10.2 Simplifying Radicals

(*) Radical expression
- an expression under the radical
- examples:

$$\sqrt{4}, \sqrt{y}, \sqrt{x^2+4}, 2\sqrt{3}, \sqrt{x}+3$$

(*) A radical expression is simplified when...
1. the radicand has no perfect-square factors other than 1 $\sqrt{12}$
2. the radicand contains no fractions $\sqrt{\frac{x}{2}}$
3. No radicals appear in the denominator $\frac{5}{\sqrt{7}}$

(*) How do you simplify these radicals?
(Look for perfect square roots as factors)

1. $\sqrt{12}$ * Use the Multiplication Property of Square Roots
For $a \geq 0$ & $b \geq 0$, $\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$

$\downarrow$

$\sqrt{4} \cdot \sqrt{3}$ * where one factor is a square root

$2\sqrt{3}$ * simplified

*try to always choose the greatest perfect square factor

(*) Got it #1) $\sqrt{72} = \sqrt{36} \cdot \sqrt{2} = 6\sqrt{2}$

* Review Problem 2 on pg. 620

* Got it # 2) * Assume all variables in radicands are nonnegative.

$-m\sqrt{80m^9}$

$-m\sqrt{16\cdot 5\cdot m^8\cdot m}$

$-m\sqrt{16}\cdot\sqrt{5}\cdot\sqrt{m^8}\cdot\sqrt{m}$

$-m\cdot 4\cdot\sqrt{5}\cdot m^4\cdot\sqrt{m}$

$-m\cdot 4\cdot m^4\cdot\sqrt{5m}$

$-4m^5\sqrt{5m}$

* Review Problem 3 on pg. 620

* Got it #3)

A) $3\sqrt{6}\cdot\sqrt{18}$

$3\cdot\sqrt{6}\cdot\sqrt{9}\cdot\sqrt{2}$

$3\cdot\sqrt{6}\cdot 3\sqrt{2}$

$9\sqrt{12}$

$9\sqrt{4}\cdot\sqrt{3}$

$9\cdot 2\sqrt{3}$

$18\sqrt{3}$

B) $\sqrt{2a}\cdot\sqrt{9a^3}$

$\sqrt{2}\cdot\sqrt{a^4}\cdot\sqrt{9}$

$\sqrt{2}\cdot a^2\cdot 3$

$3a^2\sqrt{2}$

C) $7\sqrt{5x}\cdot 3\sqrt{20x^5}$

$7\cdot\sqrt{5}\cdot\sqrt{x^6}\cdot 3\sqrt{4}\cdot\sqrt{5}$

$7\cdot\sqrt{5}\cdot x^3\cdot 3\cdot 2\sqrt{5}$

$42x^3\sqrt{25}$

$42\cdot x^3\cdot 5$

$210x^3$

C) Yes; $\sqrt{14t^2} = t\sqrt{14}$

* Review Problem 4 on pg. 621

* Got it #4) $d^2 = w^2 + (4w)^2$

$d^2 = w^2 + 16w^2$

$d^2 = 17w^2$

$d = \sqrt{17w^2}$

$d = w\sqrt{17}$ or about $4.12w$

* How do you simplify radicals that appear in the denominator or a radicand that is a fraction?

(2) $\sqrt{\frac{36}{49}} = \frac{\sqrt{36}}{\sqrt{49}} = \frac{6}{7}$

* Use the Division Property of Square Roots,

For $a \geq 0$ & $b \geq 0$, $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$

* Review Problem 5 on pg. 622

* Got it? 5)

A) $\sqrt{\frac{144}{9}}$

$\frac{\sqrt{144}}{\sqrt{9}}$

$\frac{12}{3}$

4

B) $\sqrt{\frac{36a}{4a^3}}$

$\sqrt{\frac{9}{a^2}}$

$\frac{\sqrt{9}}{\sqrt{a^2}}$

$\frac{3}{a}$

C) $\sqrt{\frac{25y^3}{z^2}}$

$\frac{\sqrt{25} \cdot \sqrt{y^2} \cdot \sqrt{y}}{\sqrt{z^2}}$

$\frac{5y\sqrt{y}}{z}$

(2) Rationalize the denominator - removing the radical in the denominator by multiplying the numerator & denominator by the same radical expression (Choose an expression that makes the radicand in the denominator a perfect square)

* Review Problem 6 on pg. 622

* Got it 6

A) $\frac{\sqrt{2}}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{6}}{3}$

* You changing its appearance, NOT its value as $\frac{\sqrt{3}}{\sqrt{3}}$ is equivalent to 1.

