

US 110 Exam 2, Wednesday October 21

Name Key

(54)

By submitting this exam, I certify that I have neither given nor received unauthorized aid on this assignment.

Useful information:  $c = 3.00 \times 10^8 \text{ m/s}$ ,  $\lambda\nu = c$ ,  $E = h\nu$ ,  $\lambda = \frac{h}{mv}$ ,  $h = 6.626 \times 10^{-34} \text{ Js}$ ,  $6.626 \times 10^{-34} \text{ kgm}^2/\text{s}$ ,  $N_A = 6.022 \times 10^{23} / \text{mole}$

(1) Write the definitions for the following

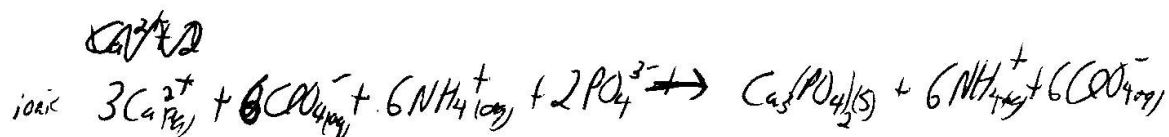
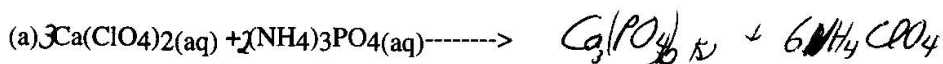
(a) Arrhenius Acid: produces  $\text{H}^+$  in water

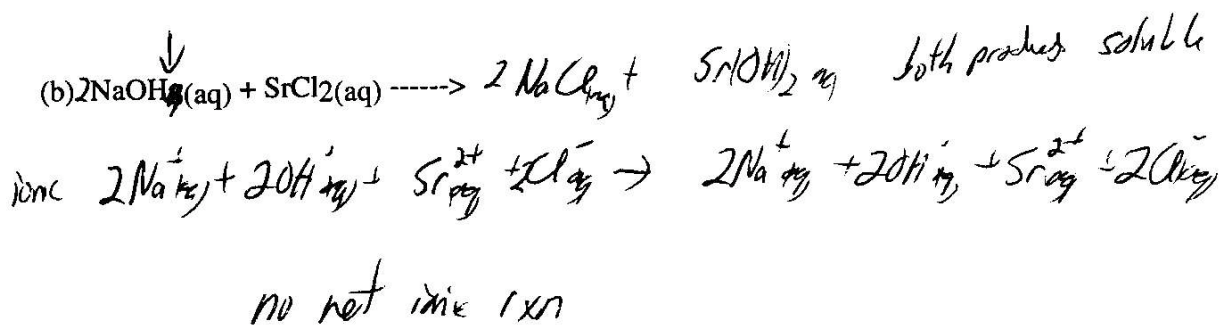
(b) Arrhenius Base: produces  $\text{H}_3\text{O}^+$  in water

(c) Brønsted-Lowry Acid  $\text{H}^+$  donor

(d) Brønsted-Lowry Base  $\text{H}^+$  acceptor

(2)(4 points) Write the balanced ionic and net ionic equations for the following reactions



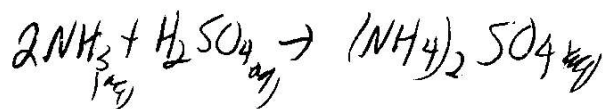
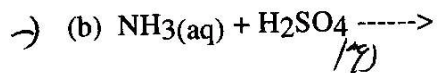


(3)(2 points) Classify the following as weak electrolytes, strong electrolytes, or nonelectrolytes

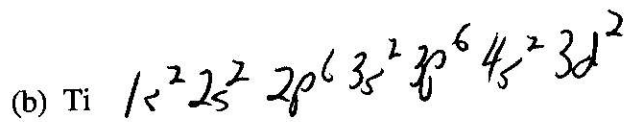
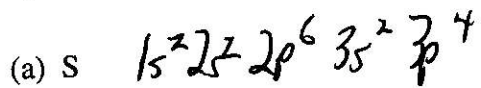
(a) HF weak electrolyte

