

Simplifying Radicals

simplifying a radical means to find another expression with the same value

You need to remember:

Perfect Squares
4 = 2 x 2
9 = 3 x 3
16 = 4 x 4
25 = 5 x 5
36 = 6 x 6
49 = 7 x 7
64 = 8 x 8
81 = 9 x 9
100 = 10 x 10

Radicals (square roots)
$\sqrt{4} = 2$
$\sqrt{9} = 3$
$\sqrt{16} = 4$
$\sqrt{25} = 5$
$\sqrt{36} = 6$
$\sqrt{49} = 7$
$\sqrt{64} = 8$
$\sqrt{81} = 9$
$\sqrt{100} = 10$

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Steps:

1. Find the largest perfect square which will divide evenly into the number under your radical sign. This means that when you divide, you get no remainders, no decimals, no fractions.

2. If the number under your radical cannot be divided evenly by any perfect square then your radical is already in its simplest form.

#4 Simplify $\sqrt{40} = \sqrt{4 \cdot 10}$
 $= 2\sqrt{10}$

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#5

Simplify $\sqrt{125}$

$$\sqrt{25 \cdot 5} = \sqrt{25} \cdot \sqrt{5}$$

$$= 5\sqrt{5}$$

or

$$\sqrt{125} = 5\sqrt{5}$$

25 5

55

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#12

Simplify $\sqrt{200}$

$$\sqrt{100 \cdot 2} =$$

$$10\sqrt{2}$$

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#15

Simplify $\sqrt{124}$

2 6 2

2 3 1

$$2\sqrt{31}$$

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#20

Simplify $\sqrt{180}$

18 10

9 2 25

3 3

$$6\sqrt{5}$$

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#39

Simplify $\sqrt{9x^2}$

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

$$3x$$

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#41

Simplify $-\sqrt{28x^4}$

$$-\sqrt{4} \cdot \sqrt{7} \cdot \sqrt{x^4}$$

$$-2x^2\sqrt{7}$$

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#44

Simplify $-\sqrt{45x^2y^9}$

$$-\sqrt{9} \cdot \sqrt{5} \cdot \sqrt{x^2} \cdot \sqrt{y^9}$$

$\begin{matrix} \wedge & & \wedge & & \wedge & & \wedge \\ \textcircled{33} & & \textcircled{xx} & & \textcircled{yy} & & \textcircled{yy} \end{matrix}$

$$-3xy^4\sqrt{5y}$$

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Simplifying Radicals Worksheet 1

Simplify.

1) $\sqrt{75} = \sqrt{25 \cdot 3} = 5\sqrt{3}$

2) $\sqrt{16} = 4$

3) $\sqrt{36} = 6$

4) $\sqrt{64} = 8$

5) $\sqrt{80} = \sqrt{4} \cdot \sqrt{20}$
 $= \sqrt{4} \cdot \sqrt{4} \cdot \sqrt{5}$
 $= 4\sqrt{5}$

6) $\sqrt{30} = \sqrt{30}$

7) $\sqrt{8} = \sqrt{4} \cdot \sqrt{2}$
 $= 2\sqrt{2}$

8) $\sqrt{18} = 3\sqrt{2}$

9) $\sqrt{32} = \sqrt{16} \cdot \sqrt{2}$
 $= 4\sqrt{2}$

10) $\sqrt{12} = 2\sqrt{3}$

11) $\sqrt{8} = 2\sqrt{2}$

12) $\sqrt{108} = 6\sqrt{3}$

13) $\sqrt{125} = \sqrt{25} \cdot \sqrt{5}$
 $= 5\sqrt{5}$

14) $\sqrt{50} = \sqrt{25} \cdot \sqrt{2}$
 $= 5\sqrt{2}$

15) $\sqrt{175} = \sqrt{25} \cdot \sqrt{7}$
 $= 5\sqrt{7}$

16) $\sqrt{28} = \sqrt{4} \cdot \sqrt{7}$
 $= 2\sqrt{7}$

17) $\sqrt{45} = \sqrt{9} \cdot \sqrt{5}$
 $= 3\sqrt{5}$

18) $\sqrt{72} = \sqrt{9} \cdot \sqrt{8}$
 $= 3 \cdot \sqrt{4} \cdot \sqrt{2} = 6\sqrt{2}$

19) $\sqrt{20} = \sqrt{4} \cdot \sqrt{5}$
 $= 2\sqrt{5}$

20) $\sqrt{150} = \sqrt{25} \cdot \sqrt{6}$
 $= 5\sqrt{6}$

$$\sqrt{128} = \sqrt{16 \cdot \sqrt{4} \cdot \sqrt{2}}$$



Why Didn't Krok Like to Go Sailing With the Baseball Uniform Designer?



