

Sinus forkurs matte oppgaver

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August 2018

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1.10

a)

$$-5 \in \mathbb{Z}$$

b)

$$-5 \notin \mathbb{N}$$

c)

$$\frac{2}{3} \notin \mathbb{Z}$$

d)

$$\frac{2}{3} \in \mathbb{Q}$$

e)

$$\sqrt{5} \in \mathbb{R}$$

f)

$$\sqrt{5} \notin \mathbb{Q}$$

1.11

$$2 \in \{1, 2, 3, 4\}$$

$$3 \notin \{0, 1, 2, 4\}$$

$$1, 5 \notin \{1, 2, 3, 4\}$$

$$-1 \notin \{-2, 1, 0, 1\}$$

1.12

$$\{0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20\}$$

$$\{21, 23, 25, 27, 29, 31, 33, 35\}$$

$$\{2, 3, 5, 7, 11, 13, 17, 19, 23, 29\}$$

1.13

$$\{1, 2, 3, 4\} \setminus \{4\} = \{1, 2, 3\}$$

$$\{1, 2, 3, 4\} \setminus \{2, 4\} = \{1, 3\}$$

$$\{1, 2, 3, 4\} \setminus \{1, 5\} = \{2, 3, 4\}$$

$$\mathbb{Z} \setminus \mathbb{N} = \{\dots, -4, -3, -2, -1, 0\}$$

1.14

a)

$$\begin{aligned} 4 * 2^2 &= 4 * 4 \\ &= 16 \end{aligned}$$

b)

$$\begin{aligned} 4 * (-2)^2 &= 4 * 4 \\ &= 16 \end{aligned}$$

c)

$$\begin{aligned} 5 - 3^2 &= 5 - 9 \\ &= -4 \end{aligned}$$

d)

$$\begin{aligned} (5 - 3)^2 &= 2^2 \\ &= 4 \end{aligned}$$

e)

$$\begin{aligned} -2^2 + 3^2 - 2 * (-2) &= -4 + 9 + 4 \\ &= 9 \end{aligned}$$

f)

$$\begin{aligned} -(-2)^2 + (-3)^2 - 2^2 &= -(4) + 9 - 4 \\ &= 1 \end{aligned}$$

g)

$$\begin{aligned} (-3)^2 + 5 * (-3) + 6 &= 9 - 15 + 6 \\ &= -5 + 6 \\ &= 1 \end{aligned}$$

Oppgave 1.15

a)

$$\begin{aligned} 2(7 - 5) + 2 &= 2 * 2 + 2 \\ &= 4 + 2 = 6 \end{aligned}$$

b)

$$\begin{aligned} -3(4 - 12) + 2 * 3^2 &= -3 * -8 + 2 * 9 \\ &= 24 + 18 = 42 \end{aligned}$$

c)

$$\begin{aligned} -(8 - 4) - (3)^2 &= -4 - 9 \\ &= -13 \end{aligned}$$

d)

$$\begin{aligned} -2^4 + 3(17 - 3^2) + (3 * 4^2 - 2 * 5^2) &= -2^4 + 3 * 8 + (3 * 4^2 - 2 * 5^2) \\ &= -2^4 + 3(17 - 3^2) - 2 \\ &= -16 + 24 - 2 \\ &= 8 - 2 \\ &= 6 \end{aligned}$$

Oppgave 1.16

a)

$$\begin{aligned} 2(2 * 2 - 2)^2 &= 2(4 - 2)^2 \\ &= 2 * 4 \\ &= 8 \end{aligned}$$

b)

$$-2^6 + (-2)^6 = -64 + 64 = 0$$

c)

$$\begin{aligned} 4(3-2)^3 - 3(2-3)^3 &= 4 * 1 - 3 * (-1) \\ &= 4 + 3 \\ &= 7 \end{aligned}$$

d)

$$\begin{aligned} 4(2^2-3)^5 - 3(2^3-3^2)^5 &= 4 * 1^5 - 3 * (-1)^5 \\ &= 4 * 1 - 3 * -1 \\ &= 4 - (-3) \\ &= 4 + 3 \\ &= 7 \end{aligned}$$

Oppgave 1.17

a)

$$\begin{aligned} 2(2 * 2 - 2)^2 &= 2(4 - 2)^2 \\ &= 2 * 4 \\ &= 8 \end{aligned}$$

b)

$$-2^6 + (-2)^6 = -64 + 64 = 0$$

c)

$$\begin{aligned} 4(3-2)^3 - 3(2-3)^3 &= 4 * 1 - 3 * (-1) \\ &= 4 + 3 \\ &= 7 \end{aligned}$$

d)

$$\begin{aligned} 4(2^2-3)^5 - 3(2^3-3^2)^5 &= 4 * 1^5 - 3 * (-1)^5 \\ &= 4 * 1 - 3 * -1 \\ &= 4 - (-3) \\ &= 4 + 3 \\ &= 7 \end{aligned}$$

Oppgave 1.20

a)

$$\begin{aligned}\frac{4}{6} &= \frac{4 : 2}{6 : 2} \\ &= \frac{2}{3}\end{aligned}$$

b)

$$\begin{aligned}\frac{9}{15} &= \frac{9 : 3}{15 : 3} \\ &= \frac{3}{5}\end{aligned}$$

c)

$$\begin{aligned}\frac{18}{21} &= \frac{18 : 3}{21 : 3} \\ &= \frac{6}{7}\end{aligned}$$

d)

$$\begin{aligned}\frac{42}{54} &= \frac{42 : 6}{54 : 6} \\ &= \frac{7}{9}\end{aligned}$$

Oppgave 1.21

a)

$$\begin{aligned}\frac{72}{120} &= \frac{72 : 8}{120 : 8} \\ &= \frac{9}{15} \\ &= \frac{9 : 3}{15 : 3} \\ &= \frac{3}{5}\end{aligned}$$

b)

$$\begin{aligned}\frac{126}{294} &= \frac{126 : 7}{294 : 7} \\ &= \frac{18 : 2}{42 : 2} \\ &= \frac{9 : 3}{21 : 3} \\ &= \frac{3}{7}\end{aligned}$$

c)

$$\begin{aligned}\frac{132}{198} &= \frac{132 : 2}{198 : 2} \\ &= \frac{66 : 3}{99 : 3} \\ &= \frac{22 : 11}{33 : 11} \\ &= \frac{2}{3}\end{aligned}$$

d)

$$\begin{aligned}\frac{153}{51} &= \frac{153 : 3}{51 : 3} \\ &= \frac{51}{17}\end{aligned}$$

exmaples

$$\begin{aligned}3 * \frac{2}{3} &= \frac{3}{1} * \frac{3}{3} - \frac{2}{3} \\ &= \frac{7}{3} = \frac{3+3+1}{3} \\ &= \frac{3}{3} + \frac{3}{3} + \frac{1}{3} \\ &= 1 + 1 + \frac{1}{3} = 2\frac{1}{3}\end{aligned}$$

1.22

$$\begin{aligned}
\frac{1}{12} + \frac{4}{9} &= \frac{9}{9} * \frac{1}{12} + \frac{4}{9} * \frac{12}{12} \\
&= \frac{9}{108} + \frac{48}{108} \\
&= \frac{57 : 3}{108 : 3} \\
&= \frac{19}{36}
\end{aligned}$$

$$\begin{aligned}
\frac{1}{12} * \frac{4}{9} &= \frac{4 : 2}{108 : 2} \\
&= \frac{2 : 2}{54 : 2} \\
&= \frac{1}{27}
\end{aligned}$$

$$\begin{aligned}
\frac{1}{12} : \frac{4}{9} &= \frac{1}{12} * \frac{9}{4} \\
&= \frac{9 : 3}{48 : 3} \\
&= \frac{3}{16}
\end{aligned}$$

