AP Chem - Unit 10 - WKst: Reviews FR

(1)

$CH_3CH_2COOH_{(aq)} + H_2O_{(\ell)} \rightleftharpoons CH_3CH_2COO^-_{(aq)} + H_3O^+_{(aq)}$

PH = 2.79, 500 mL, 0.20 M

A) Acid Base CB CA

B) $K_a = \frac{[CH_3CH_2COO^-][H_3O^+]}{[CH_3CH_2COOH]}$

$pH = -\log[H^+]$

$[H^+] = 10^{-pH} = 10^{-2.79}$

$[H^+] = 0.00162\ M$ $[H^+] = [CH_3CH_2COO^-]$

$K_a = \frac{[0.00162][0.00162]}{[0.20]}$

$K_a = 1.3 \times 10^{-5}$

C)

i) PH = 7 ?

CH_3CH_2COOH : (50.0 mL)(.20 M) = 10.0 mmol

NaOH : (50.0 mL)(.20 M) = 10.0 mmol

$CH_3CH_2COOH + NaOH \rightarrow H_2O + NaCH_3CH_2COO$

Weak Acid Strong Base Basic SALT

In Beaker : Strong Base: NaOH $\rightarrow NaCH_3CH_2COO$

Weak Acid : CH_3CH_2COOH

Strong Wins : $H_2O \rightleftharpoons OH^-$

Strong Spectator : ~~Na~~ CH_3CH_2COO

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① cont:

i) $CH_3CH_2COO^- + H_2O \rightleftharpoons OH^- + CH_3CH_2COOH$

in Beaker: weak Base

∴ at equivalence pt pH greater 7

∴ False → why

ii) HCl pH = CH_3CH_2COOH pH

is molar concencentration $[HCl] \neq [CH_3CH_2COOH]$?

True - HCl is a strong acid that dissociates completely, whereas propanoic acid is a weak acid that does not dissociate completely. to Achieve equal pH the [HCl] must Be less the [propanoic]

d) $NaOH + CH_3CH_2COOH \rightarrow NaCH_3CH_2COO + H_2O$

NaOH: $(25.0mL)(0.10M) = 2.50mmol$

CH_3CH_2COOH: $(50.0mL)(0.20M) = 10.0mmol$

		CH_3CH_2COOH	OH^-	$CH_3CH_2COO^-$
	I	2.5 mmol	10.00 mmol	0
x = 2.5	C	-x	-x	x
		-2.5	-2.5	2.5
	E	0	7.5 mmol	2.5 mmol

? moles CH_3CH_2COOH

New Total Volume = 25 + 50 = 75.0mL

$\frac{7.5mmol}{75.0mL} = .10\ M\ CH_3CH_2COOH$

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d) cont. (new volume)

$$\left(\frac{.10\ \text{Moles}}{1\ \text{L}}\right)\left(\frac{75\text{ml}}{1}\right)\left(\frac{1\ \text{L}}{1000\text{ml}}\right) = \boxed{.0075\ \text{moles } CH_3CH_2COOH}$$

e) $[CH_3CH_2COO^-]$?

$$\frac{2.5\ \text{mmols}}{75\text{ml}} = \boxed{.033\ \text{M}}$$

f) $[H_3O^+]$ & pH ?

$$[H^+] = K_a \frac{[\text{Acid}]}{[\text{Base}]} \qquad \text{Added Base}$$

$$= 1.3\times10^{-5}\ \frac{(10.0-2.5)}{(0+2.5)}$$

$$\boxed{[H^+] = 3.9\times10^{-5}}$$

$pH = -\log[H^+]$

$\boxed{pH = 4.41}$

or //

$$pH = pK_a + \log\frac{[A^-]}{[HA]}$$

$pK_a = -\log K_a$

$pK_a = 4.89$

$$pH = 4.89 + \log\frac{(.033)}{\frac{.0075\ \text{moles}}{.075\text{L}}}$$

$pH = 4.41$

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#2

An experiment is performed to determine the molar mass of an unknown solid monoprotic acid, HA, by titration with a standardized NaOH solution.

(a) What measurement(s) must be made to determine the number of moles of NaOH used in the titration?

Initial volume of standardized NaOH solution and final volume of standardized NaOH solution (volume at the endpoint of the titration)	1 point for identifying both initial and final volume of base

(b) Write a mathematical expression that can be used to determine the number of moles of NaOH used to reach the endpoint of the titration.

