SECTION 3-3

DIVIDING POLYNOMIALS

There are four types of division using polynomials, of which this section deals with three.
TYPE #1 (POLYNOMIAL ÷ MONOMIAL)

Example: $\dfrac{9x^3+3xy+15x^2}{3x}$

Split 'em up.

$$\frac{9x^3}{3x}+\frac{3xy}{3x}+\frac{15x^2}{3x}$$

and reduce each one…
$3x^2+y+5x$

Your turn:

1) $\dfrac{5np-10n^2p-35n^2p^2}{-5np}$

$$=\frac{5np}{-5np}-\frac{10n^2p}{-5np}-\frac{35n^2p^2}{-5np}$$
$$=-1+2n+7np$$

2) (21a + 2a^{3}b) ÷ (2ab)

$$=\frac{21a}{2ab}+\frac{2a^3b}{2ab}$$
$$=\frac{21}{b}+a^2$$

3) (12r^{2}q^4 – 8rq – 4q^3)(4rq)$^{-1}$

$$=\frac{12r^2q^4}{4rq}-\frac{8rq}{4rp}-\frac{4q^3}{4rq}$$
$$=3rq^3-2-\frac{q^2}{r}$$

TYPE #2 (LONG DIVISION) So much fun!! (at least for me)

Explain to me (in detail) how to do this problem: $32\overline{)9717}$

Now try this one:

$$3x^2-x+2+\frac{1}{2x+3}$$
$$2x+3\overline{)6x^3+7x^2+x+7}$$
$$\underline{6x^3+9x^2}$$
$$-2x^2+x$$
$$\underline{-2x^2-3x}$$
$$4x+7$$
$$\underline{4x+6}$$
$$1$$

Your turn:

4)
$$z+6$$
$$z-4\overline{)z^2+2z-24}$$
$$\underline{z^2-4z}$$
$$6z-24$$
$$\underline{6z-24}$$
$$0$$

5) (8x^4 – 4x^2 + x + 4) ÷ (2x + 1)

Can you use the split 'em method on this one? no!

$$4x^3-2x^2-x+1+\frac{3}{2x+1}$$
$$2x+1\overline{)8x^4+0x^3-4x^2+x+4}$$
$$\underline{8x^4+4x^3}$$
$$-4x^3-4x^2$$
$$\underline{-4x^3-2x^2}$$
$$-2x^2+x$$
$$\underline{-2x^2-x}$$
$$2x+4$$
$$\underline{2x+1}$$
$$3$$

TYPE #3
SYNTHETIC DIVISION

<u>Practice session first!</u> Long division is kinda tough, agree???
So, let's do a really tough one before we move on. I'll start it, but you can fill in the rest of the problem to make it easier on yourselves if you want. Pick any coefficient you want, just don't use it more than once!
Here we go:

$$x-2\overline{\big)\ x^6 \quad x^5 \quad x^4 \quad x^3 \quad x^2 \quad x\ }$$

TYPE #3 (SYNTHETIC DIVISION)

1) Drop the first # all the way down.
2) Multiply by the # in the box.
3) Add down.
4) Put the variables back in.

Example:

$(2y^3 + 4y^2 - 5y - 11) \div (y + 3)$

-3	2	4	-5	-11
	↓	-6	6	-3
	2	-2	1	-14

Answer: $2y^2 - 2y + 1 - \dfrac{14}{y+3}$

Your turn:

6) $(3x^4 - x^3 + 5x^2 + 2x - 10) \div (x - 1)$

7) $\dfrac{x^4 + 8x^3 + 17x^2 + 1}{x+5}$

See next page!

Limitations for synthetic division

Unfortunately, syn. div. cannot (or shouldn't) be used all the time.
Identify the reason these problems aren't syn. div. prob.s

8) $\dfrac{6a^3 - 2a + 9}{5a - 1}$

9) $\dfrac{a^2 + 8a - 13}{a^2 + 2}$

10) $\dfrac{2x^5 - x^3 - x + 7}{x^2 + 3x + 2}$

6) $(3x^4 - x^3 + 5x^2 + 2x - 10) \div (x - 1)$

1					
	3	-1	5	2	-10
	↓	3	2	7	9
	3	2	7	9	-1

Answer: $3x^3 + 2x^2 + 7x + 9 - \dfrac{1}{x-1}$

7) $\dfrac{x^4 + 8x^3 + 17x^2 + 1}{x+5}$

Must include the zero. Each exponent is treated like a "place value". There is no x-term in the problem, so it should be treated as: $x^4 + 8x^3 + 17x^2 + 0x + 1$

-5					
	1	8	17	0	1
	↓	-5	-15	-10	50
	1	3	2	-10	51

Answer: $x^3 + 3x^2 + 2x - 10 + \dfrac{51}{x+5}$