



Opgave 5

A $10^{-7,0} = 1,0 \cdot 10^{-7} \text{ M}$

B $10^{-11,75} = 1,8 \cdot 10^{-12} \text{ M}$

C $10^{-0,045} = 9,02 \cdot 10^{-1} \text{ M}$

Let op de significantieregel!

Opgave 6

A $-\log(3,2) = -0,51$

B $-\log(0,0465) = 1,332$

C $-\log(1,0000) = 0,00000$

Let op significantie!

Opgave 7

A $10^{-7,0} = 1 \cdot 10^{-7} \text{ M}$

B $10^{-0,0375} = 9,173 \cdot 10^{-1} \text{ M}$

C $10^{-11,00} = 1,0 \cdot 10^{-11} \text{ M}$

Significantie!

Opgave 8

A $-\log(4,6) = -0,66$

B $-\log(0,00412) = 2,385$

C $-\log(0,1000000) = 1,0000000$

Significantie!



Opdracht 9

A $\text{pH} = 14,0 - 7,0 = 7,0$

B $\text{pH} = 14,0000 - 0,0375 = 13,9625$

C $\text{pH} = 14,00 - 11,00 = 3,00$

D $\text{pOH} = 14,0 - 7,0 = 7,0$

E $\text{pOH} = 14,00 - 11,75 = 2,25$

F $\text{pOH} = 14,000 - 0,045 = 13,955$

Opdracht 10

A $\text{pH} = 14,0 - 7,0 = 7,0$

$[\text{H}^+] = 10^{-7,0} = 1,0 \cdot 10^{-7} \text{ M}$

B $\text{pH} = 14,0000 - 0,0871 = 13,9129$

$[\text{H}^+] = 10^{-13,9129} = 1,222 \cdot 10^{-14} \text{ M}$

C $\text{pH} = 14,000 - 13,000 = 1,000$

$[\text{H}^+] = 10^{-1,000} = 1,00 \cdot 10^{-1} \text{ M}$

Opdracht 11

A $\text{pOH} = 14,0 - 7,0 = 7,0$

$[\text{OH}^-] = 10^{-7,0} = 1 \cdot 10^{-7} \text{ M}$

B $\text{pOH} = 14,0000 - 1,0000 = 13,0000$

$[\text{OH}^-] = 10^{-13,0000} = 1,000 \cdot 10^{-13} \text{ M}$

C $\text{pOH} = 14,00 - 9,14 = 4,86$

$[\text{OH}^-] = 10^{-4,86} = 1,4 \cdot 10^{-5} \text{ M}$



Opdracht 12

$$A \quad \text{pOH} = -\log(0,37) = 0,43$$
$$\text{pH} = 14,00 - 0,43 = 13,57$$

$$B \quad \text{pOH} = -\log(0,00173) = 2,762$$
$$\text{pH} = 14,000 - 2,762 = 11,238$$

Hierna zou je zelfs nog
door kunnen rekenen naar
[H⁺]

$$C \quad \text{pOH} = -\log(0,100000) = 1,000000$$
$$\text{pH} = 14,000000 - 1,000000 = 13,000000$$

$$D \quad \text{pH} = -\log(2,0) = -0,30$$
$$\text{pOH} = 14,000 - (-0,30) = 14,30$$

$$E \quad \text{pH} = -\log(0,0870) = 1,060$$
$$\text{pOH} = 14,000 - 1,060 = 12,940$$

Hierna zou je zelfs nog
door kunnen rekenen naar
[OH⁻]

$$F \quad \text{pH} = -\log(0,0000100) = 5,000$$
$$\text{pOH} = 14,000 - 5,000 = 9,000$$



Opdracht 13

$$M_{\text{HCl}} = 20,008 \text{ g/mol}$$

$$\frac{2,5}{20,008} = 0,12 \text{ mol HCl}$$



$$[\text{H}^+] = \frac{0,12}{30} = 4,2 \cdot 10^{-3} \text{ M} \quad \text{pH} = -\log(4,2 \cdot 10^{-3}) = 2,38$$

Opdracht 14

$$15 \text{ mg} = 15 \cdot 10^{-3} \text{ g}$$

$$M_{\text{H}_2\text{SO}_4} = 98,076 \text{ g mol}^{-1}$$

$$\frac{15 \cdot 10^{-3}}{98,076} = 1,5 \cdot 10^{-4} \text{ mol H}_2\text{SO}_4$$



$$\frac{3,1 \cdot 10^{-4}}{1,5} = 2,0 \cdot 10^{-4} \text{ M} \quad \text{pH} = -\log(2,0 \cdot 10^{-4}) = 3,69$$



