PCFU: Multiplying and Dividing Rational Expressions (E8-E9) Name ________________________________
HN

Multiply the two rational expressions then <u>state any restrictions</u> on the domain. Simplify completely.

$$\frac{3x^2+11x-4}{x^2-5x}\cdot\frac{x^2-10x+25}{9x^2-1}$$

Solution:

$$\frac{(x+4)(x-5)}{x(3x+1)}=\frac{x^2-x-20}{3x^2+x}\ where\ x\neq 0,5,\frac{1}{3},-\frac{1}{3}$$

First you must factor each numerator and each denominator.	
This has no GCF and a≠1 so you must use the diamond and factoring by grouping.	$3x^2+11x-4=(x+4)(3x-1)$
This has a GCF of x.	$x^2-5x=x(x-5)$
This has no GCF and a=1. Also, it is a perfect square trinomial.	$x^2-10x+25=(x-5)(x-5)$
This has no GCF and is the difference of two squares.	$9x^2-1=(3x-1)(3x+1)$

Once each part is factored you must put the rational expressions back together	$\frac{(x+4)(3x-1)}{x(x-5)}\cdot\frac{(x-5)(x-5)}{(3x-1)(3x+1)}$

Before you reduce, you need to find the restrictions so focus on the denominators.	$x\neq 0, x-5\neq 0, 3x-1\neq 0, 3x+1\neq 0$ So that means $x\neq 0,5,\frac{1}{3},-\frac{1}{3}$

Next divide the factors in the numerator by their matching counterparts in the denominator. (When you multiply fractions together, the numerators multiply and the denominators multiply creating one big happy fraction.)	$\frac{(x+4)\cancel{(3x-1)}\cancel{(x-5)}(x-5)}{x\cancel{(x-5)}\cancel{(3x-1)}(3x+1)}$
This leaves you with two factors in the numerator and two factors in the denominator.	$\frac{(x+4)(x-5)}{x(3x+1)}$
Some teachers and tests would prefer the multiplied out version of the answer so you need to recognize the equivalent form of this expression as well.	$\frac{x^2-x-20}{3x^2+x}$

Follow Up for Multiplying Rational Expressions:

If you missed more than one factoring portion then you REALLY need to get help and practice more. This skill is required for success in this and future math classes.
Try another problem below by mimicking the steps above.

Multiply and simplify: $\frac{x^2+6x-7}{x^2+5x}\cdot\frac{x^2+12x+35}{2x^2+7x-9}$. State your restrictions.

First you must factor each numerator and each denominator.
Begin by factoring the first numerator: $x^2+6x-7=$

Now factor the first denominator: $x^2+5x=$

Then the second numerator: $x^2+12x+35=$

Now the second denominator: $2x^2+7x-9=$

Now look only at the denominators. Establish your restrictions. There should be four factors that you must restrict.

Restrictions:

Lastly, put your factored form of each numerator and denominator back into place. Look for common factors in the numerators and denominators that will divide. Simplify your expressions.

Divide the two rational expressions then <u>state any restrictions</u> on the domain. Simplify completely.

$$\frac{3m^2-10m+8}{m^2-4m-12} \div \frac{3m^2+2m-8}{m^2-8m+12}$$

Solution:

$$\frac{(m-2)^2}{(m+2)^2} = \frac{m^2-4x+4}{m^2+4m+4}\ where\ m \neq 6, 2, -2, \frac{4}{3}$$

Everything about this is just like multiplication except for two things. 1) At some point you must change division to multiplication and the second rational expression to its reciprocal. 2) There are additional restrictions because the flipping of the second expression causes you to have another denominator to deal with.	
First you must factor each numerator and each denominator.	
This has no GCF and a≠1 so you must use the diamond and factoring by grouping.	$3m^2-10m+8=(3m-4)(m-2)$
This has no GCF and a=1 so you use the shortcut.	$m^2-4m-12=(m-6)(m+2)$
This has no GCF and a≠1 so you must use the diamond and factoring by grouping.	$3m^2+2m-8=(3m-4)(m+2)$
This has no GCF and a=1 so you use the shortcut.	$m^2-8m+12=(m-6)(m-2)$

Once each part is factored you must put the rational expressions back together	$\frac{(3m-4)(m-2)}{(m-6)(m+2)} \div \frac{(3m-4)(m+2)}{(m-6)(m-2)}$

Before you change to multiplication or reduce, you need to find the restrictions so focus on the denominators you have right now.	$m-6 \neq 0, m+2 \neq 0, m-2 \neq 0,$ So that means $m \neq 6, -2, 2$
Now change to multiplication and the reciprocal of the second expression and find any new restrictions. The new denominator gives you one additional restriction: $3m-4 \neq 0\ so\ m \neq \frac{4}{3}$	$\frac{(3m-4)(m-2)}{(m-6)(m+2)} \cdot \frac{(m-6)(m-2)}{(3m-4)(m+2)}$

Next divide the factors in the numerator by their matching counterparts in the denominator. (When you multiply fractions together, the numerators multiply and the denominators multiply creating one big happy fraction.)	$\frac{\cancel{(3m-4)}(m-2)\cancel{(m-6)}(m-2)}{\cancel{(m-6)}(m+2)\cancel{(3m-4)}(m+2)}$
This leaves you with two factors in the numerator and two factors in the denominator.	$\frac{(m-2)(m-2)}{(m+2)(m+2)}$
Some teachers and tests would prefer the multiplied out version of the answer so you need to recognize the equivalent form of this expression as well.	$\frac{m^2-4m+4}{m^2+4m+4}$

Follow Up for Dividing Rational Expressions:

If factoring or restrictions were the issue then refer to the front.

If changing from division to multiplication was the problem, practice that with these:

1) $\frac{4}{7} \div \frac{2}{5} =$

2) $\frac{(r-2)(r+3)}{(r-1)(r-5)} \div \frac{(r+2)(r-2)}{(r-1)(r+3)}$

Change the sign to multiplication then use the reciprocal of the second fraction. AFTER you've changed to multiplication, see if you can reduce. Multiply tops together and bottoms together.