$$\begin{aligned}
3 + \frac{5}{12} &= \frac{3 * 12}{1 * 12} + \frac{5}{12} \\
&= \frac{36}{12} + \frac{5}{12} \\
&= \frac{41}{12}
\end{aligned}$$

$$\begin{aligned}
3 * \frac{5}{12} &= \frac{3}{1} * \frac{5}{12} \\
&= \frac{15 : 3}{12 : 3} \\
&= \frac{5}{4}
\end{aligned}$$

$$\begin{aligned}
3 : \frac{5}{12} &= \frac{3}{1} : \frac{5}{12} \\
&= \frac{3}{1} * \frac{12}{5} \\
&= \frac{36}{5}
\end{aligned}$$

1.23

$$\begin{aligned}
 2 * \left(\frac{3}{8} + \frac{1}{4} \right) &= 2 * \left(\frac{4}{4} * \frac{3}{8} + \frac{1}{4} * \frac{8}{8} \right) \\
 &= 2 * \left(\frac{12}{32} + \frac{8}{32} \right) \\
 &= 2 * \frac{20}{32} \\
 &= \frac{2 * 20}{32} \\
 &= \frac{40 : 2}{32 : 2} \\
 &= \frac{20 : 2}{16 : 2} \\
 &= \frac{10 : 2}{8 : 2} \\
 &= \frac{5}{4}
 \end{aligned}$$

$$\begin{aligned}
 \left(\frac{5}{6} - \frac{2}{9} \right) * \frac{3}{5} &= \left(\frac{5 * 3}{6 * 3} - \frac{2 * 2}{9 * 2} \right) * \frac{3}{5} \\
 &= \left(\frac{15}{18} - \frac{4}{18} \right) * \frac{3}{5} \\
 &= \frac{11}{18} * \frac{3}{5} \\
 &= \frac{33 : 3}{90 : 3} \\
 &= \frac{11}{30}
 \end{aligned}$$

$$\begin{aligned}
 \left(\frac{5}{36} + \frac{1}{12} \right) : \frac{2}{9} &= \left(\frac{5}{36} + \frac{1 * 3}{12 * 3} \right) : \frac{2}{9} \\
 &= \left(\frac{5}{36} + \frac{3}{36} \right) : \frac{2}{9} \\
 &= \frac{8}{36} * \frac{9}{2} \\
 &= \frac{72}{72} \\
 &= 1
 \end{aligned}$$

$$\begin{aligned}
\left(\frac{7}{6} - \frac{2}{9}\right) * \left(\frac{1}{5} + \frac{1}{4}\right) &= \left(\frac{7*3}{6*3} - \frac{2*2}{9*2}\right) * \left(\frac{1*4}{5*4} + \frac{1*5}{4*5}\right) \\
&= \left(\frac{21}{18} - \frac{4}{18}\right) * \left(\frac{4}{20} + \frac{5}{20}\right) \\
&= \frac{17}{18} * \frac{9}{20} \\
&= \frac{17}{\cancel{18}_2} * \frac{\cancel{9}_1}{20} \\
&= \frac{17*1}{20*2} \\
&= \frac{17}{40}
\end{aligned}$$

1.24

a)

$$\begin{aligned}
\frac{\frac{2}{3}}{\frac{5}{6}} &= \frac{\frac{2}{3} * \frac{6}{1}}{\frac{5}{6} * \frac{6}{1}} \\
&= \frac{\frac{2}{\cancel{3}_1} * \frac{\cancel{6}_2}{1}}{\frac{5}{\cancel{6}_2} * \frac{\cancel{6}_2}{1}} \\
&= \frac{\frac{4}{1}}{\frac{10}{2}} \\
&= \frac{4}{5}
\end{aligned}$$

b)

$$\begin{aligned}
\frac{\frac{21}{36}}{\frac{14}{45}} &= \frac{21}{36} * \frac{45}{14} \\
&= \frac{\cancel{21}_3}{\cancel{36}_4} * \frac{\cancel{45}_5}{\cancel{14}_2} \\
&= \frac{3}{4} * \frac{5}{2} \\
&= \frac{15}{8}
\end{aligned}$$

