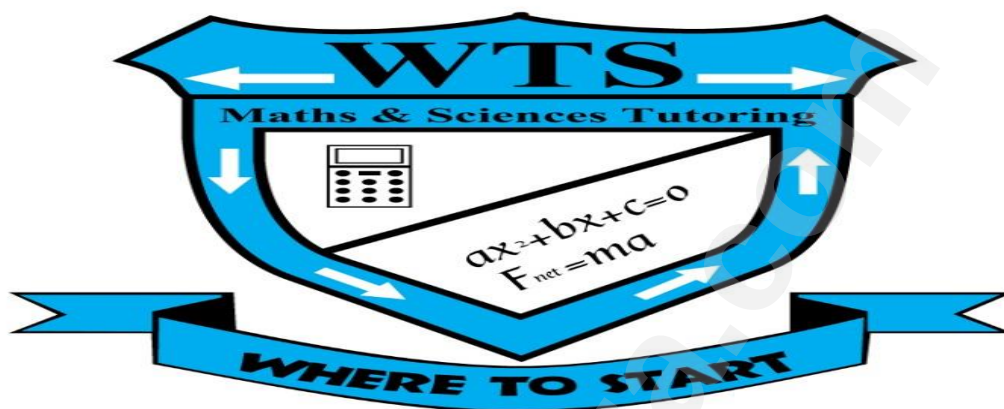




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WTS TUTORING



WTS

ACIDS AND BASES MEMO

GRADE : 12

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QUESTION/VRAAG 7

7.1.1 Hydrolysis ✓ / *Hidroliese* (1)

7.1.2 Weak ✓ / *Swak*
 K_b value/waarde is < 1 ✓
 OR/OF
 K_b value is low ✓ / *K_b waarde is laag* (2)

7.1.3 Acids ✓ / *Sure*
 Both act as proton (H^+) donors ✓ / *Donate protons(H^+)/Lose protons(H^+)*
Beide tree op as proton (H^+) skenkers/Proton(H^+) skenkers/Verloor proton (H^+). (2)

7.2.1 Burette ✓ / *buret* (1)

7.2.2 20 cm^3 ✓ (1)

7.2.3 **POSITIVE MARKING from QUESTION 7.2.2/**
POSITIEWE NASIEN vanaf VRAAG 7.2.2



$$n = Cv \checkmark$$

$$n(\text{NaOH}) = 0,2 \times 20/1000 \checkmark = 0,004 \text{ mol } \checkmark (4 \times 10^{-3} \text{ mol}) \quad (3)$$

7.2.4 **POSITIVE MARKING FROM QUESTION 7.2.3/**
POSITIEWE NASIEN VANAF VRAAG 7.2.3



$$n(\text{H}_2) = \frac{1}{2} (0,004) \checkmark = 0,002 \text{ mol } (2 \times 10^{-3} \text{ mol})$$

$$c(\text{H}_2\text{X}) = n / V = 0,002 / (40/1000) \checkmark = 0,05 \text{ mol} \cdot \text{dm}^{-3}$$

$$\text{pH} = -\log[\text{H}_3\text{O}^+] \checkmark = -\log(2 \times 0,05) \checkmark = 1 \checkmark$$

(5)

Marking Criteria/Nasien riglyne:

- Use of ratio/Gebruik verhouding $\text{NaOH} : \text{H}_2\text{X}$ ✓
- Substitution into $c = n/V$ to calculate $n(\text{H}_2\text{X})$.
Substitusie in $c = n/V$ om $n(\text{H}_2\text{X})$ te bereken. ✓
- Use formule/Gebruik formule: $\text{pH} = -\log [\text{H}_3\text{O}^+]$ ✓
- Substitution of $2 \times c(\text{H}_2\text{X})$ into $[\text{H}_3\text{O}^+]$ ✓
Substitusie van $2 \times c(\text{H}_2\text{X})$ in $[\text{H}_3\text{O}^+]$
- Final answer/Finale antwoord ✓

7.2.5 Neutral ✓ / *Neutraal*



(Titration of) strong base with a strong acid. ✓
(Titrasië van) 'n sterk basis met 'n sterk suur.

(2)

[18]

QUESTION / VRAAG 6

6.1 An acid is a substance that donates a proton. ✓✓

Or

An acid is a proton donor.

'n Suur is 'n stof wat 'n proton skenk.

Of

'n Suur is 'n protonskenker.

(2)

6.2 HPO_4^{2-} ✓

(1)

6.3 6.3.1 Bromothymol blue. ✓ / broomtimolblou

(1)

6.3.2 Strong acid + strong base ✓ pH range is between 6 and 7,6 ✓
Sterk suur + sterk basis pH reeks is tussen 6 en 7,6

(2)

6.3.3 OPTION / OPSIE 1

OPTION / OPSIE 2

$$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b} \checkmark$$

$$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b} \checkmark$$

$$\frac{(0,1)(15) \checkmark}{c_b (20) \checkmark} = \frac{1}{2} \checkmark$$

$$\frac{(0,1) \left(\frac{15}{1000} \right) \checkmark}{c_b \left(\frac{20}{1000} \right) \checkmark} = \frac{1}{2} \checkmark$$

$$c_b = 0,15 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

$$c_b = 0,15 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

(5)

