Chemistry Pretet 3.4 Lab Portion Only

Practice for Lab Section of Next test. Don't forget to prepare yourself for the 10 theory questions too. Go to http://www.emsb.qc.ca/laurenhill/science/chemacademy3.html

Green class can vote for 3 of the 5 labs we did (so far we have no votes for the Kc lab) and for two topics under each chapter (Gases, Energy, Rates, Equilibrium, Acids-Base Equil'm)

Email your choices to enricouva@gmail.com

CHEM-03	CHEM-01	CHEM-02
Le Chat	Ka	Ka
Stoich of Redox	stoich redox	stoich redox
Electrochem Lab	Electrochem Lab	Electrochem Lab
Pv=nRT	Pv=nRT	Pv=nRT
changes of State	changes of State	changes of State
Hess	Hess	Hess
Bond Energy	calorimetry	calorimetry
Ae graphs,	rate law mechanism	rate law mechanism
Factors Affecting rates	effective collision temp	graphs ; effective….
defnEqui State	defnEqui State	defnEqui State
Ksp	Ksp	Ksp
phpOH deriv	Ka	Ka
Bronsted Lowry	Bronsted Lowry	Bronsted Lowry

1. Given: $[Fe(H_2O)_6]^{3+}{}_{(aq)} + 3\ SCN^-{}_{(aq)} = [Fe(H_2O)_3(SCN)_3]_{(aq)} + 3\ H_2O$

Orangecolorless red

What substance should you add to the above equilibrium to create an orange solution? Here are some possible choices. Justify your answer.

(1) A solution of $FeCl_3$, which is light orange.
(2) A solution of silver nitrate; AgSCN does not dissolve in water
(3) A drying agent that would remove water
(4) More red thiocyanate compound

(1) will drive the equilibrium to the right and make it more red

(2) This is the answer. Silver nitrate will cause a precipitate of AgSCN to appear which will block the forward reaction. The reverse reaction will continue and produce more orange $[Fe(H_2O)_6]^{3+}{}_{(aq)}$.

(3) Removing water would block the reverse reaction and make it even more red.

(4) More red solution will create more orange solution, but it will also increase the overall concentration of

red solution(any time you add something in equilibrium it never gets completely consumed)

2. Fe $^{3+}{}_{(aq)}$ + $SCN^{-}{}_{(aq)}$ = Fe (SCN) $^{2+}{}_{(aq)}$

Why did the addition of solid KSCN create a darker color than adding aqueous iron ion if both push the equilibrium to the right?

The KSCN will create a higher concentration of $SCN^{-}{}_{(aq)}$ leading to a higher production of Fe (SCN) $^{2+}{}_{(aq)}$

3. In the oxidation of the iron nail-lab with copper solution by consulting the table of reduction potentials, can you think of a replacement for Cu^{2+} and a replacement for iron that would lead to a very similar lab?

Make sure that the oxidizing agent (like Cu^{2+}) has a higher reduction potential than the ion that becomes the metal who will replace iron.

So you could choose Ag^{+} instead of Cu^{2+} and Sn or Zn instead of iron.

