Math 20-2
Radicals with Variables

A. Skills:
Identify square and cube expressions using variables:
$(5)(5) = 5^2$ so $\sqrt{5^2} = 5$
$(x)(x) = x^2$ so $\sqrt{x^2} = x$
$(x^2)(x^2) = x^4$ so $\sqrt{x^4} = x^2$

$\sqrt[3]{\quad} \ldots (\quad)^{1/3}$

$(x)(x)(x) = x^3$ $\quad \sqrt[3]{x^3} = x$

$\sqrt[2]{x^2} = (x^2)^{1/2} = x$

B. Restrictions, domain of square root expressions?
Examples:
1. $\sqrt{x-5}$

x-5 is positive or zero
x-5 is zero or more.
x-5=0
x=5

$x \geq 5$

2. $\sqrt{2x+1}$

2x+1 is zero or more?

$2x+1=0$
$-1 \quad -1$
$\frac{2x}{2} = \frac{-1}{2}$

$x = -0.5$

$x \geq -0.5$

C. Express as mixed radicals in simplest form. Restrictions?
Examples:
1. $\sqrt{18x^3}$

$18x^3$ zero or more
$18x^3 = 0$
$x^3 = 0$

$x \geq 0$

$\sqrt{9x^2}\sqrt{2x}$

"pairs of x"

$= 3x\sqrt{2x}$

2. $\sqrt{8x^5}$

zero or more
$x \geq 0$

$= \sqrt{4x^4}\sqrt{2x}$
$2x^2\sqrt{2x}$

3. $3x\sqrt{49x^7}$

$= 3x\sqrt{49x^6}\sqrt{x}$
$= (3x)(7x^3)\sqrt{x}$
$= 21x^4\sqrt{x}$

$\sqrt{x^6} = (x^6)^{1/2}$

4. $\sqrt[3]{24x^7}$

$= \sqrt[3]{8x^6}\sqrt[3]{3x}$

$= 2x^2\sqrt[3]{3x}$

$\sqrt[3]{\quad} = (\quad)^{1/3}$
$\ldots$

D. Add and Subtract, Multiply, Divide. Restrictions.

Examples:

1. $5\sqrt{x}+2\sqrt{x}$ $= 7\sqrt{x}$

same size — size doesn't change when add

2. $(2\sqrt{x}+3)(3\sqrt{x}-5)$ $= 6\sqrt{x^2} - 10\sqrt{x} + 9\sqrt{x} - 15$

$= 6x - \sqrt{x} - 15$

$\frac{(x\cdot x\cdot x\cdot x\cdot x)}{(x)}$

3. $\frac{15\sqrt{6x^3}}{3\sqrt{2x}} = \frac{5\sqrt{6x^3}}{\sqrt{2x}} = \frac{5\sqrt{3x^2}}{(1)}$

numb÷number "3"

rad÷rad "2x"

$= 5x\sqrt{3}$

mult radicals by itself

4. $\frac{6\sqrt{5}-\sqrt{24x^3}}{2\sqrt{x}} \cdot \frac{\sqrt{x}}{\sqrt{x}} = \frac{6\sqrt{5x} - \sqrt{24x^4}}{2\sqrt{x^2}}$

numb÷numb: 6, −1, 2

5, $24x^3$, x

$= \frac{6\sqrt{5x} - \sqrt{4x^4}\sqrt{6}}{2x}$

$= \frac{6\sqrt{5x} - 2x^2\sqrt{6}}{2x}$

6, −2, 2

÷2

$= \frac{3\sqrt{5x} - x^2\sqrt{6}}{x}$