Multiplying Radicals Part 2

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PRE-CALCULUS 11
RADICALS
MULTIPLYING RADICALS PART 2

A. Definitions

1. **radical:** a mathematical symbol representing a root.
2. **distributive property:** a process of multiplying a polynomial by a monomial.

$2x(3x^2 + 2x - 5y)$

3. **FOIL method:** a process of multiplying two binomials.

$(5m + 2n)(3m - 7n)$

B. Multiplying Complex Radicals

1. Expand and simplify.

a) $\sqrt{3}(\sqrt{2}+5)$

Use distributive property

$= \sqrt{6} + 5\sqrt{3}$

b) $3\sqrt{6}(\sqrt{8}+4\sqrt{3})$

$= 3\sqrt{48} + 12\sqrt{18}$

$= 3\sqrt{16}\cdot\sqrt{3} + 12\sqrt{9}\cdot\sqrt{2}$

$= 12\sqrt{3} + 36\sqrt{2}$

c) $\sqrt{x}(3\sqrt{x}+5)$ $\quad x \geq 0$

$= 3\sqrt{x^2} + 5\sqrt{x}$

$= 3x + 5\sqrt{x}$

d) $(\sqrt{3}+2)(\sqrt{3}+4)$ Use FOIL Method

$= \sqrt{9} + 4\sqrt{3} + 2\sqrt{3} + 8$

$= 3 + 4\sqrt{3} + 2\sqrt{3} + 8$

$= 11 + 6\sqrt{3}$

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

$= 6\sqrt{25} - 4\sqrt{15} + 3\sqrt{15} - 2\sqrt{9}$

$= 30 - 4\sqrt{15} + 3\sqrt{15} - 6$

$= 24 - \sqrt{15}$

f) $(3\sqrt{2}+2\sqrt{6})^2$

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

$= 9\sqrt{4} + 6\sqrt{12} + 6\sqrt{12} + 4\sqrt{36}$

$= 9\sqrt{4} + 6\sqrt{4}\cdot\sqrt{3} + 6\sqrt{4}\cdot\sqrt{3} + 4\sqrt{36}$

$= 18 + 12\sqrt{3} + 12\sqrt{3} + 24$

$= 42 + 24\sqrt{3}$

g) $(2\sqrt{x}-\sqrt{y})^2$ $x \geq 0,\ y \geq 0$

$(2\sqrt{x}-\sqrt{y})(2\sqrt{x}-\sqrt{y})$.

$= 4\sqrt{x^2} - 2\sqrt{xy} - 2\sqrt{xy} + \sqrt{y^2}$

$= 4x - 2\sqrt{xy} - 2\sqrt{xy} + y$

$= \boxed{4x + y - 4\sqrt{xy}}$

h) $\sqrt{2}(\sqrt{3}+2) - \sqrt{3}(\sqrt{3}+4\sqrt{2})$

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

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

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

i) $(\sqrt{x}-2\sqrt{y})(\sqrt{x}+2\sqrt{y}) + (3\sqrt{x}+\sqrt{y})^2$ $x \geq 0,\ y \geq 0$

$(\sqrt{x}-2\sqrt{y})(\sqrt{x}+2\sqrt{y}) + (3\sqrt{x}+\sqrt{y})(3\sqrt{x}+\sqrt{y})$.

$= (\sqrt{x^2} + 2\sqrt{xy} - 2\sqrt{xy} - 4\sqrt{y^2}) + (9\sqrt{x^2} + 3\sqrt{xy} + 3\sqrt{xy} + \sqrt{y^2})$

$= x + 2\sqrt{xy} - 2\sqrt{xy} - 4y + 9x + 3\sqrt{xy} + 3\sqrt{xy} + y$

$= \boxed{10x - 3y + 6\sqrt{xy}}$

Assignment: Multiplying Radicals Assignment #6, 7, 8, 9

6. Expand and simplify where possible.

a) $\sqrt{6}\left(2\sqrt{6}-\sqrt{5}\right)$ b) $\sqrt{2}\left(1-\sqrt{2}\right)$ c) $2\sqrt{3}\left(2\sqrt{7}-4\sqrt{5}\right)$

