Math 96--Radicals #2--Multiply/Divide; FOIL--page #1

Part A--Multiply Radicals. Use the product rule where necessary. You can multiply when the index of the radical is identical. Keep the radical symbol and the index, and multiply (and factor) the radicands. Place the new radicand (new factors) under the radical symbol. Continue to simplify!

If the index is different, you can't multiply yet. You have to change each one to the exponent form, get a common denominator for the exponents, and continue from there. You'll learn that later.

a. $\sqrt{2}\cdot\sqrt{3}=\sqrt{6}$

b. $\sqrt{5}\cdot\sqrt{8}=\sqrt{40}=\sqrt{2\cdot2\cdot2\cdot5}=2\sqrt{2\cdot5}=2\sqrt{10}$ (multiply then factor to count "perfects")

OR

$\sqrt{5}\cdot\sqrt{8}=\sqrt{5\cdot2\cdot2\cdot2}=2\sqrt{5\cdot2}=2\sqrt{10}$ (factor first, multiply, count "perfects")

c. $\sqrt{15}\cdot\sqrt{90}$

$\sqrt{3\cdot5\cdot2\cdot3\cdot3\cdot5}=3\cdot5\sqrt{3\cdot2}=15\sqrt{6}$ (factor first, multiply, count "perfects")

d. $\sqrt[3]{4}\cdot\sqrt[3]{10}$

$\sqrt[3]{2\cdot2\cdot2\cdot5}=2\sqrt[3]{5}$

HOMEWORK. Now you simplify these.

1. $\sqrt{2}\cdot\sqrt{6}$ 2. $\sqrt{3}\cdot\sqrt{6}$ 3. $\sqrt{35}\cdot\sqrt{5}$ 4. $\sqrt{7}\cdot\sqrt{21}$

5. $\sqrt{12}\cdot\sqrt{18}$ 6. $\sqrt{10}\cdot\sqrt{6}$ 7. $\sqrt{10}\cdot\sqrt{20}$ 8. $\sqrt[3]{9}\cdot\sqrt[3]{21}$

By the way, there are times when I don't use either of the above methods. Observe the following.

e. $\sqrt{7}\cdot\sqrt{7}=\sqrt{7\cdot7}=7$ f. $\sqrt{12}\cdot\sqrt{12}=\sqrt{12\cdot12}=12$

g. $\sqrt{13}\cdot\sqrt{13}=\sqrt{13\cdot13}=13$ h. $\sqrt{20}\cdot\sqrt{20}=20$

HOMEWORK. Simplify.

9. $\sqrt{5}\cdot\sqrt{5}$ 10. $\sqrt{11}\cdot\sqrt{11}$ 11. $\sqrt{8}\cdot\sqrt{8}$ 12. $\sqrt{3}\cdot\sqrt{3}$

Part B--Divide Radicals. Use the quotient rule where necessary. You can divide when the index of the radical is identical. Keep the radical symbol and the index, and divide the radicands (place the new radicand under the radical symbol). If the new radicand is "perfect" or contains a "perfect", you must continue to simplify!

If the index is different, you can't divide yet. You have to change each one to the exponent form, get a common denominator for the exponents, and continue from there. You'll learn that later.

i. $\dfrac{\sqrt{75}}{\sqrt{3}} = \sqrt{25} = 5$

j. $\dfrac{\sqrt{20}}{\sqrt{2}} = \sqrt{10}$

k. $\dfrac{\sqrt{54}}{\sqrt{3}} = \sqrt{18} = \sqrt{2 \cdot 3 \cdot 3} = 3\sqrt{2}$

l. $\dfrac{\sqrt[3]{80}}{\sqrt[3]{2}} = \sqrt[3]{40} = \sqrt[3]{2 \cdot 2 \cdot 2 \cdot 5} = 2\sqrt[3]{5}$

HOMEWORK. Simplify.

