

Graad 9 – Handboek Memo

(Hersiene KABV uitgawe)

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Hoofstuk A1

Reële getalle

A1.1 Getalstelsels:

Voltooi: * Natuurlike getalle: $N = \{1, 2, 3, 4, \dots\}$
 * Telgetalle: $N_0 = \{0, 1, 2, 3, 4, \dots\}$
 * Heelgetalle: $Z = \{\dots, -2, -1, 0, 1, 2, \dots\}$
 * Rasionale getalle: $Q = \{\frac{a}{b} \mid a, b \in Z, b \neq 0\}$

A1.2 Irrasionale getalle:

Oefening 1:

Watter van die volgende getalle is rasionale getalle Q en watter is irrasionale getalle Q' ?

- (1) 14 : Q (2) $\frac{1}{3}$: Q (3) $9 = \sqrt{81}$: Q (4) $0,12$: Q
 (5) $\sqrt{18}$: Q' (6) $12,2\bar{3}$: Q (7) $-\sqrt{\frac{12}{3}}$: Q (8) $0,2945\dots$: Q'
 (9) $\sqrt[4]{64}$: Q (10) π : Q' (11) $\sqrt[3]{32}$: Q (12) $\frac{1}{4}$: Q
 $= 4$ $-\sqrt{4} = -2$

⊗ Watter van die volgende getalle is irrasionale getalle tussen 2 en 10?

$\sqrt{10}$	$-\sqrt{20}$	$\sqrt{32}$	π	$\sqrt{25}$	$\sqrt[3]{9}$	$3,2$	$\sqrt{99}$	$2,15$	$\sqrt{\frac{16}{3}}$	$\sqrt[3]{9}$
✓	X	✓	✓	X	✓	X	✓	X	X	X

A1.3 Herleiding van gewone breuke na desimale breuke:

Oefening 2:

Druk die volgende as desimale breuke uit sonder om 'n sakrekenaar te gebruik:

- (1) $\frac{2^3}{7}$ = $\frac{8}{7} = 1,142857\dots$
 (2) $1\frac{1}{3}$ = $1,3333\dots$
 (3) $\frac{2^2}{12}$ = $\frac{4}{12} = \frac{1}{3} = 0,3333\dots$
 (4) $\frac{1}{5}$ = $0,2$
 (5) $\frac{1}{8}$ = $0,125$
 (6) $\frac{7}{9}$ = $0,7777\dots$

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Kontaknommer: 086 618 3709 (Faks!)

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- (7) $\frac{17}{25} = \frac{17 \cdot 40}{25 \cdot 40} = 0,68$
- (8) $\frac{5}{100} = 0,05$
- (9) $\frac{1}{11} = 0,090909 \dots = 0,0\bar{9}$
- (10) $3,4 = 3,4000$
- (11) $-5\frac{5}{6} = -5,8333 \dots = -5,8\bar{3}$
- (12) $\frac{11}{4} = 2,75$

⊙ Jy het $\frac{14}{30}$ vir 'n wiskundetoets gekry. Bereken jou persentasie.

$$\% = \frac{14}{30} \times \frac{100}{1} = \frac{1400}{3} = 466,666 \dots \approx 467\%$$

A1.4 Herleiding van desimale breuke na gewone breuke:

Oefening 3:

Druk die volgende as gewone breuke in hulle eenvoudigste vorm uit:

- (1) $2,4 = 2\frac{4}{10} = 2\frac{2}{5} \left(\div \frac{2}{2}\right) = \frac{12}{5}$
- (2) $0,25 = \frac{25}{100} = \frac{1}{4} \left(\div \frac{25}{25}\right)$
- (3) $33,6 = 33\frac{6}{10} = 33\frac{3}{5} \left(\div \frac{2}{2}\right) = 33\frac{3}{5}$
- (4) $-0,5 = -\frac{5}{10} = -\frac{1}{2} \left(\div \frac{5}{5}\right)$
- (5) $-1,2 = -1\frac{2}{10} = -1\frac{1}{5} \left(\div \frac{2}{2}\right) = -1\frac{1}{5}$
- (6) $0,125 = \frac{125}{1000} = \frac{1}{8} \left(\div \frac{125}{125}\right)$
- (7) $5,02 = 5\frac{2}{100} = 5\frac{1}{50} \left(\div \frac{2}{2}\right) = 5\frac{1}{50}$
- (8) $7,3 = 7\frac{3}{10}$
- (9) $100,75 = 100\frac{75}{100} = 100\frac{3}{4} \left(\div \frac{25}{25}\right) = 100\frac{3}{4}$
- (10) $0,0005 = \frac{5}{10000} = \frac{1}{2000} \left(\div \frac{5}{5}\right)$
- (11) $-2,1 = -2\frac{1}{10} \left(\div \frac{1}{1}\right) = -2\frac{1}{10}$
- (12) $1,45 = 1\frac{45}{100} = 1\frac{9}{20} \left(\div \frac{5}{5}\right)$

⊙ Jy en jou maats eet 0,84 van jou verjaarsdagkoek op. Bereken watter gedeelte van die koek oorgebly het. (Druk jou antwoord as 'n gewone breuk uit!)

