

№ 91.

$$\begin{aligned} \text{a)} \quad \frac{b-6}{4-b^2} + \frac{2}{2b-b^2} &= \frac{b-6}{(2-b)(2+b)} + \frac{2}{b(2-b)} = \\ &= \frac{b(b-6) + 2(2+b)}{b(2-b)(2+b)} = \frac{b^2 - 6b + 4 + 2b}{b(2-b)(2+b)} = \\ &= \frac{(2-b)^2}{b(2-b)(2+b)} = \frac{2-b}{b(2+b)}; \end{aligned}$$

$$\begin{aligned} \text{б)} \quad \frac{b}{ab-5a^2} - \frac{15b-25a}{b^2-25a^2} &= \frac{b}{a(b-5a)} - \frac{15b-25a}{(b-5a)(b+5a)} = \\ &= \frac{b(b+5a)}{a(b-5a)(b+5a)} - \frac{a(15b-25a)}{a(b-5a)(b+5a)} = \frac{b^2 + 5ab - 15ab + 25a^2}{a(b-5a)(b+5a)} = \\ &= \frac{b^2 - 10ab + 25a^2}{a(b-5a)(b+5a)} = \frac{(b-5a)^2}{a(b-5a)(b+5a)} = \frac{b-5a}{a(b+5a)}; \end{aligned}$$

$$\begin{aligned} \text{в)} \quad \frac{x-12a}{x^2-16a^2} - \frac{4a}{4ax-x^2} &= \frac{x-12a}{(x-4a)(x+4a)} - \frac{4a}{x(4a-x)} = \\ &= \frac{x(x-12a) + 4a(x+4a)}{x(x-4a)(x+4a)} = \frac{x^2 - 12ax + 4ax + 16a^2}{x(x-4a)(x+4a)} = \frac{x^2 - 8ax + 16a^2}{x(x-4a)(x+4a)} = \\ &= \frac{(x-4a)^2}{x(x-4a)(x+4a)} = \frac{x-4a}{x(x+4a)}; \end{aligned}$$

$$\begin{aligned} \text{г)} \quad \frac{a-30y}{a^2-100y^2} - \frac{10y}{10ay-a^2} &= \frac{a-30y}{(a-10y)(a+10y)} - \frac{10y}{a(10y-a)} = \\ &= \frac{a(a-30y) + 10y(a+10y)}{a(a-10y)(a+10y)} = \frac{a^2 - 30ay + 10ay + 100y^2}{a(a-10y)(a+10y)} = \\ &= \frac{(a-10y)^2}{a(a-10y)(a+10y)} = \frac{a-10y}{a(a+10y)}. \end{aligned}$$

№ 92.

$$\begin{aligned}
 \text{a)} \quad & \frac{a+4}{a^2-2a} - \frac{a}{a^2-4} = \frac{a+4}{a(a-2)} - \frac{a}{(a-2)(a+2)} = \frac{a^2+4a+2a+8-a^2}{a(a-2)(a+2)} = \\
 & = \frac{6a+8}{a(a-2)(a+2)} = \frac{2(3a+4)}{a(a-2)(a+2)}; \\
 \text{б)} \quad & \frac{4-x^2}{16-x^2} - \frac{x+1}{x+4} = \frac{4-x^2}{(4-x)(4+x)} - \frac{x+1}{x+4} = \frac{4-x^2-(4-x)(x+1)}{(4-x)(4+x)} = \\
 & = \frac{4-x^2-4x-4+x^2+x}{(4-x)(4+x)} = \frac{-3x}{(4-x)(4+x)} = \frac{3x}{x^2-16}; \\
 \text{в)} \quad & \frac{3}{2b+1} + \frac{b+7}{1-4b^2} = \frac{3}{2b+1} + \frac{b+7}{(1-2b)(1+2b)} = \frac{3}{1+2b} + \frac{b+7}{(1-2b)(1+2b)} = \\
 & = \frac{3(1-2b)+b+7}{(1-2b)(1+2b)} = \frac{10-5b}{(1-2b)(1+2b)} = \frac{5(2-b)}{1-4b^2}; \\
 \text{г)} \quad & \frac{5b}{4a-5} + \frac{16ab+30b}{25-16a^2} = \frac{5b}{4a-5} + \frac{16ab+30b}{(5-4a)(5+4a)} = \\
 & = \frac{5b}{4a-5} - \frac{16ab+30b}{(4a-5)(4a+5)} = \frac{20ab+25b-16ab-30b}{(4a-5)(4a+5)} = \\
 & = \frac{b(4a-5)}{(4a-5)(4a+5)} = \frac{b}{4a+5}; \\
 \text{д)} \quad & \frac{(a+b)^2}{a^2ab} + \frac{(a-b)^2}{a^2-ab} = \frac{(a+b)^2}{a(a+b)} + \frac{(a-b)^2}{a(a-b)} = \frac{a+b}{a} + \frac{a-b}{a} = \\
 & = 1 + \frac{b}{a} + 1 - \frac{b}{a} = 2; \\
 \text{е)} \quad & \frac{x^2-4}{5x-10} - \frac{x^2+4x+4}{5x+10} = \frac{x^2-4}{5(x-2)} - \frac{x^2+4x+4}{5(x+2)} = \\
 & = \frac{(x-2)(x+2)}{5(x-2)} - \frac{(x+2)^2}{5(x+2)} = \frac{x+2}{5} - \frac{x+2}{5} = 0.
 \end{aligned}$$

№ 93.

$$\begin{aligned}
 \text{а)} \quad & \frac{x+1}{x^2-x} - \frac{x+2}{x^2-1} = \frac{x+1}{x(x-1)} - \frac{x-2}{(x-1)(x+1)} = \frac{(x+1)(x+1)-x(x+2)}{x(x-1)(x+1)} = \\
 & = \frac{x^2+2x+1-x^2-2x}{x(x-1)(x+1)} = \frac{1}{x(x^2-1)};
 \end{aligned}$$

подставим $x = -1,5$: $\frac{1}{x(x^2-1)} = \frac{1}{(-1,5)[(-1,5)^2-1]} = \frac{1}{(-1,5)1,25} =$
 $= \frac{1}{-1\frac{1}{2} \cdot 1\frac{1}{4}} = -\frac{1}{\frac{3 \cdot 5}{2 \cdot 4}} = -\frac{8}{15}.$

Ответ: $-\frac{8}{15}.$

б) $\frac{x+2}{x^2+3x} - \frac{1-x}{x^2-9} = \frac{x+2}{x(x+3)} - \frac{1+x}{(x-3)(x+3)} =$
 $= \frac{(x-3)(x+2) - x(1+x)}{x(x-3)(x+3)} = \frac{x^2+2x-3x-6-x-x^2}{x(x-3)(x+3)} =$

подставим $x = -1,5$: $\frac{2}{x(3-x)} = \frac{2}{-1,5[3-(-1,5)]} = \frac{2}{-1,5 \cdot 4,5} = -\frac{2}{\frac{3}{2} \cdot \frac{9}{2}} =$
 $= -\frac{8}{27}.$

Ответ: $-\frac{8}{27}.$

№ 94.

а) $\frac{a^2+b^2}{a^3+b^3} - \frac{1}{a+b} = \frac{a^2+b^2}{(a+b)(a^2-ab+b^2)} - \frac{1}{a+b} = \frac{ab}{a^3+b^3};$

б) $\frac{1}{p-q} - \frac{3pq}{p^3-q^3} = \frac{1}{p-q} - \frac{3pq}{(p-q)(p^2+pq+q^2)} =$
 $= \frac{p^2-2pq+q^2}{(p-q)(p^2+pq+q^2)} = \frac{(p-q)^2}{(p-q)(p^2+pq+q^2)} = \frac{p-q}{p^2+pq+q^2};$

в) $\frac{1-a}{a^2-a+1} + \frac{a^2}{a^3+1} = \frac{1-a}{a^2-a+1} + \frac{a^2}{(a+1)(a^2-a+1)} = \frac{(1+a)(1-a)+a^2}{(a+1)(a^2-a+1)} =$
 $= \frac{1}{a^3+1};$

г) $\frac{6a^3+48a}{a^3+64} - \frac{3a^2}{a^2-4a+16} = \frac{6a^3+48a}{(a+4)(a^2-4a+16)} - \frac{3a^2}{a^2-4a+16} =$

$$\begin{aligned}
&= \frac{6a^3 + 48a - 3a^2(a+4)}{(a+4)(a^2 - 4a + 16)} = \frac{6a^3 + 48a - 3a^3 - 12a^2}{(a+4)(a^2 - 4a + 16)} = \frac{3a(a^2 - 4a + 16)}{(a+4)(a^2 - 4a + 16)} = \\
&= \frac{3a}{a+4}.
\end{aligned}$$

№ 95.

$$\begin{aligned}
\text{a)} \quad & \frac{4}{y+2} - \frac{3}{y-2} + \frac{12}{y^2+4} = \frac{4(y-2) - 3(y+2) + 12}{(y+2)(y-2)} = \frac{y-2}{(y-2)(y+2)} = \\
&= \frac{1}{y+2};
\end{aligned}$$

$$\begin{aligned}
\text{б)} \quad & \frac{a}{a-6} - \frac{3}{a+6} - \frac{a^2}{36-a^2} = \frac{a}{a-6} - \frac{3}{a+6} - \frac{a^2}{(a-6)(a+6)} = \\
&= \frac{a(a+6) - 3(a-6) - a^2}{(a-6)(a+6)} = \frac{a^2 + 6a - 3a + 18 - a^2}{(a-6)(a+6)} = \frac{18+3a}{(a-6)(a+6)} = \frac{3}{a-6};
\end{aligned}$$

$$\begin{aligned}
\text{в)} \quad & \frac{x^2}{(x-y)^2} - \frac{x+y}{2x-2y} = \frac{x^2}{(x-y)^2} - \frac{x+y}{2(x-y)} = \frac{2x^2 - (x+y)(x-y)}{2(x-y)^2} = \\
&= \frac{2x^2 - x^2 + y^2}{2(x-y)^2} = \frac{x^2 + y^2}{2(x-y)^2};
\end{aligned}$$

$$\text{г)} \quad \frac{b}{(a-b)^2} - \frac{a+b}{b^2-ab} = \frac{b^2 - (b-a)(b+a)}{b(b-a)^2} = \frac{b^2 - b^2 + a^2}{b(b-a)^2} = \frac{a^2}{b(b-a)^2}.$$

№ 96.

$$\begin{aligned}
\text{a)} \quad & \frac{2a+b}{2a^2-ab} - \frac{16a}{4a^2-b^2} - \frac{2a-b}{2a^2+ab} = \frac{2a+b}{a(2a-b)} - \frac{16a}{(2a-b)(2a+b)} - \\
&- \frac{2a-b}{a(2a+b)} = \frac{(2a+b)^2 - 16a^2 - (2a-b)^2}{a(2a+b)(2a-b)} = \frac{2b \cdot 4a - 16a^2}{a(2a+b)(2a-b)} = \\
&= \frac{8ab - 16a^2}{a(2a-b)(2a+b)} = -\frac{8a(2a-b)}{a(2a-b)(2a+b)} = -\frac{8}{2a+b};
\end{aligned}$$

$$\begin{aligned}
\text{б)} \quad & \frac{1}{(a-3)^2} - \frac{2}{a^2-9} + \frac{1}{(a+3)^2} = \frac{1}{(a-3)^2} - \frac{2}{(a-3)(a+3)} + \frac{1}{(a+3)^2} = \\
&= \frac{a^2 + 6a + 9 - 2(a-3)(a+3) + a^2 - 6a + 9}{(a-3)^2(a+3)^2} = \frac{2a^2 + 18 - 2a^2 + 18}{(a-3)^2(a+3)^2} =
\end{aligned}$$

$$= \frac{36}{(a-3)^2(a+3)^2};$$

$$\begin{aligned} \text{B)} \quad & \frac{x-2}{x^2+2x+4} - \frac{6x}{x^3-8} + \frac{1}{x-2} = \frac{x-2}{x^2+2x+4} - \frac{1}{(x-2)(x^2+2x+4)} + \\ & + \frac{1}{x-2} = \frac{(x-2)(x-2) - 6x + x^2 + 2x + 4}{(x-2)(x^2+2x+4)} = \frac{2x^2 - 8x + 8}{(x-2)(x^2+2x+4)} = \\ & = \frac{2(x-2)^2}{(x-2)(x^2+2x+4)} = \frac{2(x-2)}{x^2+2x+4}; \end{aligned}$$

$$\begin{aligned} \text{r)} \quad & \frac{2a^2+7a+3}{a^3-1} - \frac{1-2a}{a^2+a+1} - \frac{3}{a-1} = \\ & = \frac{2a^2+7a+3 - (a-1)(1-2a) - 3(a^2+a+1)}{(a-1)(a^2+a+1)} = \\ & = \frac{2a^2+7a+3 - a + 2a^2 + 1 - 2a - 3a^2 - 3a - 3}{(a-1)(a^2+a+1)} = \frac{a^2+a+1}{(a-1)(a^2+a+1)} = \\ & = \frac{1}{a-1}. \end{aligned}$$

№ 97.

$$\begin{aligned} \text{a)} \quad & \frac{1}{a-4b} - \frac{1}{a+4b} - \frac{2a}{16b^2-a^2} = \frac{1}{a-4b} - \frac{1}{a+4b} + \frac{2a}{(a-4b)(a+4b)} = \\ & = \frac{a+4b - a + 4b + 2a}{(a-4b)(a+4b)} = \frac{8b+2a}{(a-4b)(a+4b)} = \frac{2}{a-4b}; \end{aligned}$$

$$\begin{aligned} \text{б)} \quad & \frac{1}{2b-2a} + \frac{1}{2b+2a} + \frac{a^2}{a^2b-b^3} = \frac{1}{2(b-a)} + \frac{1}{2(b+a)} + \frac{a^2}{b(a^2-b^2)} = \\ & = \frac{b(b+a) + b(b-a) - 2a^2}{2b(b-a)(b+a)} = \frac{b^2 + ab + b^2 - ab - 2a^2}{2b(b-a)(b+a)} = \frac{2(b^2 - a^2)}{2b(b-a)(b+a)} = \\ & = \frac{2(b-a)(b+a)}{2b(b-a)(b+a)} = \frac{1}{b}; \end{aligned}$$

$$\begin{aligned} \text{B)} \quad & \frac{1}{2x-b} + \frac{6bx}{b^3-8x^3} = \frac{6bx}{(b-2x)(b^2+2bx+4x^2)} + \frac{1}{2x-b} = \\ & = \frac{b^2+2bx+4x^2-6bx}{(2x-b)(b^2+2bx+4x^2)} = \frac{b^2-4bx+4x^2}{(2x-b)(b^2+2bx+4x^2)} = \end{aligned}$$

$$= \frac{(2x-b)^2}{(2x-b)(b^2+2bx+4x^2)} = \frac{2x-b}{b^2+2bx+4x^2};$$

$$\text{г) } \frac{2y^2+16}{y^3+8} - \frac{2}{y+2} = \frac{2y^2+16}{(y+2)(y^2-2y+4)} - \frac{2}{y+2} =$$

$$= \frac{2y^2+16-2(y^2-2y+4)}{(y+2)(y^2-2y+4)} = \frac{4y+8}{(y+2)(y^2-2y+4)} = \frac{4}{y^2-2y+4}.$$

№ 98.

$$\text{а) } \frac{3}{a^2-3a} + \frac{a^2}{a-3} = \frac{3}{a(a-3)} + \frac{a^2}{a-3} = \frac{3+a^3}{a(a-3)};$$

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

$$= \frac{a^3-9a+9a+3}{a(a-3)} = \frac{a^3+3}{a(a-3)}; \text{ т.е. выражения тождественно равны.}$$

$$\text{б) } \frac{a^3}{a^2-4} - \frac{a}{a-2} - \frac{2}{a+2} = \frac{a^3-a(a+2)-2(a-2)}{a^2-4} = \frac{a^3-a^2-4a+4}{a^2-4} =$$

$$= \frac{(a-1)(a^2-4)}{a^2-4} = a-1. \text{ т.е. выражения тождественно равны.}$$

№ 99.

$$\text{а) } \frac{x^3+3x}{x+2} - \frac{3x^2-14x+16}{x^2-4} + 2x = \frac{x^3+3x}{x+2} - \frac{3x^2-14x+16}{(x-2)(x+2)} + 2x =$$

$$= \frac{(x^3+3x)(x-2) - (3x^2-14x+16) + 2x(x^2-4)}{(x+2)(x-2)} =$$

$$= \frac{x^4-2x^3+3x^2-6x-3x^2+14x-16+2x^3-8x}{(x+2)(x-2)} = \frac{x^4-16}{x^2-4} =$$

$$= x^2+4 > 0 \text{ при всех значениях } x;$$

$$\text{б) } y + \frac{2y^2+3y+1}{y^2-1} - \frac{y^3+2y}{y-1} = \frac{y}{1} + \frac{2y^2+3y+1}{(y-1)(y+1)} - \frac{y^3+2y}{y-1} =$$

$$= \frac{y(y-1)(y+1) + 2y^2+3y+1 - (y+1)(y^3+2y)}{(y-1)(y+1)} =$$

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

$$= -\frac{(1-y^2)(1+y^2)}{1-y^2} = -(1+y^2) < 0 \text{ при всех значениях } y.$$

№ 100.

