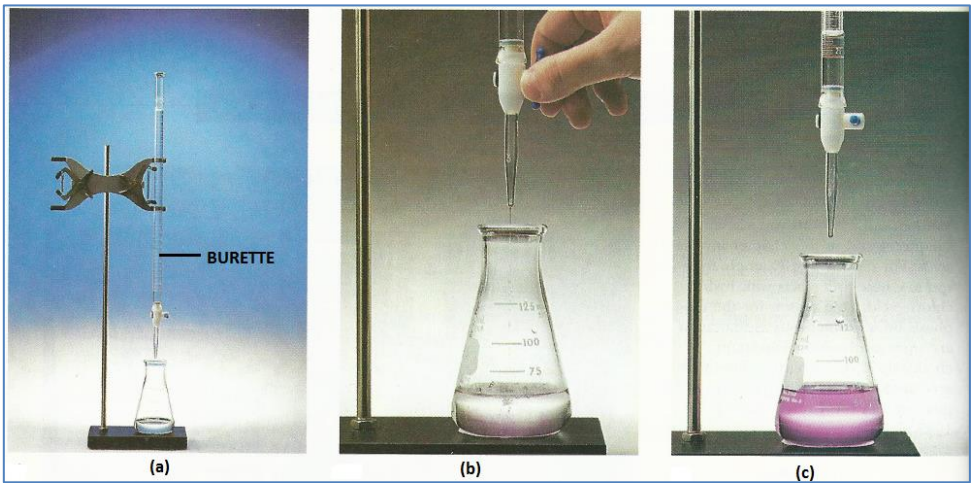
NORTHERN CAPE DEPARTMENT OF EDUCATION
NOORD- KAAP DEPARTEMENT VAN ONDERWYS

PHYSICAL SCIENCES/ *FISIESE WETENSKAPPE*
CHEMISTRY/*CHEMIE*
GRADE 12 /GRAAD 12



CONSOLIDATION/*KONSOLIDASIE*

ACIDS AND BASES

SURE EN BASISSE

MEMORANDUM

COMPILED BY/*SAAMGESTEL DEUR*:

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2020

MEMO

1 D

2 B

3 B

4 A

5 C

6 C

7.1

$$c = \frac{m}{MV}$$

$$= \frac{2}{(23+16+1)2}$$

$= 0,025\ mol \cdot dm^{-3}$

$NaOH \rightarrow Na^{+}(aq) + OH^{-}(aq)$

$\therefore [OH^{-}] = 0,025\ mol \cdot dm^{-3}$

$Kw = [H_3O^{+}][OH^{-}]$

$10^{-14} = [H_3O^{+}]\ 0,025$

$[H_3O^{+}] = 4x10^{-13}\ mol \cdot dm^{-3}$

$pH = -\log[H_3O^{+}] = -\log[4x\ 10^{-13}]$

$= 12,40$

OR

$$c = \frac{m}{MV}$$

$$= \frac{2}{(23+16+1)2}$$

$= 0,025\ mol \cdot dm^{-3}$

$Na\ OH \rightarrow Na^{+}(aq) + OH^{-}(aq)$

$\therefore [OH^{-}] = 0,025\ mol \cdot dm^{-3}$

$pOH = -\log[OH^{-}]$

$= -\log(0,025)$

$= 1,60$

$pH = 14 - pOH$

$= 14 - 1,60$

$= 12,40$

7.2

$$c = \frac{m}{MV}$$

$$= \frac{1}{(24+2[16+1])0,5}$$

$= 0,0345\ mol \cdot dm^{-3}$

$Mg(OH)_2 \rightarrow Mg^{2+}(aq) + 2OH^{-}(aq)$

$1\ mol\ Mg(OH)_2 \rightarrow 2\ mol\ OH^{-}$

$\therefore [OH^{-}] = (2)(0,0345) = 0,069\ mol \cdot dm^{-3}$

$pOH = -\log[OH^{-}]$

$= -\log(0,069) = 1,16$

$pH = 14 - 1,16$

$= 12,82$

7.3 $H_2SO_4 \rightarrow 2H^+(aq) + SO_4^-(aq)$

1 mol $H_2SO_4 \rightarrow$ 2 mol H^+

$[H^+] = [H_3O^+] = (2)(0,2) = 0,4$

$pH = -\log[H_3O^+]$

$= -\log(0,4) = 0,4$

7.4 $CH_3COOH \rightarrow CH_3COO^-(aq) + H^+(aq)$

$$= K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]} = \frac{[H^+]^2}{[CH_3COOH]}$$