Simplify each expression below and find your answer in the corresponding answer column. Write the letter of the exercise in the box that contains the number of the answer.

- | | | | |
|------------------------------|------------------|----------------------------------|---------------------|
| (L) $\sqrt{8} = 2\sqrt{2}$ | (18) $7\sqrt{2}$ | (S) $5\sqrt{18} = 15\sqrt{2}$ | (19) $6\sqrt{7}$ |
| (I) $\sqrt{45} = 3\sqrt{5}$ | (14) $5\sqrt{5}$ | (U) $3\sqrt{28} = 6\sqrt{7}$ | (13) $24\sqrt{3}$ |
| (A) $\sqrt{50} = 5\sqrt{2}$ | (12) $2\sqrt{2}$ | (A) $2\sqrt{1000} = 20\sqrt{10}$ | (3) $24\sqrt{2}$ |
| (T) $\sqrt{12} = 2\sqrt{3}$ | (4) $5\sqrt{2}$ | (P) $\sqrt{1,000,000} = 1000$ | (9) $15\sqrt{2}$ |
| (O) $\sqrt{98} = 7\sqrt{2}$ | (28) $4\sqrt{3}$ | (E) $3\sqrt{128} = 24\sqrt{2}$ | (5) $16\sqrt{5}$ |
| (S) $\sqrt{48} = 4\sqrt{3}$ | (20) $2\sqrt{3}$ | (K) $8\sqrt{27} = 24\sqrt{3}$ | (23) 1000 |
| (E) $\sqrt{125} = 5\sqrt{5}$ | (25) $3\sqrt{5}$ | (L) $4\sqrt{80} = 16\sqrt{5}$ | (16) $20\sqrt{10}$ |
| (A) $\sqrt{20}$ | (8) $3\sqrt{7}$ | (H) $-3\sqrt{54}$ | (10) $-8\sqrt{6}$ |
| (S) $\sqrt{72}$ | (1) $6\sqrt{2}$ | (A) $-7\sqrt{40}$ | (21) $30\sqrt{3}$ |
| (Y) $\sqrt{63}$ | (7) $10\sqrt{2}$ | (B) $-8\sqrt{121}$ | (11) $-14\sqrt{10}$ |
| (E) $\sqrt{144}$ | (6) $4\sqrt{2}$ | (S) $2\sqrt{500}$ | (24) $20\sqrt{5}$ |
| (W) $\sqrt{32}$ | (22) $2\sqrt{5}$ | (T) $-4\sqrt{24}$ | (26) $15\sqrt{7}$ |
| (D) $\sqrt{75}$ | (27) 12 | (Z) $3\sqrt{175}$ | (2) $-9\sqrt{6}$ |
| (A) $\sqrt{200}$ | (15) $5\sqrt{3}$ | (C) $5\sqrt{108}$ | (17) -88 |

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
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4

Homework Simplifying Radicals

Name key
Class Time _____

Simplify each of the following expressions completely.

8 1. $\sqrt{64}$

$-3\sqrt{2}$ 2. $-\sqrt{18}$
 $\begin{matrix} & \nearrow & \searrow \\ & 9 & 2 \\ & \textcircled{33} & \end{matrix}$

$4\sqrt{2}$ 3. $\sqrt{32}$
 $\begin{matrix} & \nearrow & \searrow \\ & 16 & 2 \\ & \textcircled{44} & \end{matrix}$

$5\sqrt{2}$ 4. $\sqrt{50}$
 $\begin{matrix} & \nearrow & \searrow \\ & 25 & 2 \\ & \textcircled{55} & \end{matrix}$

20 5. $\sqrt{400}$
 $\begin{matrix} & \nearrow & \searrow \\ & 4 & 100 \\ & \textcircled{22} & \textcircled{1010} \end{matrix}$

x^3 6. $\sqrt{x^6}$

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

$4x^8$ 8. $\sqrt{16x^{16}}$

$3x^4\sqrt{x}$ 9. $\sqrt{9x^9}$
 ~~$3x^4\sqrt{x}$~~

$2x^4\sqrt{10}$ 10. $\sqrt{40x^8}$
 $\begin{matrix} & \nearrow & \searrow \\ & 4 & 10 \\ & \textcircled{22} & \end{matrix}$