Opdracht 15

$$M_{\text{NaOH}} = 39,998 \text{ g mol}^{-1}$$

$$\frac{1,33}{39,998} = 3,33 \cdot 10^{-2} \text{ mol NaOH}$$



$$[\text{OH}^-] = \frac{3,33 \cdot 10^{-2}}{4} = 8,31 \cdot 10^{-3} \text{ M}$$

$$p\text{OH} = -\log(8,31 \cdot 10^{-3}) = 2,080$$

Opdracht 16

$$M_{\text{NaOH}} = 39,998 \text{ g mol}^{-1}$$

$$600 \mu\text{g} = 600 \cdot 10^{-6} \text{ g} \quad \frac{600 \cdot 10^{-6}}{39,998} = 1,50 \cdot 10^{-5} \text{ mol NaOH}$$

$$[\text{OH}^-] = \frac{1,50 \cdot 10^{-5}}{0,250} = 6,00 \cdot 10^{-5}$$

$$p\text{OH} = -\log(6,00 \cdot 10^{-5}) = 4,222$$

Opdracht 17

$$M_{\text{HNO}_3} = 63,018$$

$$37 \text{ kg} = 3,7 \cdot 10^4 \text{ g}$$

$$\frac{3,7 \cdot 10^4}{63,018} = 5,9 \cdot 10^2 \text{ mol HNO}_3 = 5,9 \cdot 10^2 \text{ mol H}^+$$

$$[\text{H}^+] = \frac{5,9 \cdot 10^2}{250} = 2,3 \text{ M}$$

$$p\text{H} = -\log(2,3) = -0,37$$

$$p\text{OH} = 14 - (-0,37) = 14,37$$



Opdracht 18

$$M_{\text{Ca(OH)}_2} = 74,096 \text{ g mol}^{-1} \quad \frac{28000}{74,096} = 377,9 \text{ mol Ca(OH)}_2$$

↳ 74,10 significant → 4 cijfers ↑

$$= 755,8 \text{ mol OH}^-$$

$$[\text{OH}^-] = \frac{755,8}{5000} = 0,1512 \text{ M} \quad \text{pOH} = -\log(0,1512) = 0,8206$$

$$\text{pH} = 14 - 0,8206 = 13,1794$$

Opdracht 19

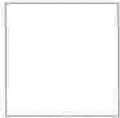
$$\text{I: } 0,050 \cdot 0,33 = 0,0165 \text{ mol H}^+$$

$$\text{II: } 0,030 \cdot 0,81 = 0,0243 \text{ mol H}^+$$

$$\text{totaal} \quad \underline{0,041} \text{ mol H}^+$$

$$[\text{H}^+] = \frac{0,041}{0,050 + 0,030} = 0,51 \text{ M}$$

$$\text{pH} = -\log(0,51) = 0,29$$



Opdracht 20

I: $[H^+] = 10^{-5,84} = 1,4 \cdot 10^{-6} M$

II: $[H^+] = 10^{-1,00} = 1,0 \cdot 10^{-1} M$

$1,4 \cdot 10^{-6} \cdot 0,080 = 1,2 \cdot 10^{-7} \text{ mol } H^+$

$1,0 \cdot 10^{-1} \cdot 0,010 = 1,0 \cdot 10^{-3} \text{ mol } H^+$

totaal: $\frac{1,0 \cdot 10^{-3}}{1,0 \cdot 10^{-3}} \text{ mol } H^+$

$\frac{1,0 \cdot 10^{-3}}{0,090} = 1,1 \cdot 10^{-2} \quad pH = -\log(1,1 \cdot 10^{-2}) = 1,95$

Opdracht 21

I: $[OH^-] = 10^{-4,50} = 3,2 \cdot 10^{-5}$

II: $[OH^-] = 10^{-2,70} = 2,0 \cdot 10^{-3}$

$3,2 \cdot 10^{-5} \cdot 0,080 = 2,5 \cdot 10^{-6} \text{ mol } OH^-$

$2,0 \cdot 10^{-3} \cdot 0,070 = 1,4 \cdot 10^{-4} \text{ mol } OH^-$

$\frac{1,4 \cdot 10^{-4}}{1,4 \cdot 10^{-4}} \text{ mol } OH^-$

$[OH^-] = \frac{1,4 \cdot 10^{-4}}{0,150} = 9,5 \cdot 10^{-4} M \quad pOH = -\log(9,5 \cdot 10^{-4}) = 3,02$