$$1 - 0,84 = 0,16 \text{ bly oor.}$$

$$\therefore 0,16 = \frac{16}{100} = \frac{4}{25}$$

A1.5 Herleiding van repeterende breuke na gewone breuke:

Oefening 4:

Herlei die volgende na gewone breuke in hulle eenvoudigste vorm:

- (1) $4,6 = 4\frac{6}{10} = 4\frac{3}{5}$
- (2) $0,15 = 0,151515 \dots = \frac{15}{99} = \frac{5}{33}$
- (3) $12,37 = 12,37777 \dots = 12\frac{37}{90} = 12\frac{34}{90} = 12\frac{17}{45}$
- (4) $1,135 = 1,135135 \dots = \frac{1135}{999} = \frac{1135}{999}$
- (5) $0,9 = 0,999 \dots = \frac{9}{10}$
- (6) $0,003 = 0,003333 \dots = \frac{3}{1000}$

(7) $2,2 \quad \sqrt{10x} = 2,2 \dots$
 $\therefore 10x = 2,2^2 \dots$
 $9x = 20$
 $x = \frac{20}{9}$
 $x = 2 \frac{2}{9}$

(8) $3,258 \quad \sqrt{1000x} = 3,258, 58 \dots$
 $\therefore 1000x = 3,258, 58^2 \dots$
 $990x = 3226$
 $x = \frac{3226}{990}$
 $x = 3 \frac{356}{990}$
 $x = 3 \frac{178}{495}$

(9) $0,02 \quad \sqrt{1000x} = 2,22 \dots$
 $\therefore 1000x = 2,22^2 \dots$
 $900x = 2$
 $x = \frac{2}{900}$
 $x = \frac{1}{450}$

(10) $1,214 \quad \sqrt{1000x} = 1,214, 214 \dots$
 $\therefore 1000x = 1,214, 214^2 \dots$
 $999x = 1,213$
 $x = \frac{1,213}{999}$
 $x = 1 \frac{14}{999}$

Watter van die volgende is die grootste: 0,251 of 0,25?

$\sqrt{0,251} = \frac{251}{1000}$
 $\therefore 1000x = 25,25 \dots$
 $99x = 25$
 $x = \frac{25}{99}$
 $x = \frac{25000}{99000} \left(x \frac{1000}{1000} \right)$

$\therefore 0,25$ is grootste!

A1.6 Voostelling van versamelings van getalle:

A1.6.1 Versamelingskeurnotasië:

- Oefening 5:
 Skryf die volgende versamelings van getalle in versamelingskeurnotasië:
 (1) Die reële getalle tussen 1 en 6: $\{x \mid 1 < x < 6, x \in \mathbb{R}\}$
 (2) Die tegetalle kleiner as 10: $\{p \mid p < 10, p \in \mathbb{N}_0\}$

- (3) Die reële getalle vanaf -2 tot en met 3: $\{y \mid -2 \leq y \leq 3, y \in \mathbb{R}\}$
 (4) Die natuurlike getalle groter as 4: $\{x \mid x > 4, x \in \mathbb{N}\}$
 (5) $\{-8; -7; -6; -5; -4; -3; -2; -1\}$: $\{x \mid -8 \leq x \leq -1, x \in \mathbb{Z}\}$
 (6) $\{17; 18; 19; \dots\}$: $\{m \mid m \geq 17, m \in \mathbb{N}\}$ of \mathbb{N}_0 of \mathbb{Z}
 (7) Die reële getalle groter as -20 maar kleiner as of gelyk aan 1: $\{x \mid -20 < x \leq 1, x \in \mathbb{R}\}$
 (8) $\{\dots; -6; -5; -4; -3\}$: $\{p \mid p \leq -3, p \in \mathbb{Z}\}$
 (9) Alle ewe heelgetalle tussen 0 en 20: $\{2x \mid 0 < 2x < 20, x \in \mathbb{Z}\}$ of \mathbb{N}_0
 (10) $\{-1; 0; 1\}$: $\{m \mid -1 \leq m \leq 1, m \in \mathbb{Z}\}$

A1.6.2 Intervallnotasië:

Oefening 6:

Skryf die volgende in intervalnotasië:

- (1) Die reële getalle tussen -2 en 15: $x \in (-2; 15)$
 (2) Die reële getalle kleiner as 10: $x \in (-\infty; 10)$
 (3) Die reële getalle vanaf -2 tot en met 3: $m \in [-2; 3]$
 (4) $\{x \mid -7 < x \leq 0, x \in \mathbb{R}\}$: $x \in (-7; 0]$
 (5) $\{y \mid y \leq 17, y \in \mathbb{R}\}$: $y \in (-\infty; 17]$
 (6) $\{p \mid -1 < p < 1, p \in \mathbb{R}\}$: $p \in (-1; 1)$
 (7) Die reële getalle groter as -8 maar kleiner as of gelyk aan 11: $x \in (-8; 11]$
 (8) $\{x \mid 3 < x \leq 8, x \in \mathbb{N}\}$: \mathbb{N}
 (9) Die versameling reële getalle: $x \in (-\infty; \infty)$
 (10) $\{t \mid t > 0, t \in \mathbb{R}\}$: $t \in (0; \infty)$

A1.6.3 Getallelyne:

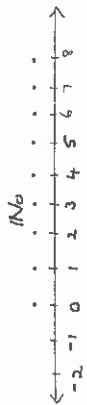
Oefening 7:

