Acid # 10

1. $Al(NO_3)_3 + H_2O$ -----> $Al(H_2O)_6^{3+} + 3NO_3^{3-}$
Then:
$Al(H_2O)_6^{3+} + H_2O$ <—> $Al(H_2O)_5(OH)^{2+} + H_3O^+$
which can hydrolyze further into:
$Al(H_2O)_4(OH)_2^+$
and further into:
$Al(H_2O)_3(OH)_3$ which is neutral and then a precipitate.
Now adding additional OH^- causes further hydrolyzation into:
$Al(H_2O)_2(OH)_4^-$ which is soluble.

2. The Colour at the transition point equals that point where Ka of the indicator is the $[H_3O^+]$ in the solution.
Then: Ka= $[H_3O] = 5.2 \times 10^{-4}$
The pH = pKa = 3.28

3. Ka = Ka1 x Ka2 x Ka3
$(7.5\times10^{-3})\ (6.2\times10^{-8})\ (2.2\times10^{-13}) = 1.0\times10^{-22}$

4. $Ca(OH)_2 + H_2O$ <—> $Ca^{2+} + 2OH^-$
a pH of 12.32 => $[OH^-] = 2.09\times 10^{-2}$
since 2OH- are produced for each Ca^{2+}, then $[Ca^{2+}] = 1.05 \times 10^{-2}$ M

$Ksp = [Ca^{2+}][OH^-]^2$
$= (1.05\times 10^{-2})(2.09\times 10^{-2})^2$
$= 4.6\times 10^{-6}$

5. Moles OH^- = (42.55mL)(0.50M) = 21.28 m mol
at the equivalence point, mol H^+ = mol OH^-
moles H^+ = 21.28 mmol
Since the acid in monoprotic, then moles acid = 21.28 mmol

molecular mass = mass/mol = 2.6g/21.28 mmol = 1.2×10^2g/mol

6.(a) HSO_3^- Ka = 6.2×10^{-8} (1.0×10^{-7})
H3PO4 Ka = 7.1×10^{-3} (7.5×10^{-3})
Since $7.1\ x10^{-3}$ ($7.5\ x10^{-3}$) > 6.2×10^{-8} (1.0×10^{-7}), H3PO4 is stronger acid and equil shifts to favor reactants.

(b) HCO_3^- Ka = 4.7×10^{-11} (5.6×10^{-11})
H_2O_2 Ka = 2.4×10^{-12}
Since 4.7×10^{-11} (5.6×10^{-11}) > 2.4×10^{-12} , HCO_3^- in the stronger acid and products are favored

(c) HSO_3^- Ka = 6.2×10^{-8} (1.0×10^{-7})
HPO_4^{2-} Ka = 4.4×10^{-13} (2.2×10^{-13})
Then HSO_3^- in the acid
$HSO_3^- + HPO_4^{2-} \longleftrightarrow H_2PO_4^- + SO_3^{2-}$
$H_2PO_4^-$ Ka = 6.3×10^{-8} (6.2×10^{-8})
Since 6.3×10^{-8} (6.2×10^{-3}) is slightly greater than 6.2×10^{-8} (1.0×10^{-7})
then the products are favored.

(d) $CH_3COO^- + H_2PO_4^- \longleftrightarrow CH_3COOH + HPO_4^{2-}$
H2PO4 - Ka = 6.3×10^{-8} (6.2×10^{-8})
CH3OOH Ka = 1.8×10^{-5}
Since $1.8 \times 10^{-5} > 6.3 \times 10^{-8}$, then the reactants are favored.

7.a)
HC	Strongest acid
H_2A	
HB	
HA^-	
HD	weakest acid

b) The conjugate of the weakest acid is the strongest base.
The strongest base is D^-

c) $NaD + H_2O \longrightarrow Na^+_{(aq)} + D^-_{(aq)}$
Na+ do not hydrolyze.
$D^- + H_2O \longleftrightarrow HD + OH^-$