

Rational Expressions - Multiply & Divide

Multiplying and dividing rational expressions is very similar to the process we use to multiply and divide fractions.

Example 1.

$$\frac{15}{49} \cdot \frac{14}{45} \quad \text{First reduce common factors from numerator and denominator (5 and 7)}$$

$$\frac{3}{7} \cdot \frac{2}{9} \quad \text{Multiply numerators across and denominators across}$$

$$\frac{6}{63} \quad \text{Our Solution}$$

The process is identical for division with the extra first step of multiplying by the reciprocal. When multiplying with rational expressions we follow the same process, first divide out common factors, then multiply straight across.

Example 2.

$$\frac{25x^2}{9y^8} \cdot \frac{24y^4}{55x^7} \quad \begin{array}{l} \text{Reduce coefficients by dividing out common factors (3 and 5)} \\ \text{Reduce, subtracting exponents, negative exponents in denominator} \end{array}$$

$$\frac{5}{3y^4} \cdot \frac{8}{11x^5} \quad \text{Multiply across}$$

$$\frac{40}{33x^5y^4} \quad \text{Our Solution}$$

Division is identical in process with the extra first step of multiplying by the reciprocal.

Example 3.

$$\frac{a^4b^2}{a} \div \frac{b^4}{4} \quad \text{Multiply by the reciprocal}$$

$$\frac{a^4b^2}{a} \cdot \frac{4}{b^4} \quad \text{Subtract exponents on variables, negative exponents in denominator}$$

$$\frac{a^3}{1} \cdot \frac{4}{b^2} \quad \text{Multiply across}$$

$$\frac{4a^3}{b^2} \quad \text{Our Solution}$$

Just as with reducing rational expressions, before we reduce a multiplication problem, it must be factored first.

Example 4.

$$\frac{x^2 - 9}{x^2 + x - 20} \cdot \frac{x^2 - 8x + 16}{3x + 9} \quad \text{Factor each numerator and denominator}$$

$$\frac{(x + 3)(x - 3)}{(x - 4)(x + 5)} \cdot \frac{(x - 4)(x - 4)}{3(x + 3)} \quad \text{Divide out common factors } (x + 3) \text{ and } (x - 4)$$

$$\frac{x - 3}{x + 5} \cdot \frac{x - 4}{3} \quad \text{Multiply across}$$

$$\frac{(x - 3)(x - 4)}{3(x + 5)} \quad \text{Our Solution}$$

Again we follow the same pattern with division with the extra first step of multiplying by the reciprocal.

Example 5.

$$\frac{x^2 - x - 12}{x^2 - 2x - 8} \div \frac{5x^2 + 15x}{x^2 + x - 2} \quad \text{Multiply by the reciprocal}$$

$$\frac{x^2 - x - 12}{x^2 - 2x - 8} \cdot \frac{x^2 + x - 2}{5x^2 + 15x} \quad \text{Factor each numerator and denominator}$$

$$\frac{(x - 4)(x + 3)}{(x + 2)(x - 4)} \cdot \frac{(x + 2)(x - 1)}{5x(x + 3)} \quad \text{Divide out common factors:}$$

$(x - 4)$ and $(x + 3)$ and $(x + 2)$

$$\frac{1}{1} \cdot \frac{x - 1}{5x} \quad \text{Multiply across}$$

$$\frac{x - 1}{5x} \quad \text{Our Solution}$$



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Practice - Multiply / Divide Rational Expressions

Simplify each expression.

