

Chemistry 101

Midterm Test #2 **KEY** $\bar{X} \pm sd = 89 \pm 19$

I. Multiple

choice: (5 points each, Any questions after #20 is considered bonus)

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|--|-----------------------------|
| _____ (1) a) Oxygen is the limited reagent in the combustion reaction. | _____ (13) a) +5 |
| _____ (2) e) Whether the reaction will proceed as written. | _____ (14) e) displacement. |
| _____ (3) a) H_2SO_4 and $CuSO_4$. | _____ (15) b) exchange |
| _____ (4) e) theoretical yield. | _____ (16) a) 1 3 2 3 |
| _____ (5) d) $AgCl$ | _____ (17) e) 36.0 |
| _____ (6) c) K_2SO_4 | _____ (18) d) 6 |
| _____ (7) c) $Al^{3+} + 3 OH^{-} \rightarrow Al(OH)_3$ | _____ (19) d) 16 |
| _____ (8) b) Strong acids are very concentrated. | _____ (20) c) VCl_3 |
| _____ (9) a) formation of a gas, precipitate or water. | _____ (21) c) C_2H_5 |
| _____ (10) a) Zn | _____ (22) c) 0.572 M |
| _____ (11) c) $Mg \rightarrow Mg^{2+}$ | _____ (23) b) 68.4% |
| _____ (12) e) None of the previous. | |

II

(1) answer: first, get the MW's: $C_2HOCl_3 + 2 C_6H_5Cl \rightarrow C_{14}H_9Cl_5 + H_2O$

$C_2HOCl_3 = 2(12.0) + (1.01) + 16.0 + 3(35.45) = 147.36 \text{ g/mol}$; total we have is: $25.0 \text{ g} / 147.36 = 0.170 \text{ mol}$

$C_6H_5Cl = 6(12.0) + 3(1.01) + 35.45 = 110.48 \text{ g/mol}$ total we have is $25.0 / 110.48 = 0.226$. It should at least be twice C_2HOCl_3 . So C_6H_5Cl is the limiting reagent.

$C_{14}H_9Cl_5 = 14(12.0) + 9(1.01) + 5(35.45) = 354.34 \text{ g/mol}$

OK: #g $C_{14}H_9Cl_5 = 0.226 \text{ mol } C_6H_5Cl (1 \text{ mol } C_{14}H_9Cl_5 / 2 \text{ mol } C_6H_5Cl) (354.34 \text{ g/mol}) = 40.1 \text{ g}$

(2) a) answer: $2 \text{H}_3\text{PO}_4 + 3\text{Mg}(\text{OH})_2 \rightarrow 6\text{H}_2\text{O} + \text{Mg}_3\text{PO}_4$

@ep: #mol $\text{H}^+ = \text{#mol OH}^-$; but mol $\text{H}^+ = 3 \times \text{#mol H}_3\text{PO}_4$ and mol $\text{OH}^- = 2 \times \text{#mol Mg}(\text{OH})_2$; so $3 M_1 V_1 = 2 M_2 V_2$ (where 1 = H_3PO_4 & 2 = $\text{Mg}(\text{OH})_2$): $M_2 = (3/2)(M_1 V_1 / V_2) = (3/2)(24.0)(.15) / (18.0) = \mathbf{0.30M}$

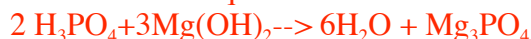
b) answer: @ equivalence point (ep), only Mg^{2+} and PO_4^{3-} ions are present. (that is, assuming that the Mg_3PO_4 is soluble) this is how you could calculate the ions:

mmol $\text{Mg}^{2+} = .30\text{M}(18.0\text{mL}) = 5.4 \text{ mmol Mg}$, mmol $\text{PO}_4^{3-} = .15(24) = 3.6 \text{ mmol PO}_4$.

$[\text{Mg}^{2+}] = 5.4 \text{ mmol} / (18.0 + 24.0 \text{ mL}) = \mathbf{0.129M}$; $[\text{PO}_4^{3-}] = \mathbf{0.0857 M}$.

However, if you recognized that Mg_3PO_4 is actually insoluble, you can say that the answers are really 0.0M for both ions.

c) answer: look at the equation:



after we add 12.0mL of acid: mmol $\text{Mg}(\text{OH})_2$

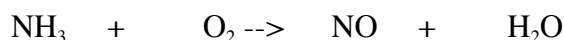
reacted = $12.0 \times (.15) (3 \text{ mol Mg}(\text{OH})_2 / 2 \text{ mol H}_3\text{PO}_4) = 2.7 \text{ mmol H}_3\text{PO}_4$

mmol Mg^{2+} remaining = total - reacted

= $(3 \text{ mmol Mg}(\text{OH})_2 (18.0 \text{ mL}) - 2.7 \text{ mmol}) = 2.7 \text{ mmol Mg}(\text{OH})_2$.

so $[\text{Mg}(\text{OH})_2]_{\text{remaining}} = 2.7 \text{ mmol} / (18.0 + 12.0) \text{ mL} = \mathbf{0.0900 M}$

4) Balance the following equation: (show how you got it below. For example, show the half reactions, etc)[10 pts]



Answer: ox. #'s: -3,+1 0 +2,-2 +1,-2

oxidation half rxn: balance O's: balance H's (assume acidic)
 $\text{NH}_3 \rightarrow \text{NO} + 5\text{e}^- \Rightarrow \text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NO} + 5\text{e}^- \Rightarrow \text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NO} + 5\text{e}^- + 5\text{H}^+$

reduction half rxn: balnce O's & e's: balance H's (assume acidic)
 $\text{O}_2 + 2\text{e}^- \rightarrow \text{H}_2\text{O} \Rightarrow \text{O}_2 + 4\text{e}^- \rightarrow 2\text{H}_2\text{O} \Rightarrow 4\text{H}^+ + \text{O}_2 + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}$

OK. To add the 2 half rxns, need to multiply the first by 4 and the second by 5 and then add:

