ACID BASE PART I
SHORT ANSWER REVIEW

1. $CH_3COOH + H_2O(l) \rightleftharpoons CH_3COO^- + H_3O^+$

	CH_3COOH	$H_2O(l)$	CH_3COO^-	H_3O^+
I	0.65		∅	∅
C	$-x$		$+x$	$+x$
E	"$0.65 - x \cong 0.65$"		x	x

$$K_a = \frac{x^2}{0.65} = 1.8 \times 10^{-5} \longrightarrow \sqrt{x^2} = \sqrt{(1.8 \times 10^{-5})(0.65)}$$

$$x = 3.4 \times 10^{-3}$$

$$\therefore [H_3O^+]_E \cong 3.4 \times 10^{-3}\ M$$

$$pH \cong -\log [3.4 \times 10^{-3}]$$

$$\boxed{pH = 2.47}$$

2. a)

	C_4H_7COOH	$+ H_2O \rightleftharpoons$	$C_4H_7COO^-$	$+ H_3O^+$
I	0.010		∅	∅
C	$-x$		$+x$	$+x$
E	"$0.010 - x \cong 0.010$"		x	x

$$K_a = \frac{x^2}{0.010} = 1.54 \times 10^{-5} \longrightarrow \sqrt{x^2} = \sqrt{(1.54 \times 10^{-5})(0.010)}$$

$$x = 3.9 \times 10^{-4}$$

$$\therefore [H_3O^+]_E = 3.9 \times 10^{-4}\ M$$

$$pH = -\log (3.9 \times 10^{-4})$$

b. $\boxed{pH = 3.41}$

3. $CH_3COOH + H_2O(l) \rightleftharpoons CH_3COO^- + H_3O^+$

1 X — Ø — Ø

	CH_3COOH	H_2O	CH_3COO^-	H_3O^+
C	-6×10^{-4}		$+6\times10^{-4}$	$+6\times10^{-4}$
E	$X-6\times10^{-4}$		6×10^{-4}	6×10^{-4}

$pH = 3.2 \therefore [H_3O^+]_E = \text{antilog}(-3.2) = 6\times10^{-4}$

$$K_a = \frac{(6\times10^{-4})^2}{X-6\times10^{-4}} = 1.8\times10^{-5} \Rightarrow (6\times10^{-4})^2 = 1.8\times10^{-5}\,x - 1.1\times10^{-8}$$

$$\rightarrow \frac{4\times10^{-7} - 1.1\times10^{-8}}{1.8\times10^{-5}} = \frac{1.8\times10^{-5}\,x}{1.8\times10^{-5}} \rightarrow 2\times10^{-2}\,M = X$$

$$\frac{1\times10^{-2}\ \text{mol}\ CH_3COOH}{1L} \times 1L = 2\times10^{-2}\ \text{mol} \times \frac{60.0\ g}{1\ \text{mol}}$$

2C = 24.0
2O = 32.0
4H = 4.0

$\cong 1\ g\ CH_3COOH$

4. $$\frac{[H^+]^2 \times [SO_3^{2-}]}{K_{a(3)}\ [H_2SO_3]} = \frac{[H^+][HSO_3^-]}{K_{a(1)}[H_2SO_3]} \times \frac{[H^+][SO_3^{2-}]}{[HSO_3^-]}$$

$$\Rightarrow \frac{[H^+][H^+][SO_3^{2-}]}{[H_2SO_3]}$$

$$\Rightarrow [H^+]^2[SO_3^{2-}] \,/\, [H_2SO_3]$$

$\therefore Ka_3 = 1.5 \times 10^{-2} \times 1.0 \times 10^{-7}$

$\boxed{Ka_3 = 1.5 \times 10^{-9}}$

5. $NaOH \longrightarrow Na^+ + OH^-$

5.0×10^{-6} $\qquad$ 5.0×10^{-6}

$\therefore [OH^-] = 5.0 \times 10^{-6} \rightarrow pOH = -\log(5.0 \times 10^{-6})$

$= 5.30$

$pH = 14.000 - 5.30$

$pH = 8.70$

$[H_3O^+] = \frac{1.00 \times 10^{-14}}{5.0 \times 10^{-6}}$

$= 2.0 \times 10^{-9}$

$[H_3O^+] = \text{antilog}(-8.70)$

$\boxed{= 2.0 \times 10^{-9}}$

6. $H_2CO_3 \rightarrow Ka = 4.3 \times 10^{-7}$

$HCO_3^- \rightarrow Ka = 5.6 \times 10^{-11}$

b/c $4.3 \times 10^{-7} > 5.6 \times 10^{-11}$

H_2CO_3 is the stronger acid.

7. $X^- + H_2O \rightleftharpoons HX + OH^-$

$Kw = Ka \times Kb \quad \therefore Ka = \frac{1.00 \times 10^{-14}}{4.1 \times 10^{-9}} = \boxed{2.4 \times 10^{-6}}$

8. HCO_3^- + $H_2PO_4^-$ $\rightleftharpoons$ H_2CO_3 + HPO_4^{2-}

base — acid — acid — base

a) $H_2PO_4^-$

b) H_2CO_3

c) HCO_3^-

d) HPO_4^{2-}

e) Reactants b/c $Ka\ H_2CO_3 > Ka\ H_2PO_4^-$

9. HSO_4^- + $H_2PO_4^-$ $\rightleftharpoons$ SO_4^{2-} + H_3PO_4

acid — base — base — acid

* PRODUCTS are favoured. b/c $Ka\ HSO_4^- > Ka\ H_3PO_4$

10. H_6TeO_6 $\xrightarrow{-H^+}$ $H_5TeO_6^-$

acid — base