1) $\frac{8x^2}{9} \cdot \frac{9}{2}$

3) $\frac{9n}{2n} \cdot \frac{7}{5n}$

5) $\frac{5x^2}{4} \cdot \frac{6}{5}$

7) $\frac{7(m-6)}{m-6} \cdot \frac{5m(7m-5)}{7(7m-5)}$

9) $\frac{7r}{7r(r+10)} \div \frac{r-6}{(r-6)^2}$

11) $\frac{25n+25}{5} \cdot \frac{4}{30n+30}$

13) $\frac{x-10}{35x+21} \div \frac{7}{35x+21}$

15) $\frac{x^2-6x-7}{x+5} \cdot \frac{x+5}{x-7}$

17) $\frac{8k}{24k^2-40k} \div \frac{1}{15k-25}$

19) $(n-8) \cdot \frac{6}{10n-80}$

21) $\frac{4m+36}{n+9} \cdot \frac{m-5}{5m^2}$

23) $\frac{3x-6}{12x-24}(x+3)$

25) $\frac{b+2}{40b^2-24b}(5b-3)$

27) $\frac{n-7}{6n-12} \cdot \frac{12-6n}{n^2-13n+42}$

29) $\frac{27a+36}{9a+63} \div \frac{6a+8}{2}$

31) $\frac{x^2-12x+32}{x^2-6x-16} \cdot \frac{7x^2+14x}{7x^2+21x}$

33) $(10m^2+100m) \cdot \frac{18m^3-36m^2}{20m^2-40m}$

35) $\frac{7p^2+25p+12}{6p+48} \cdot \frac{3p-8}{21p^2-44p-32}$

37) $\frac{10b^2}{30b+20} \cdot \frac{30b+20}{2b^2+10b}$

39) $\frac{7r^2-53r-24}{7r+2} \div \frac{49r+21}{49r+14}$

2) $\frac{8x}{3x} \div \frac{4}{7}$

4) $\frac{9m}{5m^2} \cdot \frac{7}{2}$

6) $\frac{10p}{5} \div \frac{8}{10}$

8) $\frac{7}{10(n+3)} \div \frac{n-2}{(n+3)(n-2)}$

10) $\frac{6x(x+4)}{x-3} \cdot \frac{(x-3)(x-6)}{6x(x-6)}$

12) $\frac{9}{b^2-b-12} \div \frac{b-5}{b^2-b-12}$

14) $\frac{v-1}{4} \cdot \frac{4}{v^2-11v+10}$

16) $\frac{1}{a-6} \cdot \frac{8a+80}{8}$

18) $\frac{p-8}{p^2-12p+32} \div \frac{1}{p-10}$

20) $\frac{x^2-7x+10}{x-2} \cdot \frac{x+10}{x^2-x-20}$

22) $\frac{2r}{r+6} \div \frac{2r}{7r+42}$

24) $\frac{2n^2-12n-54}{n+7} \div (2n+6)$

26) $\frac{21v^2+16v-16}{3v+4} \div \frac{35v-20}{v-9}$

28) $\frac{x^2+11x+24}{6x^3+18x^2} \cdot \frac{6x^3+6x^2}{x^2+5x-24}$

30) $\frac{k-7}{k^2-k-12} \cdot \frac{7k^2-28k}{8k^2-56k}$

32) $\frac{9x^3+54x^2}{x^2+5x-14} \cdot \frac{x^2+5x-14}{10x^2}$

34) $\frac{n-7}{n^2-2n-35} \div \frac{9n+54}{10n+50}$

36) $\frac{7x^2-66x+80}{49x^2+7x-72} \div \frac{7x^2+39x-70}{49x^2+7x-72}$

38) $\frac{35n^2-12n-32}{49n^2-91n+40} \cdot \frac{7n^2+16n-15}{5n+4}$

40) $\frac{12x+24}{10x^2+34x+28} \cdot \frac{15x+21}{5}$



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Answers - Multiply and Divide Rational Expressions

1) $4x^2$

2) $\frac{14}{3}$

3) $\frac{63}{10n}$

4) $\frac{63}{10m}$

5) $\frac{3x^5}{2}$

6) $\frac{5p}{2}$

7) $5m$

8) $\frac{7}{10}$

9) $\frac{r-6}{r+10}$

10) $x+4$

11) $\frac{2}{3}$

12) $\frac{9}{b-5}$

13) $\frac{x-10}{7}$

14) $\frac{1}{v-10}$

15) $x+1$

16) $\frac{a+10}{a-6}$

17) 5

18) $\frac{p-10}{p-4}$

19) $\frac{3}{5}$

20) $\frac{x+10}{x+4}$

21) $\frac{4(m-5)}{5m^2}$

22) 7

23) $\frac{x+3}{4}$

24) $\frac{n-9}{n+7}$

25) $\frac{b+2}{8b}$

26) $\frac{v-9}{5}$

27) $-\frac{1}{n-6}$

28) $\frac{x+1}{x-3}$

29) $\frac{1}{a+7}$

30) $\frac{7}{8(k+3)}$

31) $\frac{x-4}{x+3}$

32) $\frac{9(x+6)}{10}$

33) $9m^2(m+10)$

34) $\frac{10}{9(n+6)}$

35) $\frac{p+3}{6(p+8)}$

36) $\frac{x-8}{x+7}$

37) $\frac{5b}{b+5}$

38) $n+3$

39) $r-8$

40) $\frac{18}{5}$



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