6.3.4 Option / Opsie 1

Option / Opsie 2

$$\text{pOH} = -\log [\text{OH}] \checkmark$$

$$\text{KOH} = 0,15 \text{ mol} \cdot \text{dm}^{-3}$$

$$\text{pOH} = -\log (0,15) \checkmark$$

$$[\text{OH}][\text{H}_3\text{O}^+] = 10^{-14} = K_w \checkmark$$

$$\text{pOH} = -(-0,82)$$

$$[\text{H}_3\text{O}^+] = \frac{10^{-14}}{0,15} \checkmark$$

$$\text{pOH} = 0,82$$

$$= 6,67 \times 10^{-14} \text{ mol} \cdot \text{dm}^{-3}$$

$$\text{pH} + \text{pOH} = 14 \checkmark$$

$$\text{pH} = 14 - \text{pOH}$$

$$\text{pH} = -\log [\text{H}_3\text{O}^+] \checkmark$$

$$\text{pH} = 14 - 0,82 \checkmark$$

$$= -\log (6,67 \times 10^{-14}) \checkmark$$

$$\text{pH} = 13,18 \checkmark$$

$$= 13,18 \checkmark$$

The pH of a 0,15 M solution of potassium hydroxide is 13,18.

Die pH van 'n 0,15 M oplossing van kaliumhidroksies is 13,18.

(5)

6.4 6.4.1 Hydrolysis ✓ *Hidroliese*

(1)

6.4.2 SMALLER THAN 7 ✓ *KLEINER AS 7*

(1)

6.4.3 Hydrolysis of the salt of a strong acid and a weak base ✓ results in an acidic solution.

Hidroliese van die sout van 'n sterk suur en 'n swak basis eindig in 'n suur oplossing.

(1)

[19]

QUESTION 8

8.1 8.1.1 Strong acid ✓ (1)

8.1.2 (5)

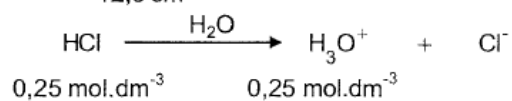
Vol. of conc. HCl required

$$\begin{aligned} n &= CV \checkmark \\ &= 0,25 \times 0,5 \checkmark \\ &= 0,0125 \checkmark \end{aligned}$$

OR

$$\begin{aligned} c_1 V_1 &= c_2 V_2 \checkmark \\ (10)(x) &= (0,25)(0,5) \checkmark \\ x &= 0,0125 \text{ dm}^3 \\ &= 12,5 \text{ cm}^3 \checkmark \end{aligned}$$

8.1.3



$$\begin{aligned} \text{pH} &= -\log [\text{H}_3\text{O}^+] \checkmark \\ &= -\log (0,25) \checkmark \\ &= 0,60 \checkmark \end{aligned}$$

(3)

8.2 8.2.1 **Option 1** $n(\text{HCl}) = cV = (0,25)(0,5)$
 $= 0,125 \text{ mol}$

$$n(\text{NaOH}) = cV = (0,2)(0,14)$$

$$= 0,028 \text{ mol}$$

$$n(\text{HCl}) \text{ reacted with } (\text{NaOH}) = 0,028 \text{ mol}$$

$$n(\text{HCl}) \text{ reacted with } (\text{CaCO}_3) = 0,125 - 0,028$$

$$= 0,097 \text{ mol}$$

$$n(\text{CaCO}_3) = \frac{1}{2} \times 0,097$$

$$= 0,0485 \text{ mol}$$

$$\text{mass of } \text{CaCO}_3 = nM$$

$$= 0,0485 \times 100$$

$$= 4,85 \text{ g}$$

Option 2

Volume of HCl reacted with NaOH

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

$$\frac{(0,25)V_a}{(0,2)(140)} = \frac{1}{1}$$

$$V_a = 112 \text{ cm}^3$$

Volume of HCl reacted with CaCO_3

$$V_{\text{HCl}} = 500 - 112$$

$$= 388 \text{ cm}^3$$

$$= 0,388 \text{ dm}^3$$

No. of mol of HCl reacted with CaCO_3

$$C = \frac{n}{V}$$

$$0,25 = \frac{n}{0,388}$$

$$n = 0,097 \text{ mol}$$

No. of mol of CaCO_3 reacted with HCl

$$n_{\text{HCl}} : n_{\text{CaCO}_3} = 2 : 1$$

$$n_{\text{CaCO}_3} = \frac{0,097}{2}$$

$$= 0,0485 \text{ mol}$$

Mass of mol of CaCO_3 reacted with HCl

$$m = n \cdot M$$

$$= 0,0485 \cdot 100$$

$$= 4,85 \text{ g}$$
(8)

8.2.2 (3)

$$\% \text{ purity} = \frac{\text{mass of } \text{CaCO}_3}{\text{mass of sample}} \cdot 100$$

