

6 Vaardigheden en vergelijkingen

Voorkennis Haakjes wegwerken en wortels herleiden

Bladzijde 10

- 1** a $5a + 7(3a - 1) = 5a + 21a - 7 = 26a - 7$
 b $5a + 7 \cdot 3a - 1 = 5a + 21a - 1 = 26a - 1$
 c $(5a + 7)(3a - 1) = 15a^2 - 5a + 21a - 7 = 15a^2 + 16a - 7$
 d $(5a + 7) \cdot 3a - 1 = 15a^2 + 21a - 1$
 e $12a - 3(4a - 1) = 12a - 12a + 3 = 3$
 f $12a - 3 \cdot 4a - 1 = 12a - 12a - 1 = -1$
 g $(12a - 3)(4a - 1) = 48a^2 - 12a - 12a + 3 = 48a^2 - 24a + 3$
 h $12a \cdot 3(4a - 1) = 36a(4a - 1) = 144a^2 - 36a$
- 2** a $(p + 6)^2 = p^2 + 12p + 36$
 b $(2x - 7)^2 = 4x^2 - 28x + 49$
 c $(3 + 2q)(3 - 2q) = 9 - 4q^2$
 d $(11a - 3b)^2 = 121a^2 - 66ab + 9b^2$
 e $(-x - y)^2 = x^2 + 2xy + y^2$
 f $(5c - 2d)(5c + 2d) = 25c^2 - 4d^2$
- 3** a $(a - 8)(a + 8) - a^2 = a^2 - 64 - a^2 = -64$
 b $(a - 1)^2 - a(a - 1) = a^2 - 2a + 1 - a^2 + a = -a + 1$
 c $(a + 7)^2 - 7 \cdot 2a = a^2 + 14a + 49 - 14a = a^2 + 49$
 d $(a - 8)(a + 7) + (a - 7)(a - 7) = a^2 + 7a - 8a - 56 + a^2 - 14a + 49 = 2a^2 - 15a - 7$
 e $(a - 8)^2 + (a + 8)^2 = a^2 - 16a + 64 + a^2 + 16a + 64 = 2a^2 + 128$
 f $a(a + 12) + (a - 12)^2 = a^2 + 12a + a^2 - 24a + 144 = 2a^2 - 12a + 144$

Bladzijde 11

- 4** a $(6p)^2 - 3(2 - 3p) - p(p + 9) = 36p^2 - 6 + 9p - p^2 - 9p = 35p^2 - 6$
 b $(a + 5b)(a - 5b) - (a^2 + 5b) = a^2 - 25b^2 - a^2 - 5b = -25b^2 - 5b$
 c $(3e - f)^2 - f(f - 7e) = 9e^2 - 6ef + f^2 - f^2 + 7ef = 9e^2 + ef$
 d $(p - 1)(2p - 3) - (p + 1)^2 = 2p^2 - 3p - 2p + 3 - (p^2 + 2p + 1) = 2p^2 - 3p - 2p + 3 - p^2 - 2p - 1 = p^2 - 7p + 2$
 e $(2a - 3)(5 - 2a) - (1 - 2a)(1 + 2a) = 10a - 4a^2 - 15 + 6a - (1 - 4a^2) = 10a - 4a^2 - 15 + 6a - 1 + 4a^2 = 16a - 16$
 f $(3 - 7y)(3 + 7y) - 9 - 3y(5 - 12y) = 9 - 49y^2 - 9 - 15y + 36y^2 = -13y^2 - 15y$
- 5** a $(\sqrt{5})^2 = 5$
 b $(5\sqrt{6})^2 = 5^2 \cdot (\sqrt{6})^2 = 25 \cdot 6 = 150$
 c $(-2\sqrt{3})^2 = (-2)^2 \cdot (\sqrt{3})^2 = 4 \cdot 3 = 12$
 d $(-\sqrt{11})^2 = (-1)^2 \cdot (\sqrt{11})^2 = 1 \cdot 11 = 11$
 e $(-3\sqrt{4})^2 = (-3 \cdot 2)^2 = (-6)^2 = 36$
 f $2^2 - (\sqrt{2})^2 = 4 - 2 = 2$
 g $-3^2 + (-\sqrt{6})^2 = -9 + (-1)^2 \cdot (\sqrt{6})^2 = -9 + 1 \cdot 6 = -3$
 h $3(\sqrt{7})^2 - (2\sqrt{2})^2 = 3 \cdot 7 - 2^2 \cdot (\sqrt{2})^2 = 21 - 4 \cdot 2 = 13$
 i $(-\sqrt{38})^2 - (-4\sqrt{3})^2 = (-1)^2 \cdot (\sqrt{38})^2 - (-4)^2 \cdot (\sqrt{3})^2 = 1 \cdot 38 - 16 \cdot 3 = 38 - 48 = -10$
- 6** a $5\sqrt{2} \cdot 3\sqrt{5} = 15\sqrt{10}$
 b $3\sqrt{6} \cdot 2\sqrt{5} = 6\sqrt{30}$
 c $5\sqrt{2} \cdot 3\sqrt{2} = 15\sqrt{4} = 15 \cdot 2 = 30$
 d $5\sqrt{3} \cdot 7\sqrt{12} = 35\sqrt{36} = 35 \cdot 6 = 210$
 e $5\sqrt{9} \cdot 7 = 5 \cdot 3 \cdot 7 = 105$
 f $3\sqrt{6} \cdot -2\sqrt{6} = -6\sqrt{36} = -6 \cdot 6 = -36$

Bladzijde 12

- 7** a $5\sqrt{2} + 8\sqrt{2} = 13\sqrt{2}$ d $\sqrt{7} + \sqrt{7} = 2\sqrt{7}$
 b $5\sqrt{2} - \sqrt{2} = 4\sqrt{2}$ e $\sqrt{36} - \sqrt{9} = 6 - 3 = 3$
 c $3\sqrt{5} - 7\sqrt{5} = -4\sqrt{5}$ f $2\sqrt{3} + 3\sqrt{2}$ kan niet
- 8** a $3\sqrt{2} \cdot 5\sqrt{7} = 15\sqrt{14}$ d $5\sqrt{7} - 2\sqrt{7} = 3\sqrt{7}$
 b $3\sqrt{2} + 5\sqrt{7}$ kan niet e $3\sqrt{25} - 5\sqrt{9} = 3 \cdot 5 - 5 \cdot 3 = 15 - 15 = 0$
 c $5\sqrt{7} \cdot 2\sqrt{7} = 10\sqrt{49} = 10 \cdot 7 = 70$ f $9\sqrt{2} \cdot -3\sqrt{8} = -27\sqrt{16} = -27 \cdot 4 = -108$
- 9** a $\sqrt{12} = \sqrt{4} \cdot \sqrt{3} = 2\sqrt{3}$ d $3\sqrt{200} = 3 \cdot \sqrt{100} \cdot \sqrt{2} = 3 \cdot 10\sqrt{2} = 30\sqrt{2}$
 b $\sqrt{75} = \sqrt{25} \cdot \sqrt{3} = 5\sqrt{3}$ e $2\sqrt{45} = 2 \cdot \sqrt{9} \cdot \sqrt{5} = 2 \cdot 3\sqrt{5} = 6\sqrt{5}$
 c $\sqrt{180} = \sqrt{36} \cdot \sqrt{5} = 6\sqrt{5}$ f $-3\sqrt{288} = -3 \cdot \sqrt{144} \cdot \sqrt{2} = -3 \cdot 12\sqrt{2} = -36\sqrt{2}$

6.1 Herleiden**Bladzijde 13**

- 1** Bob heeft gelijk, want haakjes wegwerken gaat voor vermenigvuldigen.
- 2** a $5(2x - 1)^2 = 5(4x^2 - 4x + 1) = 20x^2 - 20x + 5$
 b $-(z - 4)^2 = -(z^2 - 8z + 16) = -z^2 + 8z - 16$
 c $2(d + 7)^2 = 2(d^2 + 14d + 49) = 2d^2 + 28d + 98$
 d $-3a(2a + 5)^2 = -3a(4a^2 + 20a + 25) = -12a^3 - 60a^2 - 75a$
 e $(x + 5)^2 - 5(x - 1)(x - 5) = x^2 + 10x + 25 - 5(x^2 - 5x - x + 5) = x^2 + 10x + 25 - 5x^2 + 25x + 5x - 25 = -4x^2 + 40x$
 f $(y - 3)^2 - 2(y - 2)^2 = y^2 - 6y + 9 - 2(y^2 - 4y + 4) = y^2 - 6y + 9 - 2y^2 + 8y - 8 = -y^2 + 2y + 1$
 g $(2q - 3)^2 - 3q(q - 4)^2 = 4q^2 - 12q + 9 - 3q(q^2 - 8q + 16) = 4q^2 - 12q + 9 - 3q^3 + 24q^2 - 48q = -3q^3 + 28q^2 - 60q + 9$
 h $(3c)^2 - (3c - 1)^2 = 9c^2 - (9c^2 - 6c + 1) = 9c^2 - 9c^2 + 6c - 1 = 6c - 1$
- 3** a $(x + 5)(x - 6) - (x - 4)(x - 3) = x^2 - 6x + 5x - 30 - (x^2 - 3x - 4x + 12) = x^2 - 6x + 5x - 30 - x^2 + 3x + 4x - 12 = 6x - 42$ en $6(x - 7) = 6x - 42$
 Dus $(x + 5)(x - 6) - (x - 4)(x - 3) = 6(x - 7)$.
 b $(x + 3y)^2 - (3x + y)^2 = x^2 + 6xy + 9y^2 - (9x^2 + 6xy + y^2) = x^2 + 6xy + 9y^2 - 9x^2 - 6xy - y^2 = -8x^2 + 8y^2 = 8y^2 - 8x^2$ en $8(y + x)(y - x) = 8(y^2 - x^2) = 8y^2 - 8x^2$
 Dus $(x + 3y)^2 - (3x + y)^2 = 8(y + x)(y - x)$.
 c $(x + ay)^2 + (ax - y)^2 = x^2 + 2axy + a^2y^2 + a^2x^2 - 2axy + y^2 = a^2x^2 + a^2y^2 + x^2 + y^2$ en $(a^2 + 1)(x^2 + y^2) = a^2x^2 + a^2y^2 + x^2 + y^2$
 Dus $(x + ay)^2 + (ax - y)^2 = (a^2 + 1)(x^2 + y^2)$.
- 4** a $-5(x - 2)^2 - (2x + 5)^2 = -5(x^2 - 4x + 4) - (4x^2 + 20x + 25) = -5x^2 + 20x - 20 - 4x^2 - 20x - 25 = -9x^2 - 45$
 b $3(8 - x)^2 - 3(x + 1)(2 - x) = 3(64 - 16x + x^2) - 3(2x - x^2 + 2 - x) = 192 - 48x + 3x^2 - 6x + 3x^2 - 6 + 3x = 6x^2 - 51x + 186$
 c $2p(q - 3)^2 + 12pq = 2p(q^2 - 6q + 9) + 12pq = 2pq^2 - 12pq + 18p + 12pq = 2pq^2 + 18p$
 d $5t - 3(2t + 3)^2 = 5t - 3(4t^2 + 12t + 9) = 5t - 12t^2 - 36t - 27 = -12t^2 - 31t - 27$
 e $a(2a - 6)^2 + 4a(3 - a)^2 = a(4a^2 - 24a + 36) + 4a(9 - 6a + a^2) = 4a^3 - 24a^2 + 36a + 36a - 24a^2 + 4a^3 = 8a^3 - 48a^2 + 72a$
 f $p(3p + 2)^2 - 3(2p)^2 = p(9p^2 + 12p + 4) - 3 \cdot 4p^2 = 9p^3 + 12p^2 + 4p - 12p^2 = 9p^3 + 4p$

Bladzijde 14

- 5** a $d_1^2 = (n-1)^2 + (n+1)^2 = n^2 - 2n + 1 + n^2 + 2n + 1 = 2n^2 + 2$
 $d_2^2 = (n-2)^2 + (n+2)^2 = n^2 - 4n + 4 + n^2 + 4n + 4 = 2n^2 + 8$
 $d_2^2 - d_1^2 = 2n^2 + 8 - (2n^2 + 2) = 2n^2 + 8 - 2n^2 - 2 = 6$
 $d_3^2 = (n-3)^2 + (n+3)^2 = n^2 - 6n + 9 + n^2 + 6n + 9 = 2n^2 + 18$
 $d_4^2 = (n-4)^2 + (n+4)^2 = n^2 - 16n + 16 + n^2 + 16n + 16 = 2n^2 + 32$
 $d_4^2 - d_3^2 = 2n^2 + 32 - (2n^2 + 18) = 2n^2 + 32 - 2n^2 - 18 = 14$
b $d_k^2 = (n-k)^2 + (n+k)^2 = n^2 - 2kn + k^2 + n^2 + 2kn + k^2 = 2n^2 + 2k^2$
 $d_k^2 = 2n^2 + 2k^2$, dus $d_{k+1}^2 = 2n^2 + 2(k+1)^2 = 2n^2 + 2(k^2 + 2k + 1) = 2n^2 + 2k^2 + 4k + 2$
 $d_{k+1}^2 - d_k^2 = 2n^2 + 2k^2 + 4k + 2 - (2n^2 + 2k^2) = 2n^2 + 2k^2 + 4k + 2 - 2n^2 - 2k^2 = 4k + 2$
- 6** a $(x+3)(x+y+1) = x^2 + xy + x + 3x + 3y + 3 = x^2 + xy + 4x + 3y + 3$
b $(2x-y)(x-y+5) = 2x^2 - 2xy + 10x - xy + y^2 - 5y = 2x^2 - 3xy + 10x + y^2 - 5y$
c $(3x+2)^3 = (3x+2)(3x+2)^2 = (3x+2)(9x^2 + 12x + 4) =$
 $27x^3 + 36x^2 + 12x + 18x^2 + 24x + 8 = 27x^3 + 54x^2 + 36x + 8$
d $(x-1)^3 = (x-1)(x-1)^2 = (x-1)(x^2 - 2x + 1) = x^3 - 2x^2 + x - x^2 + 2x - 1 = x^3 - 3x^2 + 3x - 1$
- 7** a $I = (x-1)(x-2)(x-5) = (x^2 - 2x - x + 2)(x-5) = x^3 - 5x^2 - 2x^2 + 10x - x^2 + 5x + 2x - 10 =$
 $x^3 - 8x^2 + 17x - 10$
b $I = (3a-4)^3 = (3a-4)(3a-4)^2 = (3a-4)(9a^2 - 24a + 16) =$
 $27a^3 - 72a^2 + 48a - 36a^2 + 96a - 64 = 27a^3 - 108a^2 + 144a - 64$
c $I = (2x-3)(2x+3)(3x+1) = (4x^2 - 9)(3x+1) = 12x^3 + 4x^2 - 27x - 9$
- 8** a $(x+y+3)(x-y-3) = x^2 - xy - 3x + xy - y^2 - 3y + 3x - 3y - 9 = x^2 - y^2 - 6y - 9$
b $(x-y+4)(x+y)^2 = (x-y+4)(x^2 + 2xy + y^2) = x^3 + 2x^2y + xy^2 - x^2y - 2xy^2 - y^3 + 4x^2 + 8xy + 4y^2 =$
 $x^3 + x^2y - xy^2 - y^3 + 4x^2 + 8xy + 4y^2$