Исходя из условия задачи получаем, что скорость катера по течению реки $(v+5)$ км/ч, против течения $(v-5)$ км/ч; получаем что

$\left(\frac{s}{v+5}\right)$ ч – время в пути от А до В; $\left(\frac{s}{v-5}\right)$ ч – время в пути от В до

А; тогда $\left(\frac{s}{v+5} + \frac{s}{v-5}\right)$ ч – общее время в пути от А до В и обрат-

но. Получаем выражение:

$$\frac{s}{v+5} + \frac{s}{v-5} = \frac{s(v-5) + s(v+5)}{(v+5)(v-5)} = \frac{sv - 5s + sv + 5s}{(v-5)(v+5)} = \frac{2sv}{v^2 - 25}.$$

Подставим $s=50$, $v=25$:

$$\text{а) } t = \frac{2sv}{v^2 - 25} = \frac{2 \cdot 50 \cdot 25}{25^2 - 25} = \frac{2500}{625 - 25} = \frac{2500}{600} = \frac{25}{6} = 4\frac{1}{6} \text{ (ч)} = 4 \text{ ч } 10 \text{ мин};$$

Ответ: 4 ч 10 мин;

Подставим $s=105$, $v=40$:

$$\text{б) } t = \frac{2sv}{v^2 - 25} = \frac{2 \cdot 105 \cdot 40}{40^2 - 25} = \frac{8400}{1600 - 25} = \frac{8400}{1575} = 5\frac{1}{3} \text{ (ч)} = 5 \text{ ч } 20 \text{ мин};$$

Ответ: 5 ч 20 мин.

№ 101.

$s = vt$; $t = \frac{s}{v}$. Для удобства представим данные задачи в виде таб-

лицы:

	Путь, км	Скорость, км/ч	Время, ч
По шоссе	s	v	$\frac{s}{v}$
По проселочной дороге	$2s$	$v-2$	$\frac{2s}{v-2}$

$$t_{\text{общ}} = \frac{s}{v} + \frac{2s}{v-2} = \frac{s(v-2) + 2sv}{v(v-2)} = \frac{sv - 2s + 2sv}{v(v-2)} = \frac{3sv - 2s}{v(v-2)} = \frac{s(3v-2)}{v-(v-2)};$$

если $s = 10$, $v = 6$, то

$$\frac{s(3v-2)}{v(v-2)} = \frac{10(3 \cdot 6 - 2)}{6(6-2)} = \frac{10 \cdot 16}{6 \cdot 4} = \frac{10 \cdot 2}{3} = \frac{20}{3} = 6 \frac{2}{3} \text{ (ч)} = 6 \text{ ч } 40 \text{ мин.}$$

УПРАЖНЕНИЯ ДЛЯ ПОВТОРЕНИЯ

№ 102.

$$\frac{2x^2 + x - 1}{4x^2 - 3x + 2} = \frac{(2x^2 + 2x) - (x + 1)}{4x^2 - 3x + 2} = \frac{2x(x+1) - (x+1)}{4x^2 - 3x + 2} = \frac{(x+1)(2x-1)}{4x^2 - 3x + 2},$$

а) при $x = \frac{1}{2}$ числитель, а значит и вся дробь обращается в ноль;

б) при $x = -1$ числитель, а значит и вся дробь обращается в ноль.

Ответ: а) 0; б) 0.

№ 103.

I. $y = \frac{2x-5}{3};$

1) при $x = -2$; $y = \frac{2 \cdot (-2) - 5}{3} = \frac{-4 - 5}{3} = -\frac{9}{3} = -3;$

2) при $x = 0$; $y = \frac{2 \cdot 0 - 5}{3} = -\frac{5}{3} = -1 \frac{2}{3};$

3) при $x = 16$; $y = \frac{2 \cdot 16 - 5}{3} = \frac{32 - 5}{3} = \frac{27}{3} = 9;$

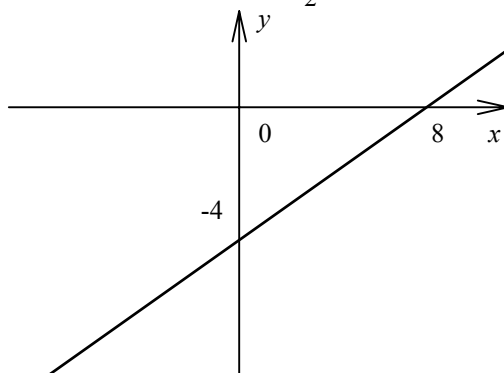
II. 1) подставим $y = 3$; $3 = \frac{2x-5}{3}$; $3 \cdot 3 = 2x-5$; $2x = 14$; $x = 7$;

2) подставим $y = 0$; $0 = \frac{2x-5}{3}$; $2x-5 = 0$; $x = \frac{5}{2}$; $x = 2,5$;

3) подставим $y = -9$; $-9 = \frac{2x-5}{3}$; $2x-5 = -27$; $2x = -22$; $x = -11$.

№ 104.

На рисунке – график функции $y = \frac{1}{2}x - 4$.

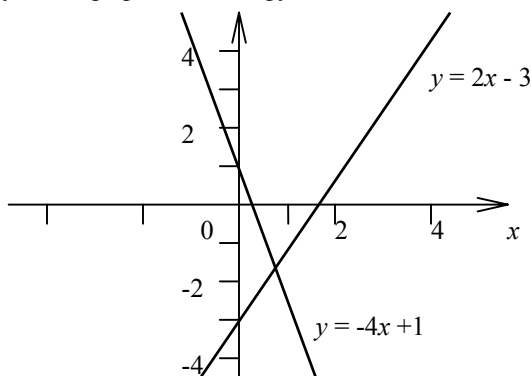


а) При $x = 6, y = -1$; при $x = -6, y = -7$;

б) при $y = -2, x = 4$; при $y = 0, x = 8$.

№ 105.

На рисунке – график данных функций.



Пусть А – их точка пересечения.

1) Из рисунка видно, что $A \approx (0,7; -1,7)$.

2) Найдем координаты точки А из уравнения:

$$-4x + 1 = 2x - 3; 2x - 3 + 4x - 1 = 0; 6x - 4 = 0; 6x = 4; x = \frac{4}{6} = \frac{2}{3};$$

$$y = 2 \cdot \frac{2}{3} - 3 = \frac{4}{3} - 3 = -1\frac{2}{3}.$$

Окончательно: $A(\frac{2}{3}; -1\frac{2}{3})$.

№ 106.

Для удобства запишем данные задачи в виде таблицы:

Ямы	Заложили, т	Взяли, т	Осталось, т
I	90	$3x$	$90-3x$
II	75	x	$75-x$

Исходя из того, что в первой яме осталось силоса в 2 раза меньше, чем во второй, запишем уравнение: $2(90-3x)=75-x$;
 $75-x+6x-180=0$; $5x=105$; $x=21$, $3x=63$.

Ответ. Из первой ямы взяли 63 т силоса.

№ 107.

Пусть дана формула:

а) $v = \frac{s}{t}$, тогда $s = vt$; $t = \frac{s}{v}$.

Пусть дана формула:

б) $p = \frac{m}{v}$, тогда $v = \frac{m}{p}$.

§ 3. Произведение и частное дробей

5. Умножение дробей. Возведение дроби в степень

№ 108.

а) $\frac{5}{3a} \cdot \frac{2b}{3} = \frac{10b}{9a}$;

б) $\frac{5a}{8y} \cdot \frac{7}{10} = \frac{5a \cdot 7}{8y \cdot 10} = \frac{7a}{16y}$;

в) $\frac{3x}{4} \cdot \frac{1}{x} = \frac{3x \cdot 1}{4x} = \frac{3}{4}$;

$$\begin{aligned}\text{г)} \quad & \frac{9}{2a} \cdot \frac{5a}{3} = \frac{9 \cdot 5a}{2a \cdot 3} = \frac{15}{2} = 7,5; \\ \text{д)} \quad & \frac{b^2}{10} \cdot \frac{5}{b} = \frac{5b^2}{10b} = \frac{b}{2}; \\ \text{е)} \quad & \frac{18}{c^4} \cdot \frac{c^3}{24} = \frac{18c^3}{24c^4} = \frac{3}{4c}; \\ \text{ж)} \quad & \frac{12x^5}{25} \cdot \frac{15}{8x^2} = \frac{12x^5 \cdot 15}{25 \cdot 8x^2} = \frac{9x^3}{10} = 0,9x^3; \\ \text{з)} \quad & \frac{3}{4a^3} \cdot \frac{16a^2}{9} = \frac{3 \cdot 16a^2}{4a^3 \cdot 9} = \frac{4}{3a}.\end{aligned}$$

№ 109.

$$\begin{aligned}\text{а)} \quad & \frac{3x}{4y} \cdot \frac{10}{3x^2} = \frac{10 \cdot 3x}{4y \cdot 3x^2} = \frac{5}{2xy} = \frac{2,5}{xy}; \\ \text{б)} \quad & \frac{2,5}{2a^2} \cdot \frac{4a^3}{5b^2} = \frac{2 \cdot \frac{1}{2} \cdot 4a^3}{2a^2 \cdot 5b^2} = \frac{\frac{5 \cdot 4}{2 \cdot 1} a^3}{2a^2 \cdot 5b^2} = \frac{10a^3}{10a^2b^2} = \frac{a}{b^2}; \\ \text{в)} \quad & \frac{m^2}{16} \cdot \frac{24}{mn} = \frac{24m^2}{16mn} = \frac{3m}{16mn} = \frac{3m}{2n} = \frac{1,5m}{n}; \\ \text{г)} \quad & \frac{1}{9x^3} \cdot \frac{3x}{2a^2} = \frac{3x}{9x^3 \cdot 2a^2} = \frac{1}{3x^2 \cdot 2a^2} = \frac{1}{6a^2x^2}; \\ \text{д)} \quad & \frac{7a^3}{24b} \cdot 8b^2 = \frac{7a^3 \cdot 8b^2}{24b \cdot 1} = \frac{7}{3} a^3 b; \\ \text{е)} \quad & 14ab \cdot \frac{1}{21b^3} = \frac{14ab}{21b^3} = \frac{2a}{3b^2} = \frac{2}{3} \frac{a}{b^2}.\end{aligned}$$

№ 110.

$$\begin{aligned}\text{а)} \quad & \frac{12}{5x} \cdot \frac{x^3}{12a} = \frac{12x^3}{5x \cdot 12a} = \frac{x^2}{5a}; \\ \text{б)} \quad & \frac{8c^2}{15m} \cdot \frac{1}{4c^2} = \frac{8c^2}{15m \cdot 4c^2} = \frac{2}{15m}; \\ \text{в)} \quad & \frac{11a^4}{6} \cdot \frac{12b}{a^5} = \frac{11a^4 \cdot 12b}{6 \cdot a^5} = \frac{22b}{a}; \\ \text{г)} \quad & \frac{4n^2}{3m^2} \cdot \frac{9m}{2} = \frac{4n^2 \cdot 9m}{3m^2 \cdot 2} = \frac{6n^2}{m}.\end{aligned}$$

№ 111.

$$\text{a)} \quad 15x^2 \cdot \frac{7}{6x^3} = \frac{15x^2 \cdot 7}{6x^3} = \frac{35}{2x} = \frac{17,5}{x};$$

$$\text{б)} \quad \frac{25}{16y^2} \cdot 2y^3 = \frac{25 \cdot 2y^3}{16y^2} = \frac{25}{8}y;$$

$$\text{в)} \quad 6am^2 \cdot \frac{4a}{3m^3} = \frac{6am^2 \cdot 4a}{3m^3} = \frac{8a^2}{m};$$

$$\text{г)} \quad \frac{2b}{5a^3} \cdot 10a^2 = \frac{2b \cdot 10a^2}{5a^3} = \frac{4b}{a}.$$

№ 112.

$$\text{a)} \quad \frac{48x^5}{49y^4} \cdot \frac{7y^2}{16x^3} = \frac{48x^5 \cdot 7y^2}{49y^4 \cdot 16x^3} = \frac{3x^2}{7y^2};$$

$$\text{б)} \quad \frac{18m^3}{11n^3} \cdot \frac{22n^4}{9m^2} = \frac{18m^3 \cdot 22n^4}{11n^3 \cdot 9m^2} = 4mn;$$

$$\text{в)} \quad -\frac{15p^4}{8q^6} \cdot \frac{16q^5}{25p^3} = \frac{15p^4 \cdot 16q^5}{8q^6 \cdot 25p^3} = -\frac{6p}{5q};$$

$$\text{г)} \quad \frac{72x^4}{25y^5} \cdot \left(-\frac{2,5y^4}{27x^5} \right) = -\frac{72x^4 \cdot 2,5y^4}{25y^5 \cdot 27x^5} = -\frac{8 \cdot 25y^4}{3x \cdot 250y^5} = -\frac{8}{30xy} = -\frac{4}{15xy};$$

$$\text{д)} \quad -\frac{35ax^2}{12b^2y} \cdot \frac{8ab}{21xy} = \frac{35ax^2 \cdot 8ab}{12b^2y \cdot 21xy} = -\frac{10a^2x}{9by^2};$$

$$\text{е)} \quad -\frac{25x^3y^3}{14a^2b} \cdot \left(-\frac{21ab}{10x^2y^2} \right) = \frac{25x^3y^3 \cdot 21ab}{14a^2b \cdot 10x^2y^2} = \frac{15xy}{4a}.$$