B) $\frac{\sqrt{5}}{\sqrt{18m}} \cdot \frac{\sqrt{18m}}{\sqrt{18m}} = \frac{\sqrt{90m}}{18m} = \frac{\sqrt{9}\cdot\sqrt{10m}}{18m} = \frac{3\sqrt{10m}}{18m} = \frac{\sqrt{10m}}{6m}$

C) $\sqrt{\frac{7s}{3}} = \frac{\sqrt{7s}}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{21s}}{3}$

* Sometimes after rationalizing the denominator, you need to still simplify by factoring & combining expressions

10.2 pg. 623 # 8 – 68 even, skip 48 (30 problems)

8) $\frac{3}{\sqrt{12}}$ 1st way $\frac{3}{\sqrt{12}} \cdot \frac{\sqrt{12}}{\sqrt{12}} = \frac{3\sqrt{12}}{12} = \frac{\sqrt{12}}{4} = \frac{\sqrt{3}\cdot\sqrt{4}}{4} = \frac{2\sqrt{3}}{4}$

$= \frac{\sqrt{3}}{2}$

or

2nd way

$\frac{3}{\sqrt{12}} = \frac{3}{\sqrt{4}\cdot\sqrt{3}} = \frac{3}{2\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{3\sqrt{3}}{2\cdot 3} = \frac{\sqrt{3}}{2}$

10) $\sqrt{225} = 15$

12) $\sqrt{128} = \sqrt{64}\cdot\sqrt{2}$

$= 8\sqrt{2}$

14) $-4\sqrt{117}$

$-4\sqrt{9}\cdot\sqrt{13}$

$-4\cdot 3\cdot\sqrt{13}$

$-12\sqrt{13}$

16) $\sqrt{192s^2}$

$\sqrt{64}\cdot\sqrt{3}\cdot\sqrt{s^2}$

$8s\sqrt{3}$

18) $3\sqrt{18a^2}$

$3\sqrt{9}\cdot\sqrt{2}\cdot\sqrt{a^2}$

$3\cdot 3\cdot a\cdot\sqrt{2}$

$9a\sqrt{2}$

20) $3\sqrt{150b^8}$

$3\sqrt{25}\cdot\sqrt{6}\cdot\sqrt{b^8}$

$3\cdot 5\cdot b^4\sqrt{6}$

$15b^4\sqrt{6}$

22) $\sqrt{8}\cdot\sqrt{32}$ OR $\sqrt{256}$

$\sqrt{4}\cdot\sqrt{2}\cdot\sqrt{16}\cdot\sqrt{2}$ 16

$2\cdot\sqrt{2}\cdot 4\cdot\sqrt{2}$

$8\sqrt{4}$

16

24) $4\sqrt{10}\cdot 2\sqrt{90}$

$4\sqrt{10}\cdot 2\sqrt{9}\cdot\sqrt{10}$

$4\cdot 10\cdot 2\cdot 3$

$40\cdot 6$

240

$c^2 = a^2 + b^2$

26) $-5\sqrt{21} \cdot (-3\sqrt{42})$

$+15\sqrt{882}$

$+15\sqrt{9} \cdot \sqrt{98}$

$+15\sqrt{9} \cdot \sqrt{49} \cdot \sqrt{2}$

$+15 \cdot 3 \cdot 7 \cdot \sqrt{2}$

$+315\sqrt{2}$

28) $3\sqrt{5c} \cdot 7\sqrt{15c^2}$

$21\sqrt{75c^2 \cdot c}$

$21c\sqrt{25} \cdot \sqrt{3} \cdot \sqrt{c}$

$21c \cdot 5\sqrt{3c}$

$105c\sqrt{3c}$

30) $-6\sqrt{15s^3} \cdot 2\sqrt{75}$

$-6\sqrt{15 \cdot s^2 \cdot s} \cdot 2\sqrt{25} \cdot \sqrt{3}$

$-6\sqrt{15} \cdot s\sqrt{s} \cdot 2 \cdot 5 \cdot \sqrt{3}$

$-60s\sqrt{45s}$

$-60s\sqrt{9}\sqrt{5s}$

$-180s\sqrt{5s}$

32) $10\sqrt{12x^3} \cdot 2\sqrt{6x^3}$

$10\sqrt{4} \cdot \sqrt{3} \cdot \sqrt{x^2} \cdot \sqrt{x} \cdot 2\sqrt{6} \cdot \sqrt{x^2}\sqrt{x}$