6.2 Breuken herleiden**Bladzijde 15**

- 9** a $\frac{7p}{28} = \frac{p}{4} = \frac{1}{4}p$ c $\frac{21x}{35} = \frac{3x}{5} = \frac{3}{5}x$ e $\frac{8c}{-8} = \frac{c}{-1} = -c$
b $\frac{15a}{45} = \frac{a}{3} = \frac{1}{3}a$ d $\frac{6q}{3} = \frac{2q}{1} = 2q$ f $\frac{8y}{16} = \frac{y}{2} = \frac{1}{2}y$
- 10** a $\frac{4xy}{8x} = \frac{y}{2} = \frac{1}{2}y$ c $\frac{p}{7p} = \frac{1}{7}$ e $\frac{3xy}{-6x} = \frac{y}{-2} = -\frac{1}{2}y$
b $\frac{6abc}{2ab} = \frac{3c}{1} = 3c$ d $\frac{6pq}{3q} = \frac{2p}{1} = 2p$ f $\frac{12abc}{-4ac} = \frac{3b}{-1} = -3b$
- 11** a $\frac{p(p+q)}{6(p+q)} = \frac{p}{6} = \frac{1}{6}p$ c $\frac{2(p+q)}{p+q} = \frac{2}{1} = 2$ e $\frac{-3c(2a+b)}{24(b+2a)} = \frac{-3c(2a+b)}{24(2a+b)} = \frac{-c}{8} = -\frac{1}{8}c$
b $\frac{x-y}{5(x-y)} = \frac{1}{5}$ d $\frac{xy}{x(x+y)} = \frac{y}{x+y}$ f $\frac{4d(b+c)}{4a(b+2c)} = \frac{d(b+c)}{a(b+2c)}$

Bladzijde 16

- 12** a $T = \frac{5a+10b}{5} = \frac{5(a+2b)}{5} = \frac{a+2b}{1} = a+2b$
b $y = \frac{x^2-3x}{10x} = \frac{x(x-3)}{10x} = \frac{x-3}{10} = \frac{1}{10}(x-3) = \frac{1}{10}x - \frac{3}{10}$
c $A = \frac{p^2+4p}{p^2+5p+4} = \frac{p(p+4)}{(p+1)(p+4)} = \frac{p}{p+1}$

13 a $\frac{8a^2 - 16a}{4a} = \frac{8a(a-2)}{4a} = \frac{2(a-2)}{1} = 2(a-2) = 2a - 4$
 b $\frac{p+q}{5p+5q} = \frac{p+q}{5(p+q)} = \frac{1}{5}$
 c $\frac{a^2+2a-3}{2a+6} = \frac{(a-1)(a+3)}{2(a+3)} = \frac{a-1}{2} = \frac{1}{2}(a-1) = \frac{1}{2}a - \frac{1}{2}$

14 a $N = \frac{3t^2+6t}{6t} = \frac{3t(t+2)}{6t} = \frac{t+2}{2} = \frac{1}{2}(t+2) = \frac{1}{2}t + 1$
 b $y = \frac{x^2-5x+4}{x^2-6x+5} = \frac{(x-1)(x-4)}{(x-1)(x-5)} = \frac{x-4}{x-5}$
 c $p = \frac{q^2-4}{q^2+4q+4} = \frac{(q+2)(q-2)}{(q+2)(q+2)} = \frac{q-2}{q+2}$

Bladzijde 17

15 a Voor $q = 1$ krijg je bij de formule $p = \frac{q^2+6q-7}{2q-2}$ in de noemer $2q-2 = 2 \cdot 1 - 2 = 0$.
 Delen door nul kan niet, dus de formule heeft geen uitkomst voor $q = 1$.
 Bij de formule $p = \frac{1}{2}q + 3\frac{1}{2}$ krijg je echter $p = \frac{1}{2} \cdot 1 + 3\frac{1}{2} = 4$.
 Dus de herleiding klopt niet voor $q = 1$.
 b $p = \frac{a^2-2a-24}{a+4} = \frac{(a+4)(a-6)}{a+4} = \frac{a-6}{1} = a-6$
 De herleiding klopt niet voor $a+4=0$, dus voor $a=-4$.
 c $y = \frac{x-2}{x^2+x-6} = \frac{x-2}{(x-2)(x+3)} = \frac{1}{x+3}$
 De herleiding klopt niet voor $x-2=0$, dus voor $x=2$.

16 a $\frac{2x^2-32}{x^2-8x+16} = \frac{2(x^2-16)}{(x-4)(x-4)} = \frac{2(x-4)(x+4)}{(x-4)(x-4)} = \frac{2(x+4)}{x-4} = \frac{2x+8}{x-4}$
 b $\frac{q^2-8q+12}{3q^2+6q-24} = \frac{(q-2)(q-6)}{3(q^2+2q-8)} = \frac{(q-2)(q-6)}{3(q-2)(q+4)} = \frac{q-6}{3(q+4)} = \frac{q-6}{3q+12}$
 c $\frac{2x^2-2x-12}{3x^2+15x+18} = \frac{2(x^2-x-6)}{3(x^2+5x+6)} = \frac{2(x+2)(x-3)}{3(x+2)(x+3)} = \frac{2(x-3)}{3(x+3)} = \frac{2x-6}{3x+9}$

Bladzijde 18

17 a $\frac{3}{x^2y} - \frac{2}{xy^2} = \frac{3y}{x^2y^2} - \frac{2x}{x^2y^2} = \frac{3y-2x}{x^2y^2}$
 b $\frac{a-1}{a+2} - \frac{3-a}{a-2} = \frac{(a-1)(a-2)}{(a+2)(a-2)} - \frac{(a+2)(3-a)}{(a+2)(a-2)} = \frac{(a-1)(a-2) - (a+2)(3-a)}{(a+2)(a-2)} = \frac{a^2-2a-a+2-(3a-a^2+6-2a)}{(a+2)(a-2)} = \frac{a^2-2a-a+2-3a+a^2-6+2a}{(a+2)(a-2)} = \frac{2a^2-4a-4}{(a+2)(a-2)}$
 c $\frac{2p-8}{p+1} : \frac{p-4}{6p+6} = \frac{2p-8}{p+1} \cdot \frac{6p+6}{p-4} = \frac{(2p-8)(6p+6)}{(p+1)(p-4)} = \frac{2(p-4) \cdot 6(p+1)}{(p+1)(p-4)} = \frac{12}{1} = 12$

18 a $\frac{3}{5a} + \frac{4}{a} = \frac{3}{5a} + \frac{20}{5a} = \frac{23}{5a}$
 b $\frac{2}{3x} - \frac{3}{2x} = \frac{4}{6x} - \frac{9}{6x} = \frac{-5}{6x}$
 c $\frac{2}{y} - \frac{1}{y^2} = \frac{2y}{y^2} - \frac{1}{y^2} = \frac{2y-1}{y^2}$
 d $\frac{a}{3} - 2a = \frac{1}{3}a - 2a = -1\frac{2}{3}a$
 e $\frac{5}{3x} : \frac{3}{5x} = \frac{5}{3x} \cdot \frac{5x}{3} = \frac{25x}{9x} = \frac{25}{9} = 2\frac{7}{9}$
 f $2a : \frac{a}{3} = 2a \cdot \frac{3}{a} = \frac{6a}{a} = \frac{6}{1} = 6$

19 a $\frac{2}{x} + \frac{1}{x+1} = \frac{2(x+1)}{x(x+1)} + \frac{x}{x(x+1)} = \frac{2x+2+x}{x(x+1)} = \frac{3x+2}{x(x+1)}$
 b $\frac{1}{a-2} - \frac{1}{a+2} = \frac{a+2}{(a-2)(a+2)} - \frac{a-2}{(a-2)(a+2)} = \frac{a+2-(a-2)}{(a-2)(a+2)} = \frac{a+2-a+2}{(a-2)(a+2)} = \frac{4}{(a-2)(a+2)}$

$$\begin{aligned} \text{c} \quad \frac{x+2}{x-3} - \frac{x}{x+2} &= \frac{(x+2)(x+2)}{(x-3)(x+2)} - \frac{x(x-3)}{(x-3)(x+2)} = \frac{(x+2)(x+2) - x(x-3)}{(x-3)(x+2)} \\ &= \frac{x^2 + 4x + 4 - x^2 + 3x}{(x-3)(x+2)} = \frac{7x+4}{(x-3)(x+2)} \\ \text{d} \quad \frac{3x^2}{x+2} : \frac{x}{x+2} &= \frac{3x^2}{x+2} \cdot \frac{x+2}{x} = \frac{3x^2(x+2)}{x(x+2)} = \frac{3x}{1} = 3x \\ \text{e} \quad \frac{p-3}{p+1} \cdot \frac{p+1}{p-4} &= \frac{(p-3)(p+1)}{(p+1)(p-4)} = \frac{p-3}{p-4} \\ \text{f} \quad \frac{2q+8}{q-1} : \frac{q+4}{3q-3} &= \frac{2q+8}{q-1} \cdot \frac{3q-3}{q+4} = \frac{(2q+8)(3q-3)}{(q-1)(q+4)} = \frac{2(q+4) \cdot 3(q-1)}{(q-1)(q+4)} = \frac{6}{1} = 6 \end{aligned}$$

$$\begin{aligned} 20 \quad \text{a} \quad A &= \frac{3}{p} + \frac{2}{5-p} = \frac{3(5-p)}{p(5-p)} + \frac{2p}{p(5-p)} = \frac{15-3p+2p}{p(5-p)} = \frac{15-p}{p(5-p)} \\ \text{b} \quad P &= \frac{2a-6}{5} \cdot \frac{10}{a-3} = \frac{10(2a-6)}{5(a-3)} = \frac{20(a-3)}{5(a-3)} = \frac{4}{1} = 4 \\ \text{c} \quad N &= \frac{a+5}{a-1} : \frac{3a+15}{a+2} = \frac{a+5}{a-1} \cdot \frac{a+2}{3a+15} = \frac{(a+5)(a+2)}{(a-1)(3a+15)} = \frac{(a+5)(a+2)}{(a-1) \cdot 3(a+5)} = \frac{a+2}{3(a-1)} \end{aligned}$$

$$\begin{aligned} 21 \quad \text{a} \quad G &= \frac{n+1}{n-2} \cdot \frac{3n-6}{3-n} = \frac{(n+1)(3n-6)}{(n-2)(3-n)} = \frac{(n+1) \cdot 3(n-2)}{(n-2)(3-n)} = \frac{3(n+1)}{3-n} = \frac{3n+3}{3-n} \\ \text{b} \quad R &= \frac{w+3}{1-w} - \frac{w+1}{w-3} = \frac{(w+3)(w-3)}{(1-w)(w-3)} - \frac{(1-w)(w+1)}{(1-w)(w-3)} = \frac{(w+3)(w-3) - (1-w)(1+w)}{(1-w)(w-3)} \\ &= \frac{w^2 - 9 - (1 - w^2)}{(1-w)(w-3)} = \frac{w^2 - 9 - 1 + w^2}{(1-w)(w-3)} = \frac{2w^2 - 10}{(1-w)(w-3)} \\ \text{c} \quad K &= \frac{2q+3}{q} : \frac{4q+6}{5q^2} = \frac{2q+3}{q} \cdot \frac{5q^2}{4q+6} = \frac{5q^2(2q+3)}{q(4q+6)} = \frac{5q^2(2q+3)}{2q(2q+3)} = \frac{5q}{2} = \frac{5}{2}q = 2\frac{1}{2}q \end{aligned}$$

6.3 Gebroken vergelijkingen

Bladzijde 19

- 22 a 24 schilders doen 3 dagen over de klus.
 b 4 schilders doen 18 dagen over de klus.
 c Als je vier keer zoveel schilders hebt, dan duurt het schilderen vier keer zo kort.
 d
- | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|
| x | 1 | 2 | 3 | 4 | 6 | 8 | 12 | 24 |
| y | 72 | 36 | 24 | 18 | 12 | 9 | 6 | 3 |
| xy | 72 | 72 | 72 | 72 | 72 | 72 | 72 | 72 |

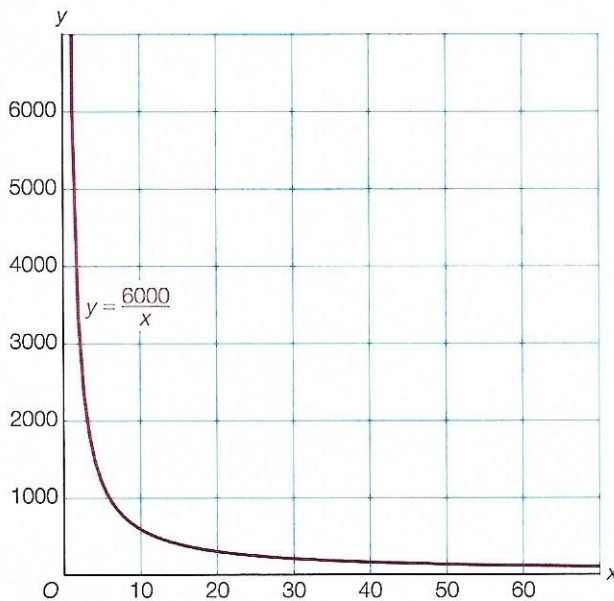
Als je x met een getal vermenigvuldigt, moet je de bijbehorende y door dat getal delen.
 De uitkomst van het product xy is steeds 72.

Bladzijde 20

- 23 a Acht personen kunnen 30 dagen van een mud eten.
 b Voor de vuistregel geldt $xy = 240$, dus de formule is $y = \frac{240}{x}$.
 c Als x heel groot is, is y heel klein.
 d Als het aantal personen verdubbelt, dan halveert y .
- 24 a Ieder ontvangt dan $6000 : 6 = 1000$ euro.
 b Er geldt $xy = 6000$, dus $y = \frac{6000}{x}$.
 c Bij heel veel goede inzendingen ontvangt ieder een heel klein geldbedrag omdat de 6000 euro over heel veel mensen moet worden verdeeld. Dus als er heel veel goede inzendingen zijn, is y heel klein.

d

x	1	2	3	4	6	10	20	30	40	50	60
y	6000	3000	2000	1500	1000	600	300	200	150	120	100



- 25 a** De oppervlakte van de stal is $40 \cdot 25 = 1000 \text{ m}^2$, dus er mogen $1000 \cdot 9 = 9000$ kippen in de stal worden gehouden.
- b** De oppervlakte van de stal is $1000 \text{ m}^2 = 10\,000\,000 \text{ cm}^2$, dus $L = 10\,000\,000 : 8000 = 1250 \text{ cm}^2$.
- c** Er geldt $L \cdot a = 10\,000\,000$, dus $L = \frac{10\,000\,000}{a}$.
- d** $20 \text{ dm}^2 = 2000 \text{ cm}^2$, dus $L = 2000$.
Dit geeft $2000 \cdot a = 10\,000\,000$, dus $a = 10\,000\,000 : 2000 = 5000$ kippen.