$5x^3\sqrt{x}$ 11. $\sqrt{25x^7}$
 $\begin{matrix} & \nearrow & \searrow \\ & 5 & x \\ & \textcircled{55} & \end{matrix}$
 ~~$5x^3\sqrt{x}$~~

$2x^2\sqrt{3x}$ 12. $\sqrt{12x^5}$
 $\begin{matrix} & \nearrow & \searrow \\ & 4 & 3 \\ & \textcircled{22} & \end{matrix}$
 ~~$2x^2\sqrt{3x}$~~

ab^2 13. $\sqrt{a^2b^4}$

$7a^4x^6$ 14. $\sqrt{49a^8x^{12}}$

$2x^4y^3\sqrt{7x}$ 15. $\sqrt{28x^9y^6}$
 $\begin{matrix} & \nearrow & \searrow \\ & 4 & 7 \\ & \textcircled{22} & \end{matrix}$

$4m^3n^5\sqrt{mn}$ 16. $\sqrt{32m^7n^{11}}$
 $\begin{matrix} & \nearrow & \searrow \\ & 16 & 2 \\ & \textcircled{44} & \end{matrix}$

$2x^5y^2\sqrt{5y}$ 17. $\sqrt{20x^{10}y^5}$
 $\begin{matrix} & \nearrow & \searrow \\ & 4 & 5 \\ & \textcircled{22} & \end{matrix}$

$10b^2\sqrt{a}$ 18. $\sqrt{100ab^4}$

$5x^4y\sqrt{3y}$ 19. $\sqrt{75x^8y^3}$
 $\begin{matrix} & \nearrow & \searrow \\ & 25 & 3 \\ & \textcircled{55} & \end{matrix}$

$7x^3y^2\sqrt{2xy}$ 20. $\sqrt{98x^7y^5}$
 $\begin{matrix} & \nearrow & \searrow \\ & 49 & 2 \\ & \textcircled{49} & \end{matrix}$

$\frac{x^2+16x+83}{2x^2+19x+9}$ 21.

Homework: This worksheet
Answers to odd problems on worksheet:

1. 8 3. $4\sqrt{2}$ 5. 20 7. $x^3\sqrt{x}$ 9. $3x^4\sqrt{x}$ 11. $5x^3\sqrt{x}$
 13. ab^2 15. $2x^4y^3\sqrt{7x}$ 17. $2x^5y^2\sqrt{5y}$ 19. $5x^4y\sqrt{3y}$ 21. $\frac{x+7}{2x+1}$

key

SIMPLIFYING RADICAL EXPRESSIONS

Perfect Squares: 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144...

$x^2, x^4, x^6, x^8, x^{10}$... Exponents must be even.

$\sqrt{25}$ is read "the square root of 25".

$\sqrt{25} = 5$ because $5^2 = 25$ $\sqrt{36} = 6$ because $6^2 = 36$ $\sqrt{100} = 10$ $\sqrt{49} = 7$

$\sqrt{a^6} = a^3$ because $(a^3)^2 = a^6$ $\sqrt{m^{16}} = m^8$ because $(m^8)^2 = m^{16}$ $\sqrt{y^{10}} = y^5$ $\sqrt{a^2} = a$

Hint: Divide the exponent by 2.

In the expression \sqrt{a} , the $\sqrt{\quad}$ is called the radical and a is called the radicand.

Simplify (Simplifying Perfect Squares):

- | | | | | |
|--|-----------------------------|--|---|--|
| 1. $\frac{\sqrt{4}}{2}$ | 2. $\frac{\sqrt{16}}{4}$ | 3. $\frac{-\sqrt{100}}{-10}$ | 4. $\frac{\sqrt{a^8}}{a^4}$ | 5. $\frac{\sqrt{w^{12}}}{w^6}$ |
| 6. $\frac{\sqrt{a^6 b^{10}}}{a^3 b^5}$ | 7. $\frac{\sqrt{9a^2}}{3a}$ | 8. $\frac{-\sqrt{81m^{64}}}{-9m^{32}}$ | 9. $\frac{\sqrt{49a^4 b^{12}}}{7a^2 b^6}$ | 10. $\frac{\sqrt{121x^{14} y^6}}{11x^7 y^3}$ |

Simplify (Simplifying Radicals that are not Perfect Squares):

