2011

Honors Chemistry Sem 2 Final Review p1

1. pOH = 4.50 $[OH^-] = 10^{-pOH} = 10^{-4.50} = 3.162 \times 10^{-5} M$

$3.162 \times 10^{-5} M \,(.600 L) = 1.897 \times 10^{-5}$ mol KOH

1.897×10^{-5} mol KOH (56.108 g/mol) = $[1.06 \times 10^{-3} g = 1.06 mg]$

#2 $NaOH + HCl \rightarrow H_2O + NaCl$

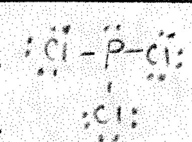
mol HCl = .015 M × .300 L = .0045 mol HCl → .0045 mol H^+

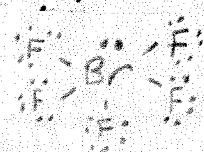
mol NaOH = .020 M × .200 L = .0040 mol NaOH → .0040 mol OH^-

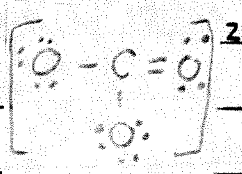
means .0005 mol H^+ left over

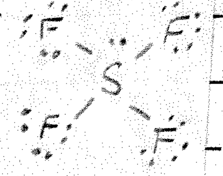
New molarity = .0005 H^+ / .500 L = .001 $[H_3O^+]$ = $\underline{1 \times 10^{-3} M}$

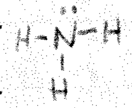
pH = 14 − pH = 14 − (−log 1×10^{-3}) = $\underline{11}$

#3  sp^3, tetrahedral, trigonal pyramidal, polar

 sp^3d^2, Octahedral, Square pyramidal, polar

 sp^2, trigonal planar, trigonal planar, resonance, nonpolar

 sp^3d, trigonal bipyramidal, unsymmetrical tetrahedron (seesaw), polar

 sp^3, tetrahedral, trigonal pyramidal, polar

#4 $Cr_2O_7^{2-} + I^- \rightarrow Cr^{3+} + I_2$

$6e^- + Cr_2O_7^{2-} + 14H^+ \rightarrow 2Cr^{3+} + 7H_2O$

$(2I^- \rightarrow I_2 + 2e^-) \times 3$

$\underline{6I^- + Cr_2O_7^{2-} + 14H^+ \rightarrow 3I_2 + 2Cr^{3+} + 7H_2O}$

#5 pH = 5.5 $[H_3O^+] = 10^{-5.5} = 3.16 \times 10^{-6} M \times .050 L$

$= 1.58 \times 10^{-7}$ mol H^+ → need same # moles OH^-

1.58×10^{-7} mol OH^- / .1 mol OH^-/L = 1.58×10^{-6} L = $\underline{2 \times 10^{-3} mL}$

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#6 $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^1$ or $[Ar] 4s^2 3d^{10} 4p^1$

#7 $K_a = 3.0\times10^{-4} = [H_3O^+][\text{salicylate ion}]/[\text{salicylic acid}]$

$3.0\times10^{-4} = \frac{[x][x]}{[.02-x]}$ $\quad 3.0\times10^{-4} = \frac{x^2}{(.02-x)}$ $\quad 3.0\times10^{-4}(.02-x) = x^2$

$x^2 + 3.0\times10^{-4}x - 6.0\times10^{-6} = 0$ $\quad x = .0023$

a b c

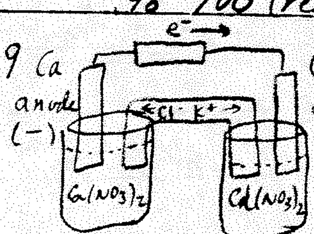
$[H_3O^+] = .0023 = \underline{2.3\times10^{-3}M}$ $\quad pOH = 14 - (-\log(2.3\times10^{-3})) = 11.36$

$\approx \underline{11}$

#8. $c = \lambda\nu$ $\quad \lambda = c/\nu = 3.0\times10^8\,m/s / 7.692\times10^{14}\,Hz$

$= 3.90\times10^{-7}\,m = \underline{390.\,nm}$ Since visible falls from 400 (blue/violet) to 700 (red) nm, this appears to fall in the Ultraviolet (UV)

#9



$Ca^{2+}/Ca = -2.87V$

$Cd^{2+}/Cd = -0.40V$ $\quad E^\circ_{cell} = -0.40V + 2.87V$

$= \boxed{2.47V}$

#10 a) $\overset{+1}{H}N\overset{-2}{O_3}$ $\underline{N = +5}$ b) $N_2\overset{-2}{O}$ $\underline{N = +1}$ c) $N\overset{-2}{O_2}$ $\underline{N = +4}$ d) $N\overset{+1}{H_4}^+$ $\underline{N = -3}$

#11 $(4, 0, 0, +\frac{1}{2})$ or $(4, 0, 0, -\frac{1}{2})$

#12 $pH = 3.5$ $\quad pOH = 14.0 - 3.5 = 10.5$

$[OH^-] = 10^{-pOH} = 10^{-10.5} = \underline{3.16\times10^{-11}M}$

#13 $\Delta E = R_H\left(\frac{1}{n_i^2} - \frac{1}{n_f^2}\right) = 2.18\times10^{-18}J\left(\frac{1}{3^2} - \frac{1}{1^2}\right)$

$= \underline{-1.94\times10^{-18}}J$ (negative means energy is released)

$\nu = E/h = 1.94\times10^{-18}J / 6.626\times10^{-34}\,Js = \underline{2.93\times10^{15}\,Hz}$

#14 $\lambda = \frac{h}{mv}$ $\quad 80\%\,c = (.80)(3.0\times10^8\,m/s) = 2.40\times10^8\,m/s$