Bladzijde 21

26 $x = \frac{7 \cdot 12}{5} = \frac{84}{5} = 16\frac{4}{5}$

Bladzijde 22

27 a $\frac{5}{5+x} = \frac{3}{4}$
 $3(5+x) = 4 \cdot 5$
 $15 + 3x = 20$
 $3x = 5$
 $x = 1\frac{2}{3}$

c $\frac{5}{x} = 7$
 $\frac{5}{x} = \frac{7}{1}$
 $7x = 5$
 $x = \frac{5}{7}$

e $5 - \frac{6}{3-x} = 5,4$
 $\frac{-6}{3-x} = \frac{0,4}{1}$
 $0,4(3-x) = -6$
 $1,2 - 0,4x = -6$
 $-0,4x = -7,2$
 $x = 18$

b $\frac{x+3}{x-3} = \frac{2}{5}$
 $5(x+3) = 2(x-3)$
 $5x + 15 = 2x - 6$
 $3x = -21$
 $x = -7$

d $\frac{8}{2x-1} = \frac{3}{x+1}$
 $8(x+1) = 3(2x-1)$
 $8x + 8 = 6x - 3$
 $2x = -11$
 $x = -5\frac{1}{2}$

f $\frac{120}{0,3x+6} - 6 = 4$
 $\frac{120}{0,3x+6} = \frac{10}{1}$
 $10(0,3x+6) = 120$
 $3x + 60 = 120$
 $3x = 60$
 $x = 20$

28 a $12 + \frac{8}{5-0,2x} = 32$
 $\frac{8}{5-0,2x} = \frac{20}{1}$
 $20(5-0,2x) = 8$
 $100 - 4x = 8$
 $-4x = -92$
 $x = 23$

b $\frac{18-2x}{6+x} = 3$
 $\frac{18-2x}{6+x} = \frac{3}{1}$
 $3(6+x) = 18-2x$
 $18+3x = 18-2x$
 $5x = 0$
 $x = 0$

c $100 - \frac{12x}{x-30} = 82$
 $-\frac{12x}{x-30} = -18$
 $\frac{12x}{x-30} = \frac{18}{1}$
 $18(x-30) = 12x$
 $18x - 540 = 12x$
 $6x = 540$
 $x = 90$

29 a $\frac{x}{x+5} = \frac{16}{x}$
 $x \cdot x = 16(x+5)$
 $x^2 = 16x + 80$
 $x^2 - 16x - 80 = 0$
 $(x+4)(x-20) = 0$
 $x = -4 \vee x = 20$

b $\frac{x-1}{3} = \frac{5}{x+1}$
 $(x-1)(x+1) = 3 \cdot 5$
 $x^2 - 1 = 15$
 $x^2 = 16$
 $x = 4 \vee x = -4$

c $x + \frac{3}{x-1} = 5$
 $\frac{3}{x-1} = 5-x$
 $\frac{3}{x-1} = \frac{5-x}{1}$
 $(x-1)(5-x) = 3$
 $5x - x^2 - 5 + x = 3$
 $-x^2 + 6x - 8 = 0$
 $x^2 - 6x + 8 = 0$
 $(x-2)(x-4) = 0$
 $x = 2 \vee x = 4$

30 a $x = 2000$ geeft $K = \frac{4,5 \cdot 2000 + 1200}{2000} = 5,1$

Dus de kosten per kalender zijn € 5,10.

b $x = 1500$ geeft $K = \frac{4,5 \cdot 1500 + 1200}{1500} = 5,3$

De totale kosten zijn $1500 \cdot 5,3 = 7950$ euro.

c $K = 4,90$ geeft $\frac{4,5x + 1200}{x} = 4,90$
 $\frac{4,5x + 1200}{x} = \frac{4,9}{1}$
 $4,9x = 4,5x + 1200$
 $0,4x = 1200$
 $x = 3000$

Er zijn 3000 kalenders gemaakt.

31 De club heeft 12 000 euro te besteden en maakt x kalenders, dus $K = \frac{12\,000}{x}$.

Dit geeft $\frac{4,5x + 1200}{x} = \frac{12\,000}{x}$.

De noemers zijn gelijk, dus moet gelden

$$4,5x + 1200 = 12\,000$$

$$4,5x = 10\,800$$

$$x = 2400$$

De club kan maximaal 2400 kalenders maken.

6.4 Wortels herleiden

Bladzijde 23

32 $\sqrt{18} + \sqrt{2} = \sqrt{9} \cdot \sqrt{2} + \sqrt{2} = 3\sqrt{2} + \sqrt{2} = 4\sqrt{2}$

33 a $7\sqrt{2} - \sqrt{8} = 7\sqrt{2} - \sqrt{4} \cdot \sqrt{2} = 7\sqrt{2} - 2\sqrt{2} = 5\sqrt{2}$

b $5\sqrt{3} \cdot 3\sqrt{21} = 15\sqrt{63} = 15 \cdot \sqrt{9} \cdot \sqrt{7} = 15 \cdot 3\sqrt{7} = 45\sqrt{7}$

c $\sqrt{12} - \sqrt{3} = \sqrt{4} \cdot \sqrt{3} - \sqrt{3} = 2\sqrt{3} - \sqrt{3} = \sqrt{3}$

$$\text{d } 5\sqrt{6} \cdot 2\sqrt{3} = 10\sqrt{18} = 10 \cdot \sqrt{9} \cdot \sqrt{2} = 10 \cdot 3\sqrt{2} = 30\sqrt{2}$$

$$\text{e } 2\sqrt{90} - 3\sqrt{40} = 2 \cdot \sqrt{9} \cdot \sqrt{10} - 3 \cdot \sqrt{4} \cdot \sqrt{10} = 2 \cdot 3\sqrt{10} - 3 \cdot 2\sqrt{10} = 6\sqrt{10} - 6\sqrt{10} = 0$$

$$\text{f } 5\sqrt{12} \cdot -3\sqrt{3} = -15\sqrt{36} = -15 \cdot 6 = -90$$

$$\text{34 a } 8\sqrt{3} \cdot -\sqrt{21} - 2\sqrt{7} = -8\sqrt{63} - 2\sqrt{7} = -8 \cdot \sqrt{9} \cdot \sqrt{7} - 2\sqrt{7} = -8 \cdot 3\sqrt{7} - 2\sqrt{7} = -24\sqrt{7} - 2\sqrt{7} = -26\sqrt{7}$$

$$\text{b } \sqrt{2} \cdot \frac{1}{2}\sqrt{32} - \sqrt{150} = \frac{1}{2}\sqrt{64} - \sqrt{25} \cdot \sqrt{6} = \frac{1}{2} \cdot 8 - 5\sqrt{6} = 4 - 5\sqrt{6}$$

$$\text{c } \sqrt{54} - 2\sqrt{3} \cdot \sqrt{2} + \frac{1}{2}\sqrt{6} = \sqrt{9} \cdot \sqrt{6} - 2\sqrt{6} + \frac{1}{2}\sqrt{6} = 3\sqrt{6} - 2\sqrt{6} + \frac{1}{2}\sqrt{6} = 1\frac{1}{2}\sqrt{6}$$

$$\text{35 a } 2\sqrt{3}(3\sqrt{6} - 4) = 6\sqrt{18} - 8\sqrt{3} = 6 \cdot \sqrt{9} \cdot \sqrt{2} - 8\sqrt{3} = 6 \cdot 3\sqrt{2} - 8\sqrt{3} = 18\sqrt{2} - 8\sqrt{3}$$

$$\text{b } (3\sqrt{2} - 2\sqrt{5})(3\sqrt{2} + 2\sqrt{5}) = (3\sqrt{2})^2 - (2\sqrt{5})^2 = 18 - 20 = -2$$

$$\text{c } (2\sqrt{5} - \sqrt{10})^2 = (2\sqrt{5})^2 - 4\sqrt{50} + (\sqrt{10})^2 = 20 - 4 \cdot \sqrt{25} \cdot \sqrt{2} + 10 = 30 - 4 \cdot 5\sqrt{2} = 30 - 20\sqrt{2}$$

Bladzijde 24

$$\begin{aligned} \text{36 In } \triangle PQR \text{ is } \angle R = 90^\circ, \text{ dus } PR^2 + QR^2 &= PQ^2 \\ PR^2 + (3\sqrt{2})^2 &= (5\sqrt{2})^2 \\ PR^2 + 18 &= 50 \\ PR^2 &= 32 \\ PR &= \sqrt{32} = \sqrt{16} \cdot \sqrt{2} = 4\sqrt{2} \end{aligned}$$

$$\text{De omtrek is } 3\sqrt{2} + 4\sqrt{2} + 5\sqrt{2} = 12\sqrt{2}.$$

$$\text{De oppervlakte is } \frac{1}{2} \cdot 3\sqrt{2} \cdot 4\sqrt{2} = 6\sqrt{4} = 6 \cdot 2 = 12.$$

$$\begin{aligned} \text{37 In } \triangle DEF \text{ is } \angle E = 90^\circ, \text{ dus } DE^2 + EF^2 &= DF^2 \\ DE^2 + (\sqrt{5})^2 &= (5\sqrt{2})^2 \\ DE^2 + 5 &= 50 \\ DE^2 &= 45 \\ DE &= \sqrt{45} = \sqrt{9} \cdot \sqrt{5} = 3\sqrt{5} \end{aligned}$$

$$\text{De omtrek is } 3\sqrt{5} + \sqrt{5} + 3\sqrt{5} + \sqrt{5} = 8\sqrt{5}.$$

$$\text{De oppervlakte is } 3\sqrt{5} \cdot \sqrt{5} = 3 \cdot 5 = 15.$$

$$\begin{aligned} \text{38 a In } \triangle ACD \text{ is } \angle D = 90^\circ, \text{ dus } AC^2 &= AD^2 + CD^2 \\ AC^2 &= (2\sqrt{3})^2 + 4^2 \\ AC^2 &= 12 + 16 \\ AC^2 &= 28 \\ AC &= \sqrt{28} = \sqrt{4} \cdot \sqrt{7} = 2\sqrt{7} \end{aligned}$$

$$\text{In } \triangle BCD \text{ is } \angle D = 90^\circ, \text{ dus } BD^2 + CD^2 = BC^2$$

$$BD^2 + 4^2 = 8^2$$

$$BD^2 + 16 = 64$$

$$BD^2 = 48$$

$$BD = \sqrt{48} = \sqrt{16} \cdot \sqrt{3} = 4\sqrt{3}$$

$$\text{De omtrek is } 2\sqrt{3} + 4\sqrt{3} + 8 + 2\sqrt{7} = 8 + 6\sqrt{3} + 2\sqrt{7}.$$

$$\text{b De oppervlakte is } \frac{1}{2} \cdot (2\sqrt{3} + 4\sqrt{3}) \cdot 4 = \frac{1}{2} \cdot 6\sqrt{3} \cdot 4 = 12\sqrt{3}.$$

$$\text{c } AC^2 + BC^2 = 28 + 64 = 92 \text{ en } AB^2 = (2\sqrt{3} + 4\sqrt{3})^2 = (6\sqrt{3})^2 = 108 \\ AC^2 + BC^2 \neq AB^2, \text{ dus } \triangle ABC \text{ is niet rechthoekig.}$$

$$\begin{aligned} \text{39 In } \triangle ABD \text{ is } \angle A = 90^\circ, \text{ dus } BD^2 &= AB^2 + AD^2 \\ BD^2 &= 8^2 + 8^2 \\ BD^2 &= 64 + 64 \\ BD^2 &= 128 \\ BD &= \sqrt{128} = \sqrt{64} \cdot \sqrt{2} = 8\sqrt{2} \end{aligned}$$

$$\text{De omtrek is } 8\sqrt{2} + 8 + 8 = 16 + 8\sqrt{2}.$$

$$BS = \frac{1}{2} BD = \frac{1}{2} \cdot 8\sqrt{2} = 4\sqrt{2}$$

In $\triangle BST$ is $\angle S = 90^\circ$, dus $ST^2 + BS^2 = BT^2$

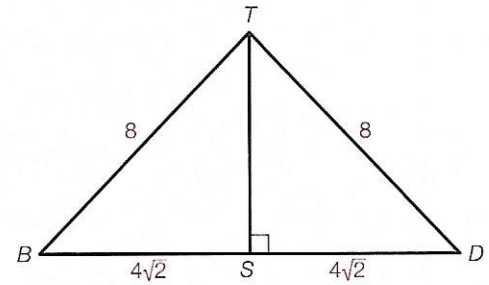
$$ST^2 + (4\sqrt{2})^2 = 8^2$$

$$ST^2 + 32 = 64$$

$$ST^2 = 32$$

$$ST = \sqrt{32} = \sqrt{16} \cdot \sqrt{2} = 4\sqrt{2}$$

De oppervlakte is $\frac{1}{2} \cdot 8\sqrt{2} \cdot 4\sqrt{2} = 16 \cdot 2 = 32$.



40 a $\frac{6}{2} = 3$, want $3 \cdot 2 = 6$.

b $\frac{\sqrt{6}}{\sqrt{2}} = \sqrt{3}$, want $\sqrt{3} \cdot \sqrt{2} = \sqrt{6}$.

