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 ✓

n(NaOH) = 0,2 x 20/1000 ✓= 0,004 mol ✓ (4 x 10^{-3} mol) (3)

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

$n(H_2)$ = ½ (0,004)✓ = 0,002 mol (2 x 10^{-3} mol)

$c(H_2X)$= n / V = 0,002/ (40/1000) ✓ = 0,05 mol.dm^{-3}

pH = - log[H_3O^+] ✓= - log(2 x 0,05) ✓= 1 ✓

(5)

Marking Criteria/*Nasien riglyne*:

- Use of ratio/*Gebruik verhouding* NaOH : H_2X ✓
- Substitution into c = n/V to calculate $n(H_2X)$.
  Substitusie in c = n/V om $n(H_2X)$ te bereken. ✓
- Use formule/*Gebruik formule:* pH = -log [H_3O^+] ✓
- Substitution of 2 x $c(H_2X)$ into [H_3O^+]✓/
  Substitusie van 2 x $c(H_2X)$ in [H_3O^+]
- Final answer/*Finale antwoord* ✓

7.2.5 Neutral ✓ / *Neutraal*

(Titration of) strong base with a strong acid. ✓
(Titrasie 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

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

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

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

OPTION / *OPSIE* 2

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

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

$c_b = 0,15 \text{ mol} \cdot \text{dm}^{-3}$ ✓ (5)

6.3.4

Option / *Opsie* 1

pOH = - log $[OH^-]$ ✓

pOH = - log (0,15) ✓

pOH = -(-0,82)

pOH = 0,82

pH + pOH = 14 ✓

pH = 14 – pOH

pH = 14 – 0,82 ✓

pH = 13,18 ✓

Option / *Opsie* 2

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

$[OH^-][H_3O^+] = 10^{-14} = K_w$ ✓

$[H_3O^+] = \frac{10^{-14}}{0,15}$ ✓

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

pH = -log$[H_3O^+]$ ✓

= - log $(6,67 \times 10^{-14})$ ✓

= 13,18 ✓

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

n =CV ✓
= 0,25 x 0,5✓
= 0,0125 ✓

OR

$c_1V_1 = c_2V_2$ ✓
$(10)(x) = (0,25)(0,5)$ ✓
$x = 0,0125 dm^3$
$= 12,5 cm^3$ ✓

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

$10 = \frac{0,0125}{V}$ ✓

$V = 0,0125$ ✓ dm^3
$= 12,5\ cm^3$

8.1.3

$HCl \xrightarrow{H_2O} H_3O^+ + Cl^-$

0,25 mol.dm^{-3} 0,25 mol.dm^{-3}

$pH = -\log [H_3O^+]$ ✓
$= -\log (0,25)$ ✓
$= 0,60$ ✓

(3)

8.2 8.2.1 **Option 1**

$$n(HCl) = cV = (0,25)(0,5) = 0,125\,mol$$

$$n(NaOH) = cV = (0,2)(0,14) = 0,028\,mol$$

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

$$n(HCl)\ reacted\ with\ (CaCO_3) = 0,125 - 0,028 = 0,097\,mol$$

$$n(CaCO_3) = \frac{1}{2} \times 0,097 = 0,0485\,mol$$

$$mass\ of\ CaCO_3 = nM = 0,0485 \times 100 = 4,85\,g$$

Option 2

Volume of HCl reacted with NaOH

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

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

$$V_a = 112\ cm^3$$

Volume of HCl reacted with $CaCO_3$

$$V_{HCl} = 500 - 112 = 388\ cm^3 = 0,388\ dm^3$$

No. of mol of HCl reacted with $CaCO_3$

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

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

$$n = 0,097\ mol$$

No. of mol of $CaCO_3$ reacted with HCl

$$n_{HCl} : n_{CaCO_3} = 2 : 1$$

$$n_{CaCO_3} = \frac{0,097}{2} = 0,0485\ mol$$

Mass of mol of $CaCO_3$ reacted with HCl

$$m = n \cdot M = 0,0485 \cdot 100 = 4,85\ g$$

(8)