- | | | |
|---|---|---|
| 1. $\sqrt{20} = \sqrt{4 \cdot 5} = 2\sqrt{5}$ | 2. $\sqrt{27} = \sqrt{9 \cdot 3} = 3\sqrt{3}$ | 3. $\sqrt{48} = \sqrt{16 \cdot 3} = 4\sqrt{3}$ |
| 4. $\sqrt{45} = \sqrt{9 \cdot 5} = 3\sqrt{5}$ | 5. $\sqrt{12} = \sqrt{4 \cdot 3} = 2\sqrt{3}$ | 6. $\sqrt{50} = \sqrt{25 \cdot 2} = 5\sqrt{2}$ |
| 7. $\sqrt{a^5} = \sqrt{a^4 \cdot a} = a^2 \sqrt{a}$ | 8. $\sqrt{x^9} = \sqrt{x^8 \cdot x} = x^4 \sqrt{x}$ | 9. $\sqrt{x^3} = \sqrt{x^2 \cdot x} = x \sqrt{x}$ |

Simplify:

- | | | | | |
|---|--|---|--|---|
| 1. $\sqrt{18} = 3\sqrt{2}$ | 2. $\sqrt{125} = \sqrt{25 \cdot 5} = 5\sqrt{5}$ | 3. $\sqrt{72} = \sqrt{36 \cdot 2} = 6\sqrt{2}$ | 4. $\sqrt{180} = \sqrt{9 \cdot 4 \cdot 5} = 6\sqrt{5}$ | 5. $\sqrt{a^3} = \sqrt{a^2 \cdot a} = a\sqrt{a}$ |
| 6. $\sqrt{b^7} = \sqrt{b^6 \cdot b} = b^3 \sqrt{b}$ | 7. $\sqrt{m^{11}} = \sqrt{m^{10} \cdot m} = m^5 \sqrt{m}$ | 8. $\sqrt{75x^7 y^5} = \sqrt{25 \cdot 3 \cdot x^6 \cdot x \cdot y^4 \cdot y} = 5x^3 y^2 \sqrt{3xy}$ | 9. $\sqrt{27a^{11} b^7} = \sqrt{9 \cdot 3 \cdot a^{10} \cdot a \cdot b^6 \cdot b} = 3a^5 b^3 \sqrt{3ab}$ | 10. $\sqrt{32a^7 b^4} = \sqrt{16 \cdot 2 \cdot a^6 \cdot a \cdot b^4} = 4a^3 b^2 \sqrt{2a}$ |
| 11. $\frac{\sqrt{9a^8}}{3a^4}$ | 12. $\frac{\sqrt{45a^7}}{3a^3 \sqrt{5a}}$ | 13. $\frac{\sqrt{36x^2 y^6}}{6xy^3}$ | 14. $\frac{\sqrt{12x^{20} y^8}}{2x^{10} y^4 \sqrt{3}}$ | 15. $\frac{-\sqrt{200}}{-10\sqrt{2}}$ |
| 16. $\frac{\sqrt{196}}{\sqrt{4 \cdot 49}} = 14$ | 17. $\frac{\sqrt{63x^4 y}}{\sqrt{9 \cdot 7 \cdot x^4 y}} = 3x^2 \sqrt{7y}$ | 18. $\frac{\sqrt{6x^3}}{x\sqrt{6x}}$ | 19. $\frac{\sqrt{100x^5 y}}{10x^2 \sqrt{xy}}$ | 20. $\frac{\sqrt{80x^{100} y^{49}}}{4x^{50} y^{24} \sqrt{5y}} = 4$ |

Why Did the Cow Give Only Buttermilk?

Simplify each expression below. Assume that all variables represent nonnegative numbers. Find your answer in the corresponding answer column. Write the letter of the exercise in the box that contains the number of the answer.