$10 \cdot 2 \cdot \sqrt{3} \cdot x \cdot \sqrt{x} \cdot 2 \cdot \sqrt{6} \cdot x \cdot \sqrt{x}$

$40x^2\sqrt{18x^2}$

$40x^2\sqrt{9}\sqrt{2}\sqrt{x^2}$

$40x^3 \cdot 3 \cdot \sqrt{2}$

$120x^3\sqrt{2}$

34) $d^2 = w^2 + (6w)^2$

$d^2 = w^2 + 36w^2$

$d^2 = 37w^2$

$d = \sqrt{37w^2}$

$d = w\sqrt{37}$ or $6.1w$

36) $\sqrt{\frac{16}{25}} = \frac{4}{5}$

38) $-4\sqrt{\frac{100}{729}} = \frac{-4}{1} \cdot \frac{10}{27} = \frac{-40}{27}$

or $-1\frac{13}{27}$

40) $-5\sqrt{\frac{162t^3}{2t}}$

$-5 \cdot \sqrt{81t^2}$

$-5 \cdot 9 \cdot t = -45t$

42) $\frac{1}{\sqrt{11}} \cdot \frac{\sqrt{11}}{\sqrt{11}} = \frac{\sqrt{11}}{11}$

44) $\frac{3\sqrt{6}}{\sqrt{15}} \cdot \frac{\sqrt{15}}{\sqrt{15}} = \frac{3\sqrt{90}}{15} = \frac{\sqrt{9}\cdot\sqrt{10}}{5} = \frac{3\sqrt{10}}{5}$

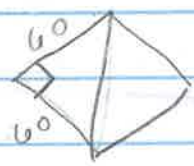
46) $\frac{2\sqrt{24}}{\sqrt{48t^4}} = 2\sqrt{\frac{24}{48t^4}} = 2\sqrt{\frac{1}{2t^4}} = \frac{2\sqrt{1}}{t^2\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{2\sqrt{2}}{2t^2} = \frac{\sqrt{2}}{t^2}$

50) Radical in the denominator

52) Yes in simpeiest form

54) $\sqrt{\frac{5x}{25}} = \sqrt{\frac{1}{5}x} = \frac{\sqrt{1x}}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{\sqrt{5x}}{5}$ ← x needs to under the radical

56)



$A = s^2$

$A = 3600$

$\sqrt{s^2} = \sqrt{3600}$

$s = 60$

$60^2 + 60^2 = c^2$

$3600 + 3600 = c^2$

$7200 = c^2$

$c = 84.85$

about 85 ft.

58) $\sqrt{12}\cdot\sqrt{75}$

$\sqrt{4}\cdot\sqrt{3}\cdot\sqrt{25}\cdot\sqrt{3}$

$2\cdot\sqrt{3}\cdot 5\cdot\sqrt{3}$

$10\sqrt{9}$

$10\cdot 3$

30

60) $\dfrac{\sqrt{72}}{\sqrt{64}} = \dfrac{\sqrt{36}\sqrt{2}}{8} = \dfrac{6\sqrt{2}}{8} = \dfrac{3\sqrt{2}}{4}$

62) $\dfrac{\sqrt{180}}{3} = \dfrac{\sqrt{36}\cdot\sqrt{5}}{3} = \dfrac{6\sqrt{5}}{3} = 2\sqrt{5}$

63) $\dfrac{\sqrt{x^2}}{\sqrt{y^3}} = \dfrac{x}{y\sqrt{y}} \cdot \dfrac{\sqrt{y}}{\sqrt{y}} = \dfrac{x\sqrt{y}}{y^2}$

skip

64) $\dfrac{-3\sqrt{2}}{\sqrt{6}} = -3\sqrt{\dfrac{2}{6}} = \dfrac{-3\sqrt{1}}{\sqrt{3}} \cdot \dfrac{\sqrt{3}}{\sqrt{3}} = \dfrac{-3\sqrt{3}}{3} = -\sqrt{3}$

66) $\sqrt{20a^2b^3} = \sqrt{4}\cdot\sqrt{5}\cdot\sqrt{a^2}\sqrt{b^2}\cdot\sqrt{b} = 2ab\sqrt{5b}$

68) $\sqrt{\dfrac{3m}{16m^2}} = \dfrac{\sqrt{3m}}{\sqrt{16m^2}} = \dfrac{\sqrt{3m}}{4m}$