$M_{NaOH} \times V_{NaOH}$ (Molarity of NaOH solution) times (volume (in L) of NaOH added)	1 point for mathematical expression

(c) How can the number of moles of HA consumed in the titration be determined?

$HA + NaOH \rightarrow NaA + H_2O$ moles HA = moles NaOH moles monoprotic acid = moles NaOH $n_{HA} = \text{moles NaOH}\left(\frac{1 \text{ mol HA}}{1 \text{ mol NaOH}}\right)$	1 point for showing conversion based on stoichiometry of the neutralization reaction

(d) In addition to the measurement(s) made in part (a), what other measurement(s) must be made to determine the molar mass of the acid, HA ?

mass of HA	1 point for measurement

(e) Write the mathematical expression that is used to determine the molar mass of HA.

$\frac{\text{mass HA}}{\text{mol HA}}$ mass of HA measured in part (d) divided by the moles of HA determined in part (c)	1 point for quotient

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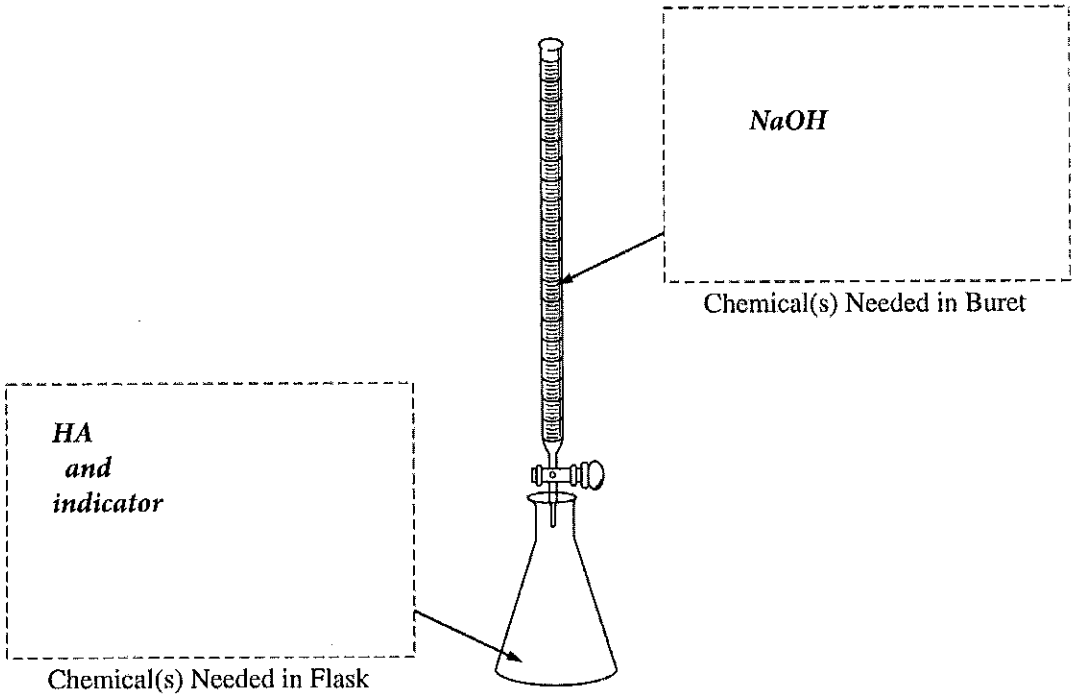
#2)

(f) The following diagram represents the setup for the titration. In the appropriate boxes below, list the chemical(s) needed to perform the titration.



Chemicals needed in flask: solid weak monoprotic acid (HA) and an indicator to detect endpoint of titration Chemical in buret: standardized NaOH solution	1 point for either one of two chemicals in flask, 2 points for both 1 point for NaOH in the buret

(g) Explain what effect each of the following would have on the calculated molar mass of HA. Justify your answers.

(i) The original solid acid, HA, was not completely dry at the beginning of the experiment.

Measured mass of HA is larger; so, according to expression in part (e), calculated molar mass will be higher than it should.	1 point for the effect on molar mass and explanation.

(ii) The procedure called for 25 mL of H_2O in the Erlenmeyer flask, but a student used 35 mL of H_2O.

No effect on calculated molar mass, because mathematical expression for molar mass does not include amount of water used to dissolve solid HA. Both mass and number of moles of HA are unaffected by the addition of water.	1 point for effect on molar mass and explanation.