№ 113.

$$\text{a)} \quad \frac{14a^2b}{3x^3} \cdot \frac{8x^2}{21a^2b} = \frac{14a^2b \cdot 8x^2}{3x^3 \cdot 21a^2b} = \frac{16}{9x};$$

$$\text{б)} \quad \frac{9a^2}{25x^2y} \cdot \frac{5ax}{6y} = \frac{9a^2 \cdot 5ax}{25x^2y \cdot 6y} = \frac{3a^3}{10xy^2};$$

$$\text{в)} \quad -\frac{10x^2y^2}{9a^2} \cdot \frac{27a^3}{5xy} = -\frac{6a^3x^2y^2}{a^2xy} = -6axy;$$

$$\text{г)} \frac{2m^3}{35a^3b^2} \cdot \left(-\frac{7a^2b}{6m^3} \right) = -\frac{2m^3 \cdot 7a^2b}{35a^3b^2 \cdot 6m^3} = -\frac{1}{15ab};$$

$$\text{д)} \frac{13x}{12mn^2} \cdot 4m^2n = \frac{13x \cdot 4m^2n}{12mn^2} = \frac{13mx}{3n};$$

$$\text{е)} -ab \cdot \left(-\frac{11x^2}{3a^2b^2} \right) = \frac{11abx^2}{3a^2b^2} = \frac{11x^2}{3ab}.$$

№ 114.

$$\text{а)} \frac{2a^2b}{3xy} \cdot \frac{3x^2y}{4ab^2} \cdot \frac{6ax}{15b^2} = \frac{2a^2b \cdot 3x^2y \cdot 6ax}{3xy \cdot 4ab^2 \cdot 15b^2} = \frac{a^2x^2}{5b^3};$$

$$\text{б)} \frac{6m^3n^2}{35p^3} \cdot \frac{49n^4}{m^5p^3} \cdot \frac{5m^4p^2}{42n^6} = \frac{6 \cdot 49 \cdot 5m^3m^4n^2n^4p^2}{35 \cdot 42m^5n^6p^3p^3} = \frac{m^2}{p^4}.$$

№ 115.

$$\text{а)} \left(\frac{x}{2y} \right)^3 = \frac{x^3}{8y^3};$$

$$\text{б)} \left(\frac{3a}{c} \right)^4 = \frac{81a^4}{c^4};$$

$$\text{в)} \left(\frac{n^2}{10m} \right)^3 = \frac{n^6}{1000m^3};$$

$$\text{г)} \left(\frac{9a^3}{2b^2} \right)^2 = \frac{81a^6}{4b^4}.$$

№ 116.

$$\text{а)} \left(\frac{2a}{p^2q^3} \right)^4 = \frac{2^4a^4}{p^8q^{12}} = \frac{16a^4}{p^8q^{12}};$$

$$\text{б)} \left(\frac{3a^2b^3}{s^4} \right)^2 = \frac{9a^4b^6}{s^8};$$

$$\text{в)} \left(-\frac{2a^2b}{3mn^3} \right)^2 = \frac{4a^4b^2}{9m^2n^6};$$

$$\text{г)} \left(-\frac{3x^2}{2y^3} \right)^3 = -\frac{27x^6}{8y^9};$$

№ 117.

$$\text{а)} \left(\frac{x^3}{y^2} \right)^2 = \frac{x^6}{y^4};$$

$$\text{б)} \left(\frac{2a^2}{b^3} \right)^3 = \frac{8a^6}{b^9};$$

$$\text{в)} \left(\frac{5a^3}{3b^2} \right)^4 = \frac{625a^{12}}{81b^8};$$

$$\text{г)} \left(\frac{2x^2}{3y^3} \right)^5 = \frac{32x^{10}}{243y^{15}};$$

$$\text{д)} \left(\frac{x^2y^4}{4m^3} \right)^5 = \frac{x^{10}y^{20}}{1024m^{15}};$$

$$\text{е)} \left(\frac{3a^2}{b^2c} \right)^4 = \frac{81a^8}{b^8c^4};$$

$$\text{ж)} \left(-\frac{10m^2}{n^2p} \right)^3 = -\frac{1000m^6}{n^6p^3};$$

$$\text{з)} \left(-\frac{b^3c^2}{8a^3} \right)^2 = \frac{b^6c^4}{64a^6}.$$

№ 118.

$$\text{а)} \frac{x^2 - xy}{y} \cdot \frac{y^2}{x} = \frac{x(x-y)y^2}{yx} = (x-y)y;$$

$$\begin{aligned}
\text{б)} \quad & \frac{3a}{b^2} \cdot \frac{ab+b^2}{9} = \frac{3ab(a+b)}{9b^2} = \frac{(a+b)a}{3b}; \\
\text{в)} \quad & \frac{m-n}{mn} \cdot \frac{2mn}{mn-m^2} = \frac{(m-n)2mn}{m(n-m)mn} = -\frac{2}{m}; \\
\text{г)} \quad & \frac{4ab}{cx+dx} \cdot \frac{ax+bx}{2ab} = \frac{4abx(a+b)}{2abx(c+d)} = \frac{2(a+b)}{c+d}; \\
\text{д)} \quad & \frac{ma-mb}{3n^2} \cdot \frac{2m}{nb-na} = \frac{(ma-mb)2m}{(nb-na)3n^2} = \frac{2m \cdot m(a-b)}{3n^2 n(b-a)} = -\frac{2m^2}{3n^3}; \\
\text{е)} \quad & \frac{ax-ay}{5x^2y^2} \cdot \left(-\frac{5xy}{by-bx} \right) = -\frac{5xy(ax-ay)}{5x^2y^2(by-bx)} = -\frac{a(x-y)}{xyb(y-x)} = \\
& = \frac{a(x-y)}{bxy(x-y)} = \frac{a}{bxy}.
\end{aligned}$$

№ 119.

$$\begin{aligned}
\text{а)} \quad & (3a-15b) \cdot \frac{8}{a^2-25b^2} = \frac{8 \cdot 3(a-5b)}{(a-5b)(a+5b)} = \frac{24}{a+5b}; \\
\text{б)} \quad & (x^2-4) \cdot \frac{2x}{(x+2)^2} = \frac{2x(x-2)(x+2)}{(x+2)^2} = \frac{2x(x-2)}{x+2}; \\
\text{в)} \quad & \frac{y}{3y^2-12} \cdot (y^2-4y+4) = \frac{y(y-2)^2}{3(y^2-4)} = \frac{y(y-2)^2}{3(y-2)(y+2)} = \frac{y(y-2)}{3(y+2)}; \\
\text{г)} \quad & \frac{2ab}{a^2-6ab+9b^2} (a^2-9b^2) = \frac{2ab(a-3b)(a+3b)}{(a-3b)^2} = \frac{2ab(a+3b)}{a-3b}.
\end{aligned}$$

№ 120.

$$\begin{aligned}
\text{а)} \quad & \frac{kx+k^2}{x^2} \cdot \frac{x}{x+k} = \frac{xk(x+k)}{x^2(x+k)} = \frac{k}{x}; \\
\text{б)} \quad & \frac{ax+ay}{xy^2} \cdot \frac{x^2y}{3x+3y} = \frac{ax(x+y)}{3y(x+y)} = \frac{ax}{3y}; \\
\text{в)} \quad & \frac{xy}{a^2+a^3} \cdot \frac{a+a^2}{x^2y^2} = \frac{xy(a+a^2)}{x^2y^2(a^2+a^3)} = \frac{a(1+a)}{a^2xy(1+a)} = \frac{1}{axy}; \\
\text{г)} \quad & \frac{6a}{x^2-x} \cdot \frac{2x-2}{3ax} = \frac{6a \cdot (2x-2)}{3ax(x^2-x)} = \frac{2 \cdot 6(x-1)}{3x^2(x-1)} = \frac{4}{x^2}.
\end{aligned}$$

№ 121.

$$\text{a)} \frac{x^2 - y^2}{2xy} \cdot \frac{2x}{x + y} = \frac{2x(x^2 - y^2)}{2xy(x + y)} = \frac{2x(x - y)(x + y)}{2xy(x + y)} = \frac{x - y}{y};$$

$$\text{б)} \frac{4x^2}{x^2 - 9} \cdot \frac{3a - ax}{4x} = \frac{4x^2(3a - ax)}{4x(x^2 - 9)} = \frac{ax(3 - x)}{(x - 3)(x + 3)} = -\frac{ax}{x + 3};$$

$$\begin{aligned} \text{в)} \frac{y^2 - 16}{10xy} \cdot \frac{5y}{3y + 12} &= \frac{5y(y^2 - 16)}{10xy(3y + 12)} = \frac{5y(y - 4)(y + 4)}{10xy(3y + 12)} = \frac{(y - 4)(y + 4)}{2 \cdot 3x(y + 4)} = \\ &= \frac{y - 4}{6x}; \end{aligned}$$

$$\text{г)} \frac{b - a}{a} \cdot \frac{3ab}{a^2 - b^2} = \frac{3ab(b - a)}{a(a - b)(a + b)} = -\frac{3b}{a + b}.$$

№ 122.

$$\begin{aligned} \text{a)} \frac{a^2 - 1}{a - b} \cdot \frac{7a - 7b}{a^2 + a} &= \frac{(a^2 - 1)(7a - 7b)}{(a - b)(a^2 + a)} = \frac{7(a - b)(a^2 - 1)}{(a - b)(a^2 + a)} = \\ &= \frac{7(a - 1)(a + 1)(a - b)}{a(a + 1)(a - b)} = \frac{7(a - 1)}{a}; \end{aligned}$$

$$\begin{aligned} \text{б)} \frac{b^2 + 2bc}{b + 3} \cdot \frac{5b + 15}{b^2 - 4c^2} &= \frac{(b^2 + 2bc)(5b + 15)}{(b + 3)(b^2 - 4c^2)} = \frac{5b(b + 2c)(b + 3)}{(b + 3)(b^2 - 4c^2)} = \\ &= \frac{5b(b + 2c)(b + 3)}{(b - 2c)(b + 2c)(b + 3)} = \frac{5b}{b - 2c}; \end{aligned}$$

$$\text{в)} \frac{(x + 3)^2}{2x - 4} \cdot \frac{x^2 - 4}{3x + 9} = \frac{(x + 3)^2(x - 2)(x + 2)}{2(x - 2) \cdot 3(x + 3)} = \frac{(x + 3)(x + 2)}{6};$$

$$\begin{aligned} \text{г)} \frac{(y - 5)^2}{2y + 12} \cdot \frac{y^2 - 36}{2y - 10} &= \frac{(y - 5)^2(y^2 - 36)}{(2y + 12)(2y - 10)} = \frac{(y - 5)^2(y^2 - 36)}{2(y + 6) \cdot 2(y - 5)} = \\ &= \frac{(y - 5)^2(y - 6)(y + 6)}{2(y + 6) \cdot 2(y - 5)} = \frac{(y - 5)(y - 6)}{4}. \end{aligned}$$

№ 123.

$$\text{a)} \frac{(5mn - m)(16m^2 - n^2)}{(4m + n)(5n - 1)} = \frac{m(5n - 1)(4m - n)(4m + n)}{(5n - 1)(4m + n)} = m(4m - n);$$

Найдем значение этого выражения при $m = \frac{1}{4}; n = -3$:

$$m(4m - n) = \frac{1}{4} \left(4 \cdot \frac{1}{4} + 3 \right) = \frac{1}{4} (1 + 3) = \frac{1}{4} \cdot 4 = 1;$$

$$\text{б) } \frac{(x+2)^2(2x+6)}{(3x+9)(x^2-4)} = \frac{2(x+2)^2(x+3)}{3(x+3)(x-2)(x+2)} = \frac{2(x+2)}{3(x-2)};$$

Найдем значение этого выражения при $x = 0,5$:

$$\frac{2(x+2)}{3(x-2)} = \frac{2(0,5+2)}{3(0,5-2)} = \frac{2 \cdot 2,5}{3 \cdot (-1,5)} = -\frac{2 \cdot 2,5}{3 \cdot 1,5} = -\frac{10}{9} = -1\frac{1}{9};$$

Найдем значение этого выражения при $x = -1,5$:

$$\frac{2(x+2)}{3(x-2)} = \frac{2(-1,5+2)}{3(-1,5-2)} = \frac{2 \cdot 0,5}{3 \cdot (-3,5)} = \frac{1}{-10,5} = -\frac{2}{21}.$$

Ответ: а) 1; б) $-1\frac{1}{9}; -\frac{2}{21}$.

№ 124.

$$\text{а) } \frac{x^2 - 1}{5xy} \cdot \frac{x^2 y}{1 + x} = \frac{x^2 y(x-1)(x+1)}{5xy(1+x)} = \frac{x(x-1)}{5}.$$

$$\begin{aligned} \text{б) } \frac{8n^2}{m^2 - 16} \cdot \frac{m^2 - 4m}{6n} &= \frac{8n^2(m^2 - 4m)}{6n(m^2 - 16)} = \frac{8mn(m-4)}{6(m^2 - 16)} = \frac{4nm(m-4)}{3(m-4)(m+4)} = \\ &= \frac{4nm}{3(m+4)}; \end{aligned}$$

$$\begin{aligned} \text{в) } \frac{a^2 - b^2}{a^2 - 3a} \cdot \frac{2a - 6}{(a+b)^2} &= \frac{(2a-6)(a^2 - b^2)}{(a^2 - 3a)(a+b)^2} = \frac{2(a-3)(a-b)(a+b)}{a(a-3)(a+b)(a+b)} = \\ &= \frac{2(a-b)}{a(a+b)}; \end{aligned}$$

$$\text{г) } \frac{bx + 3b}{x^2 - 25} \cdot \frac{(x-5)^2}{ax + 3a} = \frac{(bx + 3b)(x-5)(x-5)}{(x-5)(x+5)(ax + 3a)} = \frac{b(x+3)(x-5)}{a(x+5)(x+3)} = \frac{b(x-5)}{a(x+5)}.$$

№ 125.