8.2.2

$$\%\ purity = \frac{mass\ of\ CaCO_3}{mass\ of\ sample} \cdot 100 = \frac{4,85}{5} \cdot 100 = 97\%$$

(3)

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 $M(CaCO_3) = 40 + 12 + 3(16) = 100\ g{\cdot}mol^{-1}$

$n = \frac{m}{M}$ ✓ $= \frac{0,8}{100}$ ✓ = 0,008 mol ✓ $CaCO_3$ has reacted //
$CaCO_3$ het gereageer

2 mol HCl reacts with// *reageer met* 1 mol $CaCO_3$ ✓

∴ 2(0,008) = 0,016 mol ✓ HCl reacted with // *reageer met* 1 mol $CaCO_3$ (5)

7.2.2 Initial // *Aanvanklik*: moles HCl: n = cV ✓ = 0,5 x 0,06 ✓= 0,03 mol ✓

HCl left // *oor* = 0,03 – 0,016 = 0,014 mol ✓

(HCl is a strong acid and ionises completely thus $n(H^+)$ = 0,014 mol //
HCl is *'n sterk suur en ioniseer volledig∴ mol H^+ = 0,014 mol*)

$c = \frac{n}{V} = \frac{0,014}{0,06}$ ✓= 0,23 $mol{\cdot}dm^{-3}$ ✓

pH = - log $[H^+]$ ✓ = - log (0,23) ✓= 0,64 ✓ (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

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

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

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

m = n X M
= 6,5 X 2✓
= 13 g✓

[13]

QUESTION 7 / *VRAAG 7*

7.1.1 H_3O^+ acts as a proton donor. ✓✓ (2)
H_3O^+ tree as 'n protonskenker op.

7.1.2 HPO_4^- ✓ (1)

7.1.3 Ampholyte / *Amfoliet* ✓ (1)

7.2.1 **OPTION 1 / *OPSIE 1***

pH = -log[H_3O^+]
13,6 = -log[H_3O^+]
[H_3O^+] = 2,51189 X 10^{-14}✓

[H_3O^+][OH^-] = 1 X 10^{-14}

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

= 0,4 mol·dm^{-3} ✓

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

OPTION 2 / *OPSIE 2*

pH + pOH = 14
pOH = 14 – 13,6 ✓
= 0,4
pOH = -log[OH^-]
0,4 = -log[OH^-] ✓
[OH^-] = $10^{-0,4}$
= 0,4 mol·dm^{-3} ✓

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

(4)

7.2.2 n = c X V ✓
= 0,2 X 0,025 ✓
= 0,005 mol ✓ (3)

7.2.3 **POSITIVE MARKING FROM QUESTION 7.2.1**

H_2SO_4 : n = cV = 0,15 X 0,04 = 0,006 mol ✓

H_2SO_4 + $Ba(OH)_2$
0,005 mol ✓ + 0,005 mol

n(H_2SO_4) excess / *oormaat* = 0,006 - 0,005
= 0,001 mol✓

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

$[H_3O^+]$ = 2 x 0,0154 mol·dm^{-3} ✓

pH = - log $[H_3O^+]$ ✓
= - log (0.0308)
= 1,51 ✓ (7)

Marking criteria/Nasienriglyne

- *0,006 mol*
- *Ratio*
- *Subtraction: 0,006 – 0,005 mol*
  Trek af: 0,006 – 0,005 mol
- *0.065 dm^{-3}*
- *pH formula / formule*
- *2 x 0,0154 mol*
- *Answer / Antwoord: 1,51*