$$= \frac{4,85}{5} \cdot 100$$

$$= 97\%$$

QUESTION 7/VRAAG 7

- 7.1.1 An acid is a proton donor ✓
 a base is a proton acceptor ✓ //
'n Suur is 'n protonskenker ✓
'n basis is 'n protonontvanger ✓ (2)
- 7.1.2 Ampholyte /amphiprotic substance ✓ //
Amfoliet /amfiprotiese stof ✓ (1)
- 7.1.3 B ✓ ✓ (2)
- 7.1.4 HCO_3^- ✓ (1)
- 7.1.5 It can donate two protons ✓ //
dit kan twee protone skenk ✓ (1)
- 7.2.1 $M(\text{CaCO}_3) = 40 + 12 + 3(16) = 100 \text{ g}\cdot\text{mol}^{-1}$
- $n = \frac{m}{M} \checkmark = \frac{0,8}{100} \checkmark = 0,008 \text{ mol} \checkmark$ CaCO_3 has reacted //
 CaCO_3 het gereageer
- 2 mol HCl reacts with // *reageer met* 1 mol CaCO_3 ✓
- $\therefore 2(0,008) = 0,016 \text{ mol} \checkmark$ HCl reacted with // *reageer met* 1 mol CaCO_3 (5)
- 7.2.2 Initial // *Aanvanklik*: moles HCl: $n = cV \checkmark = 0,5 \times 0,06 \checkmark = 0,03 \text{ mol} \checkmark$
- HCl left // *oor* = $0,03 - 0,016 = 0,014 \text{ mol} \checkmark$
- (HCl is a strong acid and ionises completely thus $n(\text{H}^+) = 0,014 \text{ mol}$ //
HCl is 'n sterk suur en ioniseer volledig: mol $\text{H}^+ = 0,014 \text{ mol}$)
- $c = \frac{n}{V} = \frac{0,014}{0,06} \checkmark = 0,23 \text{ mol}\cdot\text{dm}^{-3} \checkmark$
- $\text{pH} = -\log [\text{H}^+] \checkmark = -\log (0,23) \checkmark = 0,64 \checkmark$ (9)

[21]

	N ₂	3 H ₂	2 NH ₃
[] start / begin	2	3,25 ✓	0
[] react/form [] reageer / vorm	-0,75	-2,25 ✓	+1,5 ✓
[] equilibrium [] ewewig	1,25	1 ✓	1,5

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3} \checkmark$$

$$1,8 = \frac{(1,5)^2}{(1,25)[H_2]^3} \checkmark$$

$$[H_2] = 1 \text{ mol} \cdot \text{dm}^{-3}$$

$$\begin{aligned} m &= n \times M \\ &= 6,5 \times 2 \checkmark \\ &= 13 \text{ g} \checkmark \end{aligned}$$

[13]

QUESTION 7 / VRAAG 7

7.1.1 H₃O⁺ acts as a proton donor. ✓✓
H₃O⁺ tree as 'n protonskenker op.

(2)

7.1.2 HPO₄²⁻ ✓

(1)

7.1.3 Ampholyte / Amfoliet ✓

(1)

7.2.1 OPTION 1 / OPSIE 1

$$\begin{aligned} \text{pH} &= -\log[H_3O^+] \\ 13,6 &= -\log[H_3O^+] \\ [H_3O^+] &= 2,51189 \times 10^{-14} \checkmark \end{aligned}$$

$$[H_3O^+][OH^-] = 1 \times 10^{-14}$$

$$[OH^-] = \frac{1 \times 10^{-14}}{2,51189 \times 10^{-14}} \checkmark$$

$$= 0,4 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

$$[Ba(OH)_2] = \frac{1}{2} \times 0,4 = 0,2 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

OPTION 2 / OPSIE 2

$$\text{pH} + \text{pOH} = 14$$

$$\text{pOH} = 14 - 13,6 \checkmark$$

$$= 0,4$$

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

$$0,4 = -\log[OH^-] \checkmark$$

$$[OH^-] = 10^{-0,4}$$

$$= 0,4 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

$$[Ba(OH)_2] = \frac{1}{2} \times 0,4 = 0,2 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

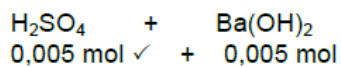
(4)

7.2.2 $n = c \times V \checkmark$
 $= 0,2 \times 0,025 \checkmark$
 $= 0,005 \text{ mol} \checkmark$

(3)

7.2.3 POSITIVE MARKING FROM QUESTION 7.2.1

$$\text{H}_2\text{SO}_4 : n = cV = 0,15 \times 0,04 = 0,006 \text{ mol} \checkmark$$



$$n(\text{H}_2\text{SO}_4) \text{ excess / oormaat} = 0,006 - 0,005 = 0,001 \text{ mol} \checkmark$$

$$\begin{aligned} c &= \frac{n}{V} \\ &= \frac{0,001}{0,065} \checkmark \\ &= 0,0154 \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

$$[\text{H}_3\text{O}^+] = 2 \times 0,0154 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

$$\begin{aligned} \text{pH} &= -\log [\text{H}_3\text{O}^+] \checkmark \\ &= -\log (0,0308) \\ &= 1,51 \checkmark \end{aligned}$$

(7)

7.3.1 The reaction of a salt $\checkmark$ with water. $\checkmark$
Die reaksie van 'n sout met water.

(2)

7.3.2 Neutral / Neutraal $\checkmark$

(1)

[21]**Marking criteria/Nasienriglyne**

- 0,006 mol
- Ratio
- Subtraction: $0,006 - 0,005 \text{ mol}$
Trek af: $0,006 - 0,005 \text{ mol}$
- $0,065 \text{ dm}^{-3}$
- pH formula / formule
- $2 \times 0,0154 \text{ mol}$
- Answer / Antwoord: 1,51

QUESTION 8/VRAAG 8

8.1 A solution of which the concentration is (precisely) known ✓✓ /
 'n Oplossing waarvan die konsentrasie presies bekend is. (2)