c)

$$\begin{aligned}
 \frac{\frac{3}{2} + \frac{5}{8}}{\frac{1}{4} + \frac{25}{2}} &= \frac{\frac{3*8}{2*8} + \frac{5*2}{8*2}}{\frac{1*2}{4*2} + \frac{25*4}{2*4}} \\
 &= \frac{\frac{24}{16} + \frac{10}{16}}{\frac{2}{8} + \frac{100}{8}} \\
 &= \frac{\frac{34}{16}}{\frac{102}{8}} \\
 &= \frac{34}{16} * \frac{8}{102} \\
 &= \frac{\cancel{34}_1}{\cancel{16}_2} * \frac{\cancel{8}_1}{\cancel{102}_3} \\
 &= \frac{1}{2} * \frac{1}{3} \\
 &= \frac{1}{6}
 \end{aligned}$$

d)

$$\begin{aligned}
 \frac{3 + \frac{4}{3}}{\frac{5}{12} + 5} &= \frac{\frac{3*3}{1*3} + \frac{4*1}{3*1}}{\frac{5*1}{12*1} + \frac{5*12}{1*12}} \\
 &= \frac{\frac{9}{3} + \frac{4}{3}}{\frac{5}{12} + \frac{60}{12}} \\
 &= \frac{\frac{13}{3}}{\frac{65}{12}} \\
 &= \frac{13}{3} * \frac{12}{65} \\
 &= \frac{\cancel{13}_1}{\cancel{3}_1} * \frac{\cancel{12}_4}{\cancel{65}_5} \\
 &= \frac{1}{1} * \frac{4}{5} \\
 &= \frac{4}{5}
 \end{aligned}$$

1.30

a)

$$\begin{aligned}
 2x - 5y + 3x + 7y + 1 &= 2x + 3x - 5y + 7y + 1 \\
 &= 5x + 2y + 1
 \end{aligned}$$

b)

$$\begin{aligned}
 a^2 + 2a + 3 + a^2 - 3a - 1 &= a^2 + a^2 + 2a - 3a + 3 - 1 \\
 &= 2a^2 - a + 2
 \end{aligned}$$

c)

$$\begin{aligned}2x^2 + x + y^2 - 2x - 2y^2 &= 2x^2 + y^2 - 2y^2 + x - 2x \\&= 2x^2 - y^2 - x\end{aligned}$$

d)

$$\begin{aligned}2xy + xy^2 - x^2y - 2xy^2 - yx &= 2xy - yx + xy^2 - 2xy^2 - x^2y \\&= xy + xy^2 - x^2y\end{aligned}$$

1.31

a)

$$\begin{aligned}(5x + y) + (2x - y) &= 5x + y + 2x - y \\&= 7x + y - y \\&= 7x\end{aligned}$$

b)

$$\begin{aligned}a + 2b - (-a + b) &= a + 2b + a - b \\&= a + a + 2b - b \\&= 2a + b\end{aligned}$$

c)

$$\begin{aligned}(x^2 + 2x + 1) - (x^2 - 2x + 1) &= x^2 + 2x + 1 - x^2 + 2x - 1 \\&= x^2 - x^2 + 2x + 2x + 1 - 1 \\&= 4x + 1 - 1 \\&= 4x\end{aligned}$$

d)

$$\begin{aligned}2a^2 - a - 3 + (-a^2 + a + 3) &= 2a^2 - a - 3 - a^2 + a + 3 \\&= 2a^2 - a^2 - a + a - 3 + 3 \\&= a^2\end{aligned}$$

