SIGNIFICANT FIGURES AND UNITS**

1. Determine the oxidation state of chromium in the following compound. (4 points)



2. Calculate the number of grams of sodium in 1.432 moles of sodium carbonate. (6 points)

3. Write the balanced half-reaction equation for the following species in acidic solution, remember to add  $\text{H}_2\text{O}$ ,  $\text{H}^+$  and  $e^-$  as needed to these equations. Also identify whether the reaction is an oxidation or reduction reaction. (8 points)



4. State whether or not each of the following is a valid set of electronic quantum numbers. If they are not, explain why. (12 points)

$n = +4, l = +3, m_l = -2, m_s = -1/2$  \_\_\_\_\_

$n = +2, l = +2, m_l = +0, m_s = +1/2$  \_\_\_\_\_

$n = +1, l = +0, m_l = +1, m_s = -1/2$  \_\_\_\_\_

$n = +1, l = +0, m_l = +0, m_s = +0$  \_\_\_\_\_

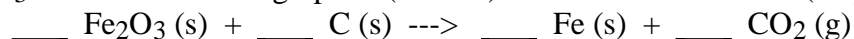
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5. Complete the following table of ionic compounds and empirical formulas and determine whether each compound is soluble in H<sub>2</sub>O (12 points):

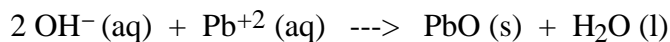
<u>Empirical Formula</u>	<u>Name</u>	<u>Solubility</u>
K <sub>2</sub> SO <sub>3</sub>	_____	_____
_____	strontium nitrate	_____
_____	lead (II) chloride	_____

6. Balance the exchange reaction below and calculate the mass (in g) of iron produced when 4.32 moles of Fe<sub>2</sub>O<sub>3</sub> and 8.74 moles of graphite (solid C) are mixed and heated. (12 points)



7. Calculate the energy of the photon which is emitted when a single electron changes from a 4d to a 2p atomic orbital in atomic hydrogen where the orbital energy is given by  $E_n = -R/n^2$  and  $R = 2.18 \times 10^{-18}\text{J}$ . (9 points)

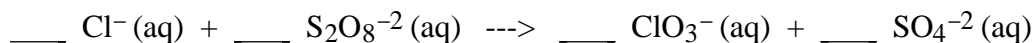
8. Given the reaction below, calculate (in kJ) the amount of heat that will be released when 1 mole of Pb<sup>2+</sup> (aq) reacts with excess OH<sup>-</sup> (aq). The heats of formation for each species are as follows: OH<sup>-</sup> (aq) is -230.0 kJ/mol; Pb<sup>2+</sup> (aq) is -1.7 kJ/mol; PbO (s) is -217.3 kJ/mol; and H<sub>2</sub>O (l) is -285.8 kJ/mol. (15 points)



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9. Balance the following reduction/oxidation reaction in acidic conditions, remember to add H<sub>2</sub>O and H<sup>+</sup> to these equations as needed. (12 points)



10. Write the orbital box, spectroscopic and rare gas notation for the ground state of a sulfur atom. (10 points)
11. BONUS QUESTION: Calculate the energy (in J) of a single X-ray photon which has a wavelength of  $2.1 \times 10^{-11}$  m (or  $0.21 \text{ \AA}$ ) where Planck's constant  $h = 6.626 \times 10^{-34}$  J s and the speed of light is  $c = 3.0 \times 10^8$  m/s (remember  $E = nh$  and  $c = \lambda\nu$ ). (4 points)
12. BONUS QUESTION: Sketch the shapes of S, P and D atomic orbitals and state the total number of different orientations possible for each type of orbital. (6 points)