8.2 HSO_4^- ✓ (1)

8.3 **OPTION 1/OPSIE 1**

$$\text{pH} = -\log [\text{H}^+] \checkmark$$

$$1 = -\log [\text{H}^+] \checkmark$$

$$[\text{H}^+] = 0,1 \text{ mol}\cdot\text{dm}^{-3}$$

$$[\text{H}_2\text{SO}_4] = \frac{1}{2} [\text{H}^+] = 0,05 \text{ mol}\cdot\text{dm}^{-3} \checkmark$$

$$n_a = c_a V$$

$$= (0,05)(0,012) \checkmark$$

$$= 6 \times 10^{-4} \text{ mol}$$

$$n(\text{H}_2\text{SO}_4) : n(\text{NaHCO}_3) = 1:2$$

$$n(\text{NaHCO}_3) = (2)(6 \times 10^{-4}) \checkmark$$

$$= 12 \times 10^{-4} \text{ mol}$$

$$c = \frac{n}{V}$$

$$c = \frac{12 \times 10^{-4}}{0,02} \checkmark$$

$$= 0,06 \text{ mol}\cdot\text{dm}^{-3} \checkmark$$

OPTION 2/OPSIE 2

$$\text{pH} = -\log [\text{H}^+] \checkmark$$

$$1 = -\log [\text{H}^+] \checkmark$$

$$[\text{H}^+] = 0,1 \text{ mol}\cdot\text{dm}^{-3}$$

$$[\text{H}_2\text{SO}_4] = \frac{1}{2} [\text{H}^+] = 0,05 \text{ mol}\cdot\text{dm}^{-3} \checkmark$$

$$\frac{n_a}{n_b} = \frac{c_a V_a}{c_b V_b}$$

$$\checkmark \frac{1}{2} = \frac{(0,05)(12)}{(c_b)(20)} \checkmark$$

$$c_b = 0,06 \text{ mol}\cdot\text{dm}^{-3} \checkmark$$

(7)

8.4 **POSITIVE MARKING FROM QUESTION 8.3/POSITIEWE NASIEN VAN VRAAG 8.3**

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

$$0,06 = \frac{m}{(84)(0,25)} \checkmark$$

$$m = 1,26 \text{ g} \checkmark$$

(3)

8.5 methyl orange/metieloranje ✓

Here the pH of the salt produced will be below 7. ✓ / Die pH van die gevormde sout is kleiner as 7

ACCEPT/AANVAAR

Weak base react with strong acid / Swak basis reageer met 'n sterk suur

(2)

[15]

QUESTION 7 (Start on a new page.)

- 7.1 7.1.1 A substance that can act as an acid and as a base. ✓✓ (2)
- 7.1.2 Acid. ✓
It is a proton donor/it donates a proton. ✓ (2)
- 7.2 7.1.3 $\text{PO}_4^{3-}(\text{aq})$ ✓ (1)
- 7.2.1 Basic. ✓ (1)
- 7.2.2 $\text{pH} = -\log [\text{H}^+]$ ✓
 $13,3 = -\log [\text{H}^+]$
 $[\text{H}^+] = 5,01 \times 10^{-14} \text{ mol.dm}^{-3}$
 $[\text{OH}^-] = \frac{10^{-14}}{[\text{H}^+]}$ ✓
 $= \frac{10^{-14}}{5,01 \times 10^{-14}}$ ✓
 $= 0,2 \text{ mol.dm}^{-3}$ ✓ (5)
- 7.2.3 $\frac{C_{\text{a}} V_{\text{a}}}{C_{\text{b}} V_{\text{b}}} = \frac{n_{\text{b}}}{n_{\text{a}}}$ ✓ N.B Positive marking - 7.2.2 to 7.2.3.
 $\frac{C_{\text{a}}(17,85)}{(0,2)(25)} = \frac{1}{2}$ ✓
 $C_{\text{a}} = 0,14 \text{ mol.dm}^{-3}$ ✓ (5)
- 7.2.4 $X + 16 + 1 = 56$
 $X = 39 \text{ g.mol}^{-1}$ ✓
 $X = \text{K (potassium)}$ ✓ (2)

[18]

QUESTION/VRAAG 7

7.1 Solution with known concentration. ✓✓
Oplossing waarvan konsentrasie bekend is. (2)

7.2 Improve accuracy of results./Ensuring more accurate results. ✓
Verbeter akkuraatheid van resultate./Versekering meer akkurate lesings. (1)

7.3 $n = cV$ ✓
 $= 0,02 \times 25 \times 10^{-3}$ ✓
 $= 5 \times 10^{-4} \text{ mol}$ ✓ (0,0005 mol) (3)