1.32

a)

$$\begin{aligned}2(x + 4) &= 2 * x + 2 * 4 \\&= 2x + 8\end{aligned}$$

b)

$$\begin{aligned}-2(t-3) &= -2 * t - (-2 * 3) \\ &= -2t + 2 * 3 \\ &= -2t + 6\end{aligned}$$

c)

$$\begin{aligned}3(2x+1) - 2(3x+1) &= 3 * 2x + 3 * 1 - 2 * 3x - 2 * 1 \\ &= 6x + 3 - 6x - 2 \\ &= 6x - 6x + 3 - 2 \\ &= 3 - 2 \\ &= 1\end{aligned}$$

d)

$$\begin{aligned}5(x^2 + 3x + 2) - 5(x^2 + 1) &= 5 * x^2 + 5 * 3x + 5 * 2 - 5 * x^2 - 5 * 1 \\ &= 5x^2 + 15x + 10 - 5x^2 - 5 \\ &= 5x^2 - 5x^2 + 15x + 10 - 5 \\ &= 15x + 10 - 5 \\ &= 15x + 5\end{aligned}$$

1.33

a)

$$\begin{aligned}2(2a-b) + 3(-2a+3b) &= 2 * 2a - 2 * b + 3 * -2a + 3 * 3b \\ &= 4a - 2b - 6a + 9b \\ &= 4a - 6a - 2b + 9b \\ &= -2a + 7b\end{aligned}$$

b)

$$\begin{aligned}2a(ab - b^2) - 2b(a^2 - ab) &= 2a * ab - 2a * b^2 - 2b * a^2 + 2b * ab \\ &= 2ba^2 - 2ab^2 - 2ba^2 + 2ab^2 \\ &= 2ba^2 - 2ba^2 + 2ab^2 - 2ab^2 \\ &= 0\end{aligned}$$

c)

$$\begin{aligned}(x+1)(2x-3) &= x * 2x + x * -3 + 1 * 2x - 3 \\ &= 2x^2 - x3 + 2x - 3 \\ &= 2x^2 - x - 3\end{aligned}$$

d)

$$\begin{aligned}5(x^2 + 3x + 2) - 5(x^2 + 1) &= 5 * x^2 + 5 * 3x + 5 * 2 - 5 * x^2 - 5 * 1 \\&= 5x^2 + 15x + 10 - 5x^2 - 5 \\&= 5x^2 - 5x^2 + 15x + 10 - 5 \\&= 15x + 10 - 5 \\&= 15x + 5\end{aligned}$$

1.34

a)

$$\begin{aligned}(2x - 1)(x + 3) + (x - 1)(x - 4) &= 2x * x + 2x * 3 - 1 * x - 1 * 3 + x * x + x * -4 - 1 * x - 1 * -4 \\&= 3x^2 - 3 + 4 \\&= 3x^2 + 1\end{aligned}$$

b)

$$\begin{aligned}2(x - 1)(2x + 3) &= 2(x * 2x + x * 3 - 1 * 2x - 1 * 3) \\&= 2(2x^2 + 3x - 2x - 3) \\&= 2(2x^2 + x - 3) \\&= 2 * 2x^2 + 2 * x + 2 * (-3) \\&= 4x^2 + 2x - 6\end{aligned}$$

c)

$$\begin{aligned}(x + 3)(4x - 1) - (2x + 1)(2x - 3) &= x * 4x + x * (-1) + 3 * 4x + 3 * (-1) - 2x * 2x - 2x * (-3) - 1 * 2x - 1 * (-3) \\&= 4x^2 - x + 12x - 3 - 4x^2 + 6x - 2x + 3 \\&= 4x^2 - 4x^2 - x + 12x + 6x - 2x - 3 + 3 \\&= 15x\end{aligned}$$

d)

$$\begin{aligned}\frac{3}{4}(t + 3)(8t - 4) &= (t + 3)(\frac{3}{4} * 8t - \frac{3}{4} * 4) \\&= (t + 3)(\frac{3 * \cancel{8} 2t}{\cancel{4}_1} - \frac{3 * \cancel{4}}{\cancel{4}}) \\&= (t + 3)(3 * 2t - 3) \\&= (t + 3)(6t - 3) \\&= (t * 6t + t * (-3)) + (3 * 6t + 3 * (-3)) \\&= 6t^2 - 3t + 18t - 9 \\&= 6t^2 + 15t - 9\end{aligned}$$