- (H) $\sqrt{5} \cdot \sqrt{3} = \sqrt{15}$ (7) $2x^2\sqrt{6}$
 (L) $\sqrt{6} \cdot \sqrt{2} \cdot \sqrt{12} = 2\sqrt{3}$ (2) $10\sqrt{2}$
 (C) $\sqrt{3} \cdot \sqrt{6} \cdot \sqrt{18} = 3\sqrt{3}$ (3) $12x^5$
 (E) $\sqrt{5} \cdot \sqrt{10} \cdot \sqrt{50} = 5\sqrt{2}$ (9) $\sqrt{15}$
 (H) $\sqrt{10} \cdot \sqrt{20} = \sqrt{200} = 10\sqrt{2}$ (12) $x\sqrt{6}$
 (M) $\sqrt{90} \cdot \sqrt{40} = \sqrt{3600} = 60$ (5) $3\sqrt{2}$
 (I) $\sqrt{2x} \cdot \sqrt{3x} = \sqrt{6x^2} = x\sqrt{6}$ (1) $3x^2\sqrt{10}$
 (U) $\sqrt{6x} \cdot \sqrt{2x} = \sqrt{12x^2} = 2x\sqrt{3}$ (23) $2\sqrt{3}$
 (W) $\sqrt{30x^2} \cdot \sqrt{3x^2} = \sqrt{90x^4} = 3x^2\sqrt{10}$ (21) 60
 (N) $\sqrt{3x} \cdot \sqrt{8x^3} = \sqrt{24x^4} = 2x^2\sqrt{6}$ (18) $20x\sqrt{x}$
 (H) $\sqrt{40x^2} \cdot \sqrt{10x} = \sqrt{400x^3} = 20x\sqrt{x}$ (14) $5\sqrt{2}$
 (A) $\sqrt{12x^5} \cdot \sqrt{12x^5} = \sqrt{144x^{10}} = 12x^5$ (16) $2x\sqrt{3}$

- (E) $5\sqrt{2} \cdot 4\sqrt{3} = 20\sqrt{6}$ (11) $5a^2\sqrt{3b}$
 (V) $-7\sqrt{3} \cdot 2\sqrt{10} = -14\sqrt{30}$ (8) $-14\sqrt{15}$
 (T) $4\sqrt{10} (-3\sqrt{2}) = -12\sqrt{20} = -24\sqrt{5}$ (4) $36ab\sqrt{6b}$
 (A) $2\sqrt{8} \cdot \sqrt{18} = 2\sqrt{144} = 24$ (17) $-24\sqrt{5}$
 (R) $-10\sqrt{3} (-2\sqrt{21}) = 20\sqrt{63} = 60\sqrt{7}$ (15) $18ab$
 (S) $-\sqrt{6} \cdot 7\sqrt{10} = -7\sqrt{60} = -14\sqrt{15}$ (22) $40a^2b^4\sqrt{6a}$
 (B) $3\sqrt{ab} \cdot 6\sqrt{ab} = 18\sqrt{a^2b^2} = 18ab$ (6) 24
 (E) $\sqrt{2ab^2} \cdot \sqrt{14ab^2} = \sqrt{28a^2b^4} = 2ab^2\sqrt{7}$ (10) $20\sqrt{6}$
 (G) $-\sqrt{15a^2b} (-\sqrt{5a^2}) = \sqrt{75a^4b} = 5a^2\sqrt{3b}$ (19) $2ab^2\sqrt{7}$
 (K) $\sqrt{8ab^2} (-\sqrt{10a^3b^4}) = \sqrt{80a^4b^6}$ (13) $-14\sqrt{30}$
 (T) $2\sqrt{18a^2b} \cdot 6\sqrt{3b^2} = 12\sqrt{54a^2b^3}$ (24) $-4a^2b^3\sqrt{5}$
 (I) $5\sqrt{2a^3b^8} \cdot 4\sqrt{12a^2} = 20\sqrt{24a^5b^8} = 40a^2b^4\sqrt{6a}$ (20) $60\sqrt{7}$

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
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K) $\sqrt{80a^4b^8} = 4a^2b^3\sqrt{5}$
 T) $12\sqrt{54a^2b^3} = 36ab\sqrt{6b}$

Multiplying Radical Expressions

Date _____ Period _____

Simplify.

1) $3\sqrt{12} \cdot \sqrt{6}$

$3\sqrt{72}$

$3\sqrt{36 \cdot 2} = 3 \cdot 6\sqrt{2} = 18\sqrt{2}$

3) $\sqrt{6} \cdot \sqrt{6} = 6$

5) $-4\sqrt{15} \cdot -\sqrt{3}$

$4\sqrt{45} = 12\sqrt{3}$

7) $\sqrt{15n^2} \cdot \sqrt{10n^3} = \sqrt{5 \cdot 3 \cdot 5 \cdot 2n^5}$
 $= 5n^2\sqrt{3n}$

9) $-3\sqrt{7r^3} \cdot 6\sqrt{7r^2}$
 $-18\sqrt{7 \cdot 7 \cdot r^5}$
 $-18(7)r^2\sqrt{r} = -126r^2\sqrt{r}$