$= 6.626\times10^{-34}\,Js / (9.11\times10^{-31}\,kg)(2.40\times10^8\,m/s) = \underline{3.03\times10^{-12}\,m}$ (m_e)

15. $1.897\times10^{-5}\,mol\,KOH/(.650L) = 2.919\times10^{-5}M$

$-\log(2.919\times10^{-5}M) = pOH = 4.53$ $\quad pH = 14 - 4.53 = \boxed{9.47}$

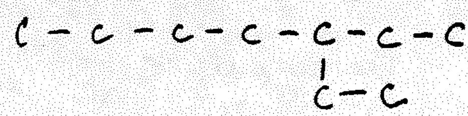
#16 71.65 g Cl / 35.45 g/mol = 2.02 mol | 24.27 g C / 12.01 g/mol = 2.02 mol | 4.07 g H / 1.008 g/mol = 4.04 mol

$C_{\frac{2.02}{2.02}} H_{\frac{4.04}{2.02}} Cl_{\frac{2.02}{2.02}} = CH_2Cl$ ← empirical formula (49.476 g/mol)

if actual mass is 98.96 g/mol $98.96/49.476 = 2$ then molecular formula is twice the empirical = $C_2H_4Cl_2$

#17 $E = h\nu = hc/\lambda = (6.626\times10^{-34} Js)(3.0\times10^{8} m/s)/(3.00\times10^{-7} m) = 6.626\times10^{-19} J$

18.



19. 3-methyl-6-propylnonane

#20 Ge has four valence electrons (2 in the 4s and 2 in the 4p)

21. $HBr + KOH \rightarrow KBr + H_2O$

HBr = .030 L (.02 M) = 6×10^{-4} mol

KOH: 6×10^{-4} mol / 3.162×10^{-5} mol/L = 18.97 L

[18,970 mL (20,000 mL rounded)]

22.

Au < Pt < Ag < Zn < Mg

1.50 1.2 0.855 −0.763 −2.37

#23 $2Al + 3Cl_2 \rightarrow 2AlCl_3$

Cl_2 is the oxidizing agent, because it is reduced $2Cl^0 + 2e^- \rightarrow 2Cl^-$

Cl has a greater electronegativity than Al because it has a greater "draw" on the bonding electrons.

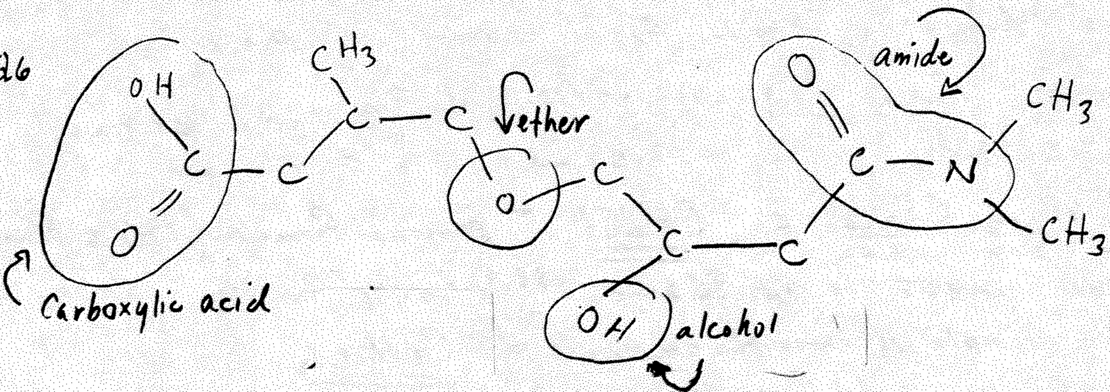
#24 Calcium is more active (ie. loses electrons more easily) than cadmium with a higher reduction potential. Cadmium should have a higher 1st ionization energy since it is holding onto its electrons more tightly.

magnesium solid would react w/ silver nitrate solution via

$Mg_{(s)} + 2AgNO_{3(aq)} \rightarrow Mg(NO_3)_{2(aq)} + 2Ag_{(s)}$

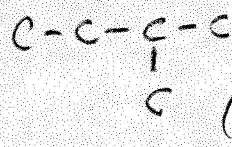
25. :C≡O: 1 sigma, 2 pi

26

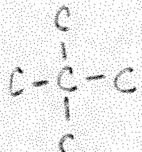


27.

C–C–C–C–C
n-pentane



methylbutane
(or 2-methylbutane)



dimethyl propane
(or 2,2-dimethylpropane)

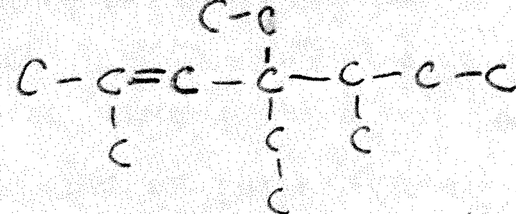
28. $Au^{3+}_{(aq)} + 3e^- \longrightarrow Au_{(s)}$

$$10.0\,\frac{C}{s}\,(3.0\,\text{min})\left(\frac{60\,s}{1\,\text{min}}\right)\left(\frac{1\,\text{mol}\,e^-}{96{,}480\,C}\right)\left(\frac{1\,\text{mol Au}}{3\,\text{mol}\,e^-}\right)$$

$= \boxed{6.2\times10^{-3}\ \text{mol Au}}$

29. If Copper (Cu) is placed in Hydrochloric acid (containing H^+) nothing will happen.
Remembering the SHE $H^+/H = 0.00V$
Copper has a higher reduction potential.
Since Copper in its solid form is already "reduced", nothing will happen.

30.



4,4-diethyl-2,5-dimethylhepta-2-ene