C15-C17 PCFU HN: Factoring Higher Degree Polynomials Name: ___________________________________

Factor each expression completely.

1) $3x^3 - 18x^2 - 27x + 162$

1. First I checked to see if there was a GCF – is is 3.
2. Using reverse distributive property, I factored out the GCF.
3. Then I counted the number of terms and saw that there were four terms. The only way we've learned to factor four terms is with grouping, so that is what I did.
4. I created two groups then looked for a GCF for each group. In the first group, both terms have x^2 as a factor. In the second group, both terms have 9 as a factor. But when I took out 9, my remaining groups didn't match, so I went back and took out a -9 from the second group instead.
5. Once the GCFs were out of the two groups, I saw that my two sets of parentheses were the same. I just treated $(x-6)$ like another GCF and factored that out, leaving me with (x^2-9).
6. I recognized that (x^2-9) was the difference of two squares. x^2 is obviously a square and 9 is the same as 3^2, so I factored it further using the short-cut for factoring a difference of squares.

1. $3x^3 - 18x^2 - 27x + 162$
2. $3(x^3 - 6x^2 - 9x + 54)$
3. $3[(x^3 - 6x^2) + (-9x + 54)]$
4. $3[x^2(x-6) - 9(x-6)]$
5. $3[(x-6)(x^2-9)]$
6. $3(x-6)(x+3)(x-3)$

2) $4x^4 - 41x^2 + 100$

1. First I checked to see if there was a GCF – there isn't. Then I counted the number of terms and saw that there were three terms with exponents that count down evenly. This is similar to a quadratic trinomial, even though the first term is degree four. The exponents here are counting down by twos .Next I checked to see if my leading coefficient (my a-value) was equal to 1 or not. Because it was not, I realized that I would have to use the diamond method without any short-cut.
2. Since I have x^4 instead of x^2, I made a substitution to make it easier for me to put into the diamond. I let $z = x^2$ which means that $z^2 = x^2$. That way I could find my factors lickety-split.
3. I needed $a \cdot c = 400$ and $b = -41$ for my top and bottom numbers in the diamond. Which made it so that -25 and -16 would be the side numbers in the diamond.
4. I substituted $-25z - 16z$ in for $-41z$ and continued to factor with grouping.
5. The first group had a common factor of z so I factored that out. The second group had a common factor of 4, but when I took that out my parentheses didn't match with the two sets,so I went back and took out -4 which made the parentheses match.
6. Once both sets had the common factors out front, I was able to finish by seeing that $(4z-25)$ was common to both, so I factored that out as another common factor, leaving $(z-4)$.
7. Then I went back and replaced z with x^2.
8. I now had two factors that were both the difference of two squares ($4x^2 = (2x)^2$ *and* $25 = 5^2$*and* $4 = 2^2$). I factored those using the short-cut for factoring a difference of squares into the four factors I ended with.

1. $4x^4 - 41x^2 + 100$
2. $4z^2 - 41z + 100$
   $a = 1$
   $b = -29$
   $c = 100$
3. $4z^2 - 25z - 16z + 100$
4. $(4z^2 - 25z) + (-16z + 100)$
5. $z(4z-25) - 4(4z-25)$
6. $(4z-25)(z-4)$
7. $(4x^2-25)(x^2-4)$
8. $(2x+5)(2x-5)(x+2)(x-2)$

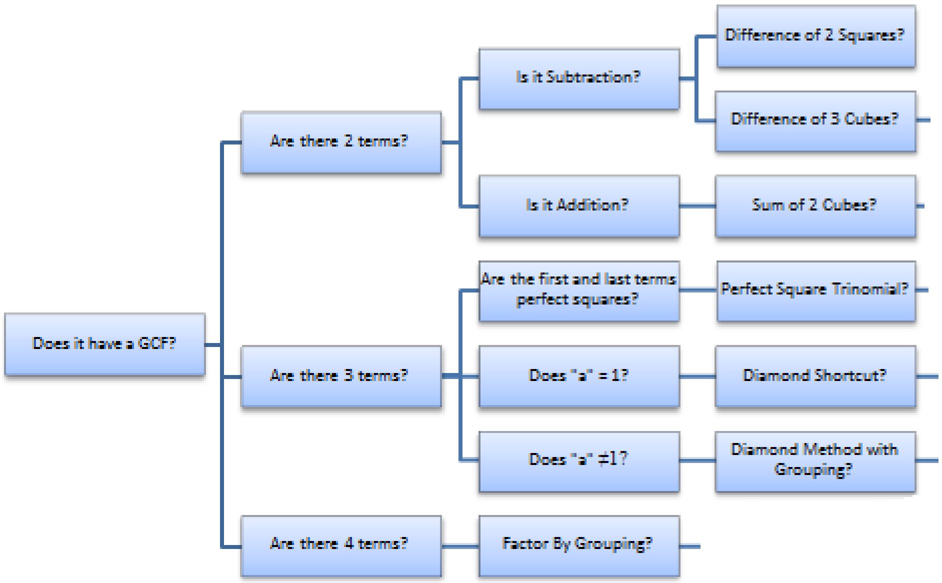
3) $4x^3 + 108$

1. First I checked to see if there was a GCF . I found the common factor to be 4, so I reverse distributed it to factor it out.
2. Then I counted the number of terms and saw that there were two terms. Next I checked to see if I had addition or subtraction. Since I had addition there was only one thing for me to try – the sum of two cubes. x^3 is obviously a perfect cube and I know that $27 = 3^3$, so I used the pattern we learned to factor the sum of cubes. Remember: $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$

1. $4x^3 + 108$
2. $4[x^3 + 27]$
   $4[(x)^3 + (3)^3]$
   $4[(x+3)(x^2 - (x)(3) + 3^2)]$
   $4(x+3)(x^2 - 3x + 9)$

Additional Practice on back

Factoring Decision Tree:



Additional Practice:

1. Factor the **GCF** from each of these polynomials.
   a) $6x^4 - 384x$

   b) $24x^3 + 42x^2 - 12x$

   c) $8x^3 - 40x^2 + 50x$

   d) $6x^4 - 30x^3 + 2x^2 - 10x$

2. Use the **factoring decision tree above** to help you determine which additional type of factoring you should try with each part of question one. Write what method you should try for each.
   a)
   b)
   c)
   d)

3. Now factor each of the expressions from #1 **COMPLETELY** using their GCFs and the type of factoring method that you chose for each one in #2. <u>Box/circle each one of your answers.</u>

a) $6x^4 - 384x$ b) $24x^3 + 42x^2 - 12x$ c) $8x^3 - 40x^2 + 50x$ d) $6x^4 - 30x^3 + 2x^2 - 10x$