Lesson 3-4   Solving Multi-Step Inequalities

> 🔑 Solving multi-step inequalities is no different from solving multi-step equation *except* when multiplying or dividing by a negative value.

The boiling point of a substance is the temperature at which the element changes from a liquid to a gas. The boiling point of chlorine is –31° F. To change from Celsius to Fahrenheit, use the formula $F = \frac{9}{5}C + 32$. You can solve $\frac{9}{5}C + 32 > -31$ to find the temperature in degrees Celsius for which Chlorine is a gas.

$$\frac{9}{5}C + 32 > -31$$

$$\frac{9}{5}C + 32 - 32 > -31 - 32$$ Subtract 32 from each side

$$\frac{9}{5}C > -63$$ Simplify

$$\frac{5}{9}\left(\frac{9}{5}C\right) > -63\left(\frac{5}{9}\right)$$ Multiply by the reciprocal of $\frac{9}{5}$

$$C > -35$$ Simplify

Chlorine will be a gas for all temperatures greater than $-35°C$

Example B. The boiling point of helium is –452° F. Solve $\frac{9}{5}C + 32 > -452$ to find the temperatures in degrees Celsius for which helium is a gas.

$$\frac{9}{5}C + 32 > -452$$

$$\frac{9}{5}C + 32 - 32 > -452 - 32$$ Subtract 32 from each side

$$\frac{9}{5}C > -484$$ Simplify

$$\frac{5}{9} \cdot \frac{9}{5}C > -484 \cdot \frac{5}{9}$$ Multiply by the reciprocal of $\frac{9}{5}$

$$C > -268.\overline{8}$$ Simplify

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Inequalities Involving a Negative Coefficient

Example C $\quad 13 - 11d \geq 7$

$13 - 13 - 11d$	$>$	$7 - 13$
$-11d$	$>$	-6
$\dfrac{-11d}{-11}$	$<$	$\dfrac{-6}{-11}$
d	$<$	$6/11$
$\{d \mid d < 6/11\}$		

Example D $\quad -8y + 3 > -5$

$-8y + 3 - 3$	$>$	$-5 - 3$
$-8y$	$>$	-8
$\dfrac{-8y}{-8}$	$<$	$\dfrac{-8}{-8}$
y	$<$	1
$\{y \mid y < 1\}$		

Solving Inequalities with the Distributive Property (Dist., CLT, move)

Example E $\quad 8 - 1(c + 3) \leq 6 + 3(2 - c)$

$8 - c - 3$	$\leq$	$6 + 6 - 3c$
$5 - c$	$\leq$	$12 - 3c$
$5 - c + 3c$	$\leq$	$12 - 3c + 3c$
$5 + 2c$	$\leq$	12
$5 - 5 + 2c$	$\leq$	$12 - 5$
$2c$	$\leq$	7
$\dfrac{2c}{2}$	$\leq$	$\dfrac{7}{2}$
$\{c \mid c \leq \frac{7}{2}\}$		

Example F $\quad 3p - 2(p - 4) < p - (2 - 3p)$

$3 - 2p + 8$	$<$	$p - 2 + 3p$
$-2p + 11$	$<$	$4p - 2$
$-2p - 4p + 11$	$<$	$4p - 4p - 2$
$-6p + 11$	$<$	-2
$-6p + 11 - 11$	$<$	$-2 - 11$
$\dfrac{-6p}{-6}$	$<$	-13
$\dfrac{-6p}{-6}$	$>$	$\dfrac{-13}{-6}$
p	$>$	$\dfrac{13}{6}$
$\{p \mid p > \frac{13}{6}\}$		