Stel die volgende op 'n getallelyne voor:

- (1) $\{t \mid t > 4, t \in \mathbb{R}\}$
 (2) $\{x \mid 1 < x \leq 7, x \in \mathbb{N}\}$



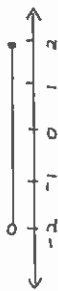
(3) $\{x: -3 \leq x \leq 8; x \in \mathbb{N}_0\}$



(4) $\{x/2 \frac{1}{2} \leq x \leq 8; x \in \mathbb{Z}\}$



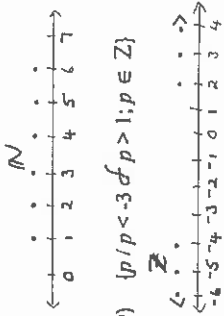
(5) $m \in (-2; 2]$



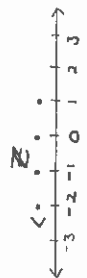
(6) Alle telgetalle tussen 4 en 8.



(7) $\{y/ y < 7; y \in \mathbb{N}\}$



(8) $\{ \dots; -2; -1; 0; 1\}$



(9) $\{p/ p < -3 \wedge p > 1; p \in \mathbb{Z}\}$



(10) $k \in [-3; \infty)$



A1.6.4 Oplos van lineaire ongelijkheden:

Oefening 8:

(1) Los op vir x en stel jou antwoord op 'n getallelyn voor:

(a) $x + 1 < 3; x \in \mathbb{N}_0$



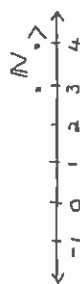
(b) $2x \geq -8; x \in \mathbb{R}$



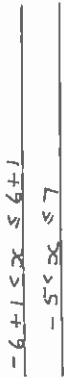
(c) $x - 4 \leq 0; x \in \mathbb{Z}$



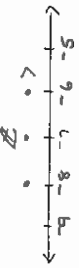
(d) $2x + 3 > 7; x \in \mathbb{N}$



(e) $-6 < x - 1 \leq 6; x \in \mathbb{R}$



(f) $x + 7 \geq -1; x \in \mathbb{Z}$



(2) Stel die volgende op 'n getallelyn voor:

(a) $\{x/ 2x < \frac{2}{2}; x \in \mathbb{R}\}$



(b) $\{x/ -2 \leq x + 1 \leq 4; x \in \mathbb{Z}\}$



(c) $\{y/ y - 3 < -1; y \in \mathbb{N}\}$



(d) $\{x/ x \leq -1; x \in \mathbb{R}\}$



\mathbb{N}



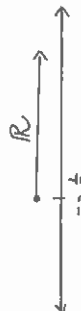
(e) $\{x/ x < 3; x \in \mathbb{Z}\}$



(f) $\{p/ 2p \geq -5; p \in \mathbb{R}\}$



\mathbb{Z}



(g) $\{m: -1 \leq 2m - 1 < 7; m \in \mathbb{R}\}$
 $-1+1 \leq 2m < 7+1$
 $0 \leq 2m < 8$
 $0 \leq m < 4$

(h) $\{x: 2x - 3 < 7; x \in \mathbb{N}_0\}$
 $2x < 7+3$
 $2x < 10$
 $x < 5$

A1.6.5 Kombinasies:

Oefening 9:

Voltooi die ontbrekende voorstellings in die onderstaande tabel:

Versamelingkeurdenotasie:	Intervallnotasie:	Getalrelyn:
$\{x/-1 < x \leq 2; x \in \mathbb{R}\}$	$x \in (-1; 2]$	
$\{x/-2 \leq x \leq 5; x \in \mathbb{R}\}$	$x \in [-2; 5]$	
$\{y/y \leq 3; y \in \mathbb{R}\}$	$y \in (-\infty; 3]$	
$\{x/x \leq 3; x \in \mathbb{N}_0\}$	Nut	
$\{y/y \geq 3; y \in \mathbb{N}\}$	Nut	
$\{m/0 < m \leq 4; m \in \mathbb{R}\}$	$m \in (0; 4]$	
$\{t/t \geq -5; t \in \mathbb{R}\}$	$t \in [-5; \infty)$	

(8) $\{m: m \leq 6; m \in \mathbb{R}\}$	$m \in (-\infty; 6]$	
(9) $\{x/-1 < x < 2; x \in \mathbb{Z}\}$	Nut	
(10) $\{x/x > -1; x \in \mathbb{R}\}$	$x \in (-1; \infty)$	

© 'n Boer het genoeg weiding vir 13 beeste. Skryf die verskillende permutasies neer van die aantal beeste wat hy moontlik op die plaas kan aanhou. Stel jou antwoord ook grafies voor.