а)

$$\frac{mx^2 - my^2}{2m + 8} \cdot \frac{3m + 12}{my + mx} = \frac{(mx^2 - my^2)(3m + 12)}{(2m + 8)(my + mx)} = \frac{3(mx^2 - my^2)(m + 4)}{(2m + 8)(my + mx)} =$$

$$= \frac{3m(x^2 - y^2)(m+4)}{2m(m+4)(y+x)} = \frac{3(x-y)(x+y)(m+4)}{2(m+4)(x+y)} = \frac{3(x-y)}{2};$$

$$\begin{aligned} \text{б)} \quad & \frac{ax+ay}{x^2-2xy+y^2} \cdot \frac{x^2-xy}{7x+7y} = \frac{(ax+ay)(x^2-xy)}{(x^2-2xy+y^2)(7x+7y)} = \\ & = \frac{ax(x+y)(x-y)}{7(x-y)^2(x+y)} = \frac{ax(x-y)}{7(x-y)^2} = \frac{ax}{7(x-y)}; \end{aligned}$$

$$\begin{aligned} \text{в)} \quad & \frac{x^3-y^3}{x+y} \cdot \frac{x^2-y^2}{x^2+xy+y^2} = \frac{(x^3-y^3)(x^2-y^2)}{(x+y)(x^2+xy+y^2)} = \\ & = \frac{(x-y)(x^2+xy+y^2)(x-y)(x+y)}{(x+y)(x^2+xy+y^2)} = (x-y)^2; \end{aligned}$$

$$\begin{aligned} \text{г)} \quad & \frac{a^2-1}{a^3+1} \cdot \frac{a^2-a+1}{a^2+2a+1} = \frac{(a^2-1)(a^2-a+1)}{(a+1)(a^2-a+1)(a^2+2a+1)} = \\ & = \frac{(a-1)(a+1)}{(a+1)^3} = \frac{a-1}{(a+1)^2}; \end{aligned}$$

$$\text{д)} \quad \frac{b^3-8}{b^2-9} \cdot \frac{b+3}{b^2+2b+4} = \frac{(b-2)(b^2+2b+4)(b+3)}{(b-3)(b+3)(b^2+2b+4)} = \frac{b-2}{b+3};$$

$$\text{е)} \quad \frac{c^2+6c+9}{c^3+27} \cdot \frac{c^2-3c+9}{3c+9} = \frac{(c+3)^2(c^2-3c+9)}{3(c+3)(c^2-3c+9)(c+3)} = \frac{1}{3}.$$

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№ 126.

$$\begin{aligned} \text{а)} \quad & \frac{x^2-10x+25}{3x+12} \cdot \frac{x^2-16}{2x-10} = \frac{(x-5)^2 \cdot (x^2-16)}{(3x+12) \cdot 2(x-5)} = \frac{(x-5)(x-4)(x+4)}{6(x+4)} = \\ & = \frac{(x-4)(x-5)}{6}; \end{aligned}$$

$$\text{б)} \quad \frac{1-a^2}{4a+8b} \cdot \frac{a^2+4ab+4b^2}{3-3a} = \frac{(1-a)(1+a) \cdot (a+2b)^2}{4 \cdot (a+2b) \cdot (1-a) \cdot 3} = \frac{(1+a)(a+2b)}{12};$$

$$\text{в)} \quad \frac{y^2-25}{y^2+12y+36} \cdot \frac{3y+18}{2y+10} = \frac{(y-5)(y+5) \cdot 3 \cdot (y+6)}{(y+6)^2 \cdot 2 \cdot (y+5)} = \frac{3(y-5)}{2(y+6)};$$

$$\text{г)} \quad \frac{b^3+8}{18b^2+27b} \cdot \frac{2b+3}{b^2-2b+4} = \frac{(b+2)(b^2-2b+4) \cdot (2b+3)}{9b(2b+3)(b^2-2b+4)} = \frac{b+2}{9b}.$$

№ 127.

$$\begin{aligned}
 \text{a)} \quad & \frac{2a+3c}{2a+c} - \frac{2b-3a}{3a+b} - \frac{2c(3a+b)}{6a^2+2ab+3ac+bc} = \\
 & = \frac{2a+3c}{2a+c} - \frac{2b-3a}{3a+b} - \frac{2c(3a+b)}{2a(3a+b)+c(3a+b)} = \\
 & = \frac{2a+3c}{2a+c} - \frac{2b-3a}{3a+b} - \frac{2c(3a+b)}{(3a+b)(2a+c)} = \\
 & = \frac{(3a+b)(2a+3c) - (2a+c)(2b-3a) - 2c(3a+b)}{(3a+b)(2a+c)} = \\
 & = \frac{6a^2+9ac+2ab+3bc-4ab+6a^2-2bc+3ac-6ac-2bc}{(3a+b)(2a+c)} = \\
 & = \frac{12a^2+6ac-2ab-bc}{(3a+b)(2a+c)} = \frac{6a(2a+c)-b(2a+c)}{(3a+b)(2a+c)} = \frac{(2a+c)(6a-b)}{(3a+b)(2a+c)} = \\
 & = \frac{6a-b}{3a+b}; \\
 \text{б)} \quad & \frac{a^2-4ac+3bc}{a^2-ab+bc-ac} + \frac{a+3b}{b-a} + \frac{a+2c}{a-c} = \\
 & = \frac{a^2-4ac+3bc}{a(a-b)-c(a-b)} - \frac{a+3b}{a-b} + \frac{a+2c}{a-c} = \\
 & = \frac{a^2-4ac+3bc}{(a-b)(a-c)} - \frac{a+3b}{a-b} + \frac{a+2c}{a-c} = \\
 & = \frac{a^2-4ac+3bc-(a-c)(a+3b)+(a-b)(a+2c)}{(a-b)(a-c)} = \\
 & = \frac{a^2-4ac+3bc-a^2-3ab+ac+3bc+a^2+2ac-ab-2bc}{(a-b)(a-c)} = \\
 & = \frac{a^2-ac+4bc-4ab}{(a-b)(a-c)} = \frac{a(a-c)-4b(a-c)}{(a-b)(a-c)} = \frac{(a-c)(a-4b)}{(a-b)(a-c)} = \frac{a-4b}{a-b}.
 \end{aligned}$$

№ 128.

Первые 30 км велосипедист проехал за $\frac{30}{v}$ ч; на втором этапе пути

его скорость была - $(v + 2)$ км/ч, значит он проехал его за $\frac{17}{v + 2}$ ч.

Тогда всего ему потребовалось:

$$\frac{30}{v} + \frac{17}{v + 2} = \frac{30(v + 2) + 17v}{v(v + 2)} = \frac{47v + 60}{v(v + 2)}.$$

а) Подставим $v = 15$ и вычислим t :

$$t = \frac{47v + 60}{v(v + 2)} = \frac{47 \cdot 15 + 60}{15(15 + 2)} = \frac{705 + 60}{15 \cdot 17} = \frac{765}{255} = 3 \text{ (ч)};$$

б) Подставим $v = 18$ и вычислим t :

$$t = \frac{47v + 60}{v(v + 2)} = \frac{47 \cdot 18 + 60}{18(18 + 2)} = \frac{846 + 60}{18 \cdot 20} = \frac{906}{360} \text{ (ч)} = 2 \text{ ч } 31 \text{ мин.}$$

№ 129.

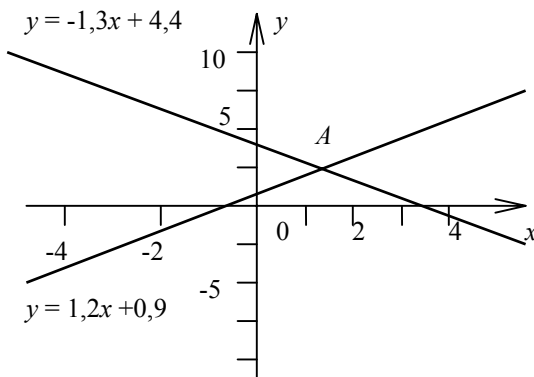
На рисунке изображены графики данных функций.

Найдем координаты точки пересечения:

I. А $(1,5; 2,6)$ – из рисунка.

II. Найдем координаты точки пересечения графиков данных функций из уравнения:

$$1,2x + 0,9 = -1,3x + 4,4;$$



$$1,2x + 1,3x = 4,4 - 0,9;$$

$$2,5x = 3,5; x = 3,5 : 2,5; x = 1,4.$$

$$\text{Тогда } y = 1,2 \cdot 1,4 + 0,9;$$

$$y = 1,68 + 0,9; y = 2,58; \text{ т.е. } A(1,4; 2,58).$$

Абсолютная погрешность приближенного значения абсциссы равна $|1,4 - 1,5| = |-0,1| = 0,1$; абсолютная погрешность приближенного значения ординаты равна $|2,58 - 2,6| = |-0,02| = 0,02$.

№ 130.

а) $3x + b = a$; $3x = a - b$; $x = \frac{a - b}{3}$;

б) $b - 7x = a - b$; $7x = 2b - a$; $x = \frac{2b - a}{7}$;

в) $\frac{x}{a} + 1 = b$; $\frac{x}{a} = b - 1$; $x = a(b - 1) = ab - a$;

г) $b - \frac{x}{10} = a$; $10b - x = 10a$; $x = 10b - 10a = 10(b - a)$.

6. Деление дробей

№ 131.

а) $\frac{5m}{6n} \div \frac{15m^2}{8} = \frac{5m \cdot 8}{6n \cdot 15m^2} = \frac{40m}{90m^2n} = \frac{4m}{9m^2n} = \frac{4}{9mn}$;

б) $\frac{14}{9x^3} \div \frac{7x}{2y^2} = \frac{14 \cdot 2y^2}{9x^3 \cdot 7x} = \frac{14 \cdot 2y^2}{7 \cdot 9x^4} = \frac{4y^2}{9x^4}$;

в) $\frac{a^2}{12b} \div \frac{ab}{36} = \frac{36a^2}{12b \cdot ab} = \frac{3a}{b^2}$;

г) $\frac{3x}{10a^3} \div \frac{1}{5a^2} = \frac{3x \cdot 5a^2}{10a^3} = \frac{15xa^2}{10a^3} = \frac{3x}{2a}$;

д) $\frac{11x}{4y^2} \div (22x^2) = \frac{11x}{4y^2} \div \frac{22x^2}{1} = \frac{11x \cdot 1}{4y^2 \cdot 22x^2} = \frac{1}{8xy^2}$;

е) $27a^3 \div \frac{18a^4}{7b^2} = \frac{27a^3}{1} \div \frac{18a^4}{7b^2} = \frac{27a^3 \cdot 7b^2}{18a^4} = \frac{21b^2}{2a}$;

ж) $\frac{18c^4}{7d} \div (9c^2d) = \frac{18c^4}{7d} \div \frac{9c^2d}{1} = \frac{18c^4}{7d \cdot 9c^2d} = \frac{2c^2}{7d^2}$;

з) $35x^5y \div \frac{7x^3}{34} = \frac{35x^5y}{1} \div \frac{7x^3}{34} = \frac{35x^5y \cdot 34}{7x^3} = 170x^2y$.

№ 132.

$$\begin{aligned}
\text{a)} \quad & \frac{6x^2}{5y} \div \frac{3x}{10y^3} = \frac{6x^2 \cdot 10y^3}{3x \cdot 5y} = \frac{4x^2 y^3}{xy} = 4xy^2; \\
\text{б)} \quad & \frac{8c}{21d^2} \div \frac{6c^2}{7d} = \frac{8c \cdot 7d}{21d^2 \cdot 6c^2} = \frac{4}{9cd}; \\
\text{в)} \quad & \frac{12p^2}{7d^2} \div \frac{6p^3}{35d^2} = \frac{12p^2 \cdot 35d^2}{7d^4 \cdot 6p^3} = \frac{10}{pd^2}; \\
\text{г)} \quad & -\frac{9y^2}{20x^3} \div \frac{y^5}{16x} = -\frac{9y^2 \cdot 16x}{20x^3 y^5} = -\frac{36 \cdot 4xy^2}{4 \cdot 5x^3 y^5} = -\frac{36}{5x^2 y^3}; \\
\text{д)} \quad & \frac{3ab}{4xy} \div \left(-\frac{21a^2 b}{10x^2 y} \right) = -\frac{3ab \cdot 10x^2 y}{21a^2 b \cdot 4xy} = -\frac{5x}{14a}; \\
\text{е)} \quad & -\frac{18a^2 b^2}{5cd} \div \left(-\frac{9ab^3}{5c^2 d^4} \right) = \frac{18a^2 b^2 \cdot 5c^2 d^4}{5cd \cdot 9ab^3} = \frac{2acd^3}{b}.
\end{aligned}$$

№ 133.

$$\begin{aligned}
\text{a)} \quad & \frac{6x^2}{m^3 n} : \frac{x}{3mn^2} = \frac{6x^2 \cdot 3mn^2}{xm^3 n} = \frac{18x^2 mn^2}{xm^3 n} = \frac{18xn}{m^2}; \\
\text{б)} \quad & \frac{35x^2 y}{12ab} : \frac{7xy}{8ab^2} = \frac{35x^2 y \cdot 8ab^2}{12ab \cdot 7xy} = \frac{10ab^2 x^2 y}{3abxy} = \frac{10bx}{3}; \\
\text{в)} \quad & \frac{a^2 b^3}{11mn^2} : \left(-\frac{4ab^3}{33mn} \right) = \frac{a^2 b^3 \cdot 33mn}{11mn^2 \cdot 4ab^3} = -\frac{3a^2 b^3 mn}{4ab^3 mn^2} = -\frac{3a}{4n}; \\
\text{г)} \quad & -\frac{6xy^2}{5ab} : \left(\frac{9x^2 y^2}{10ab} \right) = -\frac{6xy^2 \cdot 10ab}{5ab \cdot 9x^2 y^2} = -\frac{4}{3x}; \\
\text{д)} \quad & \frac{8mx^2}{3y^3} : (4m^2 x) = \frac{8mx^2}{3y^3} : \frac{4m^2 x}{1} = \frac{8mx^2 \cdot 1}{3y^3 \cdot 4m^2 x} = \frac{2x}{3my^3}; \\
\text{е)} \quad & 15a^2 bx : \frac{a^3 b^2}{30x^2} = \frac{15a^2 bx}{1} : \frac{a^3 b^2}{30x^2} = \frac{15a^2 bx \cdot 30x^2}{a^3 b^2} = \frac{450x^3}{ab}.
\end{aligned}$$

№ 134.

$$\text{a)} \quad \frac{3x^2}{5y^3} : \frac{9x^3}{2y^2} : \frac{5y}{3x} = \frac{3x^2 \cdot 2y^2 \cdot 5y}{5y^3 \cdot 9x^3 \cdot 3x} = \frac{2}{9x^3};$$

$$\begin{aligned}
 \text{б)} \quad & \frac{7p^4}{10q^3} \cdot \frac{5q}{14p^2} \cdot \frac{3p}{4q^4} = \frac{7p^4 \cdot 5q \cdot 4q^4}{10q^3 \cdot 14p^2 \cdot 3p} = \frac{pq^2}{3}; \\
 \text{в)} \quad & \frac{2ab}{3c^2d} \cdot \frac{2cd^2}{9ab} \cdot \frac{a^2b}{c^3d} = \frac{2ab \cdot 9ab \cdot c^3d}{3c^2d \cdot 2cd^2 \cdot a^2b} = \frac{3a^2b^2c^3d}{a^2bc^3d^3} = \frac{3b}{d^2}; \\
 \text{г)} \quad & \frac{8x^2y}{7ab^2} \cdot \frac{4xy^2}{7a^2b} \cdot \frac{2x^2y}{ab} = \frac{8x^2y \cdot 7a^2b \cdot ab}{7ab^2 \cdot 4xy^2 \cdot 2x^2y} = \frac{a^3b^2x^2y}{ab^2x^3y^3} = \frac{a^2}{xy^2}.
 \end{aligned}$$

№ 135.