1.40

a)

$$\begin{aligned}\frac{a}{2} + \frac{a}{3} + \frac{a}{6} &= \frac{a}{2 * 3} + \frac{a}{3 * 2} + \frac{a}{6} \\ &= \frac{a}{6} + \frac{a}{6} + \frac{a}{6} \\ &= \frac{x}{y}\end{aligned}$$

b)

$$\begin{aligned}2a(ab - b^2) - 2b(a^2 - ab) &= 2ba^2 - 2ab^2 - 2ba^2 + 2ab^2 \\ &= 2ba^2 - 2ba^2 + 2ab^2 - 2ab^2 \\ &= 0\end{aligned}$$

c)

$$\begin{aligned}(x + 1)(2x - 3) &= x * 2x + x * (-3) + 1 * 2x + 1 * (-3) \\ &= 2x^2 - 3x + 2x - 3 \\ &= 2x^2 - x - 3\end{aligned}$$

d)

$$\begin{aligned}5(x^2 + 3x + 2) - 5(x^2 + 1) &= 5x^2 + 15x + 10 - 5x^2 - 5 \\ &= 15x + 10 - 5 \\ &= 15x + 5\end{aligned}$$

1.50

a)

$$\begin{aligned}3^2 &= 3 * 3 \\ &= 9\end{aligned}$$

b)

$$\begin{aligned}(-3)^2 &= (-3) * (-3) \\ &= 9\end{aligned}$$

c)

$$\begin{aligned}3^3 &= 3 * 3 * 3 \\ &= 27\end{aligned}$$

d)

$$\begin{aligned}(-3)^2 &= (-3) * (-3) \\ &= 9\end{aligned}$$

1.51*a)*

$$\begin{aligned}
 3^2 * 3^3 &= 3 * 3 * 3 * 3 * 3 \\
 &= 3^2 +^3 \\
 &= 3^5 \\
 &= 243
 \end{aligned}$$

b)

$$\begin{aligned}
 2^4 * 2^6 &= 2^4 +^6 \\
 &= 2^{10}
 \end{aligned}$$

c)

$$\begin{aligned}
 5^3 * 5 &= 5^3 +^1 \\
 &= 5^4
 \end{aligned}$$

d)

$$\begin{aligned}
 10^2 * 10^3 * 10^5 &= 10^2 +^3 +^5 \\
 &= 10^{10}
 \end{aligned}$$

e)

$$\begin{aligned}
 (2 * 10^4) * (5 * 10^3) &= 2 * 5 * 10^4 * 10^3 \\
 &= 10 * 10^4 +^3 \\
 &= 10 * 10^7 \\
 &= 10^7 +^1 \\
 &= 10^8
 \end{aligned}$$

1.52*a)*

$$\begin{aligned}
 \frac{2^4}{2^3} &= 2^{4-3} \\
 &= 2^1 \\
 &= 2
 \end{aligned}$$

b)

$$\begin{aligned}
 \frac{10^5}{10^3} &= 10^{5-3} \\
 &= 10^2 \\
 &= 100
 \end{aligned}$$

c)

$$\begin{aligned}\frac{4^3 * 4^2}{4^4} &= \frac{4^{3+2}}{4^4} \\ &= \frac{4^5}{4^4} \\ &= 4^{5-4} \\ &= 4^1 \\ &= 4\end{aligned}$$

d)

$$\begin{aligned}\frac{3^8 * 3^6}{3^5 * 3^7} &= \frac{3^{8+6}}{3^{5+7}} \\ &= \frac{3^{14}}{3^{12}} \\ &= 3^{14-12} \\ &= 3^2 \\ &= 9\end{aligned}$$

e)

$$\begin{aligned}\frac{2 * 10^5 * 6 * 10^2}{4 * 10^4} &= \frac{2 * 6 * 10^{5+2}}{4 * 10^4} \\ &= \frac{12 * 10^7}{4 * 10^4} \\ &= \frac{12 * 10^{7-4}}{4} \\ &= \frac{12 * 10^3}{4} \\ &= \frac{12 * 1000}{4} \\ &= \frac{12000}{4} \\ &= 3000\end{aligned}$$