$$1,8 \times 10^{-5} = \frac{[H^+]^2}{0,02}$$

$[H^+] = [H_3O^+] = 0,0006$ mol·dm^{-3}

$pH = -\log[H_3O^+] = -\log[0,0006]$

$= 3,22$

STRUCTURED QUESTIONS

QUESTION 1

1.1 $pH = -\log[H_+]$ ✓

$= -\log(3,2x10^{-5})$ ✓

$= 4,5$ ✓

NO, the fish will not survive✓

Nee, die vis sal nie oorleef nie (4)

1.2 A substance that donates protons (H_+) OR proton donor ✓✓

'N Stof wat protone (H +) OF proton skenker (2)

1.3

1.3.1 C (Na_2CO_3) ✓ (1)

1.3.2 A ($HC\ell$) ✓ (1)

1.3.3 D (CH_3COOH) ✓ (1)

QUESTION 2

2.1 $c = \frac{m}{MV}$

$0,2 = \frac{m}{(39+16+1)(0,3)}$

$m = 3,36\ g$

2.2 $KOH \rightarrow K^+(aq) + OH^-(aq)$

$[OH^-] = [KOH] = 0,2$ (Ratio - 1:1)

$[H_3O^+][OH^-] = 10^{-14}$

$[H_3O^+] = \frac{10^{-14}}{0,2}$

$= 5x10^{-14}$

$pH = -\log[H_3O^+] = -\log[5 \times 10^{-14}]$

$= 13,3$

2.3 $\frac{C_a V_a}{C_b V_b} = \frac{n_a}{n_b}$

$\therefore \frac{C_a(20,0)}{(0,2)(15,0)} = \frac{1}{2}$ (ratio)

$\therefore C_a = \frac{(0,2)(15,0)}{(2)(20,0)} = 0,075\ mol \cdot dm^{-3}$

QUESTION 3

3.1 $m = cMV$

$= 0,2 \times 58 \times 0,5$

$= 5,8\ g$

3.2 $0,2 \times 2 = 0,4\ mol \cdot dm^{-3}$

3.3 $[OH] = 0,4\ mol \cdot dm^{-3}$

$pOH = -\log[OH] = -\log(0,4) = 0,4$

$pH + pOH = 14$

$pH = 14 - 0,4 = 13,6$

The solution is NOT safe for consumption.

Die oplossing is nie veilig vir menslike verbruik nie.

3.4 $\frac{C_a V_a}{C_b V_b} = \frac{n_a}{n_b}$

$\frac{(0,1)V_a}{(0,2)(0,025)} = \frac{2}{1}$

$V_a = 0,1 dm^3$

QUESTION 4

4.1 Burette/*Buret*

4.2 weak acid ionizes (incompletely) in water to form a low concentration of H_3O^+ .
swak suur dissosieer (onvolledig) in water tot 'n lae konsentrasie van H_3O^+.

4.3 colour change of indicator / kleurverandering van aanwyser

4.4 Phenolphthalein because the equivalent point will be at pH > 7 since CH_3 COOH is weak acid and KOH a strong base.
Fenolftaleïen omdat die ekwivalent punt by pH > 7 sal wees aangesien CH_3COOH 'n swak suur is en KOH 'n sterk basis is.

4.5 average volume /*gemiddelde volume* = $\frac{21,1 + 21,1 + 20,9}{3}$

$= 21,0$

$$\frac{Ca\ Va}{Cb\ Vb} = \frac{na}{nb}$$

$$\frac{Ca \times 21,0}{0,009 \times 25} = \frac{1}{1}$$

$Ca = 0,01\ mol.dm^{-3}$

4.6 no of moles of CH_3COOH before dilution/ *hoeveelheid mol CH_3COOH voor verdunning* = no of moles of CH_3COOH after dilution./ *hoeveelheid mol CH_3COOH na verdunning.*