$$\begin{aligned}
 \text{а)} \quad & \frac{11m^4}{6n^2} \cdot \frac{5m}{6n^3} \cdot \frac{11n^3}{12m^3} = \frac{11m^4 \cdot 5m \cdot 12m^3}{6n^2 \cdot 6n^3 \cdot 11n^3} = \frac{10m^8}{6n^8} = \frac{5m^8}{3n^8}; \\
 \text{б)} \quad & \frac{8x^3}{7y^3} \cdot \frac{4x^4}{49y^2} \cdot \frac{7x}{y^2} = \frac{8x^3 \cdot 49y^2 \cdot y^2}{7y^3 \cdot 4x^4 \cdot 7x} = \frac{2y}{x^2}; \\
 \text{в)} \quad & \frac{4c^3d^2}{9a^3x^3} \cdot \frac{2cd^2}{3a^2x} \cdot \frac{2cd}{3a^2x^2} = \frac{4c^3d^2 \cdot 3a^2x \cdot 3a^2x^2}{9a^3x^3 \cdot 2cd^2 \cdot 2cd} = \frac{ac}{d}; \\
 \text{г)} \quad & \frac{2ax}{yz} \cdot \frac{3bx}{ay} \cdot \frac{9b^2z}{8a^2xy} = \frac{2ax \cdot ay \cdot 9b^2z}{yz \cdot 3bx \cdot 8a^2xy} = \frac{3a^2xyb^2z}{4a^2x^2y^2bz} = \frac{3b}{4xy}.
 \end{aligned}$$

№ 136.

$$\begin{aligned}
 \text{а)} \quad & \frac{m^2 - 3m}{8x^2} \cdot \frac{3m}{8x} = \frac{m(m-3) \cdot 8x}{3m \cdot 8x^2} = \frac{m-3}{3x}; \\
 \text{б)} \quad & \frac{5a^2}{6b^3} \cdot \frac{a^3}{ab-b^2} = \frac{5 \cdot b(a-b)}{6ab^3} = \frac{5(a-b)}{6ab^2}; \\
 \text{в)} \quad & \frac{x^2 + x^3}{11a^2} \cdot \frac{4+4x}{a^3} = \frac{a^3(x^2 + x^3)}{11a^2(4+4x)} = \frac{ax^2(1+x)}{11 \cdot 4(1+x)} = \frac{ax^2}{44}; \\
 \text{г)} \quad & \frac{6ax}{m^2 - 2m} \cdot \frac{8ax}{3m-6} = \frac{6ax(3m-6)}{8ax(m^2 - 2m)} = \frac{3 \cdot 3(m-2)}{4m(m-2)} = \frac{9}{4m}; \\
 \text{д)} \quad & \frac{a^2 - 3ab}{3b} : (7a - 21b) = \frac{a(a-3b)}{3 \cdot 7b(a-3b)} = \frac{a}{21b}; \\
 \text{е)} \quad & (x^2 - 4y^2) : \frac{5x-10y}{x} = \frac{(x^2 - 4y^2)}{1} : \frac{5x-10y}{x} = \\
 & = \frac{(x-2y)(x+2y)x}{5(x-2y)} = \frac{x(x+2y)}{5};
 \end{aligned}$$

$$\begin{aligned}
 \text{ж)} \quad (2a-b)^2 : \frac{4a^3 - ab^2}{3} &= \frac{(2a-b)^2}{1} : \frac{4a^3 - ab^2}{3} = \frac{3(2a-b)^2}{a(4a^2 - b^2)} = \\
 &= \frac{3(2a-b)^2}{a(2a-b)(2a+b)} = \frac{3(2a-b)}{a(2a+b)}; \\
 3) \quad (10m-15n) : \frac{(2m-3n)^2}{2m} &= \frac{(10m-15n)}{1} : \frac{(2m-3n)^2}{2m} = \\
 &= \frac{5(2m-3n)2m}{(2m-3n)(2m-3n)} = \frac{10m}{(2m-3n)}.
 \end{aligned}$$

№ 137.

$$\begin{aligned}
 \text{а)} \quad \frac{x^2 - 4y^2}{xy} : \frac{x^2 - 2xy}{3y} &= \frac{(x^2 - 4y^2)3y}{(x^2 - 2xy)xy} = \frac{3y(x-2y)(x+2y)}{yx^2(x-2y)} = \\
 &= \frac{3(x+2y)}{x^2}; \\
 \text{б)} \quad \frac{ab^2}{a^2 - 1} : \frac{5b}{a - a^2} &= \frac{a \cdot ab^2(1-a)}{5b(a-1)(a+1)} = -\frac{a^2b^2(a-1)}{5b(a-1)(a+1)} = -\frac{a^2b}{5(a+1)}; \\
 \text{в)} \quad \frac{a^2 - 3a}{a^2 - 25} : \frac{a^2 - 9}{a^2 + 5a} &= \frac{(a^2 - 3a)(a^2 + 5a)}{(a^2 - 2)(a^2 - 9)} = \\
 &= \frac{a \cdot a(a-3)(a+5)}{(a-5)(a+5)(a-3)(a+3)} = \frac{a^2}{(a-5)(a+3)}; \\
 \text{г)} \quad \frac{3m^2 - 3n^2}{m^2 + mp} : \frac{6m - 6n}{p + m} &= \frac{(3m^2 - 3n^2)(p+m)}{(m^2 + mp)(6m - 6n)} = \\
 &= \frac{3(m-n)(m+n)(m+p)}{3 \cdot 2m(m+p)(m-n)} = \frac{m+n}{2m}; \\
 \text{д)} \quad (x+3y) : (x^2 - 9y^2) &= \frac{(x+3y)}{1} : \frac{(x^2 - 9y^2)}{1} = \\
 &= \frac{x+3y}{(x-3y)(x+3y)} = \frac{1}{x-3y}; \\
 \text{е)} \quad (a^2 - 6ab + 9b^2) : (a^2 - 9b^2) &= \frac{(a-3b)^2}{1} : \frac{(a^2 - 9b^2)}{1} = \\
 &= \frac{(a-3b)^2}{a^2 - 9b^2} = \frac{(a-3b)^2}{(a-3b)(a+3b)} = \frac{a-3b}{a+3b}.
 \end{aligned}$$

№ 138.

$$\text{a)} \frac{x^2 - xy}{9y^2} : \frac{2x}{3y} = \frac{x(x-y)3y}{2x \cdot 9y^2} = \frac{x-y}{6y};$$

$$\text{б)} \frac{2a^3 - a^2b}{36b^2} : \frac{2a-b}{9b^3} = \frac{(2a^3 - a^2b)9b^3}{36b^2(2a-b)} = \frac{a^2(2a-b)b}{4(2a-b)} = \frac{a^2b}{4};$$

$$\begin{aligned} \text{в)} (m^2 - 16n^2) : \frac{3m+12n}{mn} &= \frac{(m^2 - 16n^2)}{1} : \frac{3m+12n}{mn} = \\ &= \frac{mn(m-4n)(m+4n)}{3(m+4n)} = \frac{mn(m-4n)}{3}; \end{aligned}$$

$$\begin{aligned} \text{г)} (x^2 - 25y^2) : (x^2 + 10xy + 25y^2) &= \frac{x^2 - 25y^2}{x^2 + 10xy + 25y^2} = \\ &= \frac{(x-5y)(x+5y)}{(x+5y)^2} = \frac{x-5y}{x+5y}; \end{aligned}$$

$$\begin{aligned} \text{д)} \frac{c^2 + 4c}{c^2 - 4} : \frac{3c+12}{c-2} &= \frac{(c^2 + 4c)(c-2)}{(c^2 - 4)(3c+12)} = \\ &= \frac{c(c+4)(c-2)}{3(c+4)(c-2)(c+2)} = \frac{c}{3(c+2)}; \end{aligned}$$

$$\begin{aligned} \text{е)} \frac{9p^2 - 1}{pq - 2q} : \frac{1-3p}{3p-6} &= \frac{(9p^2 - 1)(3p-6)}{(pq - 2q)(1-3p)} = \frac{3(9p^2 - 1)(p-2)}{q(p-2)(1-3p)} = \\ &= \frac{3(3p-1)(3p+1)(p-2)}{-q(p-2)(3p-1)} = -\frac{3(3p+1)}{q}. \end{aligned}$$

№ 139.

$$\text{а)} \frac{4x^2 - 4x}{x+3} : \frac{(2x-2)}{1} = \frac{4x^2 - 4x}{(2x-2)(x+3)} = \frac{4x(x-1)}{2(x-1)(x+3)} = \frac{2x}{x+3};$$

$$\text{подставим } x = 2,5, \text{ получим: } \frac{2x}{x+3} = \frac{2 \cdot 2,5}{2,5+3} = \frac{5}{5,5} = \frac{50}{55} = \frac{10}{11};$$

$$\text{подставим } x = -1, \text{ получим: } \frac{2x}{x+3} = \frac{2 \cdot (-1)}{-1+3} = \frac{-2}{2} = -1.$$

$$\text{б)} \frac{(3a+6b)}{1} : \frac{2a^2 - 8b^2}{a+b} = \frac{(3a+6b)(a+b)}{2a^2 - 8b^2} = \frac{3(a+2b)(a+b)}{2(a^2 - 4b^2)} =$$

$$= \frac{3(a+2b)(a+b)}{2(a-2b)(a+2b)} = \frac{3(a+b)}{2(a-2b)};$$

подставим $a = 26$, получим:

$$\frac{3(a+b)}{2(a-2b)} = \frac{3(26-12)}{2(26-2(-12))} = \frac{3 \cdot 14}{2(26+24)} = \frac{42}{2 \cdot 50} = \frac{42}{100} = 0,42.$$

Ответ: а) $\frac{10}{11}$; -1; б) 0,42.

№ 140.

$$\begin{aligned} \text{а)} \quad \frac{3x+6y}{x^2-y^2} : \frac{5x+10y}{x^2-2xy+y^2} &= \frac{(3x+6y)(x^2-2xy+y^2)}{(x^2-y^2)(5x+10y)} = \\ &= \frac{3(x+2y)(x-y)^2}{5(x-y)(x+y)(x+2y)} = \frac{3(x-y)}{5(x+y)}; \end{aligned}$$

$$\begin{aligned} \text{б)} \quad \frac{a^2+4a+4}{16-b^4} : \frac{4-a^2}{4+b^2} &= \frac{(a+2)^2(4+b)^2}{(4-b^2)(4+b^2)(2-a)(2+a)} = \\ &= \frac{a+2}{(4-b^2)(2-a)}; \end{aligned}$$

$$\begin{aligned} \text{в)} \quad \frac{a^2+ax+x^2}{ax+2ay} : \frac{a^3-x^3}{bx+2by} &= \frac{b(a^2+ax+x^2)(x+2y)}{a(x+2y)(a-x)(a^2+ax+x^2)} = \\ &= \frac{b}{a(a-x)}; \end{aligned}$$

$$\begin{aligned} \text{г)} \quad \frac{4m^2-25n^2}{m^3+8} : \frac{2m+5n}{m^2-2m+4} &= \frac{(4m^2-25n^2)(m^2-2m+4)}{(m^3+8)(2m+5n)} = \\ &= \frac{(2m+5n)(2m-5n)(m^2-2m+4)}{(m+2)(m^2-2m+4)(2m+5n)} = \frac{2m-5n}{m+2}. \end{aligned}$$

№ 141.

$$\begin{aligned} \text{а)} \quad \frac{m^2+6m+9}{2x^2y} : \frac{am+3a}{4xy} &= \frac{(m^2+6m+9)4xy}{(am+3a)2x^2y} = \\ &= \frac{(m+3)^2 4xy}{a(m+3)2x^2y} = \frac{2(m+3)}{ax}; \end{aligned}$$

$$\begin{aligned}
 \text{б)} \quad & \frac{ab^3}{7-7p} : \frac{a^2b^2}{1-2p+p^2} = \frac{ab^3(1-2p+p^2)}{(7-7p)a^2b^2} = \frac{b^2(1-p)^2}{7(1-p)ab} = \\
 & = \frac{b(1-p)}{7a}; \\
 \text{в)} \quad & \frac{a^2+ax+x^2}{x-1} : \frac{a^3-x^3}{x^2-1} = \frac{(a^2+ax+x^2)(x^2-1)}{(x-1)(a^3-x^3)} = \\
 & = \frac{(x-1)(x+1)(a^2+ax+x^2)}{(x-1)(a-x)(a^2+ax+x^2)} = \frac{x+1}{a-x}; \\
 \text{г)} \quad & \frac{ap^2-9a}{p^3-8} : \frac{p+3}{2p-4} = \frac{(ap^2-9a)(2p-4)}{(p^3-8)(p+3)} = \frac{a(p^2-9)(2p-4)}{(p^3-8)(p+3)} = \\
 & = \frac{2a(p-3)(p+3)(p-2)}{(p-2)(p^2+2p+4)(p+3)} = \frac{2a(p-3)}{p^2+2p+4}.
 \end{aligned}$$

УПРАЖНЕНИЯ ДЛЯ ПОВТОРЕНИЯ

№ 142.

$$\begin{aligned}
 \text{а)} \quad & \frac{2b}{2b+3} + \frac{5}{3-2b} - \frac{4b^2+9}{4b^2-9} = \frac{2b}{2b+3} - \frac{5}{2b-3} - \frac{4b^2+9}{(2b-3)(2b+3)} = \\
 & = \frac{2b(2b-3) - 5(2b+3) - (4b^2+9)}{(2b-3)(2b+3)} = \frac{4b^2-6b-10b-15-4b^2-9}{(2b-3)(2b+3)} = \\
 & = -\frac{8(2b+3)}{(2b-3)(2b+3)} = -\frac{8}{2b-3} = -\frac{8}{3-2b}; \\
 \text{б)} \quad & \frac{c+6b}{ac+2bc-6ab-3a^2} + \frac{2b}{a^2+2ab} - \frac{b}{ac-3a^2} = \\
 & = \frac{c+6b}{c(a+2b)-3a(2b+a)} + \frac{2b}{a(a+2b)} - \frac{b}{a(c-3a)} = \\
 & = \frac{c+6b}{(a+2b)(c-3a)} + \frac{2b}{a(a+2b)} - \frac{b}{a(c-3a)} = \\
 & = \frac{a(c+6b) + 2b(c-3a) - b(a+2b)}{a(a+2b)(c-3a)} = \\
 & = \frac{ac+6ba+2bc-6ab-ab-2b^2}{a(a+2b)(c-3a)} = \frac{ac+2bc-ab-2b^2}{a(a+2b)(c-3a)} =
 \end{aligned}$$

$$= \frac{c(a+2b) - b(a+2b)}{a(a+2b)(c-3a)} = \frac{(a+2b)(c-b)}{a(a+2b)(c-3a)} = \frac{c-b}{a(c-3a)}.$$

№ 143.

Пусть x км/ч – скорость течения реки, тогда $(10 - x)$ км/ч – скорость лодки против течения; $45 \text{ мин} = \frac{3}{4} \text{ ч}$; за $\frac{3}{4} \text{ ч}$ лодка прошла -

$\frac{3}{4}(10 - x)$ км; $(3 - x)$ км – лодка прошла обратно до пристани после того, как испортился мотор. Получаем уравнение:

$$\frac{3}{4}(10 - x) = 3x; \frac{30}{4} - \frac{3}{4}x = 3x; \frac{30}{4} = \frac{15}{4}x; x = \frac{30}{4} : \frac{15}{4} = 2.$$

Ответ: 2 км/ч.

№ 144.

Из условия задачи:

$$\text{а) } 2cy = ab; c = \frac{ab}{2y};$$

Из условия задачи:

$$\text{б) } 2cy = ab; a = \frac{2cy}{b}.$$

№ 145.

