Section: 5.4

Objective: Factoring with leading coefficient other than 1 (F.IF.8)

Review Examples: Multiply the following.

a) $(2x+3)(5x+4)$

	$2x$	$+3$
$5x$	$10x^2$	$15x$
$+4$	$8x$	12

$10x^2 + 23x + 12$

b) $(3v-1)(v+2)$

	$3v$	-1
v	$3v^2$	$-1v$
$+2$	$6v$	-2

$3v^2 + 5v - 2$

c) $(4c-3)(7c-2)$

	$4c$	-3
$7c$	$28c^2$	$-21c$
-2	$-8c$	6

$28c^2 - 21c - 8c + 6$
$28c^2 - 29c + 6$

Factoring a Trinomial of the Form $ax^2 + bx + c$ **by Grouping:**
1. Always check for a GCF first! If there is a GCF, factor it out.
2. Multiply $a \cdot c$.
3. Find two numbers that multiply to your answer $(a \cdot c)$ and add to b.
4. Rewrite the middle term bx as $\textbf{1st \# } \cdot x + \textbf{2nd \# } \cdot x$
5. Factor the resulting polynomial by grouping.
6. If there are no numbers that multiply to $a \cdot c$ and add to b, the polynomial is prime.

Examples: Factor the following polynomials using grouping.

a) $9h^2 + 9h + 2$
  (a)   (c)

$ac = \dfrac{18}{9 \cdot 2}$ $b = 9$

mult   add
18   9
1 18
2 9
3 6

Factors of ac:
2·9
3·6   (circled)
1·18

Which factors add to b? 3,6

Factor the expression.

	$3h$	$+1$
$3h$	$9h^2$	$3h$
2	$6h$	2

$(3h+1)(3h+2)$

b) $3x^2 + 19x + 15$

$ac = \dfrac{45}{3 \cdot 15}$ $b = 19$

Factors of ac:
1·45
3·15
9·5

Which factors add to b? none

Factor the expression.
not factorable
prime

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c) $2z^2 - 11z + 12$

$ac = \dfrac{24}{2 \cdot 12}$ $b = -11$

Factors of ac:

$-1 \cdot 24$ $-1 + -24$
$-2 \cdot 12$ $-2 + -12$
$-3 \cdot 8$ $-3 + -8$
$-4 \cdot 6$ $-4 + -6$

Which factors add to b? $-3, -8$
$-11z$

Factor the expression.

	$2z$	-3
z	$2z^2$	$-3z$
-4	$-8z$	12

$(2z - 3)(z - 4)$

d) $4p^2 - 20p + 21$

$ac = \dfrac{84}{4 \cdot 21}$ $b = -20$

Factors of ac:

$-1 \cdot 84$
$-2 \cdot 42$
$-3 \cdot 28$
$-4 \cdot 21$
$-6, -14$

Which factors add to b? $-20p$
$-6p$ $-14p$

Factor the expression.

	$2p$	-7
$2p$	$4p^2$	$-14p$
-3	$-6p$	21

$(2p - 7)(2p - 3)$

e) $4n^2 - 20n + 25$

$4n^2 - 20n + 25$

top right

ac
$4 \cdot 25$
$100, -20$

bottom left
$-1 \cdot -100$
$-2 \cdot -50$
$-4 \cdot -25$
$-5 \cdot -20$
$-10 \cdot -10$

	$2n$	-5
$2n$	$4n^2$	$-10n$
-5	$-10n$	25

$(2n - 5)(2n - 5)$

OR $(2n - 5)^2$

f) $10m^2 + 13m - 3$

ac

-30	13
-1	30
-2	15
-3	10
-5	6

	$5m$	-1
$2m$	$10m^2$	$-2m$
3	$15m$	-3

$(5m - 1)(2m + 3)$

2

g) $12y^2 + 30y - 72$ GCF=6   h) $8k^4 + 42k^3 - 36k^2$

$6(2y^2 + 5y - 12)$ GCF: $2k^2$

$$\begin{array}{c|c} & 5 \\ 2 \cdot \overset{-24}{-12} & \\ \hline -1 \cdot 24 & \\ -2 \cdot 12 & \\ \boxed{-3 \cdot 8} & \\ -4 \cdot 6 & \end{array}$$

$2k^2(4k^2 + 21k - 18)$

$$\begin{array}{c|c} 4 \cdot 18 & 21 \\ -72 & \\ \hline -1 \cdot 72 & \\ -2 \cdot 36 & \\ \boxed{-3 \cdot 24} & \end{array}$$

	$2y$	-3
y	$2y^2$	$-3y$
4	$8y$	-12

	$4k$	-3
$1k$	$4k^2$	$-3k$
6	$24k$	-18

$6(2y-3)(y+4)$

$2k^2(4k-3)(1k+6)$

i) $3r^2 - 16r - 12$ j) $9x^2 - 4$

$$\begin{array}{c|c} -36 & -16 \\ \hline 1 \cdot \overset{-}{36} & \\ \boxed{2 \cdot -18} & \end{array}$$

$9x^2 + 0x - 4$

$$\begin{array}{c|c} 9 \cdot -4 & 0 \\ -36 & \\ \hline 6 \cdot -6 & \end{array}$$

	$3r$	2
r	$3r^2$	$2r$
-6	$-18r$	-12

	$3x$	$+2$
$3x$	$9x^2$	$6x$
-2	$-6x$	-4

$(3r+2)(r-6)$

$(3x-2)(3x+2)$