7.4 **POSITIVE MARKING FROM QUESTION 7.3**
POSITIEWE NASIEN VANAF VRAAG 7.3

$n(\text{NaOH}) = 2 \times 5 \times 10^{-4}$ $= 1 \times 10^{-3} \text{ mol}$ $c(\text{NaOH})_{\text{dilute/opgelos}} = n/V$ $= 1 \times 10^{-3} / 19,97 \times 10^{-3}$ ✓ $= 0,05 \text{ mol} \cdot \text{dm}^{-3}$ OR/OR $c(\text{NaOH})_{\text{dilute/opgelos}} \times V_{\text{dilute/opgelos}}$ $= c(\text{NaOH}) \times V(\text{NaOH})$ $0,05 \times 100 = c(\text{NaOH}) \times 10$ ✓ $c(\text{NaOH}) = 0,5 \text{ mol} \cdot \text{dm}^{-3}$ $[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$ $[\text{H}_3\text{O}^+] \cdot 0,5 = 10^{-14}$ $[\text{H}_3\text{O}^+] = 2 \times 10^{-14} \text{ mol} \cdot \text{dm}^{-3}$ $\text{pH} = -\log[\text{H}_3\text{O}^+]$ ✓ $= -\log 2 \times 10^{-14}$ ✓ $= 13,7$ ✓ (accept/aanvaar 13,699)	Concentration changes by a factor of/Konsentrasie verander met 'n faktor van $100/10 = 10$ Therefore/Daarom $c(\text{NaOH}) = 0,5 \text{ mol} \cdot \text{dm}^{-3}$ ✓ $\text{pOH} = -\log[\text{OH}^-]$ ✓ $= -\log 0,5$ ✓ $= 0,3$ $\text{pH} + \text{pOH} = 14$ $\text{pH} = 14 - 0,3$ ✓ $= 13,7$ ✓ (accept/aanvaar 13,699)
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Marking Criteria/Nasienriglyne:

- Use mole ratio/Gebruik mol verhouding: $n(\text{H}_2\text{C}_2\text{O}_4) : n(\text{NaOH}) = 1 : 2$ ✓
- Substitute volume and number of moles to calculate $c(\text{NaOH})_{\text{dilute}}$. ✓
Vervang volume en aantal mol om $c(\text{NaOH})_{\text{opgelos}}$ te bereken.
- Substitute 100, ✓ value for $c(\text{NaOH})_{\text{dilute}}$ and 10. ✓
 $c(\text{NaOH})_{\text{dilute}} \times 100 = c(\text{NaOH}) \times 10$ to calculate $c(\text{NaOH})$ before dilution.
Vervang 100, waarde van $c(\text{NaOH})_{\text{opgelos}}$ en 10 in $c(\text{NaOH})_{\text{opgelos}} \times 100 = c(\text{NaOH}) \times 10$ om $c(\text{NaOH})$ voor oplossing te bereken.
- Formule of pH. ✓/Formule van pH.
- Substitute $c(\text{NaOH})_{\text{concentrated}}$ in $[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$ ✓
Vervang $c(\text{NaOH})_{\text{gekonsentreerd}}$ in $[\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14}$
- Substitute value for $[\text{H}_3\text{O}^+]$ in formula for pH. ✓
Vervang waarde vir $[\text{H}_3\text{O}^+]$ in formule vir pH.
- Final answer/Finale antwoord: 13,7 ✓ (accept/aanvaar 13,699)

Notes/Aantekeninge:

Wrong formula for pH e.g $\text{pH} = -\log[\text{OH}^-]$; $\text{pOH} = -\log[\text{NaOH}]$

Verkeerde formule vir bv. $\text{pH} = -\log[\text{OH}^-]$; $\text{pOH} = -\log[\text{NaOH}]$

No marks for substitution and answer in the pH calculation part.

Geen punte vir substitusie en antwoord in die gedeelte van pH berekening: 5/8

(8)
[14]

QUESTION 7/VRAAG 7

7.1.1 An acid that dissociates/ionises completely in water ✓✓
'n Suur wat heeltemal in water ioniseer/dissosieer (2)

7.1.2 $\text{HCl(aq)} + \text{H}_2\text{O(l)} \checkmark \rightarrow \text{H}_3\text{O}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \checkmark$ ✓ balancing/balansering
OR/OF
 $\text{HCl} + \text{H}_2\text{O} \checkmark \rightarrow \text{H}_3\text{O}^+ + \text{Cl}^- \checkmark$ ✓ balancing/balansering (3)

7.1.3 Acid✓ pH below (<)7 ✓/Suur pH onder (<)7 (2)

7.1.4 $\text{pH} = -\log[\text{H}_3\text{O}^+]$ **OR/OF** $\text{pH} = -\log[\text{H}^+]$ ✓
4 = $-\log[\text{H}_3\text{O}^+]$ ✓
 $[\text{H}_3\text{O}^+] = 1 \times 10^{-4} \text{ mol.dm}^{-3}$ ✓ (3)

7.1.5

POSITIVE MARKING FROM QUESTION 7.1.4/POSITIEWE NASIEN VANAF VRAAG 7.1.4**Marking criteria/Nasienriglyne:**

- Final/*Finale* $n(\text{HCl})$: Multiplying/*Vermenigvuldig* $1 \times 10^{-4} \text{ mol} \cdot \text{dm}^{-3}$ by/*met* $0,17 \text{ dm}^3$ ✓
- Initial/*Aanvanklike* $n(\text{HCl})$: Multiplying/*Vermenigvuldig* $0,03 \text{ mol} \cdot \text{dm}^{-3}$ by/*met* $0,15 \text{ dm}^3$ ✓
- $n(\text{HCl reacted/reageer}) = \text{initial/ Aanvanklike} - \text{final/ finale}$ ✓
- Use mol ratio of acid:base/*Molverhouding suur:basis* = $1 : 1$. ✓
- Substitute/*Vervang*: $n(\text{NaOH})$ in $c = \frac{n}{V}$ ✓
- Final answer /*Finale antwoord*: $0,22 \text{ mol} \cdot \text{dm}^{-3}$ ✓