Из условия задачи:

$$\text{а) } \frac{bc + ac}{abc} = \frac{ab}{abc}; bc + ac = ab;$$

$$c(a + b) = ab; c = \frac{ab}{a + b};$$

Из условия задачи:

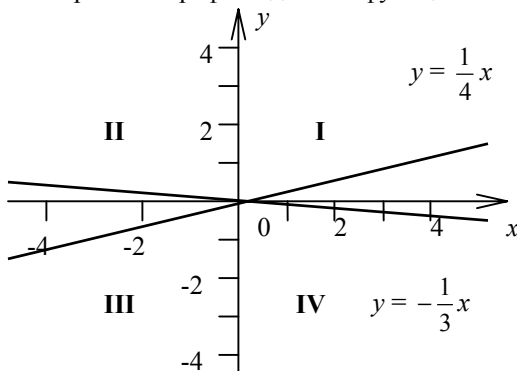
$$\text{б) } \frac{bc + ac}{abc} = \frac{ab}{abc}; bc + ac = ab;$$

$$bc - ab = -ac; b(c - a) = -ac;$$

$$b = -\frac{ac}{c - a}; b = \frac{ac}{a - c}.$$

№ 146.

На рисунке изображены графики данных функций.



При $k > 0$ график в I и III четвертях;

При $k < 0$ график во II и IV четвертях.

7. Преобразование рациональных выражений

№ 147.

$$\begin{aligned} \text{а) } \left(\frac{x}{y^2} - \frac{1}{x} \right) : \left(\frac{1}{y} + \frac{1}{x} \right) &= \frac{x^2 - y^2}{xy^2} : \frac{x+y}{xy} = \\ &= \frac{(x+y)(x-y)xy}{(x+y)xy^2} = \frac{x-y}{y}; \end{aligned}$$

$$\begin{aligned} \text{б) } \left(\frac{a}{m^2} + \frac{a^2}{m^3} \right) : \left(\frac{m^2}{a^2} + \frac{m}{a} \right) &= \frac{am + a^2}{m^3} : \frac{m^2 + am}{a^2} = \\ &= \frac{a^2(am + a^2)}{m^3(m^2 + am)} = \frac{a^2 \cdot a(m+a)}{m^3 \cdot m(m+a)} = \frac{a^3}{m^4}; \end{aligned}$$

$$\begin{aligned} \text{в) } \frac{ab + b^2}{3} : \frac{b^3}{3a} + \frac{a+b}{b} &= \frac{3a(ab + b^2)}{3b^3} + \frac{a+b}{b} = \\ &= \frac{ab(a+b)}{b^3} + \frac{a+b}{b} = \frac{a^2 + ab + ab + b^2}{b^2} = \frac{(a+b)^2}{b^2}; \end{aligned}$$

$$\begin{aligned} \text{г) } \frac{x-y}{x} - \frac{5y}{x^2} : \frac{x^2 - xy}{5y} &= \frac{x-y}{x} - \frac{5y(x^2 - xy)}{5x^2y} = \end{aligned}$$

$$= \frac{x-y}{x} - \frac{5yx(x-y)}{5x^2y} = \frac{x-y}{x} - \frac{x-y}{x} = 0.$$

№ 148.

$$\text{a)} \left(\frac{x}{x+1} + 1 \right) \cdot \frac{1+x}{2x-1} = \frac{(2x+1)(x+1)}{(x+1)(2x-1)} = \frac{2x+1}{2x-1};$$

$$\begin{aligned} \text{б)} \frac{5y^2}{1-y^2} : \left(1 - \frac{1}{1-y} \right) &= \frac{5y^2}{1-y^2} : \left(\frac{1-y-1}{1-y} \right) = \\ &= -\frac{5y^2(1-y)}{y(1-y^2)} = -\frac{5y(1-y)}{(-y)(1+y)} = -\frac{5y}{1+y}; \end{aligned}$$

$$\begin{aligned} \text{в)} \left(\frac{4a}{2-a} - a \right) : \frac{a+2}{a-2} &= \left[\frac{4a - a(2-a)}{2-a} \right] : \frac{a+2}{a-2} = \\ &= \frac{4a - 2a + a^2}{2-a} : \frac{a+2}{a-2} = \frac{(a^2 + 2a)(a-2)}{(2-a)(a+2)} = -a; \end{aligned}$$

$$\begin{aligned} \text{г)} \frac{x-2}{x-3} \cdot \left(x + \frac{x}{2-x} \right) &= \frac{x-2}{x-3} \cdot \left[\frac{x(2-x)+x}{2-x} \right] = \frac{(x-2)(2x-x^2+x)}{(x-3)(2-x)} = \\ &= \frac{-(x-2)(x^2-3x)}{-(x-3)(x-2)} = \frac{x(x-2)(x-3)}{(x-3)(x-2)} = x. \end{aligned}$$

№ 149.

$$\begin{aligned} \text{a)} \left(\frac{2m+1}{2m-1} - \frac{2m-1}{2m+1} \right) : \frac{4m}{10m-5} &= \\ &= \frac{(2m+1)^2 - (2m-1)^2}{(2m-1)(2m+1)} : \frac{4m}{10m-5} = \\ &= \frac{(4m^2 + 4m + 1 - 4m^2 + 4m - 1)(10m-5)}{(2m-1)(2m+1) \cdot 4m} = \\ &= \frac{8m(10m-5)}{4m(2m-1)(2m+1)} = \frac{10}{2m+1}; \end{aligned}$$

$$\text{б)} \frac{x+3}{x^2+3} \left(\frac{x+3}{x-3} + \frac{x-3}{x+3} \right) = \frac{x+3}{x^2+3} \left(\frac{x^2+6x+9+x^2-6x+9}{(x-3)(x+3)} \right) =$$

$$= \frac{(x+3)(2x^2+18)}{(x^2+3)(x-3)(x+3)} = \frac{2(x^2+9)}{(x-3)(x^2+3)}.$$

№ 150.

$$\begin{aligned} \text{a)} \quad & \frac{a^2-9}{2a^2+1} : \left(\frac{6a+1}{a-3} + \frac{6a-1}{a+3} \right) = \\ & = \frac{a^2-9}{2a^2+1} \cdot \left(\frac{6a^2+18a+a+3+6a^2-18a-a+3}{(a-3)(a+3)} \right) = \\ & = \frac{a^2-9}{2a^2+1} \cdot \left(\frac{12a^2+6}{(a-3)(a+3)} \right) = \frac{6(a-3)(a+3)(2a^2+1)}{(2a^2+1)(a-3)(a+3)} = 6; \\ \text{б)} \quad & \left(\frac{5x+y}{x-5y} + \frac{5x-y}{x+5y} \right) : \frac{x^2+y^2}{x^2-25y^2} = \\ & = \frac{(5x+y)(x+5y) + (x-5y)(5x-y)}{(x-5y)(x+5y)} : \frac{x^2+y^2}{x^2-25y^2} = \\ & = \frac{(5x^2+25xy+xy+5y^2+5x^2-xy-25xy+5y^2)(x^2-25y^2)}{(x-5y)(x+5y)(x^2+y^2)} = \\ & = \frac{10(x^2+y^2)(x-5y)(x+5y)}{(x-5y)(x+5y)(x^2+y^2)} = 10. \end{aligned}$$

№ 151.

$$\begin{aligned} \text{a)} \quad & \left(\frac{a}{b^2-ab} + \frac{b}{a^2-ab} \right) \cdot \frac{ab}{b-a} = \left(\frac{a}{b(b-a)} + \frac{b}{a(a-b)} \right) \cdot \frac{ab}{b-a} = \\ & = \frac{a^2-b^2}{ab(b-a)} \cdot \frac{ab}{b-a} = \frac{(a-b)(a+b)ab}{ab(b-a)(b-a)} = \frac{ab(a-b)(a+b)}{ab(a-b)(a-b)} = \frac{a+b}{a-b}; \\ \text{б)} \quad & \left(\frac{x}{xy-y^2} - \frac{y}{x^2-xy} \right) : \frac{x^2-y^2}{8xy} = \\ & = \left(\frac{x}{y(x-y)} - \frac{y}{x(x-y)} \right) : \frac{x^2-y^2}{8xy} = \\ & = \frac{(x^2-y^2)8xy}{(x^2-y^2)xy(x-y)} = \frac{8}{x-y}; \end{aligned}$$

$$\begin{aligned}
\text{B)} \quad & \left(\frac{4p-8}{p^3-2p^2} - \frac{q+2}{q^3+2q^2} \right) \cdot \frac{p}{2q-p} = \\
& = \left(\frac{4(p-2)}{p^2(p-2)} - \frac{q+2}{q^2(q+2)} \right) \cdot \frac{p}{2q-p} = \left(\frac{4}{p^2} - \frac{1}{q^2} \right) \cdot \frac{p}{2q-p} = \\
& = \frac{4q^2-p^2}{p^2q^2} \cdot \frac{p}{2q-p} = \frac{(2q-p)(2q+p)}{(2q-p)pq^2} = \frac{2q+p}{pq^2}; \\
\text{Г)} \quad & \left(\frac{a-7b}{ab-b^2} + \frac{7a+b}{a^2-ab} \right) : \frac{a^2+b^2}{a-b} = \\
& = \left(\frac{a-7b}{b(a-b)} + \frac{7a+b}{a(a-b)} \right) : \frac{a^2+b^2}{a-b} = \frac{a(a-7b)+b(7a+b)}{ab(a-b)} : \frac{a^2+b^2}{a-b} = \\
& = \frac{(a^2-7ab+7ab+b^2)(a-b)}{ab(a-b)(a^2+b^2)} = \frac{1}{ab}.
\end{aligned}$$

№ 152.

$$\begin{aligned}
\text{a)} \quad & \frac{a^2-25}{a+3} \cdot \frac{1}{a^2+5a} - \frac{a+5}{a^2-3a} = \frac{(a-5)(a+5)}{a(a+5)(a+3)} - \frac{a+5}{a(a-3)} = \\
& = \frac{a-5}{a(a+3)} - \frac{a+5}{a(a-3)} = \frac{(a-3)(a-5) - (a+3)(a+5)}{a(a+3)(a-3)} = \\
& = \frac{a^2-5a-3a+15-a^2-5a-3a-15}{a(a+3)(a-3)} = -\frac{16a}{a(a+3)(a-3)} = -\frac{16}{9-a^2}; \\
\text{б)} \quad & \frac{1-2x}{2x+1} + \frac{x^2+3x}{4x^2-1} : \frac{3+x}{4x+2} = \frac{1-2x}{2x+1} + \frac{(x^2+3x)(4x+2)}{(4x^2-1)(3+x)} = \\
& = \frac{1-2x}{2x+1} + \frac{2x(x+3)(2x+1)}{(2x-1)(2x+1)(x+3)} = \frac{1-2x}{2x+1} + \frac{2x}{2x-1} = \\
& = \frac{-(2x-1)(2x-1)+2x(2x+1)}{(2x+1)(2x-1)} = \\
& = \frac{-4x^2+4x-1+4x^2+2x}{4x^2-1} = \frac{6x-1}{4x^2-1}; \\
\text{B)} \quad & \frac{b-c}{a+b} - \frac{ab-b^2}{a^2-ac} : \frac{a^2-c^2}{a^2-b^2} = \frac{b-c}{a+b} - \frac{b(a-b)(a-c)(a+c)}{a(a-c)(a-b)(a+b)} = \\
& = \frac{b-c}{a+b} - \frac{b(a+c)}{a(a+b)} = \frac{a(b-c)-b(a+c)}{a(a+b)} =
\end{aligned}$$

$$\begin{aligned}
&= \frac{ab - ac - ab - bc}{a(a+b)} = \frac{-c(a+b)}{a(a+b)} = -\frac{c}{a}; \\
\text{г)} \quad &\frac{a^2 - 4}{x^2 - 9} : \frac{a^2 - 2a}{xy + 3y} + \frac{2 - y}{x - 3} = \frac{a^2 - 4}{x^2 - 9} : \frac{a(a-2)}{y(x+3)} + \frac{2 - y}{x - 3} = \\
&= \frac{y(a^2 - 4)(x+3)}{a(a-2)(x-3)(x+3)} + \frac{2 - y}{x - 3} = \frac{y(a-2)(a+2)}{a(a-2)(x-3)} + \frac{2 - y}{x - 3} = \\
&= \frac{y(a+2)}{a(x-3)} + \frac{2 - y}{x - 3} = \frac{y(a+2) + a(2 - y)}{a(x-3)} = \frac{ay + 2y + 2a - ay}{a(x-3)} = \\
&= \frac{2y + 2a}{a(x-3)} = \frac{2(a+y)}{a(x-3)}.
\end{aligned}$$

№ 153.

$$\begin{aligned}
\text{а)} \quad &\left(2x + 1 - \frac{1}{1 - 2x}\right) : \left(2x - \frac{4x^2}{2x - 1}\right) = \\
&= \left(\frac{2x + 1}{1} + \frac{1}{2x - 1}\right) : \left(\frac{2x}{1} - \frac{4x^2}{2x - 1}\right) = \\
&= \frac{(2x - 1)(2x + 1) + 1}{2x - 1} : \frac{2x(2x - 1) - 4x^2}{2x - 1} = \\
&= \frac{4x^2 - 1 + 1}{2x - 1} : \frac{4x^2 - 2x - 4x^2}{2x - 1} = \\
&= \frac{-4x^2(2x - 1)}{2x(2x - 1)} = -2x; \\
\text{б)} \quad &\left(\frac{pq}{p^2 - q^2} + \frac{q}{q - p}\right) : \left(p - q + \frac{4q^2 - p^2}{p + q}\right) = \\
&= \left(\frac{pq}{(p - q)(p + q)} - \frac{q}{p - q}\right) : \left(\frac{p - q}{1} + \frac{4q^2 - p^2}{p + q}\right) = \\
&= \frac{pq - q(p + q)}{(p - q)(p + q)} : \frac{(p + q)(p - q) + 4q^2 - p^2}{p + q} = \\
&= \frac{(pq - pq - q^2)}{(p - q)(p^2 - q^2 + 4q^2 - p^2)} =
\end{aligned}$$

$$= \frac{-q^2}{(p-q)3q^2} = \frac{1}{3(q-p)};$$

$$\begin{aligned} \text{в) } (a^2 + 2a + 1) \cdot \left(\frac{1}{a+1} + \frac{1}{a^2-1} - \frac{1}{a-1} \right) &= \\ (a+1)^2 \left(\frac{1}{a+1} - \frac{1}{(a+1)(a-1)} - \frac{1}{a-1} \right) &= \\ = (a+1)^2 \frac{a-1+1-a-1}{(a+1)(a-1)} = -\frac{(a+1)^2}{(a+1)(a-1)} = \frac{a+1}{a-1}; \end{aligned}$$

$$\begin{aligned} \text{г) } \left(1 - \frac{9x^2+4}{12x} \right) : \left(\frac{1}{3x} - \frac{1}{2} \right) + 1 &= \\ = \left(\frac{12x-9x^2-4}{12x} : \frac{2-3x}{6x} \right) + 1 &= \\ = \frac{-6(9x^2-12x+4)}{12x(2-3x)} + 1 = \frac{(3x-2)^2}{2(3x-2)} + 1 &= \\ \frac{3x-2}{2} + 1 = \frac{3x}{2} - 1 + 1 = \frac{3x}{2}; \end{aligned}$$

$$\begin{aligned} \text{д) } 1 - \left(\frac{2}{a-2} - \frac{2}{a+2} \right) \cdot \left(a - \frac{3a+2}{4} \right) &= \\ = 1 - \left(\frac{2(a+2)-2(a-2)}{(a-2)(a+2)} \right) \cdot \left(\frac{4a-3a-2}{4} \right) &= \\ = 1 - \left(\frac{2a+4-2a+4}{(a-2)(a+2)} \right) \cdot \frac{a-2}{4} = 1 - \frac{8(a-2)}{4(a-2)(a+2)} &= \\ = 1 - \frac{2}{a+2} = \frac{a+2-2}{a+2} = \frac{a}{a+2}; \end{aligned}$$

$$\begin{aligned} \text{е) } (y^2 - 4) \cdot \left(\frac{3}{y+2} - \frac{2}{y-2} \right) + 5 &= \\ = (y-2)(y+2) \cdot \left(\frac{3y-6-2y-4}{(y+2)(y-2)} \right) + 5 &= \\ = y-10+5 = y-5. \end{aligned}$$

