Mathematics 11U

3.4 – Operations with Radicals

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$\sqrt{5}$ $\sqrt{4} = 2$

$1^2 = 1$

$2^2 = 4$

$3^2 = 9$

$4^2 = 16$

$5^2 = 25$

$6^2 = 36$

$7^2 = 49$

$8^2 = 64$

$9^2 = 81$

$10^2 = 100$

$11^2 = 121$

$12^2 = 144$

$13^2 = 169$

$14^2 = 196$

$15^2 = 225$

$16^2 = 256$

$17^2 = 289$

$18^2 = 324$

$19^2 = 361$

$20^2 = 400$

Simplifying Radicals: $\sqrt{2} \times \sqrt{3} = \sqrt{6}$

1. $2\sqrt{48}$

$= 2\sqrt{16}\sqrt{3}$

$= 2(4)\sqrt{3}$

$= 8\sqrt{3}$

2. $-\sqrt{20}$

$= -\sqrt{4}\sqrt{5}$

$= -2\sqrt{5}$

3. $\frac{1}{8}\sqrt{320}$

$= \frac{1}{8}\sqrt{8}\sqrt{40}\sqrt{5}$

$= \sqrt{5}$

4. $-3\sqrt{513}$

$= -3\sqrt{9}\sqrt{57}$

$= -9\sqrt{57}$

Simplifying Radicals with variables:

1. $7\sqrt{288b^4}$

$= 7\sqrt{144b^4}\sqrt{2}$

$= 84b^2\sqrt{2}$

2. $-5\sqrt{45n^3}$

$= -5\sqrt{9n^2}\sqrt{5n}$

$= -15n\sqrt{5n}$

Adding and Subtracting Radicals: Same radicals

1. $-2\sqrt{12} - 3\sqrt{8} + 3\sqrt{32} + 2\sqrt{27}$

$= -2\sqrt{4}\sqrt{3} - 3\sqrt{4}\sqrt{2} + 3\sqrt{16}\sqrt{2} + 2\sqrt{9}\sqrt{3}$

$= -4\sqrt{3} - 6\sqrt{2} + 12\sqrt{2} + 6\sqrt{3}$

$= 2\sqrt{3} + 6\sqrt{2}$

2. $2\sqrt{45} - \sqrt{8} - 2\sqrt{32} - 2\sqrt{18}$

$= 2\sqrt{9}\sqrt{5} - \sqrt{4}\sqrt{2} - 2\sqrt{16}\sqrt{2} - 2\sqrt{9}\sqrt{2}$

$= 6\sqrt{5} - 2\sqrt{2} - 8\sqrt{2} - 6\sqrt{2}$

$= 6\sqrt{5} - 16\sqrt{2}$

Multiplying Radicals:

1. $2\sqrt{6} \times 4\sqrt{5}$

$= 8\sqrt{30}$

2. $-3\sqrt{10} \times 6\sqrt{2}$

$= -18\sqrt{20}$

$= -18\sqrt{4}\sqrt{5}$

$= -36\sqrt{5}$

3. $(1\sqrt{2} + 1\sqrt{3})(2\sqrt{2} - 5\sqrt{3})$

$= 2\sqrt{4} - 5\sqrt{6} + 2\sqrt{6} - 5\sqrt{9}$

$= 4 - 3\sqrt{6} - 15$

$= -11 - 3\sqrt{6}$

Rationalizing the Denominator:

1. $\frac{10}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}}$

$= \frac{10\sqrt{2}}{2} = 5\sqrt{2}$

2. $\frac{\sqrt{8}}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$

$= \frac{\sqrt{24}}{3} = \frac{\sqrt{4}\sqrt{6}}{3} = \frac{2\sqrt{6}}{3}$

3. $\frac{9\sqrt{63}}{7\sqrt{54}}$

$= \frac{9\sqrt{9}\sqrt{7}}{7\sqrt{9}\sqrt{6}}$

$= \frac{9\sqrt{7}}{7\sqrt{6}} \times \frac{\sqrt{6}}{\sqrt{6}}$

$= \frac{9\sqrt{42}}{42}$

$= \frac{3\sqrt{42}}{14}$

4. $\frac{7+\sqrt{2}}{5\sqrt{40}} \times \frac{\sqrt{40}}{\sqrt{40}}$

$= \frac{7\sqrt{40} + \sqrt{80}}{200}$

$= \frac{7\sqrt{4}\sqrt{10} + \sqrt{16}\sqrt{5}}{200}$

$= \frac{14\sqrt{10} + 4\sqrt{5}}{200} = \frac{7\sqrt{10} + 2\sqrt{5}}{100}$