$n(\text{HCl in excess/ in oormaat})$:

$$c = \frac{n}{V}$$

$$n(\text{HCl}) = (1 \times 10^{-4})(0,17) \checkmark$$

$$= 1,7 \times 10^{-5} \text{ mol}$$

$n(\text{HCl initial/ aanvanklik})$:

$$c = \frac{n}{V}$$

$$n(\text{HCl}) = (0,03)(0,15) \checkmark$$

$$= 4,5 \times 10^{-3} \text{ mol}$$

$$n(\text{HCl reacted/reageer}) = 4,5 \times 10^{-3} - 1,7 \times 10^{-5} \checkmark$$

$$= 4,48 \times 10^{-3} \text{ mol}$$

$$\text{Ratio/Verhouding } n(\text{HCl}) = n(\text{NaOH}) = 4,48 \times 10^{-3} \checkmark$$

$c(\text{NaOH})$ initial/ aanvanklik :

$$c = 4,483 \times 10^{-3} / 2 \times 10^{-2} \checkmark$$

$$= 0,22 \text{ mol} \cdot \text{dm}^{-3} \checkmark$$

(6)
[22]

7.2

Marking criteria/Nasienriglyne:

- Divide volume by/Deel volume deur: 22,4 ✓
- Use ratio/Gebruik verhouding: $n(\text{CO}_2) = n(\text{CaCO}_3) = 1:1$ ✓
- Substitute/Vervang 100 in $n = \frac{m}{M}$. ✓
- Mass/Massa (4g – 4,46g) ✓
- Divide by/Deel deur 5 x 100 ✓
- Final answer/Finale antwoord: 80% to 90% ✓

$$\begin{aligned}
 n(\text{CO}_2) &= \frac{V}{V_m} \\
 &= \frac{1,06}{22,4} \quad \checkmark \\
 &= 0,04 \text{ mol } (0,0446 \text{ mol})
 \end{aligned}$$

$$n(\text{CaCO}_3) = n(\text{CO}_2) = 0,04 \text{ mol } \checkmark (0,0446 \text{ mol})$$

$$\begin{aligned}
 n(\text{CaCO}_3) &= \frac{m}{M} \\
 0,04 &= \frac{m}{100} \quad \checkmark \\
 \therefore m &= 4 \text{ g } (4,46 \text{ g}) \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 \% \text{ CaCO}_3 &= \frac{4}{5} \times 100\% \\
 &= 80 \% \quad \checkmark
 \end{aligned}$$

(6)

(Accept range/Anvaar variasie: 80% – 90%)

[22]

QUESTION / VRAAG 10

10.1 $\text{pH} = -\log [\text{H}^+]$ OR $\text{pH} = -\log [\text{H}_3\text{O}^+]$ ✓
 $= -\log (5,6 \times 10^{-6})$ ✓
 $= 5,25$ ✓

(3)

10.2 10.2.1 $c = \frac{n}{V}$ ✓
 $n = cV$
 $= (2,5)(0,5)$ ✓
 $= 1,25 \text{ mol NaOH}$ ✓

(3)

10.2.2 **POSITIVE MARKING FROM QUESTION 10.2.1 / POSITIEWE NASIEN VAN VRAAG 10.2.1**

$n_{\text{acid}} = c_a V_a$
 $= (0,2)(0,095)$ ✓
 $= 0,019 \text{ mol H}_2\text{SO}_4$

$n(\text{NaOH}) = 2n(\text{H}_2\text{SO}_4)$
 $= 2 \times 0,019$ ✓
 $= 0,038 \text{ mol NaOH}$

$n(\text{NaOH used/gebruik}) = n(\text{NaOH initial/aanvanklik}) - n(\text{NaOH excess/oormaat}):$
 $1,25 - 0,038$ ✓ $= 1,212 \text{ mol}$

$n[\text{Mg}(\text{NO}_3)_2] = \frac{1,212}{2}$ ✓
 $= 0,606 \text{ mol}$

$m[\text{Mg}(\text{NO}_3)_2] = nM$
 $= 0,606 \times 148$ ✓
 $= 89,69 \text{ g}$ ✓

(6)

[12]**Marking guidelines/ Nasienriglyne:**

- Substitution into/Vervang in $c = \frac{n}{V}$ ✓
- Using ratio/Gebruik verhouding 2:1 ✓
- $n(\text{NaOH}_{\text{used/gebr}}) = n(\text{NaOH}_{\text{initial/aanvk}}) - n(\text{NaOH}_{\text{excess/oormt}})$ ✓
- $n[\text{Mg}(\text{NO}_3)_2] = \frac{1}{2}n(\text{NaOH})$ ✓
- Substitute/Vervang $M[\text{Mg}(\text{NO}_3)_2] = 148 \text{ g} \cdot \text{mol}^{-1}$ ✓
- Final answer/Finale antwoord: 89,69 g ✓

QUESTION 7

7.1.1

Option 1:

$$\text{pH} = -\log [\text{H}_3\text{O}^+] \checkmark$$

$$= 1$$

$$\therefore [\text{H}_3\text{O}^+] = 10^{-1} = 0,1 \checkmark$$

$$\therefore [\text{HCl}] = 0,1 \text{ mol}\cdot\text{dm}^{-3} \checkmark$$

Option 2:

$$\text{pH} = -\log [\text{H}_3\text{O}^+] \checkmark$$

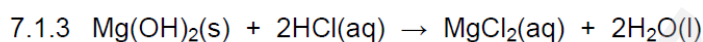
$$= 1$$

$$\therefore [\text{HCl}] = 0,1 \text{ mol}\cdot\text{dm}^{-3} \checkmark\checkmark$$

(3)