7.3.1 The reaction of a salt✓ with water.✓
Die reaksie van 'n sout met water. (2)

7.3.2 Neutral / *Neutraal* ✓ (1)
[21]

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

$pH = -\log [H^+]$ ✓

$1 = -\log [H^+]$ ✓

$[H^+] = 0,1 \text{ mol·dm}^{-3}$

$[H_2SO_4] = ½ [H^+] = 0,05 \text{ mol·dm}^{-3}$✓

$n_a = c_aV$

$= (0,05)(0,012)$ ✓

$= 6x10^{-4}$ mol

$n(H_2SO_4) : n(NaHCO_3) = 1:2$

$n(NaHCO_3) = (2)(6x10^{-4})$ ✓

$= 12 x10^{-4}$ mol

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

$c = \frac{12x10^{-4}}{0,02}$ ✓

$= 0,06 \text{ mol·dm}^{-3}$✓

OPTION 2/OPSIE 2

$pH = -\log [H^+]$ ✓

$1 = -\log [H^+]$ ✓

$[H^+] = 0,1 \text{ mol·dm}^{-3}$

$[H_2SO_4] = ½ [H^+] = 0,05 \text{ mol·dm}^{-3}$✓

$\frac{n_a}{n_b} = \frac{c_aV_a}{c_bV_b}$

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

$c_b = 0,06 \text{ mol·dm}^{-3}$✓

(7)

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

$c = \frac{m}{MV}$ ✓

$0,06 = \frac{m}{(84)(0,25)}$ ✓

$m = 1,26$ g✓ (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)

7.1.3 PO^{3-}_4(aq) ✓ (1)

7.2

7.2.1 Basic. ✓ (1)

7.2.2 pH = - log [H^+] ✓

13,3✓ = - log [H^+]

[H^+] = 5,01 x 10^{-4} mol.dm^{-3}

$[OH^-] = \frac{10^{-14}}{[H^+]}$ ✓

$= \frac{10^{-14}}{5,01 \times 10^{-14}}$ ✓

= 0,2 mol.dm^{-3}✓ (5)

7.2.3 $\frac{CaVa}{CbVb} = \frac{n_a}{n_b}$ ✓ **N.B** Positive marking - 7.2.2 to 7.2.3.

$\frac{Ca(17,85)}{(0,2)(25)}$ ✓✓ $= \frac{1}{2}$ ✓

Ca = 0,14 mol.dm^{-3}✓ (5)

7.2.4 X + 16 +1 = 56

X = 39 g.mol^{-1}✓

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

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

$n(NaOH) = 2✓ \times 5 \times 10^{-4}$ $= 1x10^{-3}$ mol c(NaOH)dilute/*opgelos* = nV $= 1 \times 10^{-3}/19,97 \times 10^{-3}$✓ $= 0,05$ mol·dm^{-3} **OR/OF** c(NaOH)dilute/*opgelos* × Vdilute/*opgelos* = c(NaOH) × V(NaOH) 0,05 × 100✓ = c(NaOH) × 10 ✓ c(NaOH) = 0,5 mol·dm^{-3} $[H_3O^+].[OH^-] = 10^{-14}$ $[H_3O].0,5✓ = 10^{-14}$ $[H_3O^+] = 2 \times 10^{-14}$ mol·dm^{-3} pH = -log$[H_3O^+]$✓ = -log 2×10^{-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(NaOH) = 0,5 mol·dm^{-3} ✓ pOH = -log$[OH^-]$ ✓ = -log 0,5 ✓ = 0,3 pH + pOH = 14 pH = 14 – 0,3✓ = 13,7✓ (accept/*aanvaar* 13,699)

Marking Criteria/Nasienriglyne:

- Use mole ratio/*Gebruik mol verhouding:* $n(H_2C_2O_4) : n(NaOH) = 1: 2$ ✓
- Substitute volume and number of moles to calculate c(NaOH)dilute. ✓
  Vervang volume en aantal mol om c(NaOH)opgelos te bereken.
- Substitute 100, ✓ value for c(NaOH)dilute and 10. ✓
  c(NaOH)dilute × 100 = c(NaOH) × 10 to calculate c(NaOH) before dilution.
  Vervang 100, waarde van c(NaOH)opgelos en 10 in c(NaOH)opgelos × 100 = c(NaOH) × 10 om c(NaOH) voor oplossing te bereken.
- Formule of pH. ✓*IFormule van pH.*
- Subsitute c(NaOH)concentrated in $[H_3O^+].[OH^-] = 10^{-14}$ ✓
  Vervang c(NaOH)gekonsentreerd in $[H_3O^+].[OH^-] = 10^{-14}$
- Substitute value for $[H_3O^+]$ in formula for pH.✓
  Vervang waarde vir $[H_3O^+]$ *in formule vir pH.*
- Final answer/*Finale antwoord*: 13,7 ✓ (accept/*aanvaar* 13,699)