Beeste $\in \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13\}$

A1.7 HERSIENINGSOEFENING:

(1) Teken die tabel oor en voltooi deur 'n \checkmark te maak in die toepasslike blokkie(s) waartoe die getal behoort:

	N	\mathbb{N}_0	Z	\mathbb{C}	\mathbb{C}'	R	N	\mathbb{N}_0	Z	\mathbb{C}	\mathbb{C}'	R
(1) $\frac{2}{3}$				<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>					<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
(2) 0		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	$\sqrt[4]{9} = \frac{3}{2}$		<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>
(3) 0,3				<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	$\sqrt{8} = 2\sqrt{2}$					<input checked="" type="checkbox"/>
(4) $\sqrt{27}$					<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	-1,7					<input checked="" type="checkbox"/>
					<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	111		<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>

(2) Druk elk van die volgende as 'n desimale breuk uit:

(a) $\frac{2}{7} = \frac{2 \cdot 15}{7 \cdot 15} = \frac{30}{105}$

(b) $\frac{1}{24} = \frac{1 \cdot 15}{24 \cdot 15} = \frac{15}{360}$

(c) $-1 \frac{5}{9} = -\frac{14}{9} = -1,55\overline{5} = -1,5\overline{5}$

(d) $\frac{2^7}{8} = \frac{128}{8} = 16$

(e) $\frac{1}{6} = \frac{1 \cdot 16}{6 \cdot 16} = \frac{16}{96} = 0,16\overline{6} = 0,1\overline{6}$

(f) $\frac{33}{12} = \frac{33 \div 3}{12 \div 3} = \frac{11}{4} = 2,75$

(g) $\frac{1916}{16} = 119,75$

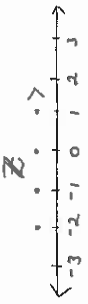
(3) Druk elk van die volgende as 'n gewone breuk in sy eenvoudigste vorm uit:


(a) $0,45 = \frac{45}{100} = \frac{9}{20}$
 (b) $-3,25 = -3 \frac{25}{100} = -3 \frac{1}{4}$
 (c) $17,2 = 17 \frac{2}{10} = 17 \frac{1}{5}$

(4) Herlei die volgende na 'n gewone breuk in sy eenvoudigste vorm:

(a) $2,1 = \frac{21}{10} = 2 \frac{1}{10}$
 (b) $0,44 = \frac{44}{100} = \frac{11}{25}$
 (c) $0,02\bar{3} = \frac{23}{900} = 23 \frac{23}{900}$
 (d) $25,2\bar{5} = \frac{2525}{100} = 25 \frac{25}{100} = 25 \frac{1}{4}$

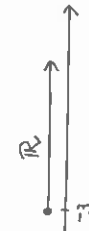
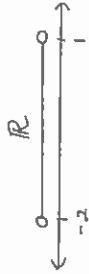
(5) Los vir x op. Gee jou oplossing in (i) versamelingskeurdernotasie (ii) intervalnotasie en (iii) stel dit grafies voor.

(a) $\frac{-4 \leq 2x}{2} \leq \frac{2}{2}; x \in \mathbb{Z}$
 $-2 \leq x$
 (i) $\{x \mid x \geq -2; x \in \mathbb{Z}\}$
 (ii) Geen intervalnotasie


(b) $x + 1 < 7; x \in \mathbb{N}$
 $x < 7 - 1$
 $x < 6$
 (i) $\{x \mid x < 6; x \in \mathbb{N}\}$
 (ii) Geen intervalnotasie


(c) $-1 < x + 1 < 2; x \in \mathbb{R}$
 $-1 - 1 < x < 2 - 1$
 $-2 < x < 1$
 (i) $\{x \mid -2 < x < 1; x \in \mathbb{R}\}$
 (ii) $x \in (-2; 1)$


(d) $x - 2 \geq -5; x \in \mathbb{R}$
 $x \geq -5 + 2$
 $x \geq -3$
 (i) $\{x \mid x \geq -3; x \in \mathbb{R}\}$
 (ii) $x \in [-3; \infty)$



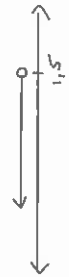
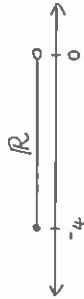
(6) Skryf die volgende in intervalnotasie en stel dit grafies voor:

(a) $\{x \mid 0 > x \geq -4; x \in \mathbb{R}\}$
 $x \in [-4; 0)$

(b) $\{p \mid p < 1,5; p \in \mathbb{R}\}$
 $p \in (-\infty; 1,5)$

(c) $\{m \mid m \geq -2\frac{1}{2}; m \in \mathbb{Z}\}$
 Geen intervalnotasie


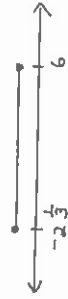
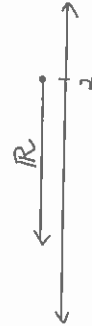
(d) $\{x \mid x < 1 \text{ or } x > 5; x \in \mathbb{R}\}$
 $x \in (-\infty; 1) \cup (5; \infty)$



(7) Skryf die volgende in versamelingskeurdernotasie en stel dit grafies voor:

(a) $y \in (-\infty; 2]$
 $\{y \mid y \leq 2; y \in \mathbb{R}\}$

(b) $t \in [-2\frac{1}{3}; 6]$
 $\{t \mid -2\frac{1}{3} \leq t \leq 6; t \in \mathbb{R}\}$



Hoofstuk A2
EkspONENTE

A2.1 Eksponentwette:

Oefening 1:

(1) Vereenvoudig sonder 'n sakrekenaar (skryf antwoorde as positiewe eksponente!):

(a) $a^4 \cdot b^{-7} \cdot b^4 \cdot a^4$
 $= a^{4+4} \cdot b^{-7+4}$
 $= a^8 \cdot b^{-3} = \frac{a^8}{b^3}$

