AMDG

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Advanced Geometry – period
Wednesday, 20 February 2013

Divisibility Rules

These rules let you test if one number is divisible by another, without having to do too much calculation!

Divisible by:	If:	Examples:
2	The last digit is even (0,2,4,6,8)	12**8** is 12**9** is not
3	The sum of the digits is divisible by 3	381 (3+8+1=12, and 12÷3 = 4) **Yes** 217 (2+1+7=10, and 10÷3 = 3 $^{1}/_{3}$) **No**
4	The last 2 digits are divisible by 4	13**12** is (12÷4=3) 70**19** is not
5	The last digit is 0 or 5	17**5** is 80**9** is not
6	The number is divisible by both 2 *and* 3	11**4** (it is even, and 1+1+4=6 and 6÷3 = 2)**Yes** 308 (it is even, but 3+0+8=11 and 11÷3 = 3 $^{2}/_{3}$) **No**
7	If you double the last digit and subtract it from the rest of the number and the answer is: • **0**, or • **divisible by 7** (Note: you can apply this rule to that answer again if you want)	672 (Double 2 is 4, 67-4=63, and 63÷7=9)**Yes** 905 (Double 5 is 10, 90-10=80, and 80÷7=11 $^{3}/_{7}$) **No**
8	The last three digits are divisible by 8	109**816** (816÷8=102) **Yes** 216**302** (302÷8=37 $^{3}/_{4}$) **No**
9	The sum of the digits is divisible by 9 (Note: you can apply this rule to that answer again if you want)	1629 (1+6+2+9=18, and again, 1+8=9) **Yes** 2013 (2+0+1+3=6) **No**
10	The number ends in 0	22**0** is 22**1** is not
11	If you sum every second digit and then subtract all other digits and the answer is: • **0**, or • **divisible by 11**	13**6**4 ((3+4) - (1+6) = **0**) **Yes** 37**2**9 ((7+9) - (3+2) = **11**) **Yes** 25176 ((5+7) - (2+1+6) = **3**) **No**
12	The number is divisible by both 3 ***and*** 4	6**48** (*By 3?* 6+4+8=18 and 18÷3=6 Yes. *By 4?* 48÷4=12 Yes) **Yes** 524 (*By 3?* 5+2+4=11, 11÷3= 3 $^{2}/_{3}$ No. Don't need to check by 4.) **No**

There are lots more! Not only are there divisibility tests for larger numbers, but there are more tests for the numbers we have shown.

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Practice

Random Number	Divisible by…
1. 3,255,036,419	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
2. 2,522,122,008	2, 3, 4, 6, 7, 8, 12
3. 5,636,784,890	2, 5, 10, 11,
4. 634,639,608	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
5. 8,321,598,759	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
6. 4,897,905,653	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
7. 4,184,640,505	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
8. 6,902,395,841	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
9. 1,219,912,547	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
10. 9,769,702,699	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

9.1: Review of Radicals and Quadratic Equations

Objective

After studying this section, you will be able to

- Simplify radical expressions and solve quadratic equations

Problem 1 Simplify $\sqrt{48}$.

X

method 1 → 48 → 24 → 12 → 6 → 2 · 3

$\sqrt{48} = 48^{1/2} \rightarrow \sqrt{2 \cdot 2 \cdot 2 \cdot 2 \cdot 3}$

$2 \cdot 2\sqrt{3}$

$4\sqrt{3}$

method 2 → $\sqrt{16}\sqrt{3} = 4 \cdot \sqrt{3}$

Problem 2 Simplify $\sqrt{18} + \sqrt{32} + \sqrt{75}$.

$\sqrt{9}\cdot\sqrt{2} + \sqrt{16}\cdot\sqrt{2} + \sqrt{25}\sqrt{3}$

$3\sqrt{2} + 4\sqrt{2} + 5\sqrt{3} \rightarrow 3x + 4x + 5y$

$7\sqrt{2} + 5\sqrt{3} \leftarrow 7x + 5y$

Problem 3 Simplify $\sqrt{\frac{5}{3}}$.

$= \frac{\sqrt{5}}{\sqrt{3}} \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{15}}{\sqrt{9}} = \frac{\sqrt{15}}{3}$

Problem 4 Solve $x^2 + 9 = 25$ for x.

method 1

$x^2 + 9 - 25 = 25 - 25$

$x^2 - 16 = 0$

$(x+4)(x-4) = 0$

$x+4=0$ $\quad$ $x-4=0$

$x=-4$ $\quad$ $x=4$

method 2

$x^2 = 16$

$x = \pm\sqrt{16}$

$x = \pm 4$

Problem 5 Solve $(3\sqrt{5})^2 + (3\sqrt{2})^2 = x^2$ for x.