Notes/Aantekeninge:
Wrong formula for pH e.g pH = -log[OH-]; pOH = -log[NaOH]
Verkeerde formule vir bv. pH = -log[OH-]; pOH = -log[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 $HC\ell(aq) + H_2O(\ell)$ ✓ $\rightarrow H_3O^+(aq) + C\ell^-(aq)$ ✓ ✓ balancing/*balansering*
OR/OF
$HC\ell + H_2O$ ✓ $\rightarrow H_3O^+ + C\ell^-$ ✓ ✓ balancing/*balansering* (3)

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

7.1.4 $pH = -\log[H_3O^+]$ **OR/OF** $pH = -\log[H^+]$✓
$4 = -\log[H_30^+]$✓
$[H_30^+] = 1 \times 10^{-4}$ 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(HCℓ): Multiplying/ *Vermenigvuldig1* x 10^{-4}mol.dm^{-3} by/ met 0,17 dm^3 ✓
- Initial/*Aanvanklike* n(HCℓ):Multiplying/*Vermenigvuldig* 0,03 mol.dm^{-3} by/met 0,15 dm^3 ✓
- n(HCℓ reacted/*reageer*) = initial/ *Aanvanklike* – final/ *finale* .✓
- *Use mol ratio of acid:base/Molverhouding suur:basis= 1 : 1.* ✓
- Substitute/*Vervang*: n(NaOH) in $c = \frac{n}{V}$ ✓
- Final answer /*Finale antwoord:* 0,22 mol.dm^{-3} ✓

n(HCℓ in excess/ *in oormaat*):

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

$n(HCℓ) = (1 \times 10^{4})(0,17)$ ✓

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

n(HCℓ initial/ a*anvanklik*):

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

$n(HCℓ) = (0,03)(0,15)$ ✓

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

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

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

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

c(NaOH) initial/ a*anvanklik* :

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

$= 0,22$ mol.dm^{-3} ✓ (6)

[22]

7.2

Marking criteria/*Nasienriglyne:*

- Divide volume by/*Deel volume deur*: 22,4 ✓
- Use ratio/Gebruik *verhouding*: $n(CO_2) = n(CaCO_3) = 1:1$ ✓
- 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% ✓

$$n(CO_2) = \frac{V}{V_m}$$
$$= \frac{1,06}{22,4} \quad ✓$$
$$= 0,04 \text{ mol} \quad (0,0446 \text{ mol})$$

$n(CaCO_3) = n(CO_2) = 0,04$ mol ✓ (0, 0446 mol)

$$n(CaCO_3) = \frac{m}{M}$$
$$0,04 = \frac{m}{100} \quad ✓$$
$\therefore$ m = 4 g (4,46 g) ✓

$$\% \ CaCO_3 = \frac{4}{5} \times 100\%$$
= 80 % ✓ (6)

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

[22]

QUESTION / *VRAAG* 10

10.1 $pH = - \log [H^+]$ OR $pH = - \log [H_3O^+]$ ✓
$= - \log (5,6 \times 10^{-6})$ ✓
$= 5,25$ ✓ (3)

10.2 10.2.1
$c = \frac{n}{V}$ ✓
$n = cV$
$= (2,5)(0,5)$ ✓
$= 1,25$ mol NaOH ✓ (3)