$n(CH_3COOH$ before dilution = $n(CH_3COOH)$ after dilution ✓

$C_1V_1 = C_2V_2$

$C_1 \times 25 = 0,01 \times 250$

$C_1 = 2,5\ mol.dm^{-3}$

QUESTION 5

5.1 $n_{HF} = cV = (0,5)(0,1) = 0,05$ mol

n_{OH^-} reacted /*gereageer*= 0,05 mol (Ratio/*verhouding* - 1:1)

n_{OH^-} initial/$_{aanvanklik} = cV = (0,8)(0,25) = 0,2$ mol

n_{OH^-} excess/*oortollig* = 0,2-0,05

= 0,15 mol

5.2 $c_{OH^-} = \frac{n}{V} = \frac{0,15}{(0,5+0,8)}$

$= 0,115$ mol·dm^{-3}

$[H_3O^+][OH^-] = 10^{-14}$

$[H_3O^+] = \frac{10^{-14}}{0,115}$

$= 8,69 \times 10^{-14}$

$pH = -\log[H_3O^+] = -\log[8,69 \times 10^{-14}]$

$= 13,06$

QUESTION 6

$$\frac{n_a}{n_b} = \frac{c_a v_a}{c_b v_b}$$

$$\frac{2}{1} = \frac{0,1 \times 0,02}{c_b \times 0,015}$$

$C_b = 0,067$ moldm^{-3}

$$c = \frac{m}{MV}$$

$$0,067 = \frac{m}{58 \times 0,02}$$

$m = 0,078$ g (in 20 cm^3 or 0,02 dm^3)

In 0,02 dm^3 → 0,078 m $Mg(OH)_2$

So in 0,25 dm^3 → 0, 975 $Mg(OH)_2$

$$\therefore \%\ \text{purity} = \frac{\text{mass of compound}}{\text{mass of sample}} \times 100$$

$$\therefore \%\text{purity} = \frac{0,975}{2,56} \times 100$$

= 38,09 %

QUESTION 7

7.1 $NaOH\ (aq) \rightarrow Na^+(aq) + OH^-(aq)$

$[OH^-] = 0,11\ mol.dm^3$

$pOH = -\log[OH^-] = -\log(0,11) = 0,959$

$pH + pOH = 14$

$pH = 14 - 0,959 = 13,04$

7.2 $n = CV$

$= 0,11 \times 0,0285$

$= 3,14 \times 10^{-3}\ mol$

7.3 $n_{acid} : n_{base} = 1 : 1$

$n_{acid} = 3,14 \times 10^{-3}\ mol$

m_{acid} in 28,5 $cm^3 = nM = (3,14 \times 10^{-3})(60)$

$= 0,188\ g$

m_{acid} in 100 $cm^3 = 0,188 \times 3,51 = 0,66\ g$

$$\% \text{ of } CH_3COOH = \frac{\text{Original mass}}{\text{mass of the sample}} \times 100$$

$$= \frac{0,66}{7,5} \times 100$$

$= 8,8\ \%$

QUESTION 8

8.1 An acid forms hydronium ions / H_3O^+ ions when it dissolves in water. ✓✓

'n Suur vorm hidroniumione / H_3O^+-ione wanneer dit in water oplos. (2)

8.2 Incompletely / partially ionised ✓

Onvolledig / gedeeltelik geioniseer (1)

8.3 Solution of known concentration. / *Oplossing van bekende konsentrasie*. ✓ (1)

8.4 Burette / *Buret* ✓

Pipette / *Pipet* ✓ (2)

8.5

8.5.1

OPTION 1/*OPSIE 1*

$K_w = [H_3O^+][OH^-]$

$\therefore 1 \times 10^{-14} = [H_3O^+](0,5)$ ✓

$\therefore [H_3O^+] = 2 \times 10^{-14}\ mol \cdot dm^{-3}$

$pH = - \log[H_3O^+]$ ✓

$= - \log (2 \times 10^{-14})$ ✓

$= 13,7$ ✓

OPTION 2/*OPSIE 2*

$pOH = - \log[OH^-]$ ✓

$= - \log(0,5)$ ✓

$= 0,3$

$pH = 14 - pOH$ ✓

$= 14 - 0,3$

$= 13,7$ ✓

(4)

8.5.2 $n(NaOH) = cV$ ✓

$= (0,5)(0,04)$ ✓

$= 0,02$ mol

$n(CH_3COOH) = n(NaOH) = 0,02$ mol ✓

$m(CH_3COOH) = nM$ ✓

$= (0,02)(60)$ ✓

$= 1,2$ g

% mass of / *massa van* $CH_3COOH = \frac{1,2}{20} \times 100 = 6\%$ ✓ (7)

8.6 $CH_3COO^-(aq) + H_2O(\ell)$ ✓ → $CH_3COOH(aq) + OH^-(aq)$ ✓ Bal. ✓ (2)