$pH = 14,00 - 3,02 = 10,98$



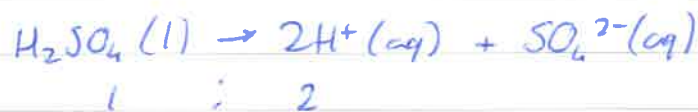
Opdracht 22

$$[H^+] = 10^{-4,00} = 1,0 \cdot 10^{-4} \text{ M} \quad 1,0 \cdot 10^{-4} \cdot 0,450 = 4,5 \cdot 10^{-5} \text{ mol H}^+$$

$$\text{bij pH} = 3,00: [H^+] = 10^{-3,00} = 1,0 \cdot 10^{-3} \text{ M} \quad 1,0 \cdot 10^{-3} \cdot 0,450 = 4,5 \cdot 10^{-4} \text{ mol H}^+$$

$$\text{toevoegen: } 4,5 \cdot 10^{-4} - 4,5 \cdot 10^{-5} = 4,1 \cdot 10^{-4} \text{ mol H}^+$$

gewenst - aanwezig = nodig



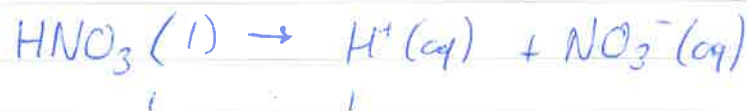
$$\Rightarrow \frac{4,1 \cdot 10^{-4}}{2} = 2,05 \cdot 10^{-4} \text{ mol H}_2\text{SO}_4$$

Opdracht 23

$$[H^+] = 10^{-6,00} = 1,0 \cdot 10^{-6} \text{ M} \quad 1,0 \cdot 10^{-6} \cdot 0,250 = 2,5 \cdot 10^{-7} \text{ mol H}^+$$

$$[H^+] = 10^{-3,00} = 1,0 \cdot 10^{-3} \text{ M} \quad 1,0 \cdot 10^{-3} \cdot 0,250 = 2,5 \cdot 10^{-4} \text{ mol H}^+$$

$$2,5 \cdot 10^{-4} - 2,5 \cdot 10^{-7} = 2,5 \cdot 10^{-4} \text{ mol toevoegen}$$



$$\Rightarrow 2,5 \cdot 10^{-4} \text{ mol HNO}_3$$

$$M_{\text{HNO}_3} = 63,018 \text{ g/mol}$$

$$63,018 \cdot 2,5 \cdot 10^{-4} = 1,6 \cdot 10^{-2} \text{ g HNO}_3$$



Opdracht 24

$$pOH = 14,00 - 10,00 = 4,00$$

$$[OH^-] = 10^{-4,00} = 1,0 \cdot 10^{-4} \text{ M}$$

$$1,0 \cdot 10^{-4} \cdot 0,100 = 1,0 \cdot 10^{-5} \text{ mol OH}^-$$

$$pOH = 13,00 - 12,00 = 1,00$$

$$[OH^-] = 10^{-1,00} = 1,0 \cdot 10^{-1} \text{ M}$$

$$1,0 \cdot 10^{-1} \cdot 0,100 = 1,0 \cdot 10^{-2} \text{ mol OH}^-$$

$$1,0 \cdot 10^{-2} - 1,0 \cdot 10^{-5} = 1,0 \cdot 10^{-2} \text{ mol OH}^-$$



$$\Rightarrow 1,0 \cdot 10^{-2} \text{ mol NaOH}$$

$$1,0 \cdot 10^{-2} \cdot 39,998 = 4,0 \cdot 10^{-1} \text{ g NaOH}$$



Opgave 25

$$\text{pH} = 4,00 \Rightarrow [\text{H}^+] = 10^{-4,00} = 1,0 \cdot 10^{-4} \text{ M}$$
$$1,0 \cdot 10^{-4} \cdot 0,450 = 4,5 \cdot 10^{-5} \text{ mol H}^+$$

$$\text{pH} = 2,00 \Rightarrow [\text{H}^+] = 10^{-2,00} = 1,0 \cdot 10^{-2} \text{ M}$$
$$1,0 \cdot 10^{-2} \cdot 0,150 = 1,5 \cdot 10^{-3} \text{ mol H}^+$$

V_{mengsel} wordt 600 ml!

$$6,0 \cdot 10^{-3} - 4,5 \cdot 10^{-5} = 6,0 \cdot 10^{-3} \text{ mol H}^+ \text{ toevoegen}$$