Bladzijde 25

41 a $\frac{48\sqrt{135}}{12\sqrt{3}} = 4\sqrt{45} = 4 \cdot \sqrt{9} \cdot \sqrt{5} = 4 \cdot 3\sqrt{5} = 12\sqrt{5}$

c $\frac{3\sqrt{5}}{18\sqrt{5}} = \frac{1}{6}$

b $8\sqrt{5\frac{1}{16}} = 8\sqrt{\frac{81}{16}} = 8 \cdot \frac{\sqrt{81}}{\sqrt{16}} = 8 \cdot \frac{9}{4} = 18$

d $\frac{15\sqrt{80}}{125} = \frac{3 \cdot \sqrt{16} \cdot \sqrt{5}}{25} = \frac{3 \cdot 4\sqrt{5}}{25} = \frac{12\sqrt{5}}{25} = \frac{12}{25}\sqrt{5}$

Bladzijde 26

42 a $\frac{20\sqrt{6}}{5\sqrt{2}} = 4\sqrt{3}$

c $\frac{15\sqrt{6}}{25\sqrt{6}} = \frac{3}{5}$

b $\frac{12\sqrt{27}}{6\sqrt{3}} = 2\sqrt{9} = 2 \cdot 3 = 6$

d $\frac{5\sqrt{24}}{2\sqrt{3}} = \frac{5}{2}\sqrt{8} = 2\frac{1}{2} \cdot \sqrt{4} \cdot \sqrt{2} = 2\frac{1}{2} \cdot 2\sqrt{2} = 5\sqrt{2}$

43 a $\frac{2\sqrt{7}}{7} = \frac{2}{7}\sqrt{7}$

c $\sqrt{\frac{2 \cdot 2}{25}} = \sqrt{\frac{52}{25}} = \frac{\sqrt{52}}{\sqrt{25}} = \frac{\sqrt{4} \cdot \sqrt{13}}{5} = \frac{2\sqrt{13}}{5} = \frac{2}{5}\sqrt{13}$

b $\sqrt{3\frac{1}{9}} = \sqrt{\frac{28}{9}} = \frac{\sqrt{28}}{\sqrt{9}} = \frac{\sqrt{4} \cdot \sqrt{7}}{3} = \frac{2\sqrt{7}}{3} = \frac{2}{3}\sqrt{7}$

d $\frac{8\sqrt{50}}{4} = 2\sqrt{50} = 2 \cdot \sqrt{25} \cdot \sqrt{2} = 2 \cdot 5\sqrt{2} = 10\sqrt{2}$

44 a $\frac{4\sqrt{81}}{2\sqrt{25}} = \frac{2 \cdot 9}{1 \cdot 5} = \frac{18}{5} = 3\frac{3}{5}$

b $3\sqrt{60} + 2\sqrt{135} = 3 \cdot \sqrt{4} \cdot \sqrt{15} + 2 \cdot \sqrt{9} \cdot \sqrt{15} = 3 \cdot 2\sqrt{15} + 2 \cdot 3\sqrt{15} = 6\sqrt{15} + 6\sqrt{15} = 12\sqrt{15}$

c $\frac{6\sqrt{40}}{3\sqrt{2}} - 5\sqrt{125} = 2\sqrt{20} - 5\sqrt{125} = 2 \cdot \sqrt{4} \cdot \sqrt{5} - 5 \cdot \sqrt{25} \cdot \sqrt{5} = 2 \cdot 2\sqrt{5} - 5 \cdot 5\sqrt{5} = 4\sqrt{5} - 25\sqrt{5} = -21\sqrt{5}$

d $2\sqrt{3} \cdot \sqrt{8} - 5\sqrt{2} \cdot \sqrt{12} = 2\sqrt{24} - 5\sqrt{24} = -3\sqrt{24} = -3 \cdot \sqrt{4} \cdot \sqrt{6} = -3 \cdot 2\sqrt{6} = -6\sqrt{6}$

e $\frac{20\sqrt{7}}{2\sqrt{7}} - \sqrt{18} \cdot \frac{1}{2}\sqrt{2} = 10 - \frac{1}{2}\sqrt{36} = 10 - \frac{1}{2} \cdot 6 = 10 - 3 = 7$

f $\sqrt{\frac{2 \cdot 2}{9}} - \frac{5\sqrt{15}}{15\sqrt{3}} = \sqrt{\frac{20}{9}} - \frac{1}{3}\sqrt{5} = \frac{\sqrt{20}}{\sqrt{9}} - \frac{1}{3}\sqrt{5} = \frac{\sqrt{4} \cdot \sqrt{5}}{3} - \frac{1}{3}\sqrt{5} = \frac{2\sqrt{5}}{3} - \frac{1}{3}\sqrt{5} = \frac{2}{3}\sqrt{5} - \frac{1}{3}\sqrt{5} = \frac{1}{3}\sqrt{5}$

Bladzijde 27

45 a $\frac{10}{\sqrt{5}} = \frac{10 \cdot \sqrt{5}}{\sqrt{5} \cdot \sqrt{5}} = \frac{10\sqrt{5}}{5} = 2\sqrt{5}$

d $4\sqrt{\frac{1}{2}} = 4 \cdot \frac{\sqrt{1}}{\sqrt{2}} = \frac{4 \cdot 1 \cdot \sqrt{2}}{\sqrt{2} \cdot \sqrt{2}} = \frac{4\sqrt{2}}{2} = 2\sqrt{2}$

b $\sqrt{4\frac{1}{6}} = \sqrt{\frac{25}{6}} = \frac{\sqrt{25} \cdot \sqrt{6}}{\sqrt{6} \cdot \sqrt{6}} = \frac{5\sqrt{6}}{6} = \frac{5}{6}\sqrt{6}$

e $\frac{9}{2\sqrt{6}} = \frac{9 \cdot \sqrt{6}}{2 \cdot \sqrt{6} \cdot \sqrt{6}} = \frac{9\sqrt{6}}{2 \cdot 6} = \frac{9}{12}\sqrt{6} = \frac{3}{4}\sqrt{6}$

c $\frac{21}{3\sqrt{7}} = \frac{7}{\sqrt{7}} = \frac{7 \cdot \sqrt{7}}{\sqrt{7} \cdot \sqrt{7}} = \frac{7\sqrt{7}}{7} = \sqrt{7}$

f $\sqrt{3\frac{1}{3}} = \sqrt{\frac{10}{3}} = \frac{\sqrt{10} \cdot \sqrt{3}}{\sqrt{3} \cdot \sqrt{3}} = \frac{\sqrt{30}}{3} = \frac{1}{3}\sqrt{30}$

$$46 \quad a \quad \frac{10}{\sqrt{2}} + 3\sqrt{8} = \frac{10 \cdot \sqrt{2}}{\sqrt{2} \cdot \sqrt{2}} + 3 \cdot \sqrt{4} \cdot \sqrt{2} = \frac{10\sqrt{2}}{2} + 3 \cdot 2\sqrt{2} = 5\sqrt{2} + 6\sqrt{2} = 11\sqrt{2}$$

$$b \quad \sqrt{12\frac{1}{2}} - \sqrt{4\frac{1}{2}} = \sqrt{\frac{25}{2}} - \sqrt{\frac{9}{2}} = \frac{\sqrt{25} \cdot \sqrt{2}}{\sqrt{2} \cdot \sqrt{2}} - \frac{\sqrt{9} \cdot \sqrt{2}}{\sqrt{2} \cdot \sqrt{2}} = \frac{5\sqrt{2}}{2} - \frac{3\sqrt{2}}{2} = \frac{5}{2}\sqrt{2} - \frac{3}{2}\sqrt{2} = \sqrt{2}$$

$$c \quad \sqrt{24} - \frac{12}{\sqrt{6}} = \sqrt{4} \cdot \sqrt{6} - \frac{12 \cdot \sqrt{6}}{\sqrt{6} \cdot \sqrt{6}} = 2\sqrt{6} - \frac{12\sqrt{6}}{6} = 2\sqrt{6} - 2\sqrt{6} = 0$$

$$47 \quad a \quad \sqrt{24\frac{1}{2}} - \frac{1}{2}\sqrt{18} = \sqrt{\frac{49}{2}} - \frac{1}{2} \cdot \sqrt{9} \cdot \sqrt{2} = \frac{\sqrt{49} \cdot \sqrt{2}}{\sqrt{2} \cdot \sqrt{2}} - \frac{1}{2} \cdot 3\sqrt{2} = \frac{7\sqrt{2}}{2} - 1\frac{1}{2}\sqrt{2} = 3\frac{1}{2}\sqrt{2} - 1\frac{1}{2}\sqrt{2} = 2\sqrt{2}$$

$$b \quad \frac{3}{\sqrt{3}} - \sqrt{\frac{1}{3}} = \frac{3 \cdot \sqrt{3}}{\sqrt{3} \cdot \sqrt{3}} - \frac{\sqrt{1} \cdot \sqrt{3}}{\sqrt{3} \cdot \sqrt{3}} = \frac{3\sqrt{3}}{3} - \frac{\sqrt{3}}{3} = \sqrt{3} - \frac{1}{3}\sqrt{3} = \frac{2}{3}\sqrt{3}$$

$$c \quad \frac{18}{\sqrt{3}} + 4\sqrt{27} = \frac{18 \cdot \sqrt{3}}{\sqrt{3} \cdot \sqrt{3}} + 4 \cdot \sqrt{9} \cdot \sqrt{3} = \frac{18\sqrt{3}}{3} + 4 \cdot 3\sqrt{3} = 6\sqrt{3} + 12\sqrt{3} = 18\sqrt{3}$$

$$48 \quad BD = AB + AD = 5\sqrt{6} + \sqrt{6} = 6\sqrt{6}$$

In $\triangle BCD$ is $\angle D = 90^\circ$, dus $BC^2 = BD^2 + CD^2$

$$BC^2 = (6\sqrt{6})^2 + (6\sqrt{2})^2$$

$$BC^2 = 216 + 72$$

$$BC^2 = 288$$

$$BC = \sqrt{288} = \sqrt{144} \cdot \sqrt{2} = 12\sqrt{2}$$

$$\text{opp } \triangle ABC = \frac{1}{2} \cdot BC \cdot AE = \frac{1}{2} \cdot 12\sqrt{2} \cdot AE = 6\sqrt{2} \cdot AE, \text{ maar ook}$$

$$\text{opp } \triangle ABC = \frac{1}{2} \cdot AB \cdot CD = \frac{1}{2} \cdot 5\sqrt{6} \cdot 6\sqrt{2} = 15\sqrt{12} = 15 \cdot \sqrt{4} \cdot \sqrt{3} = 15 \cdot 2\sqrt{3} = 30\sqrt{3}.$$

$$\text{Dus } 6\sqrt{2} \cdot AE = 30\sqrt{3}.$$

$$\text{Dit geeft } AE = \frac{30\sqrt{3}}{6\sqrt{2}} = \frac{5\sqrt{3} \cdot \sqrt{2}}{\sqrt{2} \cdot \sqrt{2}} = \frac{5\sqrt{6}}{2} = 2\frac{1}{2}\sqrt{6}.$$

49 a Sacha herleidt zo:

$$\frac{5}{\sqrt{32}} = \frac{5 \cdot \sqrt{32}}{\sqrt{32} \cdot \sqrt{32}} = \frac{5\sqrt{32}}{32} = \frac{5}{32}\sqrt{32} = \frac{5}{32} \cdot \sqrt{16} \cdot \sqrt{2} = \frac{5}{32} \cdot 4\sqrt{2} = \frac{20}{32}\sqrt{2} = \frac{5}{8}\sqrt{2}$$

Bo herleidt zo:

$$\frac{5}{\sqrt{32}} = \frac{5 \cdot \sqrt{2}}{\sqrt{32} \cdot \sqrt{2}} = \frac{5\sqrt{2}}{\sqrt{64}} = \frac{5}{8}\sqrt{2}$$

Dus Bo heeft gelijk.

b Bo heeft gezien dat $32 \cdot 2 = 64$ een kwadraat is. Dus dat $\sqrt{32} \cdot \sqrt{2} = \sqrt{64} = 8$.

$$c \quad \frac{\sqrt{5}}{\sqrt{12}} = \frac{\sqrt{5} \cdot \sqrt{3}}{\sqrt{12} \cdot \sqrt{3}} = \frac{\sqrt{15}}{\sqrt{36}} = \frac{\sqrt{15}}{6} = \frac{1}{6}\sqrt{15} \text{ en } \frac{10\sqrt{3}}{\sqrt{20}} = \frac{10\sqrt{3} \cdot \sqrt{5}}{\sqrt{20} \cdot \sqrt{5}} = \frac{10\sqrt{15}}{\sqrt{100}} = \frac{10\sqrt{15}}{10} = \sqrt{15}$$

$$d \quad \frac{6\sqrt{7}}{\sqrt{63}} = \frac{6\sqrt{7}}{\sqrt{9} \cdot \sqrt{7}} = \frac{6\sqrt{7}}{3\sqrt{7}} = 2$$

6.5 Wortelvergelijkingen

Bladzijde 28

$$50 \quad a \quad \sqrt{x} = 5 \text{ geeft } x = 25$$

$$\sqrt{x} = 25 \text{ geeft } x = 625$$

$$\sqrt{x-1} = 10 \text{ geeft } x-1 = 100, \text{ dus } x = 101.$$

b $\sqrt{x} = -3$ heeft geen oplossing omdat de wortel van een getal niet negatief is.

Bladzijde 29**51**

a $\sqrt{x} = 11$
 $x = 121$

b $\sqrt{x} + 7 = 15$
 $\sqrt{x} = 8$
 $x = 64$

c $\sqrt{x-2} = 9$
 $x-2 = 81$
 $x = 83$

d $18 + 2\sqrt{x} = 10$
 $2\sqrt{x} = -8$
 $\sqrt{x} = -4$
 geen oplossing

e $5\sqrt{x} = 6$
 $\sqrt{x} = \frac{6}{5}$
 $x = \frac{36}{25} = 1\frac{11}{25}$

f $3 + \sqrt{3x-2} = 5$
 $\sqrt{3x-2} = 2$
 $3x-2 = 4$
 $3x = 6$
 $x = 2$

g $5 - \sqrt{x} = 2$
 $-\sqrt{x} = -3$
 $\sqrt{x} = 3$
 $x = 9$

h $\sqrt{0,1x+8} = 10$
 $0,1x+8 = 100$
 $0,1x = 92$
 $x = 920$

i $3\sqrt{x} - 1 = 11$
 $3\sqrt{x} = 12$
 $\sqrt{x} = 4$
 $x = 16$

52

a $\sqrt{1-2x} = 13$
 $1-2x = 169$
 $-2x = 168$
 $x = -84$

b $7 + \sqrt{\frac{1}{3}x - 1} = 8$
 $\sqrt{\frac{1}{3}x - 1} = 1$
 $\frac{1}{3}x - 1 = 1$
 $\frac{1}{3}x = 2$
 $x = 6$

c $20 - 3\sqrt{x} = 5$
 $-3\sqrt{x} = -15$
 $\sqrt{x} = 5$
 $x = 25$

53

a $x = 5$ geeft $v = \sqrt{1600 - 200 \cdot 5} \approx 24$
 Dus de snelheid is 24 km per uur.

b $x = 0$ geeft $v = \sqrt{1600 - 200 \cdot 0} = 40$
 De snelheid was 40 km per uur.

c $x = 4$ geeft $v = \sqrt{1600 - 200 \cdot 4} = 28,28...$
 $\frac{28,28... - 40}{40} \times 100\% \approx -29,3\%$

Dus de snelheid is met 29,3% afgenomen.

d $v = 25$ geeft $\sqrt{1600 - 200x} = 25$
 $1600 - 200x = 625$
 $-200x = -975$
 $x = 4,875$

De automobilist heeft dan 4,875 meter geremd.

e $v = 0$ geeft $\sqrt{1600 - 200x} = 0$
 $1600 - 200x = 0$
 $-200x = -1600$
 $x = 8$

Na 8 meter staat de auto stil.