(b) $(3xy - 2x^2y)^{2m+1-6}$
 $= (3xy - 2x^2y)^{2m-5}$

(c) $a^4 b^3 \times ab^4$
 $= \frac{a^4 b^3}{a^4 b^4} = \frac{1}{b}$

(d) $3^{-1} \times m^2 \times m^2$
 $= \frac{m^2 \times m^2}{3} = \frac{m^4}{3}$

(e) $\sqrt{2 \frac{1}{4} p^{-4}}$
 $= \sqrt{\frac{2}{4} p^{-4}} = \frac{2}{2} p^{-2} = p^{-2} = \frac{1}{p^2}$

(f) $(4 \text{ min } p^{-15})$
 $= 4^5 m^5 n^{15} p^{-15}$
 $= \frac{4^5 m^5 n^{15}}{p^{15}}$

(g) $4^k \times 2^{2k}$
 $= (2^2)^k \times 2^{2k} = 2^{2k} \times 2^{2k} = 2^{4k}$

(h) $(-12x^6y)(-4x^3y^2)$
 $= (12 \times 4) x^{-6+3} y^{1+2} = 48 x^{-3} y^3 = \frac{48 y^3}{x^3}$

(i) $4^0(x^2)^3 \div x^2 x^3$
 $= 1 \cdot (x^6) \div x^2 \times x^3 = \frac{x^6}{x^2} \times x^3 = x^4 \times x^3 = x^7$

(j) $(3^2 a^2 b)^1$
 $= 3^{-2} a^2 b^{-1} = \frac{a^2}{3^2 b} = \frac{a^2}{9b}$

(m) $\frac{5^{n+1} \cdot 5^n}{5^{2n+1}}$
 $= \frac{5^{2n+1}}{5^{2n+1}} = 1$

(n) $\frac{c^4 \times c^5}{c \times c^3}$
 $= \frac{c^9}{c^4} = c^5$

(o) $2\sqrt{8} \times \sqrt{2}$
 $= 2\sqrt{16} = 2 \times 4 = 8$

(p) $2^m \times 3^{mn}$
 $= (2 \times 3)^{mn} = 6^{mn}$

(q) $(m^2 n)(mn^2)^0$
 $= m^2 n(1) = m^2 n$

(r) $2x^3 + 5x^2$
 $= 2x^2(x + 5x^2)$

(s) $\frac{(-3pq)(5pq)}{-30p^2q^4}$
 $= \frac{-15p^2q^2}{-30p^2q^4} = \frac{1}{2} q^{-2} = \frac{1}{2q^2}$

(t) $m^2 n^4 \times mn^3$
 $= m^{2+1} n^{4+3} = m^3 n^7$

(u) $\frac{(2a^3c)^2}{(4ac)^2}$
 $= \frac{4a^6c^6}{16a^2c^2} = \frac{a^4c^4}{4}$

(v) $2^2 \cdot 4^2 \cdot 8^2 \cdot 16^2$
 $= 2^2 \cdot (2^2)^2 \cdot (2^3)^2 \cdot (2^4)^2 = 2^2 \cdot 2^4 \cdot 2^6 \cdot 2^8 = 2^{20}$

(w) $\frac{2^2 \cdot 4^2 \cdot 8^2 \cdot 16^2}{4^{-2} \cdot 6^{-2} \cdot 2^{-6}}$
 $= \frac{2^2 \cdot 2^4 \cdot 2^6 \cdot 2^8}{2^{-2} \cdot 6^{-2} \cdot 2^{-6}} = 2^{20} \cdot 6^2 \cdot 2^6 = 2^{26} \cdot 6^2$

(x) $\frac{3^2 y^2 x^{-3} y^4}{(9x-3)y^4}$
 $= \frac{3^2 y^2 x^{-3} y^4}{9x^2 y^4} = \frac{3^2 y^2 x^{-3} y^4}{9x^2 y^4} = \frac{1}{3x^2}$

(y) $\frac{2^2 \cdot 4^2 \cdot 8^2 \cdot 16^2}{4^{-2} \cdot 6^{-2} \cdot 2^{-6}}$
 $= \frac{2^2 \cdot 2^4 \cdot 2^6 \cdot 2^8}{2^{-2} \cdot 6^{-2} \cdot 2^{-6}} = 2^{20} \cdot 6^2 \cdot 2^6 = 2^{26} \cdot 6^2$

(z) $\frac{2^2 \cdot 4^2 \cdot 8^2 \cdot 16^2}{4^{-2} \cdot 6^{-2} \cdot 2^{-6}}$
 $= \frac{2^2 \cdot 2^4 \cdot 2^6 \cdot 2^8}{2^{-2} \cdot 6^{-2} \cdot 2^{-6}} = 2^{20} \cdot 6^2 \cdot 2^6 = 2^{26} \cdot 6^2$

(aa) $\frac{2^2 \cdot 4^2 \cdot 8^2 \cdot 16^2}{4^{-2} \cdot 6^{-2} \cdot 2^{-6}}$
 $= \frac{2^2 \cdot 2^4 \cdot 2^6 \cdot 2^8}{2^{-2} \cdot 6^{-2} \cdot 2^{-6}} = 2^{20} \cdot 6^2 \cdot 2^6 = 2^{26} \cdot 6^2$