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

$n_{acid} = c_a V_a$
$= (0,2)(0,095)$ ✓
$= 0,019$ mol H_2SO_4

$n(NaOH) = 2n(H_2SO_4)$
$= 2 \times 0,019$ ✓
$= 0,038$ mol NaOH

Marking guidelines/ *Nasienriglyne*:
- Substitution into/*Vervang in* $c = \frac{n}{V}$ ✓
- Using ratio/*Gebruik verhouding* 2:1 ✓
- $n(NaOH_{used/gebr}) = n(NaOH_{initial/aanvk}) - n(NaOH_{excess/oormt})$
- $n[Mg(NO_3)_2] = ½n(NaOH)$ ✓
- Substitute/*Vervang* $M[Mg(NO_3)_2] = 148$ g·mol^{-1} ✓
- Final answer/*Finale antwoord*: 64,38 g ✓

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

$n[Mg(NO_3)_2] = \frac{1,212}{2}$ ✓
$= 0,606$ mol

$m[Mg(NO_3)_2] = nM$
$= 0,606 \times 148$ ✓
$= 89,69$ g ✓ (6)

[12]

QUESTION 7

7.1.1

Option 1:

pH = - log $[H_3O^+]$ ✓
= 1

$\therefore [H_3O^+] = 10^{-1} = 0,1$ ✓
$\therefore [HCl] = 0,1 \text{ mol.dm}^{-3}$ ✓

Option 2:

pH = - log $[H_3O^+]$ ✓
= 1

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

(3)

7.1.2 increase ✓ (1)

7.1.3 $Mg(OH)_2(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + 2H_2O(l)$ (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:

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$ ✓

n(NaOH) = c x V ✓ = 0,1 x 0,012✓ = 0,0012 mol

$n(H_2SO_4)$ = ½ x n(NaOH) ✓ = 0,0006 mol

$V(H_2SO_4)$ = n/C = 0,0006 / 0,05 = 0,012 dm^3

$V(H_2SO_4)$ that reacts with $Ba(OH)_2$ = 54 – 12 ✓ = 42 cm^3 (OR 0,054 - 0,012 = 0,042 dm^3)

$Ba(OH)_2 + H_2SO_4 \rightarrow BaSO_4 + 2H_2O$ ✓

$n(H_2SO_4)$ that reacts with $Ba(OH)_2$ = c x V = 0,05 x (42 x 10^{-3} mol) = 0,0021 mol

$n(Ba(OH)_2)$ = 1 x 0,0021 = 0,0021 mol

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

7.3

Option 2:	**Option 3:**
$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$✓ $n(NaOH) = c \times V$ ✓ $= 0,1 \times 0,012$✓ $= 0,0012$ mol $n(H_2SO_4) = ½ \times n(NaOH)$ ✓ $= 0,0006$ mol $n(H_2SO_4)_{tot} = c \times V$ $= 0,05 \times (54 \times 10^{-3})$ $= 0,0027$ mol $n(H_2SO_4)_{with\ Ba(OH)_2}$ $= 0,0027 - 0,0006$ ✓ $= 0,0021$ mol $Ba(OH)_2 + H_2SO_4 \rightarrow BaSO_4 + 2H_2O$✓ $n(Ba(OH)_2) = 1 \times 0,0021$ $= 0,0021$ mol $[Ba(OH)_2] = n / v = 0,0021 \times 0,048$ ✓ $=$ $0,04375$ mol·dm^{-3} ✓	$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$✓ $\frac{n_a}{n_b} = \frac{V_a \times c_a}{V_b \times c_b}$ ✓ $\frac{1}{2}$ ✓ $= \frac{V_a \times 0,05}{0,1 \times 12}$ ✓ $V_a = 12$ cm^3 $V(H_2SO_4)_{with\ Ba(OH)_2} = 54 - 12$ ✓ $= 42$ cm^3 $Ba(OH)_2 + H_2SO_4 \rightarrow BaSO_4 + 2H_2O$ ✓ $\frac{n_a}{n_b} = \frac{V_a \times c_a}{V_b \times c_b}$ $\frac{1}{1} = \frac{0,05 \times 42}{48 \times c_b}$ ✓ $[Ba(OH)_2] = 0,04375$ mol·dm^{-3} ✓