Bladzijde 30**54**

a $t = 12,28$ geeft $P = \frac{29550}{12,28} - 1881,5 \approx 524,9$

Ronald heeft 524,9 punten behaald.

b $P = 959$ geeft $\frac{29550}{t} - 1881,5 = 959$

$$\frac{29550}{t} = 2840,5$$

$$\frac{29550}{t} = \frac{2840,5}{1}$$

$$2840,5t = 29550$$

$$t = \frac{29550}{2840,5} \approx 10,40$$

De tijd van Eelco was 10,40 seconden.

- c $h = 1,62$ geeft $P = 2440\sqrt{1,62} - 2593,5 \approx 512,1$
Thomas behaalt hiermee 512,1 punten.
- d $h = 1,69$ geeft $P = 2440\sqrt{1,69} - 2593,5 = 578,5$
Na het hoogspringen heeft Ronald $1850 + 578,5 = 2428,5$ punten.
Om hem voor te blijven moet Thomas meer dan $2428,5 - 1975 = 453,5$ punten halen.
 $P = 453,5$ geeft $2440\sqrt{h} - 2593,5 = 453,5$
 $2440\sqrt{h} = 3047$
 $\sqrt{h} = \frac{3047}{2440}$
 $h = \left(\frac{3047}{2440}\right)^2 = 1,559...$

Dus Thomas moet minimaal 1,56 meter hoog springen.

6.6 Substitueren

Bladzijde 31

- 55 a $f(a+4) = (a+4)^2 + 5 \cdot (a+4) + 2 = a^2 + 8a + 16 + 5a + 20 + 2 = a^2 + 13a + 38$
b $f(a-1) = (a-1)^2 + 5 \cdot (a-1) + 2 = a^2 - 2a + 1 + 5a - 5 + 2 = a^2 + 3a - 2$
- 56 a $f(p+3) = (p+3)^2 + 3(p+3) + 2 = p^2 + 6p + 9 + 3p + 9 + 2 = p^2 + 9p + 20$
b $f(3p) = (3p)^2 + 3 \cdot 3p + 2 = 9p^2 + 9p + 2$
c $f(3-p) = (3-p)^2 + 3(3-p) + 2 = 9 - 6p + p^2 + 9 - 3p + 2 = p^2 - 9p + 20$

Bladzijde 32

- 57 a $g(2a) = -3(2a)^2 + 2 \cdot 2a = -3 \cdot 4a^2 + 4a = -12a^2 + 4a$
b $g(a^2) = -3(a^2)^2 + 2a^2 = -3a^4 + 2a^2$
c $g(a-b) = -3(a-b)^2 + 2(a-b) = -3(a^2 - 2ab + b^2) + 2(a-b) = -3a^2 + 6ab - 3b^2 + 2a - 2b$
- 58 a $h(-3p) = -(-3p)^2 + 7 \cdot -3p - 8 = -9p^2 - 21p - 8$
b $h(1-p) = -(1-p)^2 + 7(1-p) - 8 = -(1-2p+p^2) + 7-7p-8 = -1+2p-p^2+7-7p-8 = -p^2-5p-2$
c $h(p+q) = -(p+q)^2 + 7(p+q) - 8 = -(p^2+2pq+q^2) + 7p+7q-8 = -p^2-2pq-q^2+7p+7q-8$
- 59 a $f(a-3) = 2(a-3)^2 - 4(a-3) + 9 = 2(a^2 - 6a + 9) - 4a + 12 + 9 = 2a^2 - 12a + 18 - 4a + 12 + 9 = 2a^2 - 16a + 39$
 $f(a-3) = a^2$ geeft $2a^2 - 16a + 39 = a^2$
 $a^2 - 16a + 39 = 0$
 $(a-3)(a-13) = 0$
 $a = 3 \vee a = 13$

Punt $A(a-3, a^2)$ met $a = 3$ geeft $A(0, 9)$ en met $a = 13$ geeft $A(10, 169)$.

- b $f(\sqrt{b+3\frac{1}{2}}) = 2(\sqrt{b+3\frac{1}{2}})^2 - 4\sqrt{b+3\frac{1}{2}} + 9 = 2(b+3\frac{1}{2}) - 4\sqrt{b+3\frac{1}{2}} + 9 = 2b + 7 - 4\sqrt{b+3\frac{1}{2}} + 9 = 2b - 4\sqrt{b+3\frac{1}{2}} + 16$
 $f(\sqrt{b+3\frac{1}{2}}) = 2b$ geeft $2b - 4\sqrt{b+3\frac{1}{2}} + 16 = 2b$
 $-4\sqrt{b+3\frac{1}{2}} = -16$
 $\sqrt{b+3\frac{1}{2}} = 4$
 $b+3\frac{1}{2} = 16$
 $b = 12\frac{1}{2}$

Punt $B(\sqrt{b+3\frac{1}{2}}, 2b)$ met $b = 12\frac{1}{2}$ geeft $B(4, 25)$.

- 60 a** Van de grafiek van $g(x) = x^2 + 6px + 8$ is $x_{\text{top}} = -\frac{6p}{2 \cdot 1} = -3p$.
- b** Van de grafiek van $h(x) = \frac{1}{2}x^2 - 4px + 10$ is $x_{\text{top}} = -\frac{-4p}{2 \cdot \frac{1}{2}} = 4p$.
- c** Van de grafiek van $k(x) = 2x^2 + 8px$ is $x_{\text{top}} = -\frac{8p}{2 \cdot 2} = -2p$.
- d** Van de grafiek van $l(x) = -x^2 + 10px + 1$ is $x_{\text{top}} = -\frac{10p}{2 \cdot -1} = 5p$.

Bladzijde 33

- 61 a** $f(x) = x^2 + 2px + 4p$
 $x_{\text{top}} = -\frac{2p}{2 \cdot 1} = -p$
 $y_{\text{top}} = f(-p) = (-p)^2 + 2p \cdot -p + 4p = p^2 - 2p^2 + 4p = -p^2 + 4p$
- b** $y_{\text{top}} = 3$ geeft $-p^2 + 4p = 3$
 $-p^2 + 4p - 3 = 0$
 $p^2 - 4p + 3 = 0$
 $(p - 1)(p - 3) = 0$
 $p = 1 \vee p = 3$

- 62** $g(x) = -x^2 + 8px + 32p$
 $x_{\text{top}} = -\frac{8p}{2 \cdot -1} = 4p$
 $y_{\text{top}} = g(4p) = -(4p)^2 + 8p \cdot 4p + 32p = -16p^2 + 32p^2 + 32p = 16p^2 + 32p$
 $y_{\text{top}} = 128$ geeft $16p^2 + 32p = 128$
 $16p^2 + 32p - 128 = 0$
 $p^2 + 2p - 8 = 0$
 $(p - 2)(p + 4) = 0$
 $p = 2 \vee p = -4$

- 63 a** $h(x) = 3x^2 - 6px + 4p$
 $x_{\text{top}} = -\frac{-6p}{2 \cdot 3} = p$
 $y_{\text{top}} = h(p) = 3p^2 - 6p \cdot p + 4p = 3p^2 - 6p^2 + 4p = -3p^2 + 4p$
 $y_{\text{top}} = -4$ geeft $-3p^2 + 4p = -4$
 $-3p^2 + 4p + 4 = 0$, dus $a = -3$, $b = 4$ en $c = 4$.
 $D = 4^2 - 4 \cdot -3 \cdot 4 = 64$
 $p = \frac{-4 + \sqrt{64}}{-6} \vee p = \frac{-4 - \sqrt{64}}{-6}$
 $p = \frac{-4 + 8}{-6} \vee p = \frac{-4 - 8}{-6}$
 $p = -\frac{2}{3} \vee p = 2$
 $x_{\text{top}} = p$, dus $x_{\text{top}} = -\frac{2}{3}$ of $x_{\text{top}} = 2$.
- b** $y_{\text{top}} = 0$ geeft $-3p^2 + 4p = 0$
 $p(-3p + 4) = 0$
 $p = 0 \vee -3p + 4 = 0$
 $p = 0 \vee -3p = -4$
 $p = 0 \vee p = 1\frac{1}{3}$

Gemengde opgaven

Bladzijde 34

- 1 a $(3+2p)(3-2p) - (2p-3)^2 = 9 - 4p^2 - (4p^2 - 12p + 9) =$
 $9 - 4p^2 - 4p^2 + 12p - 9 = -8p^2 + 12p$
- b $2(5k-n)^2 - 6k(3k-2n) = 2(25k^2 - 10kn + n^2) - 18k^2 + 12kn =$
 $50k^2 - 20kn + 2n^2 - 18k^2 + 12kn = 32k^2 - 8kn + 2n^2$
- c $-(4a-3b)(4a+3b) - 3(2a-b)^2 = -(16a^2 - 9b^2) - 3(4a^2 - 4ab + b^2) =$
 $-16a^2 + 9b^2 - 12a^2 + 12ab - 3b^2 = -28a^2 + 6b^2 + 12ab$
- d $5(2a-3)^2 - (4a)^2 - 4(3-a)^2 = 5(4a^2 - 12a + 9) - 16a^2 - 4(9 - 6a + a^2) =$
 $20a^2 - 60a + 45 - 16a^2 - 36 + 24a - 4a^2 = -36a + 9$
- e $3(p-3q)(5q+2p) - 5(p-3q)^2 = 3(5pq + 2p^2 - 15q^2 - 6pq) - 5(p^2 - 6pq + 9q^2) =$
 $15pq + 6p^2 - 45q^2 - 18pq - 5p^2 + 30pq - 45q^2 = p^2 - 90q^2 + 27pq$
- f $(a+2b+3)(a-3) = a^2 - 3a + 2ab - 6b + 3a - 9 = a^2 + 2ab - 6b - 9$

- 2 a $\frac{a^2 - 4a - 5}{a^2 + 2a + 1} = \frac{(a+1)(a-5)}{(a+1)(a+1)} = \frac{a-5}{a+1}$
- b $x - \frac{x+5}{1-x} = \frac{x(1-x)}{1-x} - \frac{x+5}{1-x} = \frac{x(1-x) - (x+5)}{1-x} = \frac{x - x^2 - x - 5}{1-x} = \frac{-x^2 - 5}{1-x}$
- c $\frac{x^3 + 3x}{2x^2 + 6} = \frac{x(x^2 + 3)}{2(x^2 + 3)} = \frac{x}{2} = \frac{1}{2}x$
- d $\frac{p^2 - 1}{p} \cdot \frac{p+1}{p+1} = \frac{3p(p^2 - 1)}{3p(p+1)(p-1)} = \frac{3p(p+1)(p-1)}{3p(p+1)(p-1)} = \frac{3(p-1)}{1} = 3(p-1) = 3p - 3$
- e $\frac{4-2a}{5} : \frac{2-a}{15} = \frac{4-2a}{5} \cdot \frac{15}{2-a} = \frac{15(4-2a)}{5(2-a)} = \frac{30(2-a)}{5(2-a)} = \frac{6}{1} = 6$
- f $\frac{x^2 + 6x + 8}{x^2 - 16} = \frac{(x+2)(x+4)}{(x-4)(x+4)} = \frac{x+2}{x-4}$
- g $\frac{4xy^2}{2x-6} : \frac{xy}{x-3} = \frac{4xy^2}{2x-6} \cdot \frac{x-3}{xy} = \frac{4xy^2(x-3)}{xy(2x-6)} = \frac{4xy^2(x-3)}{2xy(x-3)} = \frac{2y}{1} = 2y$
- h $\frac{a+2}{a-1} - \frac{a-4}{a+3} = \frac{(a+2)(a+3)}{(a-1)(a+3)} - \frac{(a-1)(a-4)}{(a-1)(a+3)} = \frac{(a+2)(a+3) - (a-1)(a-4)}{(a-1)(a+3)} =$
 $\frac{a^2 + 3a + 2a + 6 - (a^2 - 4a - a + 4)}{(a-1)(a+3)} = \frac{a^2 + 3a + 2a + 6 - a^2 + 4a + a - 4}{(a-1)(a+3)} = \frac{10a + 2}{(a-1)(a+3)}$

- 3 a $8 - \sqrt{x-3} = 2$
 $-\sqrt{x-3} = -6$
 $\sqrt{x-3} = 6$
 $x-3 = 36$
 $x = 39$
- b $8 + \frac{2}{2x-3} = 8,4$
 $\frac{2}{2x-3} = \frac{0,4}{1}$
 $0,4(2x-3) = 2$
 $0,8x - 1,2 = 2$
 $0,8x = 3,2$
 $x = 4$
- c $3\sqrt{5-4x} - 1 = 14$
 $3\sqrt{5-4x} = 15$
 $\sqrt{5-4x} = 5$
 $5 - 4x = 25$
 $-4x = 20$
 $x = -5$
- d $\frac{8}{2-x} = \frac{9}{2x+6}$
 $8(2x+6) = 9(2-x)$
 $16x + 48 = 18 - 9x$
 $25x = -30$
 $x = -1\frac{1}{5}$