11) $\sqrt{3}(5 + \sqrt{3})$

$5\sqrt{3} + \sqrt{9}$

$3 + 5\sqrt{3}$

13) $-3\sqrt{3}(2 + \sqrt{6})$

$-6\sqrt{3} - 3\sqrt{18} = -6\sqrt{3} - 9\sqrt{2}$

2) $\sqrt{5} \cdot \sqrt{10} = \sqrt{50} = 5\sqrt{2}$

4) $\sqrt{5} \cdot -4\sqrt{20} = -4\sqrt{5 \cdot 4 \cdot 5}$
 $= -4(5)(2)$
 $= -20(2) = -40$

6) $\sqrt{20x^2} \cdot \sqrt{20x} = \sqrt{400x^3} = 20x\sqrt{x}$

8) $\sqrt{18a^2} \cdot 4\sqrt{3a^2} = 4\sqrt{6 \cdot 3 \cdot 3a^4}$
 $= 4(3)a^2\sqrt{6}$
 $= 12a^2\sqrt{6}$

10) $-4\sqrt{28x} \cdot \sqrt{7x^3} = -4\sqrt{7 \cdot 4 \cdot 7 \cdot x^4}$
 $-4(7)x^2\sqrt{4}$
 $-4(7)(2)(x^2)$
 $= -56x^2$

12) $2\sqrt{5}(\sqrt{6} + 2)$

$2\sqrt{30} + 4\sqrt{5}$

14) $\sqrt{3}(-5\sqrt{10} + \sqrt{6})$

$-5\sqrt{30} + \sqrt{18}$
 $-5\sqrt{30} + 3\sqrt{2}$

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

$$6\sqrt{45} - 6\sqrt{75} = 18\sqrt{5} - 30\sqrt{3}$$

$\begin{matrix} \nearrow & \searrow \\ 9 & 5 \\ \textcircled{33} & \end{matrix}$
 $\begin{matrix} \nearrow & \searrow \\ 25 & 3 \\ \textcircled{55} & \end{matrix}$