7. Expand and simplify.

a) $\sqrt{3}\left(2\sqrt{6}-\sqrt{12}\right)$ b) $\sqrt{8}\left(\sqrt{6}-\sqrt{2}\right)$ c) $2\sqrt{10}\left(\sqrt{6}+4\sqrt{5}\right)$

d) $2\sqrt{11}\left(3\sqrt{2}-\sqrt{50}+3\sqrt{32}\right)$ e) $\sqrt{5}\left(3\sqrt{5}-\sqrt{75}+3\sqrt{3}\right)$

f) $\sqrt{2}\left(\sqrt{5}-12\sqrt{3}\right)-\sqrt{3}\left(\sqrt{8}-2\sqrt{30}\right)$ g) $2\sqrt{3}\left(\sqrt{243}-2\right)-\sqrt{2}\left(5+7\sqrt{2}\right)$

8. Simplify.

a) $(4+\sqrt{27})(1-\sqrt{12})$

b) $(\sqrt{2}+\sqrt{3})(\sqrt{3}+\sqrt{2})$

c) $(5\sqrt{8}-2)(3\sqrt{8}+4)$

d) $(2\sqrt{3}-\sqrt{10})(\sqrt{6}-7\sqrt{20})$

9. Expand and simplify.

a) $(5\sqrt{3}-2)^2$

b) $(4\sqrt{6}-\sqrt{2})^2$

c) $(2\sqrt{12}+\sqrt{24})^2$

d) $(3\sqrt{208}-8)^2$

e) $2(\sqrt{15}-3\sqrt{5})^2$

f) $(\sqrt{5}-3\sqrt{2}+\sqrt{10})^2$

Answer Key

1. a) $\sqrt{21}$ b) $8\sqrt{15}$ c) $40\sqrt{22}$ d) $3\sqrt{5}$ e) 450 f) $30\sqrt{15}$ g) 30
   h) $-6\sqrt{10}$ i) 252 j) $8\sqrt{3}$ k) $27\sqrt{5}$ l) 360

2. Answers may vary a) $(3\sqrt{3})(5\sqrt{6})$ b) $(5\sqrt{2})(7\sqrt{3})$

3. a) 3 b) 32 c) 45 d) −12 e) $5\sqrt{5}$

4. a) $6\sqrt{30}$ b) 72 c) $36\sqrt{10}$ d) $6\sqrt{2}$ e) 8 f) $48\sqrt[3]{2}$

5. a) 113.94 b) $36\sqrt{10}$ c) 113.84 d) c) because rounding is not done until the last step.

6. a) $12-\sqrt{30}$ b) $\sqrt{2}-2$ c) $4\sqrt{21}-8\sqrt{15}$

7. a) $6\sqrt{2}-6$ b) $4\sqrt{3}-4$ c) $4\sqrt{15}+40\sqrt{2}$ d) $20\sqrt{22}$
   e) $15-2\sqrt{15}$ f) $7\sqrt{10}-14\sqrt{6}$ g) $40-4\sqrt{3}-5\sqrt{2}$

8. a) $-14-5\sqrt{3}$ b) $5+2\sqrt{6}$ c) $112+28\sqrt{2}$ d) $76\sqrt{2}-30\sqrt{15}$

9. a) $79-20\sqrt{3}$ b) $98-16\sqrt{3}$ c) $72+48\sqrt{2}$ d) $1936-192\sqrt{13}$
   e) $120-60\sqrt{3}$ f) $33-6\sqrt{10}+10\sqrt{2}-12\sqrt{5}$

10. a) Area $= 105\sqrt{2}-9$, Perimeter $= 12\sqrt{3}+12\sqrt{6}$
    b) Area $= 45\sqrt{5}-6\sqrt{7}$, Perimeter $= 30\sqrt{5}-4\sqrt{7}+6$

11. a) 4 b) 1 c) 22

12. a) $\sqrt{2}+\sqrt{5}$ b) $4-\sqrt{7}$ c) $-3\sqrt{8}+15$

13. a) $\sqrt{3}+1$, 2 b) $2-\sqrt{5}$, −1 c) $2\sqrt{6}+\sqrt{3}$, 21
    d) $2\sqrt{8}-\sqrt{27}$, 5 e) $\sqrt{32}+\sqrt{3}$, 29 f) $-3\sqrt{40}-2\sqrt{10}$, 320

14. B 15. C 16. C

17. | 7 | 4 | | |

18. | 2 | | | |

19. | 2 | 0 | | |