- 4 a** $5\sqrt{3} \cdot \sqrt{6} - 3 \cdot 5\sqrt{2} + \sqrt{75} = 5\sqrt{18} - 15\sqrt{2} + \sqrt{25} \cdot \sqrt{3} = 5 \cdot \sqrt{9} \cdot \sqrt{2} - 15\sqrt{2} + 5\sqrt{3} =$
 $5 \cdot 3\sqrt{2} - 15\sqrt{2} + 5\sqrt{3} = 15\sqrt{2} - 15\sqrt{2} + 5\sqrt{3} = 5\sqrt{3}$
- b** $\frac{3\sqrt{2} \cdot 2\sqrt{5}}{9} - 2\sqrt{5} \cdot \frac{1}{3}\sqrt{8} = \frac{6\sqrt{10}}{9} - \frac{2}{3}\sqrt{40} = \frac{2}{3}\sqrt{10} - \frac{2}{3} \cdot \sqrt{4} \cdot \sqrt{10} = \frac{2}{3}\sqrt{10} - \frac{2}{3} \cdot 2\sqrt{10} =$
 $\frac{2}{3}\sqrt{10} - \frac{4}{3}\sqrt{10} = -\frac{2}{3}\sqrt{10}$
- c** $\sqrt{1\frac{7}{25}} - \frac{3}{5}\sqrt{72} = \sqrt{\frac{32}{25}} - \frac{3}{5} \cdot \sqrt{36} \cdot \sqrt{2} = \frac{\sqrt{32}}{\sqrt{25}} - \frac{3}{5} \cdot 6\sqrt{2} = \frac{\sqrt{16} \cdot \sqrt{2}}{5} - \frac{18}{5}\sqrt{2} = \frac{4\sqrt{2}}{5} - 3\frac{3}{5}\sqrt{2} =$
 $\frac{4}{5}\sqrt{2} - 3\frac{3}{5}\sqrt{2} = -2\frac{4}{5}\sqrt{2}$
- d** $\frac{3\sqrt{80}}{2\sqrt{2}} + 3\sqrt{3} \cdot \sqrt{30} = 1\frac{1}{2}\sqrt{40} + 3\sqrt{90} = 1\frac{1}{2} \cdot \sqrt{4} \cdot \sqrt{10} + 3 \cdot \sqrt{9} \cdot \sqrt{10} = 1\frac{1}{2} \cdot 2\sqrt{10} + 3 \cdot 3\sqrt{10} =$
 $3\sqrt{10} + 9\sqrt{10} = 12\sqrt{10}$
- e** $\sqrt{3\frac{15}{16}} + \frac{5}{8}\sqrt{28} = \sqrt{\frac{63}{16}} + \frac{5}{8} \cdot \sqrt{4} \cdot \sqrt{7} = \frac{\sqrt{63}}{\sqrt{16}} + \frac{5}{8} \cdot 2\sqrt{7} = \frac{\sqrt{9} \cdot \sqrt{7}}{4} + \frac{10}{8}\sqrt{7} = \frac{3\sqrt{7}}{4} + 1\frac{1}{4}\sqrt{7} =$
 $\frac{3}{4}\sqrt{7} + 1\frac{1}{4}\sqrt{7} = 2\sqrt{7}$
- f** $6\sqrt{12} - 7\sqrt{27} + \frac{1}{2}\sqrt{8} \cdot 4\sqrt{6} = 6 \cdot \sqrt{4} \cdot \sqrt{3} - 7 \cdot \sqrt{9} \cdot \sqrt{3} + 2\sqrt{48} = 6 \cdot 2\sqrt{3} - 7 \cdot 3\sqrt{3} + 2 \cdot \sqrt{16} \cdot \sqrt{3} =$
 $12\sqrt{3} - 21\sqrt{3} + 2 \cdot 4\sqrt{3} = 12\sqrt{3} - 21\sqrt{3} + 8\sqrt{3} = -\sqrt{3}$
- g** $\sqrt{\frac{8}{162}} - \frac{2}{27}\sqrt{18} = \sqrt{\frac{4}{81}} - \frac{2}{27} \cdot \sqrt{9} \cdot \sqrt{2} = \frac{\sqrt{4}}{\sqrt{81}} - \frac{2}{27} \cdot 3\sqrt{2} = \frac{2}{9} - \frac{6}{27}\sqrt{2} = \frac{2}{9} - \frac{2}{9}\sqrt{2}$
- h** $7\sqrt{44} - 2\sqrt{99} - 8\sqrt{11} = 7 \cdot \sqrt{4} \cdot \sqrt{11} - 2 \cdot \sqrt{9} \cdot \sqrt{11} - 8\sqrt{11} = 7 \cdot 2\sqrt{11} - 2 \cdot 3\sqrt{11} - 8\sqrt{11} =$
 $14\sqrt{11} - 6\sqrt{11} - 8\sqrt{11} = 0$

5 a $p = 6$ geeft $K = \frac{80\,000 \cdot 6}{100 - 6} \approx 5106,38$

Dat kost 5106,38 euro.

b $p = 98$ geeft $K = \frac{80\,000 \cdot 98}{100 - 98} = 3\,920\,000$

Dat kost 3 920 000 euro.

c Alle chemische stoffen verwijderen betekent $p = 100$.

Je mag in de formule $K = \frac{80\,000p}{100 - p}$ voor p niet 100 nemen omdat delen door 0 niet is toegestaan.

En dus lukt het niet de kosten te berekenen voor het verwijderen van alle chemische stoffen.

d $K = 170\,000$ geeft $\frac{80\,000p}{100 - p} = \frac{170\,000}{1}$
 $80\,000p = 170\,000(100 - p)$
 $80\,000p = 17\,000\,000 - 170\,000p$
 $250\,000p = 17\,000\,000$
 $p = 68$

Dus 68% van de chemische stoffen wordt verwijderd.

Bladzijde 35

- 6** In $\triangle ACD$ is $\angle D = 90^\circ$, dus $AD^2 + CD^2 = AC^2$
 $AD^2 + (3\sqrt{2})^2 = (6\sqrt{2})^2$
 $AD^2 + 18 = 72$
 $AD^2 = 54$
 $AD = \sqrt{54} = \sqrt{9} \cdot \sqrt{6} = 3\sqrt{6}$
- In $\triangle BCD$ is $\angle D = 90^\circ$, dus $BC^2 = BD^2 + CD^2$
 $BC^2 = (\sqrt{6})^2 + (3\sqrt{2})^2$
 $BC^2 = 6 + 18$
 $BC^2 = 24$
 $BC = \sqrt{24} = \sqrt{4} \cdot \sqrt{6} = 2\sqrt{6}$
- De omtrek van $\triangle ABC$ is $3\sqrt{6} + \sqrt{6} + 2\sqrt{6} + 6\sqrt{2} = 6\sqrt{6} + 6\sqrt{2}$.
 De oppervlakte van $\triangle ABC$ is $\frac{1}{2} \cdot 4\sqrt{6} \cdot 3\sqrt{2} = 6\sqrt{12} = 6 \cdot \sqrt{4} \cdot \sqrt{3} = 6 \cdot 2\sqrt{3} = 12\sqrt{3}$.

- 7 a** $R = 12,9895$ geeft $TVF = 0,22\sqrt{12,9895} + 0,32 \approx 1,1129$
b $R = 11,4029$ geeft $TVF = 0,22\sqrt{11,4029} + 0,32 \approx 1,0629$
 48 minuten en 17 seconden is $48 \cdot 60 + 17 = 2897$ seconden.
 De gecorrigeerde tijd is $1,0629 \cdot 2897 \approx 3079$ seconden, dat is 51 minuten en 19 seconden.
c $TVF = 1,0900$ geeft $0,22\sqrt{R} + 0,32 = 1,0900$
 $0,22\sqrt{R} = 0,77$
 $\sqrt{R} = \frac{0,77}{0,22} = 3,5$
 $R = 12,2500$

- 8 a** $(p+q-2)(p-q)^2 = (p+q-2)(p^2-2pq+q^2) =$
 $p^3-2p^2q+pq^2+p^2q-2pq^2+q^3-2p^2+4pq-2q^2 = p^3-p^2q-pq^2+q^3-2p^2+4pq-2q^2$
b $\frac{p^3-4p^2}{3p^2-21p+36} = \frac{p^2(p-4)}{3(p^2-7p+12)} = \frac{p^2(p-4)}{3(p-3)(p-4)} = \frac{p^2}{3(p-3)}$
c $4(x-2)^3 - (4x)^3 = 4(x-2)(x-2)^2 - 64x^3 = 4(x-2)(x^2-4x+4) - 64x^3 =$
 $4(x^3-4x^2+4x-2x^2+8x-8) - 64x^3 = 4x^3-16x^2+16x-8x^2+32x-32-64x^3 =$
 $-60x^3-24x^2+48x-32$
d $\frac{6a^2+36a+54}{8a^2+16a-24} = \frac{6(a^2+6a+9)}{8(a^2+2a-3)} = \frac{6(a+3)(a+3)}{8(a-1)(a+3)} = \frac{3(a+3)}{4(a-1)} = \frac{3a+9}{4a-4}$

- 9 a** $\frac{5}{\sqrt{3}} - 2\sqrt{27} = \frac{5 \cdot \sqrt{3}}{\sqrt{3} \cdot \sqrt{3}} - 2 \cdot \sqrt{9} \cdot \sqrt{3} = \frac{5\sqrt{3}}{3} - 2 \cdot 3\sqrt{3} = \frac{5}{3}\sqrt{3} - 6\sqrt{3} = -4\frac{1}{3}\sqrt{3}$
b $\frac{4}{\sqrt{5}} + \sqrt{\frac{1}{5}} = \frac{4 \cdot \sqrt{5}}{\sqrt{5} \cdot \sqrt{5}} + \frac{\sqrt{1} \cdot \sqrt{5}}{\sqrt{5} \cdot \sqrt{5}} = \frac{4\sqrt{5}}{5} + \frac{\sqrt{5}}{5} = \frac{4}{5}\sqrt{5} + \frac{1}{5}\sqrt{5} = \sqrt{5}$
c $\sqrt{\frac{1}{2}} + \sqrt{18} = \frac{\sqrt{1} \cdot \sqrt{2}}{\sqrt{2} \cdot \sqrt{2}} + \sqrt{9} \cdot \sqrt{2} = \frac{\sqrt{2}}{2} + 3\sqrt{2} = \frac{1}{2}\sqrt{2} + 3\sqrt{2} = 3\frac{1}{2}\sqrt{2}$
d $3\sqrt{\frac{12}{5}} - 5\sqrt{\frac{3}{5}} = 3\sqrt{\frac{5}{3}} - 5\sqrt{\frac{3}{5}} = \frac{3\sqrt{5}}{\sqrt{3}} - \frac{5\sqrt{3}}{\sqrt{5}} = \frac{3\sqrt{5} \cdot \sqrt{3}}{\sqrt{3} \cdot \sqrt{3}} - \frac{5\sqrt{3} \cdot \sqrt{5}}{\sqrt{5} \cdot \sqrt{5}} = \frac{3\sqrt{15}}{3} - \frac{5\sqrt{15}}{5} = \sqrt{15} - \sqrt{15} = 0$
e $(2\sqrt{7} - \sqrt{3})(\sqrt{7} + 3\sqrt{3}) = 2 \cdot 7 + 6\sqrt{21} - \sqrt{21} - 3 \cdot 3 = 14 + 6\sqrt{21} - \sqrt{21} - 9 = 5 + 5\sqrt{21}$
f $(10\sqrt{2} + 2\sqrt{10})^2 - (5\sqrt{5} + 8)^2 = (10\sqrt{2})^2 + 40\sqrt{20} + (2\sqrt{10})^2 - ((5\sqrt{5})^2 + 80\sqrt{5} + 8^2) =$
 $200 + 40 \cdot \sqrt{4} \cdot \sqrt{5} + 40 - (125 + 80\sqrt{5} + 64) = 200 + 40 \cdot 2\sqrt{5} + 40 - 125 - 80\sqrt{5} - 64 =$
 $51 + 80\sqrt{5} - 80\sqrt{5} = 51$

- 10 a** $f(p-3) = -2(p-3)^2 + 16p(p-3) + 48p = -2(p^2-6p+9) + 16p^2-48p+48p =$
 $-2p^2+12p-18+16p^2-48p+48p = 14p^2+12p-18$ en
 $f(3p) = -2(3p)^2 + 16p \cdot 3p + 48p = -2 \cdot 9p^2 + 48p^2 + 48p = -18p^2 + 48p^2 + 48p = 30p^2 + 48p$
 Dus $f(p-3) - f(3p) = 14p^2 + 12p - 18 - (30p^2 + 48p) = 14p^2 + 12p - 18 - 30p^2 - 48p = -16p^2 - 36p - 18$.
b $x_{\text{top}} = -\frac{16p}{2 \cdot -2} = 4p$
 $y_{\text{top}} = f(4p) = -2(4p)^2 + 16p \cdot 4p + 48p = -2 \cdot 16p^2 + 64p^2 + 48p = -32p^2 + 64p^2 + 48p = 32p^2 + 48p$
 $y_{\text{top}} = -16$ geeft $32p^2 + 48p = -16$
 $32p^2 + 48p + 16 = 0$
 $2p^2 + 3p + 1 = 0$
 $(2p+1)(p+1) = 0$
 $2p = -1 \vee p = -1$
 $p = -\frac{1}{2} \vee p = -1$
 Dus $x_{\text{top}} = 4 \cdot -\frac{1}{2} = -2 \vee x_{\text{top}} = 4 \cdot -1 = -4$.
 De coördinaten van de top zijn $(-2, -16)$ of $(-4, -16)$.
c $f(p) = 20p$ geeft $-2p^2 + 16p^2 + 48p = 20p$
 $14p^2 + 28p = 0$
 $14p(p+2) = 0$
 $p = 0 \vee p = -2$

Diagnostische toets

Bladzijde 38

- 1 **a** $3a(a+6)^2 - (6a)^2 = 3a(a^2 + 12a + 36) - 36a^2 = 3a^3 + 36a^2 + 108a - 36a^2 = 3a^3 + 108a$
b $4(3x-5)^2 - 9(2x+1)(2x-1) = 4(9x^2 - 30x + 25) - 9(4x^2 - 1) =$
 $36x^2 - 120x + 100 - 36x^2 + 9 = -120x + 109$
c $(x+3y)(3-x+y) = 3x - x^2 + xy + 9y - 3xy + 3y^2 = 3x - x^2 - 2xy + 9y + 3y^2$
d $(x+4)^3 = (x+4)(x^2 + 8x + 16) = x^3 + 8x^2 + 16x + 4x^2 + 32x + 64 = x^3 + 12x^2 + 48x + 64$

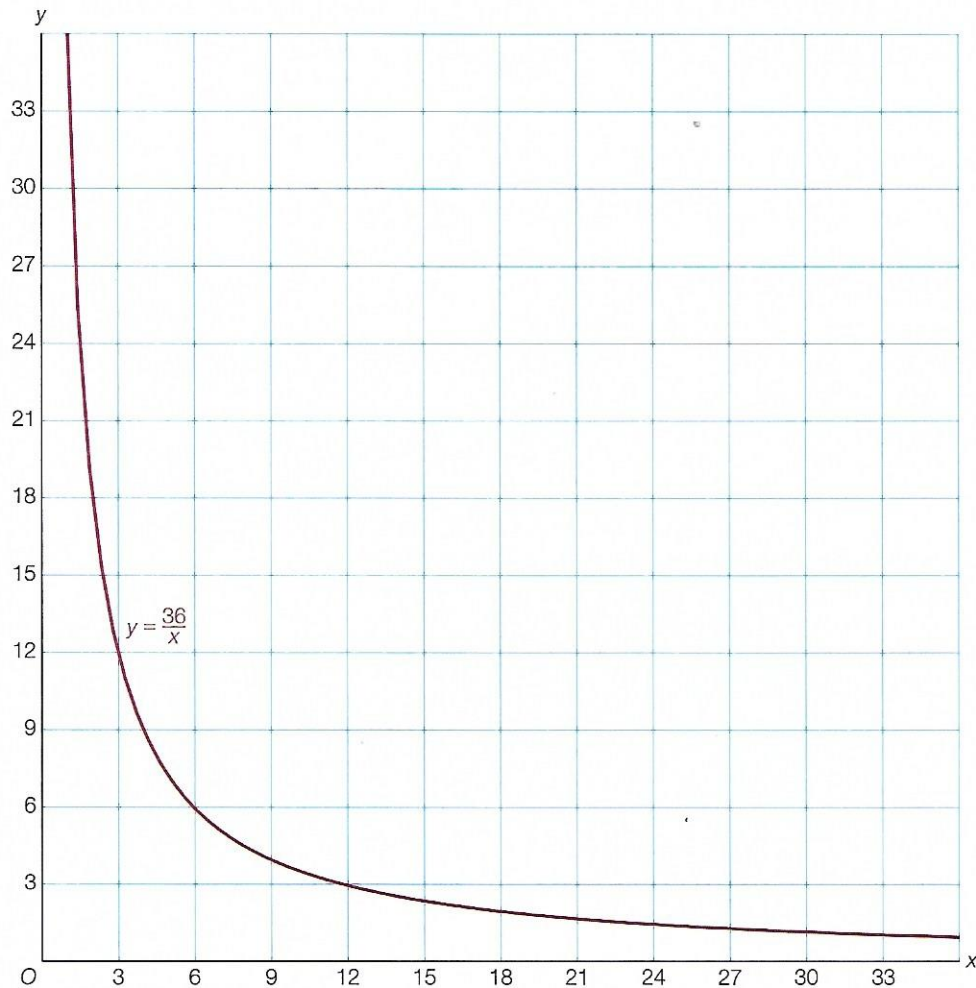
- 2 **a** $P = \frac{8a^2 - 16a}{2a} = \frac{8a(a-2)}{2a} = \frac{4(a-2)}{1} = 4(a-2) = 4a - 8$
b $y = \frac{2x^2 + 4x}{x^2 - 4} = \frac{2x(x+2)}{(x-2)(x+2)} = \frac{2x}{x-2}$
c $N = \frac{t^2 + 10t + 25}{t^2 + 4t - 5} = \frac{(t+5)(t+5)}{(t-1)(t+5)} = \frac{t+5}{t-1}$

