PCFU HN: Synthetic Division and Remainder Theorem (C13-C14) Name: ________________________________

Reminder:

$$\text{Divisor}\,\overline{)\,\text{Dividend}}^{\;\text{Quotient}}$$

1. a) Use Synthetic Division and the given factor to factor the polynomial <u>completely</u>:

$$3x^3 + 22x^2 + 51x + 36 \;\div x + 3$$

First, I will find the zero so that I can set up the synthetic division.	$x + 3 = 0$ $-3 \quad -3$ $x = -3$
Now I will make sure that I am not missing any terms as I use the coefficients of the standard form of the dividend as my top row of numbers to go after the -3 in the box. The first coefficient of 3 drops down to begin the synthetic division cycle. We multiply it by the -3 in the box and the answer will go in the next open spot above the line (next to the arrow) in the second row of numbers from left to right. The numbers that line up above the line will get added together and the result will go under the line. From there, we will repeat this cycle over and over until we fill all the spaces.	$\begin{array}{c\|cccc} \boxed{-3} & 3 & 22 & 51 & 36 \\ & \downarrow & -9 & -39 & -36 \\ \hline & 3 & 13 & 12 & 0 \end{array}$
The last number underneath the line represents the remainder. Since the remainder is 0, we know that the divisor $(x + 3)$ is actually one factor of the dividend. The quotient is another factor, created by the numbers underneath the line that will be used as coefficients in standard form with variables and exponents put back in. The degree of the quotient will be one less than the degree of the dividend. Since the original polynomial was degree 3, the resulting quotient will have a degree 2. Since the quotient is a factor and since it is quadratic, we can try and factor further using the diamond method.	Quotient: $3x^2 + 13x + 12$ 36 9 4 13 $3x^2 + 9x + 4x + 12$ $(3x^2 + 9x) + (4x + 12)$ $3x(x + 3) + 4(x + 3)$ $(x + 3)(3x + 4)$
Because the directions say to factor the polynomial <u>completely,</u> we need to put the factors from the quotient with the divisor factor as well to get a complete final answer. Since one factor repeats, we could also write the answer using an exponent.	Answer: $(x + 3)(x + 3)(3x + 4)$ or $(x + 3)^2(3x + 4)$

Additional Practice:

1) Given $(3x^4 + 6x^2 - 9x) \;\div\; (x + 1)$,

   a) What value do you put in the "box" (or on the "shelf") as the divisor?

   b) Which terms need placeholders?

   c) Set up the synthetic division for this problem. Do not actually divide or work it out.

2) Use synthetic division and the factor $(x-3)$ to factor the polynomial $m(x) = 2x^3 + x^2 - 18x - 9$ completely.

a) Divide using synthetic division. Show your work below.

b) Write your quotient in polynomial form: ________________________

c) Factor your quotient from above. Show your work below.

d) Write $m(x)$ in its complete form: ____

2. Determine $P(-2)$, if $\frac{P(x)}{x+2} = x^3 - 4x^2 + 12x + 95 \quad R\ 47$

$P(-2) = 47$. I know this because the Remainder Theorem tells me that the remainder I get from division is the same result as the value of the function if I substitute the root of the factor into the function, $P(x)$. Since they tell us that the remainder is 47, then we know that the answer for $P(-2)$ will equal 47 without having to actually do any work.

3) Using the same polynomial $m(x)$ from #2 above, answer the following:

a) There are two ways to find $m(2)$. One way is to substitute 2 for x into the polynomial function. What is the other way?

b) Find $m(2)$ using the method you identified in part a.