№ 154.

$$\begin{aligned} \text{a)} \quad & \left(\frac{1}{y} + \frac{2}{x-y} \right) \cdot \left(x - \frac{x^2 + y^2}{x+y} \right) = \left(\frac{x-y+2y}{y(x-y)} \right) \cdot \left(\frac{x(x+y) - x^2 - y^2}{x+y} \right) = \\ & = \left(\frac{x+y}{y(x-y)} \right) \cdot \left(\frac{x^2 + xy - x^2 - y^2}{x+y} \right) = \frac{(xy - y^2)}{y(x-y)} = \frac{y(x-y)}{y(x-y)} = 1; \end{aligned}$$

$$\begin{aligned} \text{б)} \quad & \left(a+b - \frac{2ab}{a+b} \right) : \left(\frac{a-b}{a+b} + \frac{b}{a} \right) = \\ & = \frac{(a+b)^2 - 2ab}{a+b} : \frac{a(a-b) + b(a+b)}{a(a+b)} = \\ & = \frac{a^2 + 2ab + b^2 - 2ab}{a+b} : \frac{a^2 - ab + ab + b^2}{a(a+b)} = \\ & = \frac{a(a^2 + b^2)(a+b)}{(a^2 + b^2)(a+b)} = a; \end{aligned}$$

$$\begin{aligned} \text{в)} \quad & (x^2 - 1) \cdot \left(\frac{1}{x-1} - \frac{1}{x+1} + 1 \right) = (x^2 - 1) \cdot \left(\frac{x+1 - x+1 + x^2 - 1}{(x-1)(x+1)} \right) = \\ & = \frac{(x^2 - 1)(x^2 + 1)}{(x-1)(x+1)} = x^2 + 1; \end{aligned}$$

$$\begin{aligned} \text{г)} \quad & \left(m+1 - \frac{1}{1-m} \right) \div \left(m - \frac{m^2}{m-1} \right) = \frac{(m+1)(1-m) - 1}{1-m} \div \frac{m(m-1) - m^2}{m-1} = \\ & = \frac{-(m+1)(m-1) - 1}{-(m-1)} \div \frac{m^2 - m - m^2}{m-1} = - \frac{(-m^2 + 1 - 1)(m-1)}{m(m-1)} = \\ & = - \frac{m^2(m-1)}{m(m-1)} = -m. \end{aligned}$$

№ 155.

$$\begin{aligned} \text{a)} \quad & \frac{4xy}{y^2 - x^2} \div \left(\frac{1}{y^2 - x^2} + \frac{1}{x^2 + 2xy + y^2} \right) = \\ & = \frac{4xy}{y^2 - x^2} \div \left(\frac{1}{(y-x)(y+x)} + \frac{1}{(x+y)^2} \right) = \\ & = \frac{4xy}{(y-x)(y+x)} \div \frac{x+y+y-x}{(y-x)(y+x)^2} = \frac{4xy}{(y-x)(y+x)} \div \frac{2y}{(y-x)(y+x)^2} = \end{aligned}$$

$$= \frac{4xy(y-x)(y+x)^2}{(y-x)(y+x)2y} = 2x(y+x);$$

$$\begin{aligned} \text{б)} \left(\frac{x-2y}{x^2+2xy} - \frac{1}{x^2-4y^2} \div \frac{x+2y}{(2y-x)^2} \right) \cdot \frac{(x+2y)^2}{4y^2} &= \\ &= \left(\frac{x-2y}{x(x+2y)} - \frac{(2y-x)^2}{(x-2y)(x+2y)(x+2y)} \right) \cdot \frac{(x+2y)^2}{4y^2} = \\ &= \left(\frac{x-2y}{x(x+2y)} - \frac{(x-2y)}{(x+2y)^2} \right) \cdot \frac{(x+2y)^2}{4y^2} = \\ &= \left(\frac{(x+2y)(x-2y) - x(x-2y)}{x(x+2y)^2} \right) \cdot \frac{(x+2y)^2}{4y^2} = \\ &= \frac{x^2-4y^2-x^2+2xy}{x(x+2y)^2} \cdot \frac{(x+2y)^2}{4y^2} = \frac{-2y(2y-x)(x+2y)^2}{4y^2x(x+2y)^2} = \\ &= \frac{(x-2y)(x+2y)^2}{2yx(x+2y)^2} = \frac{x-2y}{2xy}; \end{aligned}$$

$$\begin{aligned} \text{в)} \left(\frac{a^2}{a+n} - \frac{a^3}{a^2+n^2+2an} \right) \div \left(\frac{a}{a+n} - \frac{a^2}{a^2-n^2} \right) &= \\ &= \left(\frac{a^2}{a+n} - \frac{a^3}{(a+n)^2} \right) \div \left(\frac{a}{a+n} - \frac{a^2}{(a-n)(a+n)} \right) = \\ &= \left(\frac{a^2(a+n)-a^3}{(a+n)^2} \right) \div \left(\frac{a^2-an-a^2}{(a+n)(a-n)} \right) = \\ &= -\frac{a^2n(a+n)(a-n)}{an(a+n)^2} = \frac{a(n-a)}{a+n}; \end{aligned}$$

$$\begin{aligned} \text{г)} \left(\frac{2a}{2a+b} - \frac{4a^2}{4a^2+4ab+b^2} \right) \div \left(\frac{2a}{4a^2-b^2} + \frac{1}{b-2a} \right) &= \\ &= \left(\frac{2a}{2a+b} - \frac{4a^2}{(2a+b)^2} \right) \div \left(\frac{2a}{(2a-b)(2a+b)} - \frac{1}{2a-b} \right) = \\ &= \frac{2a(2a+b)-4a^2}{(2a+b)^2} \cdot \frac{2a-2a-b}{(2a-b)(2a+b)} = \\ &= \frac{4a^2+2ab-4a^2}{(2a+b)^2} \cdot \frac{(-b)}{(2a-b)(2a+b)} = -\frac{2ab(2a-b)(2a+b)}{(2a+b)^2b} = \\ &= -\frac{2a(2a-b)}{2a+b} = \frac{2a(b-2a)}{2a+b}. \end{aligned}$$

№ 156.

$$\begin{aligned} \text{a)} \quad & \frac{x+2}{x^2-2x+1} \cdot \frac{3x-3}{x^2-4} - \frac{3}{x-2} = \\ & = \frac{3(x+2)(x-1)}{(x-1)^2(x-2)(x+2)} - \frac{3}{x-2} = \frac{3}{(x-1)(x-2)} - \frac{3}{x-2} = \\ & = \frac{3-3(x-1)}{(x-1)(x-2)} = \frac{3-3x+3}{(x-1)(x-2)} = \frac{3(2-x)}{(x-1)(x-2)} = -\frac{3}{x-1} = \frac{3}{1-x}; \end{aligned}$$

$$\begin{aligned} \text{б)} \quad & \frac{a-2}{4a^2+16a+16} : \left(\frac{a}{2a-4} - \frac{a^2+4}{2a^2-8} - \frac{2}{a^2+2a} \right) = \\ & = \frac{a-2}{(2a+4)^2} : \left(\frac{a}{2(a-2)} - \frac{a^2+4}{2(a-2)(a+2)} - \frac{2}{a(a+2)} \right) = \\ & = \frac{a-2}{(2a+4)^2} : \frac{a^2(a+2) - a(a^2+4) - 4(a-2)}{2a(a-2)(a+2)} = \\ & = \frac{a-2}{(2a+4)^2} : \frac{a^3+2a^2-a^3-4a-4a+8}{2a(a-2)(a+2)} = \\ & = \frac{a-2}{(2a+4)^2} : \frac{2a^2-8a+8}{2a(a-2)(a+2)} = \frac{a-2}{(2a+4)^2} : \frac{2(a-2)^2}{2a(a-2)(a+2)} = \\ & = \frac{a(a-2)(a-2)(a+2)}{(2a+4)^2(a-2)^2} = \frac{a(a+2)}{(2a+4)(2a+4)} = \frac{a}{4(a+2)}; \end{aligned}$$

$$\begin{aligned} \text{в)} \quad & \left(\frac{y^2-3y}{y^2-6y+9} - \frac{3y+9}{y^2-9} \right) : \left(1 - \frac{3}{y} \right) = \\ & = \left(\frac{y^2-3y}{(y-3)^2} - \frac{3y+9}{(y-3)(y+3)} \right) : \left(1 - \frac{3}{y} \right) = \\ & = \frac{y(y-3)(y+3) - 3(y+3)(y-3)}{(y-3)^2(y+3)} : \left(\frac{y-3}{y} \right) = \\ & = \frac{(y+3)(y-3)(y-3)}{(y-3)^2(y+3)} \cdot \frac{y-3}{y} = \frac{y-3}{y}. \end{aligned}$$

№ 157.

$$\text{a)} \quad \left(\frac{a-1}{3a+(a-1)^2} - \frac{1-3a+a^2}{a^3-1} - \frac{1}{a-1} \right) : \frac{a^2+1}{1-a} =$$

$$\begin{aligned}
&= \left(\frac{a-1}{3a+a^2-2a+1} - \frac{1-3a+a^2}{(a-1)(a^2+a+1)} - \frac{1}{a-1} \right) : \frac{a^2+1}{1-a} = \\
&= \frac{a^2-2a+1-a^2+3a-1-a^2-a-1}{(a-1)(a^2+a+1)} : \frac{a^2+1}{1-a} = \\
&= \frac{(-a^2-1)(1-a)}{(a-1)(a^2+a+1)(a^2+1)} = \frac{1}{a^2+a+1}; \\
\text{б)} \left(\frac{1}{x+1} - \frac{3}{x^3+1} + \frac{3}{x^2-x+1} \right) \cdot \left(x - \frac{2x-1}{x+1} \right) &= \\
&= \left(\frac{1}{x+1} - \frac{3}{(x+1)(x^2-x+1)} + \frac{3}{x^2-x+1} \right) \cdot \left(\frac{x(x+1)-2x+1}{x+1} \right) = \\
&= \frac{x^2-x+1-3+3x+3}{(x+1)(x^2-x+1)} \cdot \frac{x^2+x-2x+1}{x+1} = \\
&= \frac{x^2+2x+1}{(x+1)(x^2-x+1)} \cdot \frac{x^2-x+1}{x+1} = \frac{(x+1)^2(x^2-x+1)}{(x+1)(x+1)(x^2-x+1)} = 1.
\end{aligned}$$

№ 158.

$$\begin{aligned}
\text{а)} \frac{2p-q}{pq} - \frac{1}{p+q} \cdot \left(\frac{p}{q} - \frac{q}{p} \right) &= \frac{2p-q}{pq} - \frac{1}{p+q} \cdot \frac{p^2-q^2}{qp} = \\
&= \frac{2p-q}{pq} - \frac{1}{p+q} \cdot \frac{(p-q)(p+q)}{qp} = \frac{2p-q}{pq} - \frac{(p-q)(p+q)}{pq(p+q)} = \\
&= \frac{2p-q}{pq} - \frac{p-q}{pq} = \frac{2p-q-p+q}{pq} = \frac{p}{pq} = \frac{1}{q}; \text{ что и требовалось дока-}
\end{aligned}$$

зать.

$$\begin{aligned}
\text{б)} \left(a - \frac{4ab}{a+b} + b \right) : (a-b) &= \frac{a(a+b)-4ab+b(a+b)}{a+b} : (a-b) = \\
&= \frac{a^2+ab-4ab+ab+b^2}{a+b} : \frac{a-b}{1} = \frac{a^2-2ab+b^2}{(a-b)(a+b)} = \\
&= \frac{(a-b)^2}{(a-b)(a+b)} = \frac{a-b}{a+b}; \\
\frac{a}{a+b} - \frac{b}{b-a} - \frac{2ab}{a^2-b^2} &= \frac{a}{a+b} + \frac{b}{a-b} - \frac{2ab}{(a-b)(a+b)} =
\end{aligned}$$

$$= \frac{a^2 - ab + ab + b^2 - 2ab}{(a-b)(a+b)} = \frac{a^2 - 2ab + b^2}{(a-b)(a+b)} = \frac{a-b}{a+b}; \text{ что и требовалось}$$

доказать.

$$\text{в)} \frac{1,2x^2 - xy}{0,36x^2 - 0,25y^2} = \frac{20x}{6x+5y}; \frac{100(1,2x^2 - xy)}{100(0,36x^2 - 0,25y^2)} = \frac{20x}{6x+5y};$$

$$\frac{120x^2 - 100xy}{36x^2 - 25y^2} - \frac{20x}{6x+5y} = 0; \frac{120x^2 - 100xy}{(6x-5y)(6x+5y)} - \frac{20x}{6x+5y} = 0;$$

$$\frac{120x^2 - 100xy - 120x^2 + 100xy}{(6x-5y)(6x+5y)} = 0; \frac{0}{(6x-5y)(6x+5y)} = 0;$$

$0=0$, что и требовалось доказать.

№ 159.

$$\text{а)} \frac{a+b}{2(a-b)} - \frac{a-b}{2(a+b)} = \frac{(a+b)^2 - (a-b)^2}{2(a-b)(a+b)} =$$

$$= \frac{(a+b+a-b)(a+b-a+b)}{2(a-b)(a+b)} = \frac{2a \cdot 2b}{2(a-b)(a+b)} =$$

$$= \frac{2ab}{(a-b)(a+b)};$$

$$= \frac{b}{a-b} - \frac{b^2 - ab}{a^2 - b^2} = \frac{b}{a-b} - \frac{b(b-a)}{(a-b)(a+b)} =$$

$$= \frac{b}{a-b} + \frac{b(a-b)}{(a-b)(a+b)} = \frac{b}{a-b} + \frac{b}{a+b} =$$

$$= \frac{ab + b^2 + ab - b^2}{(a-b)(a+b)} = \frac{2ab}{(a-b)(a+b)}; \text{ тождество доказано.}$$

$$\text{б)} \frac{4,5a + 4x}{0,81a^2 - 0,64x^2} = \frac{50}{9a-8x}; \frac{100(4,5a + 4x)}{100(0,81a^2 - 0,64x^2)} = \frac{50}{9a-8x},$$

$$\frac{100(4,5a + 4x)}{81a^2 - 64x^2} = \frac{50}{9a-8x}; \frac{100(4,5a + 4x)}{(9a-8x)(9a+8x)} - \frac{50}{9a-8x} = 0;$$

$$\frac{450a + 400x - 450a - 400x}{(9a-8x)(9a+8x)} = 0; \frac{0}{(9a-8x)(9a+8x)} = 0, 0 = 0; \quad \text{тождество}$$

доказано.