- 3 **a** $\frac{x-2}{x-4} - \frac{x+1}{x+2} = \frac{(x-2)(x+2)}{(x-4)(x+2)} - \frac{(x-4)(x+1)}{(x-4)(x+2)} = \frac{(x-2)(x+2) - (x-4)(x+1)}{(x-4)(x+2)} =$
 $\frac{x^2 - 4 - (x^2 + x - 4x - 4)}{(x-4)(x+2)} = \frac{x^2 - 4 - x^2 - x + 4x + 4}{(x-4)(x+2)} = \frac{3x}{(x-4)(x+2)}$
b $\frac{a+1}{3} \cdot \frac{2a^2}{a^2+a} = \frac{2a^2(a+1)}{3(a^2+a)} = \frac{2a^2(a+1)}{3a(a+1)} = \frac{2a}{3} = \frac{2}{3}a$
c $\frac{n+2}{2n-2} \cdot \frac{n+1}{n-1} = \frac{n+2}{2n-2} \cdot \frac{n-1}{n+1} = \frac{(n+2)(n-1)}{(2n-2)(n+1)} = \frac{(n+2)(n-1)}{2(n-1)(n+1)} = \frac{n+2}{2(n+1)}$

- 4 **a** $xy = 36$, dus $y = \frac{36}{x}$.

b

x	1	2	3	4	6	9	12	18	36
y	36	18	12	9	6	4	3	2	1



- c** Als x vier keer zo groot wordt, wordt y vier keer zo klein.
d Als x een heel klein getal is, dan is y een heel groot getal.

5 a $\frac{6x+1}{1-2x} = 5$
 $\frac{6x+1}{1-2x} = \frac{5}{1}$
 $5(1-2x) = 6x+1$
 $5-10x = 6x+1$
 $-16x = -4$
 $x = \frac{1}{4}$

b $18 + \frac{10}{4-0,1x} = 68$
 $\frac{10}{4-0,1x} = \frac{50}{1}$
 $50(4-0,1x) = 10$
 $200-5x = 10$
 $-5x = -190$
 $x = 38$

c $50 - \frac{6x}{x-8} = 42\frac{1}{2}$
 $-\frac{6x}{x-8} = -7\frac{1}{2}$
 $\frac{6x}{x-8} = \frac{15}{2}$
 $15(x-8) = 2 \cdot 6x$
 $15x - 120 = 12x$
 $3x = 120$
 $x = 40$

6 a $t = 28$ geeft $N = 3600 - \frac{1200}{2+0,1 \cdot 28} = 3350$ insecten

b $N = 3475$ geeft $3600 - \frac{1200}{2+0,1t} = 3475$
 $-\frac{1200}{2+0,1t} = -125$
 $\frac{1200}{2+0,1t} = \frac{125}{1}$
 $125(2+0,1t) = 1200$
 $250 + 12,5t = 1200$
 $12,5t = 950$
 $t = 76$

Dus voor $t = 76$ zijn er 3475 insecten.

Bladzijde 39

7 a $\sqrt{2} \cdot 3\sqrt{10} - 5\sqrt{5} = 3\sqrt{20} - 5\sqrt{5} = 3 \cdot \sqrt{4} \cdot \sqrt{5} - 5\sqrt{5} = 3 \cdot 2\sqrt{5} - 5\sqrt{5} = 6\sqrt{5} - 5\sqrt{5} = \sqrt{5}$
 b $3\sqrt{80} - 5\sqrt{45} = 3 \cdot \sqrt{16} \cdot \sqrt{5} - 5 \cdot \sqrt{9} \cdot \sqrt{5} = 3 \cdot 4\sqrt{5} - 5 \cdot 3\sqrt{5} = 12\sqrt{5} - 15\sqrt{5} = -3\sqrt{5}$
 c $\sqrt{6} \cdot 3\sqrt{3} + 4\sqrt{3} - \sqrt{72} = 3\sqrt{18} + 4\sqrt{3} - \sqrt{72} = 3 \cdot \sqrt{9} \cdot \sqrt{2} + 4\sqrt{3} - \sqrt{36} \cdot \sqrt{2} =$
 $3 \cdot 3\sqrt{2} + 4\sqrt{3} - 6\sqrt{2} = 9\sqrt{2} + 4\sqrt{3} - 6\sqrt{2} = 3\sqrt{2} + 4\sqrt{3}$

8 In $\triangle ABC$ is $\angle B = 90^\circ$, dus $AB^2 + BC^2 = AC^2$
 $AB^2 + (4\sqrt{3})^2 = (2\sqrt{15})^2$
 $AB^2 + 48 = 60$
 $AB^2 = 12$
 $AB = \sqrt{12} = \sqrt{4} \cdot \sqrt{3} = 2\sqrt{3}$

De omtrek van rechthoek $ABCD$ is $2\sqrt{3} + 4\sqrt{3} + 2\sqrt{3} + 4\sqrt{3} = 12\sqrt{3}$.

De oppervlakte van rechthoek $ABCD$ is $2\sqrt{3} \cdot 4\sqrt{3} = 8 \cdot 3 = 24$.

9 a $\frac{\sqrt{20}}{4\sqrt{5}} = \frac{1}{4}\sqrt{4} = \frac{1}{4} \cdot 2 = \frac{1}{2}$
 b $\frac{5\sqrt{24}}{\sqrt{2}} = 5\sqrt{12} = 5 \cdot \sqrt{4} \cdot \sqrt{3} = 5 \cdot 2\sqrt{3} = 10\sqrt{3}$
 c $\frac{15\sqrt{108}}{24\sqrt{3}} = \frac{15}{24}\sqrt{36} = \frac{5}{8} \cdot 6 = 3\frac{3}{4}$
 d $\sqrt{\frac{16}{9}} + \frac{6\sqrt{11}}{9\sqrt{11}} = \sqrt{\frac{16}{9}} + \frac{6}{9} = \frac{\sqrt{16}}{\sqrt{9}} + \frac{2}{3} = \frac{4}{3} + \frac{2}{3} = \frac{6}{3} = 2$
 e $5\sqrt{\frac{7}{25}} - 3\sqrt{8} = 5\sqrt{\frac{32}{25}} - 3 \cdot \sqrt{4} \cdot \sqrt{2} = \frac{5\sqrt{32}}{\sqrt{25}} - 3 \cdot 2\sqrt{2} = \frac{5 \cdot \sqrt{16} \cdot \sqrt{2}}{5} - 6\sqrt{2} = 4\sqrt{2} - 6\sqrt{2} = -2\sqrt{2}$
 f $\frac{6\sqrt{80}}{2\sqrt{2}} - \frac{1}{2}\sqrt{200} = 3\sqrt{40} - \frac{1}{2} \cdot \sqrt{100} \cdot \sqrt{2} = 3 \cdot \sqrt{4} \cdot \sqrt{10} - \frac{1}{2} \cdot 10\sqrt{2} = 3 \cdot 2\sqrt{10} - 5\sqrt{2} = 6\sqrt{10} - 5\sqrt{2}$

10 a $\frac{3}{\sqrt{6}} - \sqrt{24} = \frac{3 \cdot \sqrt{6}}{\sqrt{6} \cdot \sqrt{6}} - \sqrt{4} \cdot \sqrt{6} = \frac{3\sqrt{6}}{6} - 2\sqrt{6} = \frac{1}{2}\sqrt{6} - 2\sqrt{6} = -1\frac{1}{2}\sqrt{6}$
 b $\sqrt{10\frac{2}{3}} - \sqrt{2\frac{2}{3}} = \sqrt{\frac{32}{3}} - \sqrt{\frac{8}{3}} = \frac{\sqrt{32} \cdot \sqrt{3}}{\sqrt{3} \cdot \sqrt{3}} - \frac{\sqrt{8} \cdot \sqrt{3}}{\sqrt{3} \cdot \sqrt{3}} = \frac{\sqrt{96}}{3} - \frac{\sqrt{24}}{3} = \frac{1}{3} \cdot \sqrt{16} \cdot \sqrt{6} - \frac{1}{3} \cdot \sqrt{4} \cdot \sqrt{6} =$
 $\frac{1}{3} \cdot 4\sqrt{6} - \frac{1}{3} \cdot 2\sqrt{6} = \frac{4}{3}\sqrt{6} - \frac{2}{3}\sqrt{6} = \frac{2}{3}\sqrt{6}$
 c $\sqrt{\frac{1}{6}} + \frac{5}{6}\sqrt{24} = \frac{\sqrt{1} \cdot \sqrt{6}}{\sqrt{6} \cdot \sqrt{6}} + \frac{5}{6} \cdot \sqrt{4} \cdot \sqrt{6} = \frac{\sqrt{6}}{6} + \frac{5}{6} \cdot 2\sqrt{6} = \frac{1}{6}\sqrt{6} + \frac{10}{6}\sqrt{6} = \frac{11}{6}\sqrt{6} = 1\frac{5}{6}\sqrt{6}$
 d $\frac{\sqrt{27} - \sqrt{3}}{\sqrt{2}} = \frac{\sqrt{9} \cdot \sqrt{3} - \sqrt{3}}{\sqrt{2}} = \frac{3\sqrt{3} - \sqrt{3}}{\sqrt{2}} = \frac{2\sqrt{3} \cdot \sqrt{2}}{\sqrt{2} \cdot \sqrt{2}} = \frac{2\sqrt{6}}{2} = \sqrt{6}$

11 a $12 + \sqrt{2x-3} = 21$
 $\sqrt{2x-3} = 9$
 $2x-3 = 81$
 $2x = 84$
 $x = 42$
 b $12 + \sqrt{1-x} = 10$
 $\sqrt{1-x} = -2$
 geen oplossing

c $180 - 5\sqrt{x} = 60$
 $-5\sqrt{x} = -120$
 $\sqrt{x} = 24$
 $x = 576$
 d $15\sqrt{x} - 21 = 204$
 $15\sqrt{x} = 225$
 $\sqrt{x} = 15$
 $x = 225$

12 a $f(4-a) = -5(4-a)^2 + 8(4-a) + 3$
 $= -5(16 - 8a + a^2) + 32 - 8a + 3$
 $= -80 + 40a - 5a^2 + 32 - 8a + 3$
 $= -5a^2 + 32a - 45$

b $f(-5a) = -5(-5a)^2 + 8 \cdot -5a + 3$
 $= -5 \cdot 25a^2 - 40a + 3$
 $= -125a^2 - 40a + 3$

- 13 a** $f(x) = -x^2 + 6px + 3p$
 $x_{\text{top}} = -\frac{6p}{2 \cdot -1} = 3p$
 $y_{\text{top}} = f(3p) = -(3p)^2 + 6p \cdot 3p + 3p = -9p^2 + 18p^2 + 3p = 9p^2 + 3p$
 $y_{\text{top}} = 6$ geeft $9p^2 + 3p = 6$
 $9p^2 + 3p - 6 = 0$
 $3p^2 + p - 2 = 0$
 $a = 3, b = 1$ en $c = -2$, dus $D = 1^2 - 4 \cdot 3 \cdot -2 = 25$.
 $p = \frac{-1 + \sqrt{25}}{6} \vee p = \frac{-1 - \sqrt{25}}{6}$
 $p = \frac{-1 + 5}{6} \vee p = \frac{-1 - 5}{6}$
 $p = \frac{2}{3} \vee p = -1$
Dus $x_{\text{top}} = 3 \cdot \frac{2}{3} = 2 \vee x_{\text{top}} = 3 \cdot -1 = -3$.
- b** $y_{\text{top}} = 0$ geeft $9p^2 + 3p = 0$
 $3p(3p + 1) = 0$
 $p = 0 \vee 3p = -1$
 $p = 0 \vee p = -\frac{1}{3}$

Herhaling

Bladzijde 40

- 1 a** $3(2x + 5)^2 = 3(4x^2 + 20x + 25) = 12x^2 + 60x + 75$
b $-2(3a + 1)(3a - 1) = -2(9a^2 - 1) = -18a^2 + 2$
c $2(x - 1)(2x + 3) - 4(x + 1)^2 = 2(2x^2 + 3x - 2x - 3) - 4(x^2 + 2x + 1) =$
 $4x^2 + 6x - 4x - 6 - 4x^2 - 8x - 4 = -6x - 10$
d $3(2p + 1)^2 - 6(2p + 3)(1 - p) = 3(4p^2 + 4p + 1) - 6(2p - 2p^2 + 3 - 3p) =$
 $12p^2 + 12p + 3 - 12p + 12p^2 - 18 + 18p = 24p^2 + 18p - 15$
- 2 a** $(x + 2)(x + y - 3) = x^2 + xy - 3x + 2x + 2y - 6 = x^2 + xy - x + 2y - 6$
b $(7a + b)(a - 4b + 1) = 7a^2 - 28ab + 7a + ab - 4b^2 + b = 7a^2 - 27ab + 7a - 4b^2 + b$
c $(3p - 1)^3 = (3p - 1)(3p - 1)^2 = (3p - 1)(9p^2 - 6p + 1) = 27p^3 - 18p^2 + 3p - 9p^2 + 6p - 1 =$
 $27p^3 - 27p^2 + 9p - 1$
d $(n - 1)(n + 3)^2 = (n - 1)(n^2 + 6n + 9) = n^3 + 6n^2 + 9n - n^2 - 6n - 9 = n^3 + 5n^2 + 3n - 9$
- 3 a** $\frac{a^2 - 2a - 3}{2a - 6} = \frac{(a + 1)(a - 3)}{2(a - 3)} = \frac{a + 1}{2} = \frac{1}{2}(a + 1) = \frac{1}{2}a + \frac{1}{2}$
b $\frac{3p + 15}{p^2 - 25} = \frac{3(p + 5)}{(p - 5)(p + 5)} = \frac{3}{p - 5}$
c $\frac{x^2 + 9x + 8}{x^2 - 4x - 5} = \frac{(x + 1)(x + 8)}{(x + 1)(x - 5)} = \frac{x + 8}{x - 5}$
- 4 a** $\frac{2}{x - 1} + \frac{1}{x + 3} = \frac{2(x + 3)}{(x - 1)(x + 3)} + \frac{x - 1}{(x - 1)(x + 3)} = \frac{2x + 6 + x - 1}{(x - 1)(x + 3)} = \frac{3x + 5}{(x - 1)(x + 3)}$
b $\frac{x + 1}{x - 2} - \frac{x}{x - 1} = \frac{(x + 1)(x - 1)}{(x - 2)(x - 1)} - \frac{x(x - 2)}{(x - 2)(x - 1)} = \frac{(x + 1)(x - 1) - x(x - 2)}{(x - 2)(x - 1)} =$
 $\frac{x^2 - 1 - x^2 + 2x}{(x - 2)(x - 1)} = \frac{2x - 1}{(x - 2)(x - 1)}$
c $\frac{2}{3x^2} - \frac{5}{6x} = \frac{4}{6x^2} - \frac{5x}{6x^2} = \frac{4 - 5x}{6x^2}$