(ab) $\frac{2^2 \cdot 4^2 \cdot 8^2 \cdot 16^2}{4^{-2} \cdot 6^{-2} \cdot 2^{-6}}$
 $= \frac{2^2 \cdot 2^4 \cdot 2^6 \cdot 2^8}{2^{-2} \cdot 6^{-2} \cdot 2^{-6}} = 2^{20} \cdot 6^2 \cdot 2^6 = 2^{26} \cdot 6^2$

(2) Vereenvoudig sonder 'n sakrekenaar (skryf antwoord as positiewe eksponente):

(a)
$$\frac{(2x^3y^{-1})^2(-xy)^2}{4(x^2y)^2(xy)^0} = \frac{4x^6y^{-2} \cdot y^2(-x^2y^2)}{4x^4y^4} = \frac{4x^6y^0(-x^2y^2)}{4x^4y^4} = \frac{-4x^4y^2}{4x^4y^4} = -\frac{1}{y^2} \quad (2^{-1} = \frac{1}{2})$$

(b)
$$\sqrt{\frac{12m^3}{3m^5}} \times \sqrt{\frac{25}{n^4}} = \sqrt{\frac{4}{n^2}} \times \sqrt{\frac{25}{n^4}} = \frac{2}{n} \times \frac{5}{n^2} = \frac{10}{n^3}$$

(c)
$$\frac{-4(a^2b^3)}{\sqrt{a^6}} = \frac{-4a^2b^3}{a^3} = -\frac{4a^2b^3}{a^3} = -\frac{4b^3}{a}$$

(d)
$$\sqrt[3]{\frac{144r^4s^1}{-24r^2s^3}} = \sqrt[3]{\frac{-6r^2s^3}{-24r^2s^3}} = \sqrt[3]{-1} = -1$$

(e)
$$\sqrt{16r^8} + \sqrt[3]{8r^{12}} = 4r^4 + 2r^4 = 6r^4$$

(f)
$$12p^3q \div (2p^2q)^2 \times 3q^{-3}(pq)^0 = 12p^3q \div 2^2p^4q^2 \times 3q^{-3} = \frac{12p^3q}{4p^4q^2} \times 3q^{-3} = \frac{3p^{-1}q^{-1}}{p^1q^1} = \frac{3}{pq}$$

(3) Bewys dat: $2^{3+2} \times 4^{3 \cdot 1} = 8^{11}$

L.K. $= 2^{20+5} \times 4^{3 \cdot 1} = 2^{25} \times 2^6 = 2^{31}$

R.K. $= 8^{3+2} = 8^5 = 2^{31}$

\therefore L.H.S. = R.H.S.

(4) Is die volgende bewerings waar of onwaar?

- (a) $3^2 \times 2^3 = 6^6$ Onwaar
- (b) $x^3 \times y^3 = (xy)^3$ Waar
- (c) $\sqrt[4]{64x^4} = 4$ Onwaar
- (d) $(x-y)^2 = x^2 - y^2$ Onwaar
- (e) $\frac{1}{9p^2} = 9p^2$ Onwaar

© As die lengte van 'n reghoek $2x^2y^3$ is en die breedte is $3xy^4$; bepaal

- (a) die omtrek van die reghoek en $2 \times \text{Opp}$
- (b) dubbel die oppervlakte van die reghoek in terme van x en y . $2 \times [L \times b]$
- Omtrek $= 2(2x^2y^3 + 3xy^4) = 4x^2y^3 + 6xy^4$
- $= 2(2x^2y^3)(3xy^4)$
- $= 12x^3y^7$

A2.2. Wetenskaplike notasie:

Oefening 2:

(1) Skryf in wetenskaplike notasie:

- (a) 0,000346 = $3,46 \times 10^{-4}$
- (b) 15,19 = $1,519 \times 10^1$
- (c) 7 000 = 7×10^3
- (d) 67 000 000 000 = $6,7 \times 10^{10}$
- (e) 0,743 = $7,43 \times 10^{-1}$
- (f) 3,0003 = $3,0003 \times 10^0$
- (g) 0,000000001 = $1,0 \times 10^{-9}$
- (h) 10 001 = $1,0001 \times 10^4$

(2) Skryf as 'n gewone getal:

- (a) $3,1 \times 10^{-2} = 0,031$
- (b) $6,6006 \times 10 = 66,006$
- (c) $4,21 \times 10^3 = 4\,210$
- (d) $7,0 \times 10^{-1} = 0,7$
- (e) $9,4736 \times 10^{-7} = 0,00000094736$
- (f) $7,5 \times 10^{-4} = 0,00075$
- (g) $2,2 \times 10^4 = 22\,000$
- (h) $6 \times 10^8 = 600\,000\,000$

(3) Vereenvoudig sonder 'n sakrekenaar, en skryf die antwoord in wetenskaplike notasie.