1.53

a)

$$5^0 = \frac{1}{5}$$

b)

$$(-2)^0 = \frac{1}{-2}$$

c)

$$5^{-1} = \frac{1}{5^1}$$

d)

$$2^{-4} = \frac{1}{2^4}$$

e)

$$10^{-2} = \frac{1}{10^2}$$

f)

$$10^0 = 1$$

g)

$$10^{-4} = \frac{1}{10^4}$$

1.54

a)

$$\begin{aligned} 2^3 - 2^{-4} &= 2^3 - \frac{1}{2^4} \\ &= \frac{1 * 2^3}{2^4} \\ &= \frac{1 * 8}{16} \\ &= \frac{8}{16} \\ &= 2 \end{aligned}$$

b)

$$\begin{aligned} 3^{-4} * 3^5 &= 3^{-4+5} \\ &= 3^1 \\ &= 3 \end{aligned}$$

c)

$$\begin{aligned} \frac{3^{-2}}{3^{-3}} &= \frac{3^3}{3^2} \\ &= 3^{3-2} \\ &= 3^1 \\ &= 3 \end{aligned}$$

d)

$$\begin{aligned}\frac{2^{-3} * 2^5}{2^3 * 2^{-1}} &= \frac{2^{-3+5}}{2^{3-1}} \\ &= \frac{2^2}{2^2} \\ &= \frac{4}{4} \\ &= 1\end{aligned}$$

e)

$$\begin{aligned}\frac{a^4 * a^{-3}}{a^{-2} * a} &= \frac{a^{4-3}}{a^{-2+1}} \\ &= \frac{a^1}{a^{-1}} \\ &= a * a^1 \\ &= a^2\end{aligned}$$

1.60

a)

$$\begin{aligned}\left(\frac{1}{2}\right)^3 &= \frac{1^3}{2^3} \\ &= \frac{1}{8}\end{aligned}$$

b)

$$\begin{aligned}\left(\frac{2}{3}\right)^3 &= \frac{2^3}{3^3} \\ &= \frac{8}{27}\end{aligned}$$

c)

$$\begin{aligned}\left(\frac{1}{10}\right)^3 &= \frac{1^3}{10^3} \\ &= \frac{1}{1000}\end{aligned}$$

d)

$$\begin{aligned}\left(-\frac{2}{3}\right)^4 &= -\frac{2^4}{3^4} \\ &= -\frac{16}{81}\end{aligned}$$

e)

$$\begin{aligned}\frac{a^4 * a^{-3}}{a^{-2} * a} &= \frac{a^{4-3}}{a^{-2+1}} \\ &= \frac{a^1}{a^{-1}} \\ &= a * a^1 \\ &= a^2\end{aligned}$$

1.61

a)

$$\begin{aligned}\left(\frac{2}{3}\right)^3 * 3^3 &= \frac{2^3 * 3^3}{3^3} \\ &= \frac{8 * 27}{27} \\ &= \frac{2 * 2 * 2 * 3 * 3 * 3}{3 * 3 * 3} \\ &= \frac{2 * 2 * 2 * \cancel{3} * \cancel{3} * \cancel{3}}{\cancel{3} * \cancel{3} * \cancel{3}} \\ &= \frac{8}{1}\end{aligned}$$

b)

$$\begin{aligned}\frac{2^5}{5^2} * \left(\frac{5}{2}\right)^3 &= \frac{2^5 * 5^3}{5^2 * 2^3} \\ &= \frac{2 * 2 * 2 * 2 * 2 * 5 * 5 * 5}{5 * 5 * 2 * 2 * 2} \\ &= \frac{2 * 2 * \cancel{2} * \cancel{2} * \cancel{2} * 5 * \cancel{5} * \cancel{5}}{\cancel{5} * \cancel{5} * \cancel{2} * \cancel{2} * \cancel{2}} \\ &= \frac{4 * 5}{1} \\ &= \frac{20}{1}\end{aligned}$$