Standard Reduction Potentials at 25°C (298 K) for Many Common Half-Reactions

Half-Reaction	$\mathscr{E}°$ (V)	Half-Reaction	$\mathscr{E}°$ (V)
$F_2 + 2e^- \rightarrow 2F^-$	2.87	$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$	0.40
$Ag^{2+} + e^- \rightarrow Ag^+$	1.99	$Cu^{2+} + 2e^- \rightarrow Cu$	0.34
$Co^{3-} + e^- \rightarrow Co^{2-}$	1.82	$Hg_2Cl_2 + 2e^- \rightarrow 2Hg + 2Cl^-$	0.27
$H_2O_2 + 2H^- + 2e^- \rightarrow 2H_2O$	1.78	$AgCl + e^- \rightarrow Ag + Cl^-$	0.22
$Ce^{4+} + e^- \rightarrow Ce^{3+}$	1.70	$SO_4^{2-} + 4H^+ + 2e^- \rightarrow H_2SO_3 + H_2O$	0.20
$PbO_2 + 4H^+ + SO_4^{2-} + 2e^- \rightarrow PbSO_4 + 2H_2O$	1.69	$Cu^{2+} + e^- \rightarrow Cu^+$	0.16
$MnO_4^- + 4H^+ + 3e^- \rightarrow MnO_2 + 2H_2O$	1.68	$2H^+ + 2e^- \rightarrow H_2$	0.00
$2e^- + 2H^+ + IO_4^- \rightarrow IO_3^- + H_2O$	1.60	$Fe^{3+} + 3e^- \rightarrow Fe$	−0.036
$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$	1.51	$Pb^{2+} + 2e^- \rightarrow Pb$	−0.13
$Au^{3+} + 3e^- \rightarrow Au$	1.50	$Sn^{2+} + 2e^- \rightarrow Sn$	−0.14
$PbO_2 + 4H^+ + 2e^- \rightarrow Pb^{2+} + 2H_2O$	1.46	$Ni^{2+} + 2e^- \rightarrow Ni$	−0.23
$Cl_2 + 2e^- \rightarrow 2Cl^-$	1.36	$PbSO_4 + 2e^- \rightarrow Pb + SO_4^{2-}$	−0.35
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$	1.33	$Cd^{2+} + 2e^- \rightarrow Cd$	−0.40
$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$	1.23	$Fe^{2+} + 2e^- \rightarrow Fe$	−0.44
$MnO_2 + 4H^+ + 2e^- \rightarrow Mn^{2+} + 2H_2O$	1.21	$Cr^{3+} + e^- \rightarrow Cr^{2+}$	−0.50
$IO_3^- + 6H^+ + 5e^- \rightarrow \frac{1}{2}I_2 + 3H_2O$	1.20	$Cr^{3+} + 3e^- \rightarrow Cr$	−0.73
$Br_2 + 2e^- \rightarrow 2Br^-$	1.09	$Zn^{2+} + 2e^- \rightarrow Zn$	−0.76
$VO_2^+ + 2H^+ + e^- \rightarrow VO^{2+} + H_2O$	1.00	$2H_2O + 2e^- \rightarrow H_2 + 2OH^-$	−0.83
$AuCl_4^- + 3e^- \rightarrow Au + 4Cl^-$	0.99	$Mn^{2+} + 2e^- \rightarrow Mn$	−1.18
$NO_3^- + 4H^+ + 3e^- \rightarrow NO + 2H_2O$	0.96	$Al^{3+} + 3e^- \rightarrow Al$	−1.66
$ClO_2 + e^- \rightarrow ClO_2^-$	0.954	$H_2 + 2e^- \rightarrow 2H^-$	−2.23
$2Hg^{2+} + 2e^- \rightarrow Hg_2^{2+}$	0.91	$Mg^{2+} + 2e^- \rightarrow Mg$	−2.37
$Ag^+ + e^- \rightarrow Ag$	0.80	$La^{3+} + 3e^- \rightarrow La$	−2.37
$Hg_2^{2+} + 2e^- \rightarrow 2Hg$	0.80	$Na^+ + e^- \rightarrow Na$	−2.71
$Fe^{3+} + e^- \rightarrow Fe^{2+}$	0.77	$Ca^{2+} + 2e^- \rightarrow Ca$	−2.76
$O_2 + 2H^+ + 2e^- \rightarrow H_2O_2$	0.68	$Ba^{2+} + 2e^- \rightarrow Ba$	−2.90
$MnO_4^- + e^- \rightarrow MnO_4^{2-}$	0.56	$K^+ + e^- \rightarrow K$	−2.92
$I_2 + 2e^- \rightarrow 2I^-$	0.54	$Li^+ + e^- \rightarrow Li$	−3.05
$Cu^+ + e^- \rightarrow Cu$	0.52		

4. Given: $Cu^{2+} + Fe \rightarrow Fe^{2+} + Cu$
This reaction with the nail in direct contact was fast --- you even saw the blue color of Cu^{2+} fade. And yet the same concentration of Cu^{2+} in the battery lab created a very slow reaction? How come?

Since the Cu^{2+} is in direct contact with the nail it's much easier for electrons to transfer from the nail to the ion. In the electrochemical setup, far fewer electrons travel through a wire while ions from the bridge have to constantly maintain the ion gradient to maintain adequate voltage.

5. How many measurements do you need in the lab to get a weak acid's K_A? What equipment is needed for each measurement?

You need a pH which ideally should be measured with a meter, but given that we spent the money on a barely- used telescope (and the bouncy things for grade 7s too), we had to use pH paper.

The equilibrium concentration of the weak acid can be figured out from its volume and from measuring the base's volume during a neutralization. To apply n = CV to the base we also needed to know its concentration.

6. Are any sig fig errors being made at any stage in solving this problem? Why or why not?

Problem: *Calculate the quantity of electricity (Coulombs) necessary to deposit 100.00 g of copper from a $CuSO_4$ solution. Analyze all three steps.*

Solution:

1) Determine moles of copper plated out:

100.00 g divided by 63.546 g/mole = 1.573663 mol

No mistakes. These guys are good.

They used at least 5 SF in the molar mass to match the 5Sf of 100.00 g, and they are not rounding off prematurely.

2) Determine moles of electrons required:

$Cu^{2+} + 2e^{-} \rightarrow Cu$

therefore, every mole of Cu plated out requires two moles of electrons.

1.573663 mol x 2 = 3.147326 mol e^{-} required

No mistakes. These guys are still good.

They carried on the full no-rounded answer from the previous step and 2 is an exact number so it will not affect anything later on.

3) Convert moles of electrons to Coulombs of charge:

3.147326 mol e^- ** 96,485.309 C/mol = 3.0367 x* 10^5 *C*

No mistakes. These guys are still good.

The final answer has 5 SF, even though the C/mol had 8Sf. We have to go with the measurement used in the calculation that has the least SF, which would be the emolar mass and mass, bothe with 5SF