$$16) 5\sqrt{42x}(4 + 4\sqrt{7x})$$

$$20\sqrt{42x} + 20\sqrt{6 \cdot 7 \cdot 7 \cdot x^2}$$

$$20\sqrt{42x} + 140x\sqrt{6}$$

$\frac{20}{\times 7}$
140

$$17) \sqrt{14x}(3 - \sqrt{2x})$$

$$3\sqrt{14x} - \sqrt{28x^2} = 3\sqrt{14x} - 2x\sqrt{7}$$

$\begin{matrix} \nearrow & \searrow \\ 7 & 2 \\ \textcircled{14} & \end{matrix}$

$$18) \sqrt{6n}(7n^3 + \sqrt{12})$$

$$7n^3\sqrt{6n} + \sqrt{2 \cdot 6 \cdot 6n}$$

$$7n^3\sqrt{6n} + 6\sqrt{2n}$$

$$19) \sqrt{3v}(\sqrt{6} + \sqrt{10})$$

$$\sqrt{18v} + \sqrt{30v}$$

$$3\sqrt{2v} + \sqrt{30v}$$

$\begin{matrix} \nearrow & \searrow \\ 9 & 2 \\ \textcircled{18} & \end{matrix}$

$$20) \sqrt{21r}(5 + \sqrt{7})$$

$$5\sqrt{21r} + \sqrt{3 \cdot 7 \cdot 7r}$$

$$5\sqrt{21r} + 7\sqrt{3r}$$

$$21) (-2\sqrt{3} + 2)(\sqrt{3} - 5)$$

$$-2\sqrt{9} + 10\sqrt{3} + 2\sqrt{3} - 10$$

$$-6 + 12\sqrt{3} - 10$$

$$-16 + 12\sqrt{3}$$

$$22) (5 - 4\sqrt{5})(-2 + \sqrt{5})$$

$$-10 + 5\sqrt{5} + 8\sqrt{5} - 4\sqrt{25}$$

$$-10 + 13\sqrt{5} - 20$$

$$-30 + 13\sqrt{5}$$

$$23) (-2 - 3\sqrt{5})(5 - \sqrt{5})$$

$$-10 + 2\sqrt{5} - 15\sqrt{5} + 3\sqrt{25}$$

$$-10 - 13\sqrt{5} + 15$$

$$5 - 13\sqrt{5}$$

$$24) (\sqrt{5} - \sqrt{3})(\sqrt{5} + \sqrt{3})$$

$$\sqrt{25} + \sqrt{15} - \sqrt{15} - \sqrt{9}$$

$$5 - 3 = 2$$

$$25) (5\sqrt{2x} + \sqrt{5})(-4\sqrt{2x} + \sqrt{5x})$$

$$-20\sqrt{4x^2} + 5\sqrt{10x^2} - 4\sqrt{10x} + \sqrt{25x}$$

$$-20(2)(x) + 5x\sqrt{10} - 4\sqrt{10x} + 5\sqrt{x}$$

$$-40x + 5x\sqrt{10} - 4\sqrt{10x} + 5\sqrt{x}$$

$$26) (-3\sqrt{3k} + 4)(\sqrt{3k} - 5)$$

$$-3\sqrt{9k^2} + 15\sqrt{3k} + 4\sqrt{3k} - 20$$

$$-3(3)(k) + 19\sqrt{3k} - 20$$

$$-9k - 20 + 19\sqrt{3k}$$

$$27) (5 + 4\sqrt{3})(3 + \sqrt{3})$$

$$15 + 5\sqrt{3} + 12\sqrt{3} + 4\sqrt{9}$$

$$15 + 17\sqrt{3} + 4(3)$$

$$27 + 17\sqrt{3}$$

$$28) (3\sqrt{2} + \sqrt{5})(\sqrt{2} - 3\sqrt{5r})$$

$$3\sqrt{4} - 9\sqrt{10r} + \sqrt{10} - 3\sqrt{25r}$$

$$3(2) - 9\sqrt{10r} + \sqrt{10} - 3(5)\sqrt{r}$$

$$9 - 9\sqrt{10r} + \sqrt{10} - 15\sqrt{r}$$

Did you hear about...

A	B	C	D	E	F	G	H
I His	J	K	L	M	N	O	P ?

Answers A–H:

$\sqrt{11}$	TO
$\frac{\sqrt{5}}{2}$	WAS
$\frac{\sqrt{2}}{6}$	HUG
$\frac{2\sqrt{10}}{5}$	TRIED
$4\sqrt{5}$	SAD
$\frac{5\sqrt{3}}{3}$	THE
$\frac{3\sqrt{5}}{10}$	BIG
$\frac{\sqrt{6}}{2}$	WHO
$\frac{\sqrt{3}}{2}$	KISS
$\frac{2\sqrt{7}}{7}$	VERY
$7\sqrt{2}$	GUY
$\frac{2\sqrt{6}}{3}$	GIRL

Rationalize the denominator and simplify each expression below. Find your answer in the adjacent answer column and notice the word next to it. Write this word in the box containing the letter of that exercise. Keep working and you will hear about a mistake.

- (A) $\frac{5}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{5\sqrt{3}}{3}$ (I) $\frac{30}{\sqrt{18}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{30\sqrt{2}}{6} = 5\sqrt{2}$
- (B) $\frac{2}{\sqrt{7}} \cdot \frac{\sqrt{7}}{\sqrt{7}} = \frac{2\sqrt{7}}{7}$ (J) $\frac{8}{\sqrt{20}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{8\sqrt{5}}{2\sqrt{5}} = \frac{4\sqrt{5}}{1}$
- (C) $\frac{20}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{20\sqrt{5}}{5} = 4\sqrt{5}$ (K) $\frac{9}{2\sqrt{45}}$
- (D) $\frac{14}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{14\sqrt{2}}{2} = 7\sqrt{2}$ (L) $\frac{\sqrt{7}}{\sqrt{3}}$
- (E) $\frac{3}{\sqrt{6}} \cdot \frac{\sqrt{6}}{\sqrt{6}} = \frac{3\sqrt{6}}{6} = \frac{\sqrt{6}}{2}$ (M) $\frac{\sqrt{5}}{\sqrt{10}}$
- (F) $\frac{4}{\sqrt{10}} \cdot \frac{\sqrt{10}}{\sqrt{10}} = \frac{4\sqrt{10}}{10} = \frac{2\sqrt{10}}{5}$ (N) $\frac{3\sqrt{6}}{\sqrt{2}}$
- (G) $\frac{11}{\sqrt{11}} \cdot \frac{\sqrt{11}}{\sqrt{11}} = \frac{11\sqrt{11}}{11} = \sqrt{11}$ (O) $\frac{\sqrt{3}}{2\sqrt{6}}$
- (H) $\frac{3}{\sqrt{12}} \cdot \frac{\sqrt{12}}{\sqrt{12}} = \frac{3\sqrt{12}}{12}$ (P) $\frac{2\sqrt{3}}{\sqrt{15}}$
- $\frac{\sqrt{12}}{4} = \frac{2\sqrt{3}}{4} = \frac{\sqrt{3}}{2}$