№ 160.

$$\begin{aligned}
 \text{а) } & \left(\frac{2ab}{a^2 - b^2} + \frac{a-b}{2a+2b} \right) \cdot \frac{2a}{a+b} + \frac{b}{b-a} = \\
 & = \left(\frac{2ab}{(a-b)(a+b)} + \frac{a-b}{2(a+b)} \right) \cdot \frac{2a}{a+b} - \frac{b}{a-b} = \\
 & = \frac{4ab + a^2 - 2ab + b^2}{2(a-b)(a+b)} \cdot \frac{2a}{a+b} - \frac{b}{a-b} = \\
 & = \frac{(a+b)^2 \cdot 2a}{2(a-b)(a+b)(a+b)} - \frac{b}{a-b} = \frac{a}{a-b} - \frac{b}{a-b} = 1; \text{ что и требовалось}
 \end{aligned}$$

доказать.

$$\begin{aligned}
 \text{б) } & \frac{y}{x-y} - \frac{x^3 - xy^2}{x^2 + y^2} \cdot \left(\frac{x}{(x-y)^2} - \frac{y}{x^2 - y^2} \right) = \\
 & = \frac{y}{x-y} - \frac{x(x^2 - y^2)}{x^2 + y^2} \cdot \left(\frac{x}{(x-y)^2} - \frac{y}{(x-y)(x+y)} \right) = \\
 & = \frac{y}{x-y} - \frac{x(x^2 - y^2)}{x^2 + y^2} \cdot \frac{x^2 + xy - xy + y^2}{(x-y)^2(x+y)} = \\
 & = \frac{y}{x-y} - \frac{x(x^2 - y^2)(x^2 + y^2)}{(x^2 + y^2)(x-y)^2(x+y)} = \\
 & = \frac{y}{x-y} - \frac{x(x-y)(x+y)}{(x-y)^2(x+y)} = \frac{y}{x-y} - \frac{x}{x-y} = \frac{y-x}{x-y} = -\frac{x-y}{x-y} = -1, \text{ что и} \\
 & \text{требовалось доказать.}
 \end{aligned}$$

№ 161.

$$\begin{aligned}
 \text{а) } & \left(\frac{1}{a-c} - \frac{3c^2}{a^3 - c^3} - \frac{c}{a^2 + ac + c^2} \right) \cdot \left(c + \frac{a^2}{a+c} \right) = \\
 & = \left(\frac{1}{a-c} - \frac{3c^2}{(a-c)(a^2 + ac + c^2)} - \frac{c}{a^2 + ac + c^2} \right) \cdot \left(c + \frac{a^2}{a+c} \right) = \\
 & = \frac{a^2 + ac + c^2 - 3c^2 - ac + c^2}{(a-c)(a^2 + ac + c^2)} \cdot \frac{ac + c^2 + a^2}{a+c} = \\
 & = \frac{(a^2 - c^2)(a^2 + ac + c^2)}{(a^2 + ac + c^2)(a-c)(a+c)} = 1, \text{ не зависит от } a \text{ и } c. \\
 \text{б) } & 3a \left(\frac{1}{a-c} - \frac{c}{a^3 - c^3} \cdot \frac{a^2 + ac + c^2}{a+c} \right) - \frac{3c^2}{a^2 - c^2} =
 \end{aligned}$$

$$\begin{aligned}
&= 3a \left(\frac{1}{a-c} - \frac{c(a^2 + ac + c^2)}{(a-c)(a^2 + ac + c^2)(a+c)} \right) - \frac{3c^2}{a^2 - c^2} = \\
&= 3a \left(\frac{a+c-c}{(a-c)(a+c)} \right) - \frac{3c^2}{a^2 - c^2} = \frac{3a \cdot a}{(a-c)(a+c)} - \frac{3c^2}{a^2 - c^2} = \\
&= \frac{3a^2 - 3c^2}{a^2 - c^2} = 3 \text{ - не зависит от } a \text{ и } c.
\end{aligned}$$

№ 162.

$$\text{а) } \left(n + \frac{1}{n} \right)^2 = \left(\frac{n^2 + 1}{n} \right)^2 = \frac{n^2 + 2n^2 + 1}{n^2};$$

$$\text{б) } \left(\frac{a}{b} - \frac{b}{a} \right)^2 = \left(\frac{a^2 - b^2}{ab} \right)^2 = \frac{a^4 - 2a^2b^2 + b^4}{a^2b^2};$$

$$\begin{aligned}
\text{в) } \left(\frac{x}{y} + 1 \right)^2 + \left(\frac{x}{y} - 1 \right)^2 &= \left(\frac{x}{y} \right)^2 + 2 \frac{x}{y} + 1 + \left(\frac{x}{y} \right)^2 - 2 \frac{x}{y} + 1 = \\
&= 2 \frac{x^2}{y^2} + 2 = \frac{2(x^2 + y^2)}{y^2};
\end{aligned}$$

$$\begin{aligned}
\text{г) } \left(\frac{p}{q} + \frac{q}{p} \right)^2 - \left(\frac{p}{q} - \frac{q}{p} \right)^2 &= \left(\frac{p}{q} \right)^2 + 2 \frac{p}{q} \cdot \frac{q}{p} + \left(\frac{q}{p} \right)^2 - \left(\frac{p}{q} \right)^2 + \\
&+ 2 \frac{p}{q} \cdot \frac{q}{p} - \left(\frac{q}{p} \right)^2 = 2 + 2 = 4;
\end{aligned}$$

$$\begin{aligned}
\text{д) } \left(\frac{x+y}{x} + \frac{x-y}{y} \right)^2 - \left(\frac{x+y}{x} - \frac{x-y}{y} \right)^2 &= \\
&= \left(\frac{x+y}{x} + \frac{x-y}{y} + \frac{x+y}{x} - \frac{x-y}{y} \right) \cdot \left(\frac{x+y}{x} + \frac{x-y}{y} - \frac{x+y}{x} + \frac{x-y}{y} \right) = \\
&= \frac{2(x+y)}{x} \cdot \frac{2(x-y)}{y} = \frac{4(x^2 - y^2)}{xy};
\end{aligned}$$

$$\begin{aligned}
\text{е) } a^2 \left(\frac{a+b}{a} - 1 \right)^2 + b^2 \left(\frac{a-b}{b} + 1 \right)^2 &= \\
&= a^2 \left(\frac{a+b-a}{a} \right)^2 + b^2 \left(\frac{a-b+b}{b} \right)^2 = \frac{a^2 b^2}{a^2} + \frac{b^2 a^2}{b^2} = b^2 + a^2.
\end{aligned}$$

№ 163.

$$\text{a)} \frac{1 - \frac{1}{x}}{1 + \frac{1}{x}} = \frac{x-1}{x} \div \frac{x+1}{x} = \frac{x(x-1)}{x(x+1)} = \frac{x-1}{x+1};$$

$$\text{б)} \frac{\frac{2a-b}{b} + 1}{\frac{2a+b}{b} - 1} = \frac{2a-b+b}{b} \div \frac{2a+b-b}{b} = \frac{2a}{b} \div \frac{2a}{b} = 1;$$

$$\text{в)} \frac{\frac{x}{y^2} + \frac{y}{x^2}}{\frac{x}{y^2} - \frac{y}{x^2}} = \frac{x^3 + y^3}{y^2 x^2} \div \frac{x^3 - y^3}{x^2 y^2} = \frac{(x^3 + y^3)x^2 y^2}{(x^3 - y^3)x^2 y^2} = \frac{x^3 + y^3}{x^3 - y^3};$$

$$\begin{aligned} \text{г)} \frac{\frac{1}{a} + \frac{1}{b} + \frac{1}{c}}{\frac{1}{ab} + \frac{1}{bc} + \frac{1}{ac}} &= \frac{bc + ac + ab}{abc} \div \frac{c + a + b}{abc} = \\ &= \frac{(bc + ac + ab)abc}{abc(c + a + b)} = \frac{bc + ac + ab}{a + b + c}. \end{aligned}$$

№ 164.

$$\text{а)} \frac{2 - \frac{a}{x}}{2 + \frac{a}{x}} = \frac{2x - a}{x} \div \frac{2x + a}{x} = \frac{x(2x - a)}{x(2x + a)} = \frac{2x - a}{2x + a};$$

$$\text{б)} \frac{\frac{a-b}{c} + 3}{\frac{a+b}{c} - 1} = \frac{a-b+3c}{c} \div \frac{a+b-c}{c} = \frac{(a-b+3c)c}{(a+b-c)c} = \frac{a-b+3c}{a+b-c};$$

$$\text{в)} \frac{\frac{1}{x} + \frac{1}{y}}{\frac{1}{x} - \frac{1}{y}} = \frac{y+x}{xy} \div \frac{y-x}{xy} = \frac{xy(y+x)}{xy(y-x)} = \frac{y+x}{y-x};$$

$$\text{г)} \frac{\frac{x-y}{x} - \frac{y}{x}}{\frac{x-y}{x} - \frac{y}{x}} = \frac{x-y}{1} \div \frac{x^2 - y^2}{xy} = \frac{xy(x-y)}{(x-y)(x+y)} = \frac{xy}{x+y}.$$

№ 165.

а) Подставим $x = \frac{ab}{a+b}$ и получим:

$$\begin{aligned} \frac{x-a}{x-b} &= \frac{\frac{ab}{a+b} - a}{\frac{ab}{a+b} - b} = \frac{ab - a^2 - ab}{a+b} \div \frac{ab - ab - b^2}{a+b} = \left(-\frac{a^2}{a+b} \right) \div \left(-\frac{b^2}{a+b} \right) = \\ &= \frac{a^2(a+b)}{b^2(a+b)} = \frac{a^2}{b^2}. \end{aligned}$$

б) Подставим $x = \frac{a-b}{a+b}$ и получим:

$$\begin{aligned} \frac{\frac{a}{b} - x}{\frac{b}{a} + x} &= \frac{\frac{a}{b} - \frac{a-b}{a+b}}{\frac{b}{a} + \frac{a-b}{a+b}} = \frac{a^2 + ab - ab + b^2}{b(a+b)} \div \frac{ab + b^2 + a^2 - ab}{a(a+b)} = \\ &= \frac{a^2 + b^2}{b(a+b)} \div \frac{a^2 + b^2}{a(a+b)} = \frac{a(a^2 + b^2)(a+b)}{b(a^2 + b^2)(a+b)} = \frac{a}{b}. \end{aligned}$$

№ 166.

$$\begin{aligned} \text{а) } \frac{\frac{a^4}{4} - \frac{b^2}{9}}{\frac{a}{12} + \frac{b}{18}} &= \frac{9a^2 - 4b^2}{36} \div \frac{3a+2b}{36} = \frac{36(9a^2 - 4b^2)}{36(3a+2b)} = \\ &= \frac{(3a-2b)(3a+2b)}{3a+2b} = 3a-2b; \end{aligned}$$

Подставим $a = \frac{2}{3}$, $b = -\frac{1}{2}$ и получим:

$$3a - 2b = 3 \cdot \frac{2}{3} - 2 \cdot \left(-\frac{1}{2} \right) = 2 + 1 = 3;$$

Ответ: 3.

$$\begin{aligned} \text{б) } \frac{0,2a-b}{\frac{a^2}{25} - b^2} &= \frac{0,2a-b}{\frac{a^2 - 25b^2}{25}} = \frac{0,2a-b}{1} \div \frac{a^2 - 25b^2}{25} = \\ &= \frac{5 \cdot 5(0,2a-b)}{a^2 - 25b^2} = \frac{5(a-5b)}{(a-5b)(a+5b)} = \frac{5}{a+5b}; \end{aligned}$$

Подставим $a = -8$, $b = 0,6$ и получим:

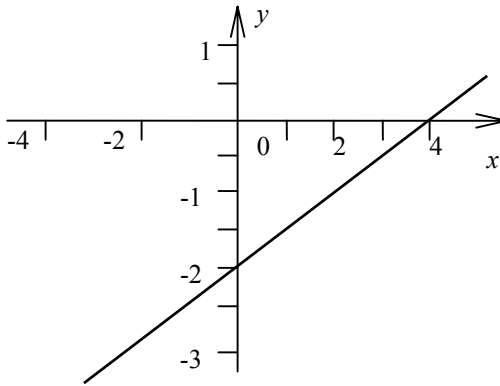
$$\frac{5}{a + 5b} = \frac{5}{-8 + 5 \cdot 0,6} = \frac{5}{-8 + 3} = -1;$$

Ответ: -1.

УПРАЖНЕНИЯ ДЛЯ ПОВТОРЕНИЯ

№ 167.

а)



1) У точки пересечения графика с осью x $y = 0$, т.е.

$$\frac{1}{2}x - 2 = 0; x = 4.$$

Таким образом, точка пересечения с осью x – это $(4; 0)$;

2) У точки пересечения графика с осью y $x = 0$, т.е.

$$y = \frac{1}{2} \cdot 0 - 2; y = -2.$$

Таким образом, точка пересечения с осью y – это $(0; -2)$.

б) 1) У точки пересечения графика с осью x $y = 0$, т.е.

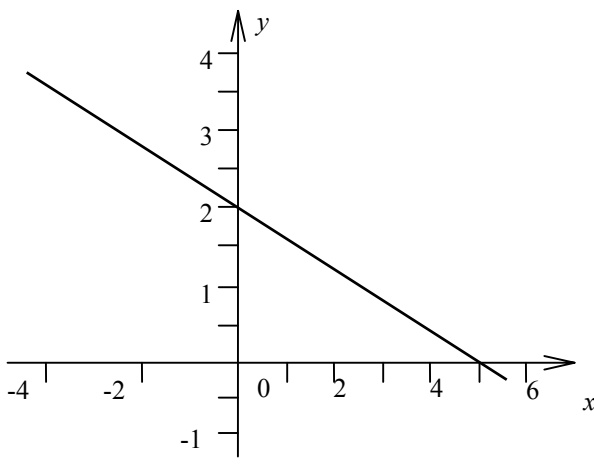
$$0 = -0,4x + 2; 0,4x = 2; x = 5.$$

Точка пересечения с осью x – это $(5; 0)$;

2) У точки пересечения графика с осью y $x = 0$, т.е.

$$y = -0,4 \cdot 0 + 2; y = 2.$$

Точка пересечения с осью y – это $(0; 2)$.



№ 168.

а) $y = kx + b$ – уравнение прямой. Подставим координаты точки $(0; 4)$ в это уравнение: $4 = k \cdot 0 + b$; $b = 4$; коэффициент k у параллельных прямых одинаковый, следовательно $k = 3$; получим уравнение: $y = 3x + 4$.

б) $y = kx + b$ – уравнение прямой. Подставим координаты точки $(0; 0)$ в это уравнение: $0 = k \cdot 0 + b$; $b = 0$; коэффициент k у параллельных прямых одинаковый, следовательно, $k = -\frac{1}{2}$; получим уравне-

ние: $y = -\frac{1}{2}x$.