(b)  $\text{CF}_4$  non electrolyte

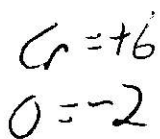
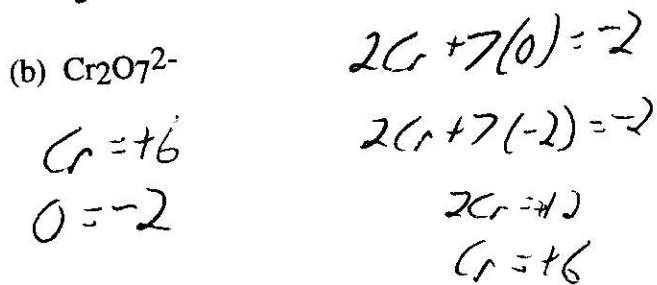
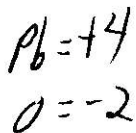
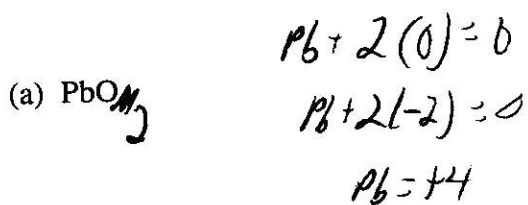
(4)(4 points) Complete the following neutralization reactions and balance them for a complete neutralization (all acidic protons neutralized, all basic units neutralized).



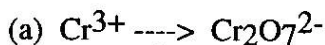
(5)(2 points) Write the ground state electron configurations (ie  $1s^2 2s^2 2p^6 \dots$ ) for the following species. Don't use the noble gas formalism.



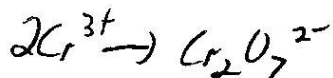
(6)(4 points) List the oxidation state for each element in the following compounds



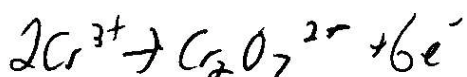
(8)(8pts) Balance the following half-reactions in base



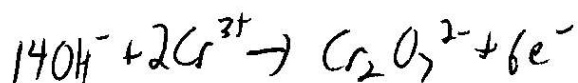
↓ balance Cr



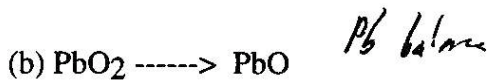
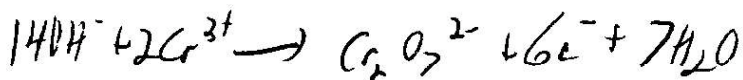
↓ balance O atoms



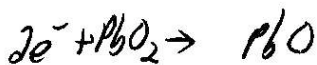
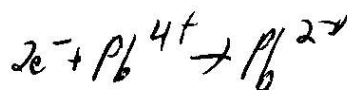
↑ ↓ balance total charge 8-