7.1.2 increase ✓

(1)



(3)

Reactants ✓

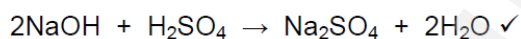
Products ✓

Balancing ✓

7.2 When an acid reacts with a base ✓ to produce a salt and water. ✓ OR
Chemically equivalent quantities of acid and base are reacted. ✓✓

(2)

7.3

Option 1:

$$n(\text{NaOH}) = c \times V \checkmark = 0,1 \times 0,012 \checkmark = 0,0012 \text{ mol}$$

$$n(\text{H}_2\text{SO}_4) = \frac{1}{2} \times n(\text{NaOH}) \checkmark = 0,0006 \text{ mol}$$

$$V(\text{H}_2\text{SO}_4) = n/C = 0,0006 / 0,05 = 0,012 \text{ dm}^3$$

$$V(\text{H}_2\text{SO}_4) \text{ that reacts with Ba}(\text{OH})_2 = 54 - 12 \checkmark = 42 \text{ cm}^3 \text{ (OR } 0,054 - 0,012 = 0,042 \text{ dm}^3)$$



$$n(\text{H}_2\text{SO}_4) \text{ that reacts with Ba}(\text{OH})_2 = c \times V = 0,05 \times (42 \times 10^{-3} \text{ mol}) = 0,0021 \text{ mol}$$

$$n(\text{Ba}(\text{OH})_2) = 1 \times 0,0021 = 0,0021 \text{ mol}$$

$$[\text{Ba}(\text{OH})_2] = n/v = 0,0021 \times 0,048 \checkmark = 0,04375 \text{ mol}\cdot\text{dm}^{-3} \checkmark$$

7.3

Option 2:	Option 3:
$2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O} \checkmark$ $n(\text{NaOH}) = c \times V \checkmark = 0,1 \times 0,012 \checkmark$ $= 0,0012 \text{ mol}$ $n(\text{H}_2\text{SO}_4) = \frac{1}{2} \times n(\text{NaOH}) \checkmark$ $= 0,0006 \text{ mol}$ $n(\text{H}_2\text{SO}_4)_{\text{tot}} = c \times V$ $= 0,05 \times (54 \times 10^{-3})$ $= 0,0027 \text{ mol}$ $n(\text{H}_2\text{SO}_4)_{\text{with Ba(OH)}_2}$ $= 0,0027 - 0,0006 \checkmark = 0,0021 \text{ mol}$ $\text{Ba(OH)}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{H}_2\text{O} \checkmark$ $n(\text{Ba(OH)}_2) = 1 \times 0,0021$ $= 0,0021 \text{ mol}$ $[\text{Ba(OH)}_2] = n / v = 0,0021 \times 0,048 \checkmark =$ $0,04375 \text{ mol} \cdot \text{dm}^{-3} \checkmark$	$2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O} \checkmark$ $\frac{n_a}{n_b} = \frac{V_a \times c_a}{V_b \times c_b} \checkmark$ $\frac{1}{2} \checkmark = \frac{V_a \times 0,05}{0,1 \times 12} \checkmark$ $V_a = 12 \text{ cm}^3$ $V(\text{H}_2\text{SO}_4)_{\text{with Ba(OH)}_2} \rightarrow 54 - 12 \checkmark$ $= 42 \text{ cm}^3$ $\text{Ba(OH)}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{H}_2\text{O} \checkmark$ $\frac{n_a}{n_b} = \frac{V_a \times c_a}{V_b \times c_b}$ $\frac{1}{1} = \frac{0,05 \times 42}{48 \times c_b} \checkmark$ $[\text{Ba(OH)}_2] = 0,04375 \text{ mol} \cdot \text{dm}^{-3} \checkmark$

(8)

[17]

QUESTION/VRAAG 7

7.1

7.1.1 Concentrated acid- contains a large amount (number of moles) of acid in proportion to the volume of water.✓

Dilute acid – contains a small amount (number of moles) of acid in proportion to the volume of water.✓/

(2)

Gekonsentreerde suur: bevat 'n groot hoeveelheid /mol suur in verhouding to die volume water

Verdunde suur bevat 'n klein hoeveelheid / aantal mol suur in verhouding tot die volume water

7.1.2 It ionises completely in water to form a high concentration of H_3O^+ ions.✓✓// dit ioniseer volledig in water en vorm 'n hoë konsentrasie H_3O^+ ione

Note: 2 or 0

(2)

7.1.3 $\text{pH} = -\log[\text{H}_3\text{O}^+] \checkmark$
 $= -\log(0,20) \checkmark$
 $= 0,7 \checkmark$

(3)

7.2.1 Basic ✓/ basies

(1)

7.2.2 $\text{CO}_3^{2-}(\text{aq}) + \text{H}_2\text{O}(\text{l}) \rightarrow \text{HCO}_3^-(\text{aq}) + \text{OH}^-(\text{aq})$
 (reactants ✓ products ✓)

Excess $\text{OH}^-(\text{aq})$ ions are produced/it is a salt of strong base and weak acid (and the resultant solution is basic.) ✓

'n Oormaat OH^- ione word geproduseer/ dit is die sout van 'n sterk basis en 'n swak suur

(3)