c)

$$\begin{aligned}\left(\frac{x}{2}\right)^2 &= \frac{x^2}{2^2} \\ &= \frac{x^2}{4}\end{aligned}$$

d)

$$\begin{aligned}
 3^5 * \left(\frac{x}{3}\right)^4 &= \frac{3^5 * x^4}{3^4} \\
 &= \frac{3 * \cancel{3} * \cancel{3} * \cancel{3} * \cancel{3} * x * x * x * x}{\cancel{3} * \cancel{3} * \cancel{3} * \cancel{3}} \\
 &= 3x^4
 \end{aligned}$$

1.62

a)

$$\begin{aligned}
 (5 * 10^3)^3 &= 5^3 * 10^{3*3} \\
 &= 5^3 * 10^9 \\
 &= 125 * 10^9 \\
 &= 125000000000
 \end{aligned}$$

b)

$$\begin{aligned}
 (2 * 10^2)^{-1} &= 2^{-1} * 10^{2*(-1)} \\
 &= 2^{-1} * 10^{-2} \\
 &= \frac{1}{2 * 10^2} \\
 &= \frac{1}{200} = 0.005
 \end{aligned}$$

c)

$$\begin{aligned}
 (3 * 10^{-3})^2 * (3 * 10^{-2})^{-1} &= 3^2 * 10^{-3*2} * 3^{-1} * 10^{-2*(-1)} \\
 &= 3^2 * 10^{-6} * 3^{-1} * 10^2 \\
 &= 3^{2-1} * 10^{-6+2} \\
 &= 3 * 10^{-4} \\
 &= \frac{3}{10^4} \\
 &= \frac{3}{10000} \\
 &= 0.0003
 \end{aligned}$$

d)

$$\begin{aligned}
 \frac{5 * 10^{-2} * 9 * 10^4}{3 * 10^3} &= \frac{5 * 9 * 10^{-2+4}}{3 * 10^3} \\
 &= \frac{5 * 9 * 10^2}{3 * 10^3} \\
 &= \frac{5 * \cancel{9}_3 * \cancel{100}_{10}}{\cancel{3}_3 * \cancel{1000}_{10}} \\
 &= \frac{5 * 3}{10} \\
 &= \frac{15}{10} \\
 &= 1.5
 \end{aligned}$$

1.63

a)

$$x^7$$

b)

$$\begin{aligned}
 (2 * 10^2)^{-1} &= 2^{-1} * 10^{2*(-1)} \\
 &= 2^{-1} * 10^{-2} \\
 &= \frac{1}{2 * 10^2} \\
 &= \frac{1}{200} = 0.005
 \end{aligned}$$

c)

$$\begin{aligned}
 (3 * 10^{-3})^2 * (3 * 10^{-2})^{-1} &= 3^2 * 10^{-3*2} * 3^{-1} * 10^{-2*(-1)} \\
 &= 3^2 * 10^{-6} * 3^{-1} * 10^2 \\
 &= 3^{2-1} * 10^{-6+2} \\
 &= 3 * 10^{-4} \\
 &= \frac{3}{10^4} \\
 &= \frac{3}{10000} \\
 &= 0.0003
 \end{aligned}$$

d)

$$\begin{aligned}\frac{5 * 10^{-2} * 9 * 10^4}{3 * 10^3} &= \frac{5 * 9 * 10^{-2+4}}{3 * 10^3} \\ &= \frac{5 * 9 * 10^2}{3 * 10^3} \\ &= \frac{5 * \cancel{9}_3 * \cancel{100}_{10}}{\cancel{3}_3 * \cancel{1000}_{10}} \\ &= \frac{5 * 3}{10} \\ &= \frac{15}{10} \\ &= 1.5\end{aligned}$$