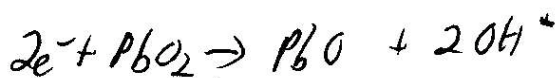
↓ balance H



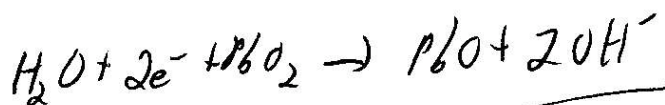
↓ balance O atoms



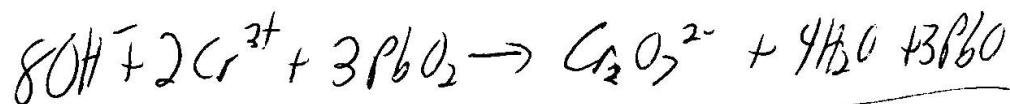
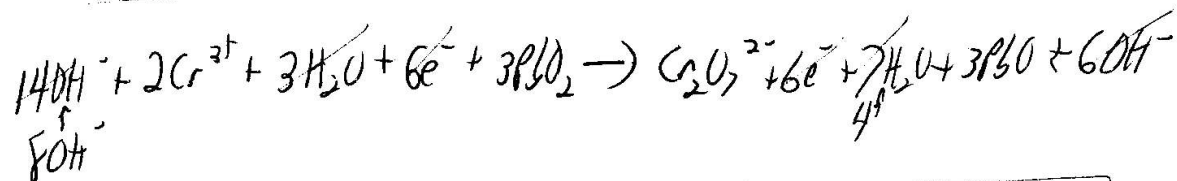
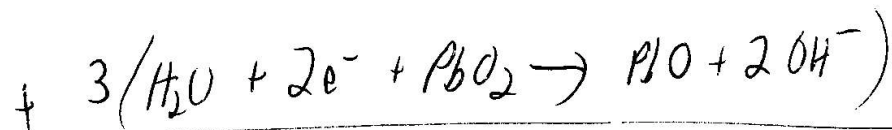
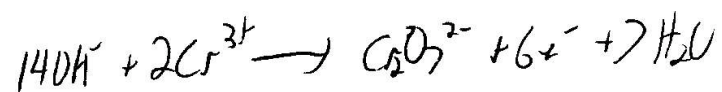
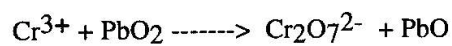
↓ balance charge



↓ balance H



(9)(4 pts) Balance the following reaction in base (see the previous question).



A radio station broadcasts at 101.1 MHz (1 MHz =  $10^6 \frac{1}{s}$ ). What is  
 (10)(2 pts) Light with a wavelength of ~~700~~ nm appears red. What is the frequency of this light? *the wavelength?*

$$v\lambda = c$$

$$\lambda = \frac{c}{v}$$

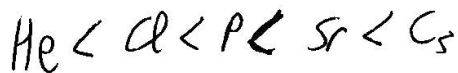
$$\lambda = \frac{3.00 \times 10^8 \frac{m}{s}}{1.011 \times 10^8 \frac{1}{s}}$$

$$\lambda = 2.967m$$

$$101.1 \text{ MHz} \times \frac{10^6 \frac{1}{s}}{1 \text{ MHz}} = 1.011 \times 10^8 \frac{1}{s}$$

(11)(4 pts) Put the following atoms in order from smallest to largest:

P, Cs, Cl, Sr, He



(12) (4 pts) Define the following:

(a) Hund's Rule

in the textbook

(b) The Aufbau Principle

(12)(4 points) Answer the following questions about quantum numbers.

(a) If  $l=2$ , how many electrons can the subshell hold?

if  $l=2$   $m_l = -2, -1, 0, 1, 2$  5 orbitals, i. 10 electrons

(b) What is the first shell that can have a g subshell and why?

$l=0$  s  
 $l=1$  p  
 $l=2$  d

$l=3$  f  
 $l=4$  g

$n=5$ , because  $l = 0 \dots n-1$ , so  $n$  must be at least 5.

(13)(2 points) Draw a picture of the orbital with the following quantum numbers:  $n=4$ ,  $l=1$ ,  $m_l=0$ .

4p orbital



(14)(6 points) Using the following reactivity data, construct an activity series for Ru, Au, Al, and Fe.

Strips of each metal were placed in solutions of each metal nitrate. The results for the reactions are shown below in table 1.

Example:  $\text{Fe}(\text{NO}_3)_3 + \text{Au} \rightarrow \text{NR}$

Table 1. Reactivity results

Salt\metal	Ru	Au	Al	Fe
<b>Ru(NO<sub>3</sub>)<sub>3</sub></b>	NR	NR	$\text{Ru} + \text{Al}^{3+}$	$\text{Ru} + \text{Fe}^{3+}$
<b>Au(NO<sub>3</sub>)<sub>3</sub></b>	$\text{Au} + \text{Ru}^{3+}$	NR	$\text{Au} + \text{Al}^{3+}$	$\text{Au} + \text{Fe}^{3+}$
<b>Al(NO<sub>3</sub>)<sub>3</sub></b>	NR	NR	NR	NR
<b>Fe(NO<sub>3</sub>)<sub>3</sub></b>	NR	NR	$\text{Fe} + \text{Al}^{3+}$	NR