7.3.1

$$n(\text{CO}_2) = \frac{V}{V_m}$$

$$= \frac{4,48}{22,4} \checkmark$$

$$= 0,2 \text{ mol}$$

$$n(\text{Na}_2\text{CO}_3) : n(\text{CO}_2) = 1:1$$

$$\therefore n(\text{Na}_2\text{CO}_3) = 0,2 \text{ mol} \checkmark$$

$$m(\text{Na}_2\text{CO}_3) = n \cdot M = (0,2)(106) \checkmark = 21,2 \text{ g}$$

$$\therefore \% \text{ purity} = \frac{\text{mass of pure Na}_2\text{CO}_3}{\text{mass of impure Na}_2\text{CO}_3} \times 100\%$$

$$= \frac{21,2}{25} \times 100 \checkmark$$

$$= 84,8\% \checkmark$$

(5)

$$7.3.2 \text{ Mass of impurity/ massa onsuierheid} = 25 - 21,2 \checkmark = 3,8 \text{ g} \checkmark$$

$$\text{OR } \% \text{ impurity/ onsuierheid} = 100 - 84,8 = 15,2\%$$

$$\frac{15,2}{100} \times 25 = 3,8 \text{ g}$$

(2)

[18]

Marking Criteria / nasienkriteria:

- Substitution into/vervanging in

$$n = \frac{V}{V_m}$$
- Using mole ratio/ gebruik molverhouding
- Multiplying by/ vermenigvuldig met 106
- Percentage purity / pesentasie suiwerheid

QUESTION 7		
7.1	It dissociates completely in water ✓ to produce a high concentration of OH ⁻ ions. ✓	(2)
7.2	(a) $n = \frac{m}{M}$ $= \frac{27}{137 + 2(16+1)}$ $= 0,158 \text{ mol} \quad \checkmark$ (b) $\text{Ba(OH)}_2 \xrightarrow{\text{H}_2\text{O}} \text{Ba}^{2+}(\text{aq}) + 2 \text{OH}^{-}(\text{aq})$ Therefore 0,158 mol Ba(OH)₂ produces 2 x 0,158 = 0,316 mol OH⁻ ✓ (c) Concentration of hydroxide ions: $c = \frac{n}{V}$ $= \frac{0,316}{2}$ $= 0,158 \text{ mol} \cdot \text{dm}^{-3}$ (d) $K_w = [\text{OH}][\text{H}^{+}] \quad \checkmark$ $10^{-14} = [0,158][\text{H}^{+}] \quad \checkmark$ $[\text{H}^{+}] = 6,329 \times 10^{-14} \text{ mol} \cdot \text{dm}^{-3}$ (e) $\text{pH} = -\log [\text{H}^{+}] \quad \checkmark$ $= -\log[6,329 \times 10^{-14}] \quad \checkmark$ $= 13,19 \quad \checkmark$ OR: Calc: $\text{pOH} = -\log [\text{OH}^{-}] \quad \checkmark$ $= -\log (0,158) \quad \checkmark$ $= 0,801 \quad \checkmark$ $\therefore \text{pH} = 14 - 0,801 \quad \checkmark$ $= 13,20 \quad \checkmark$	(7)
7.3	Burette ✓	(1)
7.4	An acid is a proton (H ⁺ -ion) donor. ✓✓ (2 or 0)	(2)
7.5	$\text{Ba(OH)}_2 + 2 \text{HCl} \longrightarrow \text{BaCl}_2 + 2 \text{H}_2\text{O}$ $n_b = 1 \quad n_a = 2$ $c_b = 0,079 \quad c_a = 2,5$ $V_b = 2 \text{ dm}^3 \quad V_a = ?$ 0,158 mol Ba(OH)₂ will be neutralized by 0,316 mol HCl ✓ $c = \frac{n}{V} \quad \checkmark$ $2,5 = \frac{0,316}{V} \quad \checkmark$ $V = 0,126 \text{ dm}^{-3} \text{ or } 0,13 \text{ dm}^{-3} \quad \checkmark.$ $\frac{C_a V_a}{C_b V_b} = \frac{n_a}{n_b} \quad \checkmark$ $\checkmark$ $\frac{(2,5)V_a}{(0,079)(2)} = \frac{2}{1} \quad \checkmark$ $V_b = 0,126 \text{ dm}^3 \quad \checkmark$	(4)
7.6	bromothymol blue changes colours when the pH is around 7. ✓ This is also the end point for a reaction between a strong acid and a strong base / ✓ Phenolphthalein is an effective indicator for a reaction between a strong base and a weak acid.	(2)
7.7	REMAINS YELLOW ✓	(1) [19]

VRAAG 7

7.1.1 'n Suur is 'n protonskenker (H^+ -ioon-skenker). ✓

7.1.2 Swak sure ioniseer onvolledig ✓ in water om 'n lae konsentrasie H_3O^+ -ione ✓ te vorm.

7.2.1 CH_3COOH en CH_3COO^- ✓✓

OH^- en H_2O ✓✓

7.2.2 Fenolftaleïen ✓

7.2.3 Groter ✓

Dis 'n titrasie van 'n swak suur met 'n sterk basis. ✓

7.2.4

$$\frac{n_a}{n_b} = \frac{c_a V_a}{c_b V_b} \quad \checkmark$$

$$\frac{1}{1} \checkmark = \frac{(0,25)(15)}{c_b(20)} \checkmark$$

7.2.5 $c_b = 0,19 \text{ mol.dm}^{-3}$ ✓

pH = $-\log [\text{H}_3\text{O}^+]$ ✓

= $-\log 0,25$ ✓

= 0,6 ✓

[17]

MERCY!!!!!!

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