Om de pH uit te rekenen heb je $[\text{H}^+]$ nodig

$$\text{molariteit} = \frac{\text{mol}}{\text{Volume}}$$

$$[\text{H}^+] = \frac{6,0 \cdot 10^{-3}}{0,150} = 0,040 \text{ M}$$

$$\text{pH} = -\log(0,040) = 1,40$$



Opgave 26

$$[\text{OH}^-] = 10^{-6,00} = 1,0 \cdot 10^{-6} \text{ M} \quad \text{V} = 1,0 \cdot 10^{-6} \cdot 0,450 = 4,5 \cdot 10^{-7} \text{ mol OH}^-$$

$$[\text{OH}^-] = 10^{-3,50} = 3,16 \cdot 10^{-4} \text{ M} \quad 3,2 \cdot 10^{-4} \cdot 0,650 = 2,1 \cdot 10^{-4} \text{ mol OH}^-$$

Vmengsel is 650 ml!

$$2,1 \cdot 10^{-4} - 4,5 \cdot 10^{-7} = 2,1 \cdot 10^{-4} \text{ mol OH}^- \text{ nodig}$$

$$[\text{OH}^-] = \frac{2,1 \cdot 10^{-4}}{0,650} = 3,23 \cdot 10^{-4} \text{ M}$$

$$\text{pOH} = -\log(3,23 \cdot 10^{-4}) = 3,49$$

Opgave 27

$$[\text{OH}^-] = 10^{-3,50} = 3,16 \cdot 10^{-4} \text{ M} \quad 3,2 \cdot 10^{-4} \cdot 0,250 = 7,9 \cdot 10^{-5} \text{ mol OH}^-$$

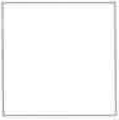
$$[\text{OH}^-] = 10^{-2,00} = 1,0 \cdot 10^{-2} \text{ M} \quad 1,0 \cdot 10^{-2} \cdot 0,350 = 3,5 \cdot 10^{-3} \text{ mol OH}^-$$

$$3,5 \cdot 10^{-3} - 7,9 \cdot 10^{-5} = 3,4 \cdot 10^{-3} \text{ mol}$$

$$[\text{OH}^-] = \frac{3,4 \cdot 10^{-3}}{0,100} = 3,4 \cdot 10^{-2} \text{ M}$$

$$\text{pOH} = -\log(3,4 \cdot 10^{-2}) = 1,47$$

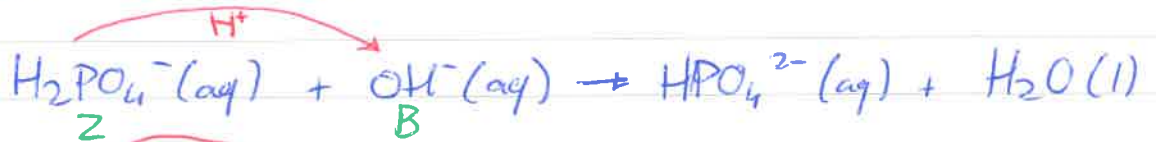
$$\text{pH} = 14,00 - 1,47 = 12,53$$



Opdracht 29

A. geen Z-B reactie

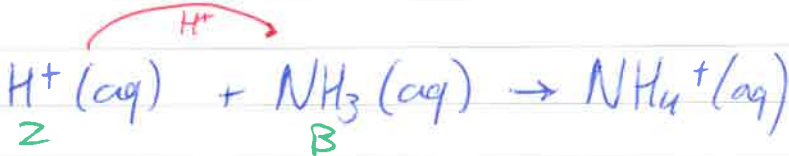
B



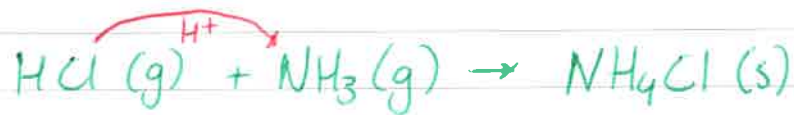
C



D

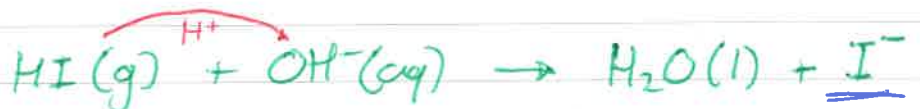


Opdracht 30

A Deeltjes: $\frac{\text{NH}_3 (\text{g})}{\text{B}}$, $\frac{\text{HCl} (\text{g})}{\text{Z}}$ 

Let op: NH_4^+ en Cl^- worden gevormd, maar er is geen water aanwezig, dus zal het niet oplossen, maar een vast zout vormen.

B

Deeltjes: $\frac{\text{HI} (\text{g})}{\text{Z}}$, $\frac{\text{Na}^+ (\text{aq})}{\text{Z}}$, $\frac{\text{OH}^- (\text{aq})}{\text{B}}$, H_2O 

$\text{I}^- (\text{aq})$ en $\text{Na}^+ (\text{aq})$ aanwezig in oplossing \Rightarrow geen neerslag