Answers I–P:

$\frac{3\sqrt{2}}{4}$	BUT
$\frac{\sqrt{2}}{4}$	AND
$\frac{\sqrt{21}}{3}$	IN
$\frac{4\sqrt{5}}{5}$	GIRL
$\frac{6\sqrt{2}}{5}$	LOST
$3\sqrt{3}$	FOG
$\frac{3\sqrt{5}}{10}$	FRIEND
$\frac{\sqrt{2}}{2}$	THE
$5\sqrt{2}$	HIS
$\frac{2\sqrt{2}}{5}$	A
$\frac{2\sqrt{5}}{5}$	MIST
$\frac{9\sqrt{3}}{10}$	TODAY

Did you hear about ...

$$I. \frac{30}{\sqrt{18}} = \frac{30}{\sqrt{9 \cdot 2}} = \frac{30}{3\sqrt{2}} = \frac{10}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{10\sqrt{2}}{2} = \boxed{5\sqrt{2}}$$

$$J. \frac{8}{\sqrt{20}} = \frac{8}{2\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{8\sqrt{5}}{10} = \boxed{\frac{4\sqrt{5}}{5}}$$

$$K. \frac{9}{2\sqrt{45}} = \frac{9}{2\sqrt{9 \cdot 5}} = \frac{9}{6\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{9\sqrt{5}}{30} = \boxed{\frac{3\sqrt{5}}{10}}$$

$$L. \frac{\sqrt{7} \cdot \sqrt{3}}{\sqrt{3} \cdot \sqrt{3}} = \boxed{\frac{\sqrt{21}}{3}}$$

$$M. \frac{\sqrt{5}}{\sqrt{10}} = \frac{1}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \boxed{\frac{\sqrt{2}}{2}}$$

$$N. \frac{3\sqrt{6}}{\sqrt{2}} = \boxed{3\sqrt{3}}$$

$$O. \frac{\sqrt{3}}{2\sqrt{6}} = \frac{1}{2\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \boxed{\frac{\sqrt{2}}{4}}$$

$$P. \frac{2\sqrt{3}}{\sqrt{15}} = \frac{2}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \boxed{\frac{2\sqrt{5}}{5}}$$

Dividing Radical Expressions

Simplify.

$$1) \frac{\sqrt{15}}{5\sqrt{20}} = \frac{\sqrt{15}}{10\sqrt{5}} = \frac{\sqrt{3}}{10}$$

$$2) \frac{\sqrt{8}}{\sqrt{100}} = \frac{2\sqrt{2}}{10}$$

$$3) \frac{\sqrt{6^2}}{\sqrt{27a}} = \frac{\sqrt{2}}{3}$$

$$4) \frac{3\sqrt{205}}{2\sqrt{41}} = \frac{3\sqrt{5}}{2}$$

$$5) \frac{4}{\sqrt{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}} = \frac{4\sqrt{5}}{5}$$

$$6) \frac{\sqrt{4}}{5\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{2\sqrt{3}}{15}$$

$$7) \frac{\sqrt{5}}{\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{15}}{3}$$

$$8) \frac{\sqrt{2}}{2\sqrt{3}} \cdot \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{6}}{6}$$

$$9) \frac{\sqrt{3x^2y^3}}{4\sqrt{5xy^3}} \cdot \frac{\sqrt{5xy^3}}{\sqrt{5xy^3}} = \frac{\sqrt{15x^3y^6}}{4(5xy^3)}$$

$$= \frac{xy^3\sqrt{15x}}{20xy^3}$$

$$10) \frac{\sqrt{18xy}}{3\sqrt{10p^3}} \cdot \frac{\sqrt{3}}{3y\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{6}}{12y}$$

$$11) \frac{3-3\sqrt{3a}}{4\sqrt{8a}} = \frac{(3-3\sqrt{3})\sqrt{2}}{8\sqrt{2}\sqrt{2}}$$

$$= \frac{3\sqrt{2}-3\sqrt{6}}{16}$$

$$12) \frac{3n^2 + \sqrt{2n^2}}{\sqrt{10n}} \cdot \frac{\sqrt{10n}}{\sqrt{10n}} = \frac{3n^2\sqrt{10n} + \sqrt{20n^3}}{10n}$$

$$= \frac{3n^2\sqrt{10n} + 2n\sqrt{5n}}{10n}$$

$$= \frac{3n\sqrt{10n} + 2\sqrt{5n}}{10}$$