- (a) $(4,0 \times 10^3) \times (1,1 \times 10^2) = 4,0 \times 1,1 \times 10^3 \times 10^2 = 4,4 \times 10^5$
- (b) $(7,6 \times 10^3) + (5,3 \times 10^4) = 7,600 + 53\,000 = 60\,600 = 6,06 \times 10^4$
- (c) $(5,4 \times 10^6) \div (9,0 \times 10^4) = \frac{5,4 \times 10^6}{9,0 \times 10^4} = \frac{5,4}{9,0} \times 10^{6-4} = 0,6 \times 10^2 = 60$
- (d) $(6,3 \times 10^2) \div (2,1 \times 10^1) = \frac{6,3 \times 10^2}{2,1 \times 10^1} = \frac{6,3}{2,1} \times 10^{2-1} = 3 \times 10^1 = 30$
- (e) $(8,59 \times 10^2) - (5,1 \times 10^1) = 859 - 51 = 808 = 8,08 \times 10^2$
- (f) $(1,2 \times 10^{-8}) \times (1,1 \times 10^{-1}) = 1,2 \times 1,1 \times 10^{-8-1} = 1,32 \times 10^{-9}$
- (g) $(7,652 \times 10^1) + (6,48 \times 10^1) = 76,52 + 64,8 = 141,32 = 1,4132 \times 10^2$
- (h) $(7,2 \times 10^3) \div (1,2 \times 10^4) = \frac{7,2 \times 10^3}{1,2 \times 10^4} = \frac{7,2}{1,2} \times 10^{3-4} = 6 \times 10^{-1} = 0,6$

⊕ As die planeet Jupiter 800 miljoen kilometer van die aarde af is, en dit was vir jou moontlik om na Jupiter en terug te reis, hoe ver het jy gereis? Skryf jou antwoord in wetenskaplike notasie.

Jupiter toe en terug = $2 \times 800\,000\,000\,000$
 = $1\,600\,000\,000\,000$
 = $1,6 \times 10^9 \text{ km}$

A2.3 Vergelykings:

Oefening 3:

Los op vir x:

(1) $3^x = 9$
 $3^x = 3^2$
 GG ⇔ GE
 $\therefore x = 2$

(2) $100^x = 10$
 $10^{2x} = 10^1$
 GG ⇔ GE
 $\therefore 2x = 1 \rightarrow x = \frac{1}{2}$

(3) $7^x = 1$
 $7^x = 7^0$
 GG ⇔ GE
 $\therefore x = 0$

(4) $25^x = 125$
 $5^{2x} = 5^3$
 $\therefore 2x = 3$
 $x = \frac{3}{2}$

(5) $x^3 = 27$
 $x^3 = 3^3$
 GG ⇔ GE
 $\therefore x = 3$

(6) $3^x = \frac{1}{3}$
 $3^x = 3^{-1}$
 GG ⇔ GE
 $\therefore x = -1$

(7) $2 \times 2^x = 4^x$
 $2^{1+x} = 2^{2x}$
 GG ⇔ GE
 $\therefore 1+x = 2x$
 $1 = x$

(8) $6^{x-3} = 1$
 $6^{x-3} = 6^0$
 GG ⇔ GE
 $\therefore x-3 = 0$
 $x = 3$

(9) $4^x = 0,5$
 $4^x = \frac{1}{2}$
 $2^{2x} = 2^{-1}$
 GG ⇔ GE
 $\therefore 2x = -1$
 $x = -\frac{1}{2}$

(10) $64 = 8^{3x-1}$
 $8^2 = 8^{3x-1}$
 GG ⇔ GE
 $\therefore 2 = 3x-1$
 $3 = 3x$
 $1 = x$

(11) $2^{x+2} = 32$
 $2^{x+2} = 2^5$
 GG ⇔ GE
 $\therefore x+2 = 5$
 $x = 5-2$
 $x = 3$

(12)

$5^x \times 25^{x+1} = 5^5$
 $5^x \times (5^2)^{x+1} = 5^5$
 $5^x \times 5^{2x+2} = 5^5$
 $5^{3x+2} = 5^5$
 $\therefore 3x+2 = 5$
 $3x = 3$
 $x = 1$

(13)

$12^{x+1} = 144^x$
 $12^{x+1} = 12^{2x}$
 GG ⇔ GE
 $\therefore x+1 = 2x$
 $1 = x$

(14) $2x^5 = -64$
 $x^5 = \frac{-64}{2}$
 $x^5 = -32$
 $2x^5 = (-2)^5$
 GG ⇔ GE
 $\therefore x = -2$

A2.4 HERSIENINGSOEFENING:

(1) Vereenvoudig (sonder 'n sakrekenaar!):

(a) $t^2 \times t^8 \times t^1 \div t^{-7}$
 $= t^{2+8+1-(-7)}$
 $= t^{11+7}$
 $= t^{18}$

(b) $(a^m \cdot n^2)^3 \cdot (a^{2m})$
 $= a^{2m \cdot 3n} \cdot a^{2m}$
 $= a^{4m \cdot 3n}$

(c) $(-3m^3n^4)^3$
 $= (-3)^3 m^{16} n^{16}$
 $= -27 m^{16} n^{16}$

(d) $\frac{-2pq^2 \times 2p^2q^3}{32p^3q^4}$
 $= \frac{-4p^3q^5}{32p^3q^4}$
 $= \frac{p^{3+5}q^{5-4}}{-8}$
 $= \frac{p^8q^1}{-8}$

(e) $\sqrt{\frac{75x^7y^4}{27xy^5}}$
 $= \sqrt{\frac{25x^6y^4}{9y^4}}$
 $= \frac{5x^3}{3y^2}$