(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.✓/
Gekonsentreede 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 (2)

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 (2)

Note: 2 or 0

7.1.3 $pH = -\log[H_3O^+]$✓
$= -\log(0,20)$✓
$= 0,7$✓ (3)

7.2.1 Basic ✓/ basies (1)

7.2.2 $CO_3^{2-}(aq) + H_2O(\ell) \rightarrow HCO_3^-(aq) + OH^-(aq)$
(reactants ✓ products ✓)
Excess $OH^-(aq)$ 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)

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

7.3.1 $n(CO_2) = \frac{V}{V_m}$

$= \frac{4,48}{22,4}$ ✓

$= 0,2$ mol

$n(Na_2CO_3) : n(CO_2) = 1:1$

$\therefore n(Na_2CO_3) = 0,2$ mol ✓

$m(Na_2CO_3) = n \cdot M = (0,2)(106)$ ✓ $= 21,2$ g

$\therefore$ % purity $= \frac{\text{mass of pure } Na_2CO_3}{\text{mass of impure } Na_2CO_3} \times 100\%$

$= \frac{21,2}{25} \times 100$ ✓

$= 84,8\%$ ✓ (5)

7.3.2 Mass of impurity/ massa onsuiwerheid = 25 -21,2✓ = 3,8 g✓

OR % impurity/ onsuiwerheid = 100-84,8 = 15,2%

$\frac{15,2}{100}$x 25 = 3,8 g (2)

[18]

QUESTION 7

7.1 It dissociates completely in water ✓ to produce a high concentration of OH^- ions. ✓ (2)

7.2

(a) $n = \frac{m}{M}$

$= \frac{27}{137 + 2(16+1)}$

$= 0,158$ mol ✓

(b) $Ba(OH)_2 \xrightarrow{H_2O} Ba^{2+}(aq) + 2\,OH^-(aq)$

Therefore 0,158 mol $Ba(OH)_2$ produces 2 x 0,158 = 0,316 mol OH^- ✓

(c) Concentration of hydroxide ions:

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

$= {}^{0,316}/_{2}$

$= 0,158$ mol·dm^{-3}

(d) $K_w = [OH^-][H^+]$ ✓

$10^{-14} = [0,158][H^+]$ ✓

$[H^+] = 6,329 \times 10^{-14}$ mol·dm^{-3}

(e) pH = -log $[H^+]$ ✓

= - log[6,329 x 10^{-14}] ✓

= 13,19 ✓

OR:

Calc: pOH = -log $[OH^-]$ ✓

= - log (0,158) ✓

= 0,801 ✓

∴ pH = 14 - 0,801 ✓

= 13,20 ✓

(7)

7.3 Burette ✓ (1)

7.4 An acid is a proton (H^+-ion) donor. ✓✓ (2 or 0) (2)

7.5

$Ba(OH)_2$ + 2 HCℓ ⟶ $BaCℓ_2$ + $2H_2O$

$n_b = 1$ $n_a = 2$

$c_b = 0,079$ $c_a = 2,5$

$V_b = 2$ dm^3 $V_a = ?$

0,158 mol $Ba(OH)_2$ will be neutralized by 0,316 mol HCℓ✓

$c = \frac{n}{v}$ ✓

$2,5 = \frac{0,316}{V}$ ✓

V = 0,126 dm^{-3} or 0,13 dm^{-3} ✓.

$^{CaVa}/_{CbVb} = {}^{na}/_{nb}$ ✓ ✓

$^{(2,5)Vb}/_{(0,079)(2)} = {}^{2}/_{1}$ ✓

$V_b = 0,126$ dm^3 ✓

(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

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

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

$c_b = 0,19\ mol.dm^{-3}$ ✓

7.2.5 $pH = - \log [H_3O^+]$ ✓

$= - \log 0,25$ ✓

$= 0,6$ ✓ **[17]**

MERCY!!!!!

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