13. $\dfrac{\sqrt{72}}{\sqrt{2}}$

14. $\dfrac{\sqrt{30}}{\sqrt{6}}$

15. $\dfrac{\sqrt{48}}{\sqrt{2}}$

16. $\dfrac{\sqrt[3]{810}}{\sqrt[3]{3}}$

Part C--FOIL. Distribute where necessary. Multiply, coefficients with coefficients and radicands with radicands. Then simplify as you can (by factoring and by combining like terms). On these examples, I will show the FOIL process in great detail, line by line.

m. $\left(\sqrt{3}+8\right)\left(\sqrt{3}+7\right)$

F: $\sqrt{3} \cdot \sqrt{3} = \sqrt{3 \cdot 3} = 3$

O: $\sqrt{3} \cdot 7 = 7\sqrt{3}$

I: $8 \cdot \sqrt{3} = 8\sqrt{3}$

L: $8 \cdot 7 = 56$

$3 + 7\sqrt{3} + 8\sqrt{3} + 56$

$3 + 56 + 7\sqrt{3} + 8\sqrt{3}$

$59 + 15\sqrt{3}$

n. $\left(5\sqrt{2}+6\right)\left(3\sqrt{2}-9\right)$

F: $5\sqrt{2} \cdot 3\sqrt{2} = 5 \cdot 3\sqrt{2 \cdot 2} = 15 \cdot 2 = 30$

O: $5\sqrt{2} \cdot -9 = -9 \cdot 5\sqrt{2} = -45\sqrt{2}$

I: $6 \cdot 3\sqrt{2} = 18\sqrt{2}$

L: $6 \cdot -9 = -54$

$30 - 45\sqrt{2} + 18\sqrt{2} - 54$

$30 - 54 - 45\sqrt{2} + 18\sqrt{2}$

$-24 - 27\sqrt{2}$

o. $\left(9-\sqrt{5}\right)\left(4-\sqrt{5}\right)$

F: $9 \cdot 4 = 36$

O: $9 \cdot -\sqrt{5} = -9\sqrt{5}$

I: $-\sqrt{5} \cdot 4 = 4 \cdot -\sqrt{5} = -4\sqrt{5}$

L: $-\sqrt{5} \cdot -\sqrt{5} = +\sqrt{5 \cdot 5} = 5$

$36 - 9\sqrt{5} - 4\sqrt{5} + 5$

$41 - 13\sqrt{5}$

p. $\left(8-\sqrt{7}\right)\left(8+\sqrt{7}\right)$

F: $8 \cdot 8 = 64$

O: $8 \cdot \sqrt{7} = 8\sqrt{7}$

I: $-\sqrt{7} \cdot 8 = 8 \cdot -\sqrt{7} = -8\sqrt{7}$

L: $-\sqrt{7} \cdot \sqrt{7} = -\sqrt{7 \cdot 7} = -7$

$64 + 8\sqrt{7} - 8\sqrt{7} - 7$

57

HOMEWORK. Simplify these.

17. $\left(\sqrt{7}+5\right)\left(\sqrt{7}+3\right)$

18. $\left(10-\sqrt{5}\right)\left(7-\sqrt{5}\right)$

19. $\left(2\sqrt{3}-5\right)\left(4\sqrt{3}+8\right)$

20. $\left(5+\sqrt{11}\right)\left(5-\sqrt{11}\right)$

21. $\left(12-\sqrt{3}\right)\left(12+\sqrt{3}\right)$

22. $\left(\sqrt{7}+4\right)\left(\sqrt{7}-4\right)$

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Answer Key.

1.	$2\sqrt{3}$	2.	$3\sqrt{2}$	3.	$5\sqrt{7}$	4.	$7\sqrt{3}$
5.	$6\sqrt{6}$	6.	$2\sqrt{15}$	7.	$10\sqrt{2}$	8.	$3\sqrt[3]{7}$
9.	5	10.	11	11.	8	12.	3
13.	$\sqrt{36}=6$	14.	$\sqrt{5}$	15.	$\sqrt{24}$ $2\sqrt{6}$	16.	$\sqrt[3]{270}$ $3\sqrt[3]{10}$
17.	$22+8\sqrt{7}$			18.	$75-17\sqrt{5}$		
19.	$-16-4\sqrt{3}$			20.	14		
21.	141			22.	-9		