(f) $\frac{-3m^3n^4}{2m^2n^5}$
 $= \left[\frac{-3m^{-3+1}n^{-4+5}}{2} \right]^3$
 $= \left[\frac{-3m^{-2}n^1}{2} \right]^3$
 $= \frac{(-3)^3 m^6 n^3}{2^3}$
 $= \frac{-27 m^6 n^3}{8}$

(g) $m^a \div m^{a+b}$
 $= m^{a-b-(a+b)}$
 $= m^{a-b-a-b}$
 $= m^{-2b}$

(h) $3x^8(4y^2)^0$
 $= 3x^8(1)$
 $= 3x^8$

(i) $8x^4y^2 - 3(x^2y)^2$
 $= 8x^4y^2 - 3x^4y^2$
 $= 5x^4y^2$

(j) $\frac{x^4y^6z^7 \div x^3y^3z^9}{xyz}$
 $= \frac{x^{4-1}y^{6-3}z^{7-9}}{x^1y^1z^1}$
 $= \frac{x^3y^3z^{-2}}{x^1y^1z^1}$
 $= x^2y^2z^{-3}$
 $= \frac{x^2y^2}{z^3}$

(k) $\frac{(5x^2a^3b^{-3})^3 \times (-2a^0 \times b)^4}{8b^{-6} \times (3cd)^{11}}$
 $= \frac{5^3 \times a^6 \times b^{-9} \times (-2)^4 \times a^0 \times b^4}{8b^{-6} \times (3cd)^{11}}$
 $= \frac{250a^6b^{-5} \times 16 \times 1 \times b^4}{8b^{-6} \times 3^{11}c^{11}d^{11}}$
 $= \frac{25 \times 2 \times a^6b^4}{500 \times 3^{11}c^{11}d^{11}}$

(l) $\frac{\sqrt{144p^{14}}}{\sqrt[3]{27p^{27}}}$
 $= \frac{12p^7}{3p^9}$
 $= \frac{4p^{7-9}}{p^2}$
 $= \frac{4p^{-2}}{p^2}$

(m) $\frac{-2x^0}{(-3x)^0} + \frac{(x^{-1})^2}{3x^2}$
 $= \frac{-2(1)}{1} + \frac{1x^{-2}}{3x^2}$
 $= -2 + \frac{1}{3}$
 $= -\frac{2}{3}$

(n) $\frac{2m^6n^1 \times 12m^3}{24m^3} \times \frac{12m^3}{8n^{-3}}$
 $= \frac{2m^6n^1}{24m^3} \times \frac{12m^3}{8n^{-3}}$
 $= \frac{2m^9n^1}{m^0n^0}$
 $= 2m^9n^1$
 $= 2m^9n$

(o) $\sqrt[3]{3^{15}} + (4 - \sqrt{16})^3 - (\sqrt{8})^2$
 $= 3^5 + (4 - 4)^3 - 8$
 $= 3^5 + 0^3 - 8$
 $= 243 + 0 - 8$
 $= 235$

(2) (a) $8^{x-1} = 0,25$
 $(2^3)^{x-1} = \frac{1}{4}$
 $2^{3x-3} = 2^{-2}$
 $\therefore 3x-3 = -2$
 $3x = 1$
 $x = \frac{1}{3}$

(b) $3^{2x-3} = 1$
 $3^{2x-3} = 3^0$
 $\therefore 2x-3 = 0$
 $\therefore 2x = 3$
 $x = \frac{3}{2}$

(c) $x^{\frac{2}{3}} = 25$
 $(x^{\frac{2}{3}})^{\frac{3}{2}} = (25)^{\frac{3}{2}}$
 $x = 5^3$
 $x = 125$

(d) $9^{2x} = 27^{x-1}$
 $(3^2)^{2x} = (3^3)^{x-1}$
 $3^{4x} = 3^{3x-3}$
 $\therefore 4x = 3x-3$
 $4x-3x = -3$
 $x = -3$

(e) $3^2 \times 3^x = 3^{2-x}$
 $3^{2+x} = 3^{2-x}$
 $\therefore 2+x = 2-x$
 $x+x = 0$
 $x = 0$

(f) $\frac{1}{8} = 4^x$
 $\frac{1}{2^3} = (2^2)^x$
 $2^{-3} = 2^{2x}$
 $\therefore -3 = 2x$
 $-\frac{3}{2} = x$

(g) $5^{x+2} = \sqrt{5}$
 $5^{x+2} = 5^{\frac{1}{2}}$
 $\therefore x+2 = \frac{1}{2}-2$
 $x = -\frac{3}{2}$

(h) $3x^2 = 12$
 $x^2 = \frac{12}{3}$
 $x^2 = 4$
 $x = \pm\sqrt{4}$
 $x = \pm 2$

(3) Vereenvoudig en skryf die antwoord in wetenskaplike notasie:

(a) $2(7,8 \times 10^5)$
 $= 15,6 \times 10^5$
 $= 1,56 \times 10^1 \times 10^5$
 $= 1,56 \times 10^6$

(b) $450 \times 3\,000 - 125$
 $= 1\,350\,000 - 125$
 $= 1\,349\,875$
 $= 1,349875 \times 10^6$