Multiplying and Dividing Rational Expressions

recall these operations with fractions:

Evaluate

~~Simplify~~ each of the following

$\frac{1}{2} \cdot \frac{-3}{5} = \frac{(1)(-3)}{2(5)} = \frac{-3}{10}$

$\frac{50}{27} \cdot \frac{-3}{5} = \frac{-10}{9}$

$\frac{12}{27} \div \frac{20}{15} = \frac{12}{27} \cdot \frac{15}{20} = \frac{1}{3}$

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Multiplying and Dividing rational expressions is very similar to carrying these operations out with fractions, except for the factoring and stating restrictions.

Steps:

1. Factor the numerator and denominator separately.
2. Identify restrictions (where is denominator = 0 ?).
3. Divide out common factors to simplify.

note:

1) In division you have to multiply by the reciprocal of the divisor before step #3.

2) In division, the restrictions are determined from the denominators and the numerator of the divisor (since you have to take its reciprocal).

Ex.1 Simplify and state any restrictions

(a) $\frac{x}{4} \cdot \frac{12}{x^2}$

Ex.1 Simplify and state any restrictions

(b) $\frac{-5x^3}{3y} \div \frac{y}{25x^2}$

$= \frac{-5x^3}{3y} \cdot \frac{25x^2}{1y}$

$(-5x^3)(25x^2)$

$= -125x^5$

$= \frac{-125x^5}{3y^2}$, $y \neq 0$, $x \neq 0$

c) $\dfrac{x+2}{x^2-4x+3} \cdot \dfrac{x-1}{x^2+3x+2}$

$= \dfrac{(x+2)}{(x-3)(x-1)} \cdot \dfrac{(x-1)}{(x+1)(x+2)}$

$= \dfrac{1}{(x-3)(x+1)}$, $x \neq -2, 1, 3, -1$

(d) $\dfrac{2x+4}{x^2-9} \div \dfrac{x^2-4}{x^2-2x-3}$ D

$= \dfrac{2x+4}{x^2-9} \cdot \dfrac{x^2-2x-3}{x^2-4}$ D

$= \dfrac{2(x+2)}{(x-3)(x+3)} \cdot \dfrac{(x-3)(x+1)}{(x-2)(x+2)}$ D

$= \dfrac{2(x+1)}{(x+3)(x-2)}$, $x \neq 3, -2, 2, -3, -1$

(e) $\dfrac{x^2-x-20}{x^2-6x} \div \dfrac{x^2+9x+20}{x^2-12x+36}$

(e) $\dfrac{3a+6}{9a^2} \div \dfrac{a+2}{-3a} \cdot \dfrac{15a}{2}$

① B ✓
② E ✓
③ D M } L→R
④ A S } L→R

$= \dfrac{(3a+6)}{9a^2} \cdot \dfrac{(-3a)}{(a+2)} \cdot \dfrac{15a}{2}$

$= \dfrac{3(a+2)}{9a^2} \cdot \dfrac{-3a}{a+2} \cdot \dfrac{15a}{2}$

$= \dfrac{-15}{2}, \quad a \neq 0, -2$

Assigned Work:

p.121 # 3, 4ad, 5ad, 6-9, 13*

9

7c

6d

6(d) $\frac{9y^2-4}{4y-12} \div \frac{9y^2+12y+4}{18-6y}$ $\quad (3y)^2 \quad (2)^2$

$= \frac{(3y-2)(3y+2)}{4(y-3)} \cdot \frac{6(3-y)^{-1}}{(3y+2)^{-1}}$ $\quad \frac{z^x}{z^{x1}}$

$= \frac{-3(3y-2)}{2(3y+2)}$ $\quad y \neq 3, -\frac{2}{3}$

$3y+2=0$

$3y=-2$

$y=-\frac{2}{3}$

7(c) $\frac{10x^2+3xy-y^2}{9x^2-y^2} \div \frac{6x^2+3xy}{12x+4y}$

$= \frac{(5x-y)(2x+y)}{(3x-y)(3x+y)} \cdot \frac{4(3x+y)}{3x(2x+y)}$

$= \frac{4(5x-y)}{3x(3x-y)}$ $\quad x \neq -\frac{y}{2}, -\frac{y}{3}, \frac{y}{3}, 0$

9. $A = \frac{bh}{2}$

$= \frac{1}{2}\left(\frac{4x^2}{(x-7)(x-9)}\right)\cdot\left(\frac{5(x-7)}{x+3}\right)$

$= \frac{10x^2}{(x-9)(x+3)}$ $x \neq -3, 7, 9$

practical restriction, $A > 0$

$x > 9$ $x > -3 \Rightarrow x > 9$

13. $\dfrac{\frac{A}{B} \div \frac{C}{D}}{\frac{E}{F}}$

$= \left(\frac{A}{B} \div \frac{C}{D}\right) \div \frac{E}{F}$

$= \left(\frac{A}{B} \cdot \frac{D}{C}\right) \div \frac{E}{F}$

$= \frac{AD}{BC} \cdot \frac{F}{E}$

$= \frac{ADF}{BCE}$

$\frac{x-3^{-1}}{3-x}$