Bladzijde 41

5 a $\frac{4x^2}{x-3} : \frac{2x}{x-3} = \frac{4x^2}{x-3} \cdot \frac{x-3}{2x} = \frac{4x^2(x-3)}{2x(x-3)} = \frac{2x}{1} = 2x$

b $\frac{2x+2}{3} : \frac{x+1}{5x} = \frac{2x+2}{3} \cdot \frac{5x}{x+1} = \frac{5x(2x+2)}{3(x+1)} = \frac{10x(x+1)}{3(x+1)} = \frac{10x}{3} = \frac{10}{3}x = 3\frac{1}{3}x$

c $\frac{3}{2p-6} \cdot \frac{p-3}{12p} = \frac{3(p-3)}{12p(2p-6)} = \frac{3(p-3)}{24p(p-3)} = \frac{1}{8p}$

6 a Hij doet er $\frac{24}{12} = 2$ uur over.

b De rit duurt $\frac{24}{48} = \frac{1}{2}$ uur.

c $t = \frac{24}{v}$

d Als v heel klein wordt, wordt t heel groot.

Als de snelheid van Bas heel laag is, zal hij er heel lang over doen.

7 a $\frac{7}{x-3} = \frac{4}{x-6}$
 $7(x-6) = 4(x-3)$
 $7x - 42 = 4x - 12$
 $3x = 30$
 $x = 10$

b $5 + \frac{3}{2x-6} = 5\frac{1}{2}$
 $\frac{3}{2x-6} = \frac{1}{2}$
 $2x-6 = 6$
 $2x = 12$
 $x = 6$

c $\frac{5-3x}{2x+1} = \frac{1}{8}$
 $2x+1 = 8(5-3x)$
 $2x+1 = 40-24x$
 $26x = 39$
 $x = 1\frac{1}{2}$

d $72 - \frac{10x}{5-0,2x} = -3$
 $-\frac{10x}{5-0,2x} = -75$
 $\frac{10x}{5-0,2x} = \frac{75}{1}$
 $10x = 75(5-0,2x)$
 $10x = 375 - 15x$
 $25x = 375$
 $x = 15$

8 a $t = 15$ geeft $N = 12000 - \frac{5000}{1+0,2 \cdot 15} = 10750$ insecten

b $12000 - \frac{5000}{1+0,2t} = 11500$

$$-\frac{5000}{1+0,2t} = -500$$

$$\frac{5000}{1+0,2t} = \frac{500}{1}$$

$$500(1+0,2t) = 5000$$

$$500 + 100t = 5000$$

$$100t = 4500$$

$$t = 45$$

Dus na 45 dagen zijn er 11500 insecten.

c $12000 - \frac{5000}{1+0,2t} = 11750$

$$-\frac{5000}{1+0,2t} = -250$$

$$\frac{5000}{1+0,2t} = \frac{250}{1}$$

$$250(1+0,2t) = 5000$$

$$250 + 50t = 5000$$

$$50t = 4750$$

$$t = 95$$

Dus na 95 dagen zijn er 11750 insecten.

Bladzijde 42

- 9** a $\sqrt{24} + 3\sqrt{6} = \sqrt{4} \cdot \sqrt{6} + 3\sqrt{6} = 2\sqrt{6} + 3\sqrt{6} = 5\sqrt{6}$
 b $3\sqrt{125} - 2\sqrt{45} = 3 \cdot \sqrt{25} \cdot \sqrt{5} - 2 \cdot \sqrt{9} \cdot \sqrt{5} = 3 \cdot 5\sqrt{5} - 2 \cdot 3\sqrt{5} = 15\sqrt{5} - 6\sqrt{5} = 9\sqrt{5}$
 c $4\sqrt{27} - 2\sqrt{3} \cdot \sqrt{6} = 4\sqrt{27} - 2\sqrt{18} = 4 \cdot \sqrt{9} \cdot \sqrt{3} - 2 \cdot \sqrt{9} \cdot \sqrt{2} = 4 \cdot 3\sqrt{3} - 2 \cdot 3\sqrt{2} = 12\sqrt{3} - 6\sqrt{2}$
 d $5\sqrt{8} + 3\sqrt{5} - 2\sqrt{10} \cdot \sqrt{5} = 5\sqrt{8} + 3\sqrt{5} - 2\sqrt{50} = 5 \cdot \sqrt{4} \cdot \sqrt{2} + 3\sqrt{5} - 2 \cdot \sqrt{25} \cdot \sqrt{2} = 5 \cdot 2\sqrt{2} + 3\sqrt{5} - 2 \cdot 5\sqrt{2} = 10\sqrt{2} + 3\sqrt{5} - 10\sqrt{2} = 3\sqrt{5}$
- 10** a $PQ^2 + PR^2 = QR^2$
 $PQ^2 + (3\sqrt{2})^2 = (5\sqrt{2})^2$
 $PQ^2 + 18 = 50$
 $PQ^2 = 32$
 b Uit $PQ^2 = 32$ volgt $PQ = \sqrt{32} = \sqrt{16} \cdot \sqrt{2} = 4\sqrt{2}$.
 c De omtrek is $3\sqrt{2} + 4\sqrt{2} + 5\sqrt{2} = 12\sqrt{2}$.
 d De oppervlakte is $\frac{1}{2} \cdot 4\sqrt{2} \cdot 3\sqrt{2} = 6 \cdot 2 = 12$.
- 11** a $\frac{12\sqrt{35}}{4\sqrt{7}} = 3\sqrt{5}$
 b $\frac{\sqrt{20}}{2\sqrt{5}} = \frac{1}{2}\sqrt{4} = \frac{1}{2} \cdot 2 = 1$
 c $\frac{15\sqrt{60}}{\sqrt{5}} = 15\sqrt{12} = 15 \cdot \sqrt{4} \cdot \sqrt{3} = 15 \cdot 2\sqrt{3} = 30\sqrt{3}$
 d $\frac{6\sqrt{90}}{9\sqrt{2}} - \sqrt{20} = \frac{2}{3}\sqrt{45} - \sqrt{20} = \frac{2}{3} \cdot \sqrt{9} \cdot \sqrt{5} - \sqrt{4} \cdot \sqrt{5} = \frac{2}{3} \cdot 3\sqrt{5} - 2\sqrt{5} = 2\sqrt{5} - 2\sqrt{5} = 0$

- 12** a $\sqrt{\frac{5}{9}} = \frac{\sqrt{50}}{\sqrt{9}} = \frac{\sqrt{25} \cdot \sqrt{2}}{3} = \frac{5\sqrt{2}}{3} = \frac{5}{3}\sqrt{2} = 1\frac{2}{3}\sqrt{2}$
 b $\sqrt{\frac{63}{4}} = \frac{\sqrt{27}}{\sqrt{4}} = \frac{\sqrt{9} \cdot \sqrt{3}}{2} = \frac{3\sqrt{3}}{2} = \frac{3}{2}\sqrt{3} = 1\frac{1}{2}\sqrt{3}$
 c $\sqrt{\frac{13}{36}} = \frac{\sqrt{49}}{\sqrt{36}} = \frac{7}{6} = 1\frac{1}{6}$
 d $\sqrt{\frac{1}{4}} + \frac{\sqrt{15}}{2\sqrt{3}} = \sqrt{\frac{1}{4}} + \frac{1}{2}\sqrt{5} = \frac{\sqrt{5}}{\sqrt{4}} + \frac{1}{2}\sqrt{5} = \frac{\sqrt{5}}{2} + \frac{1}{2}\sqrt{5} = \frac{1}{2}\sqrt{5} + \frac{1}{2}\sqrt{5} = \sqrt{5}$

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- 13** a $\frac{5}{\sqrt{6}} = \frac{5 \cdot \sqrt{6}}{\sqrt{6} \cdot \sqrt{6}} = \frac{5\sqrt{6}}{6} = \frac{5}{6}\sqrt{6}$
 b $\frac{24}{3\sqrt{6}} = \frac{24 \cdot \sqrt{6}}{3\sqrt{6} \cdot \sqrt{6}} = \frac{24\sqrt{6}}{3 \cdot 6} = \frac{24\sqrt{6}}{18} = \frac{4}{3}\sqrt{6} = 1\frac{1}{3}\sqrt{6}$
 c $\sqrt{\frac{1}{2}} = \sqrt{\frac{3}{2}} = \frac{\sqrt{3} \cdot \sqrt{2}}{\sqrt{2} \cdot \sqrt{2}} = \frac{\sqrt{6}}{2} = \frac{1}{2}\sqrt{6}$
 d $\frac{7}{\sqrt{7}} + \sqrt{\frac{1}{7}} = \frac{7 \cdot \sqrt{7}}{\sqrt{7} \cdot \sqrt{7}} + \frac{\sqrt{1} \cdot \sqrt{7}}{\sqrt{7} \cdot \sqrt{7}} = \frac{7\sqrt{7}}{7} + \frac{\sqrt{7}}{7} = \sqrt{7} + \frac{1}{7}\sqrt{7} = 1\frac{1}{7}\sqrt{7}$
 e $\sqrt{\frac{3}{5}} + \frac{1}{10}\sqrt{20} = \sqrt{\frac{16}{5}} + \frac{1}{10} \cdot \sqrt{4} \cdot \sqrt{5} = \frac{\sqrt{16} \cdot \sqrt{5}}{\sqrt{5} \cdot \sqrt{5}} + \frac{1}{10} \cdot 2\sqrt{5} = \frac{4\sqrt{5}}{5} + \frac{2}{10}\sqrt{5} = \frac{4}{5}\sqrt{5} + \frac{1}{5}\sqrt{5} = \sqrt{5}$
 f $\frac{2}{\sqrt{8}} - \sqrt{\frac{1}{2}} = \frac{2 \cdot \sqrt{8}}{\sqrt{8} \cdot \sqrt{8}} - \sqrt{\frac{9}{2}} = \frac{2\sqrt{8}}{8} - \frac{\sqrt{9} \cdot \sqrt{2}}{\sqrt{2} \cdot \sqrt{2}} = \frac{1}{4}\sqrt{8} - \frac{3\sqrt{2}}{2} = \frac{1}{4} \cdot \sqrt{4} \cdot \sqrt{2} - \frac{3}{2}\sqrt{2} = \frac{1}{4} \cdot 2\sqrt{2} - 1\frac{1}{2}\sqrt{2} = \frac{1}{2}\sqrt{2} - 1\frac{1}{2}\sqrt{2} = -\sqrt{2}$

14 a $\sqrt{x} = 25$
 $x = 625$

b $\sqrt{3x+1} = 7$
 $3x+1 = 49$
 $3x = 48$
 $x = 16$

c $2 + \sqrt{x} = 16$
 $\sqrt{x} = 14$
 $x = 196$

d $16 + \sqrt{x} = 2$
 $\sqrt{x} = -14$

geen oplossing

e $15 + \sqrt{2x+3} = 18$
 $\sqrt{2x+3} = 3$
 $2x+3 = 9$
 $2x = 6$
 $x = 3$

f $3 + 2\sqrt{0,1x-8} = 9$
 $2\sqrt{0,1x-8} = 6$
 $\sqrt{0,1x-8} = 3$
 $0,1x-8 = 9$
 $0,1x = 17$
 $x = 170$

15 a $f(a+5) = 2(a+5)^2 + 12(a+5) + 3$
 $= 2(a^2 + 10a + 25) + 12a + 60 + 3$
 $= 2a^2 + 20a + 50 + 12a + 60 + 3$
 $= 2a^2 + 32a + 113$

b $f(5a) = 2(5a)^2 + 12 \cdot 5a + 3$
 $= 2 \cdot 25a^2 + 60a + 3$
 $= 50a^2 + 60a + 3$

c $f(-2a) = 2(-2a)^2 + 12 \cdot -2a + 3$
 $= 2 \cdot 4a^2 - 24a + 3$
 $= 8a^2 - 24a + 3$

d $f(8-a) = 2(8-a)^2 + 12(8-a) + 3$
 $= 2(64 - 16a + a^2) + 96 - 12a + 3$
 $= 128 - 32a + 2a^2 + 96 - 12a + 3$
 $= 2a^2 - 44a + 227$

16 a $y_{\text{top}} = f(4p) = (4p)^2 - 8p \cdot 4p + 24p = 16p^2 - 32p^2 + 24p = -16p^2 + 24p$

b $y_{\text{top}} = 8$ geeft $-16p^2 + 24p = 8$
 $-16p^2 + 24p - 8 = 0$
 $2p^2 - 3p + 1 = 0$
 $a = 2, b = -3$ en $c = 1$, dus $D = (-3)^2 - 4 \cdot 2 \cdot 1 = 1$.

$$p = \frac{3 + \sqrt{1}}{4} \vee p = \frac{3 - \sqrt{1}}{4}$$

$$p = \frac{3+1}{4} \vee p = \frac{3-1}{4}$$

$$p = 1 \vee p = \frac{1}{2}$$

c Voor $p = 1$ en $p = \frac{1}{2}$.

17 $g(x) = -x^2 + 12px - 36p$

$$x_{\text{top}} = -\frac{12p}{2 \cdot -1} = 6p$$

$$y_{\text{top}} = g(6p) = -(6p)^2 + 12p \cdot 6p - 36p = -36p^2 + 72p^2 - 36p = 36p^2 - 36p$$

$$y_{\text{top}} = 72 \text{ geeft } 36p^2 - 36p = 72$$

$$36p^2 - 36p - 72 = 0$$

$$p^2 - p - 2 = 0$$

$$(p+1)(p-2) = 0$$

$$p = -1 \vee p = 2$$

$$x_{\text{top}} = 6p, \text{ dus } x_{\text{top}} = -6 \vee x_{\text{top}} = 12.$$