$(3\sqrt{5})(3\sqrt{5})$ $\quad$ $(3\sqrt{2})(3\sqrt{2})$

$3 \cdot 3\sqrt{25}$

$9 \cdot 5$

$45 + 18 = x^2$

$63 = x^2$

$\sqrt{9} \cdot \sqrt{7} = x$

$\pm 3\sqrt{7} = x$

Problem 6 Solve for x. **a** $x^2 - 10x = -16$ **b** $x^2 + 5x = 0$

$x^2 - 10x + 16 = 0$

$(x-8)(x-2) = 0$

$x = 8$ & $x = 2$

$x(x+5) = 0$

$x=0$ & $x=-5$

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9.1 Homework
Short Quiz on this tomorrow.

1 Simplify.

a $\sqrt{4} = 2$

b $\sqrt{27} = 3\sqrt{3}$

c $\sqrt{72} = \sqrt{9 \cdot 4 \cdot 2} = 6\sqrt{2}$

d $\sqrt{32} = \sqrt{16} \cdot \sqrt{2} = 4\sqrt{2}$

e $\sqrt{98} = 7\sqrt{2}$

f $\sqrt{200} = 10\sqrt{2}$

g $\sqrt{20} = 2\sqrt{5}$

h $\sqrt{24} = 2\sqrt{6}$

2 Simplify.

a $5\sqrt{18} = 5 \cdot 3\sqrt{2} = 15\sqrt{2}$

b $\sqrt{4 + 9} = \sqrt{13}$

c $\sqrt{3^2 + 4^2} = \sqrt{9+16} = \sqrt{25} = 5$

d $\sqrt{5^2 + 12^2} = \sqrt{25+144} = \sqrt{169} = 13$

e $\frac{1}{6}\sqrt{48} = \frac{\sqrt{48}}{6} = \frac{\sqrt{16}\sqrt{3}}{6} = \frac{4\sqrt{3}}{6} = \frac{2}{3}\sqrt{3}$ or $\frac{2\sqrt{3}}{3}$

f $\sqrt{49 \cdot 3} = 7\sqrt{3}$

3 Simplify.

a $\frac{1}{\sqrt{2}} \frac{\sqrt{2}}{\sqrt{2}} = \frac{\sqrt{2}}{\sqrt{4}} = \frac{\sqrt{2}}{2}$

b $\frac{1}{\sqrt{5}} \quad \frac{\sqrt{5}}{\sqrt{5}} = \frac{\sqrt{5}}{\sqrt{25}} = \frac{\sqrt{5}}{5}$

c $\dfrac{4}{\sqrt{2}} \cdot \dfrac{\sqrt{2}}{\sqrt{2}} = \dfrac{4\sqrt{2}}{\sqrt{4}} = \dfrac{4\sqrt{2}}{2} = 2\sqrt{2}$

d $\dfrac{6}{\sqrt{3}} \cdot \dfrac{\sqrt{3}}{\sqrt{3}} = \dfrac{6\sqrt{3}}{\sqrt{9}} = \dfrac{6\sqrt{3}}{3} = 2\sqrt{3}$

4 Simplify.

a $4\sqrt{3} + 7\sqrt{3} = 11\sqrt{3}$

b $7\sqrt{2} + \sqrt{3} + 6\sqrt{3} + \sqrt{2}$

$8\sqrt{2} + 7\sqrt{3}$

c $\sqrt{12} + \sqrt{27}$

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

d $\sqrt{72} + \sqrt{75} - \sqrt{48}$

$\sqrt{9}\sqrt{4}\sqrt{2} + \sqrt{25}\sqrt{3} - \sqrt{16}\sqrt{3}$

$6\sqrt{2} + 5\sqrt{3} - 4\sqrt{3} = \boxed{6\sqrt{2} + \sqrt{3}}$

5 Solve for x.

a $\sqrt{x^2} = \sqrt{25}$

$x = \pm 5$

b $\sqrt{x^2} = \sqrt{144}$

$x = \pm 12$

6 Solve for x.

a $x^2 + 16 = 25$

$-16 \quad -16$

$x^2 = 9$

$x = \pm 3$

OR

$x^2 - 9 = 0$

$(x+3)(x-3) = 0$

$x = -3$ & $x = 3$

b $x^2 + 6^2 = 100$

$-36 \quad -36$

$x^2 = 64$

$x = \pm 8$

7 Solve for x.

a $x^2 - 5x - 6 = 0$

$(x-6)(x+1) = 0$

$x-6=0 \quad x+1=0$

$x=6 \;\&\; x=-1$

b $x^2 + 4x - 12 = 0$

$(x+6)(x-2) = 0$

$x=-6 \;\&\; x=2$

8 Solve for x.

a $x^2 - 4x = 0$

$x(x-4) = 0$

$x=0 \quad x-4=0$

$x=4$

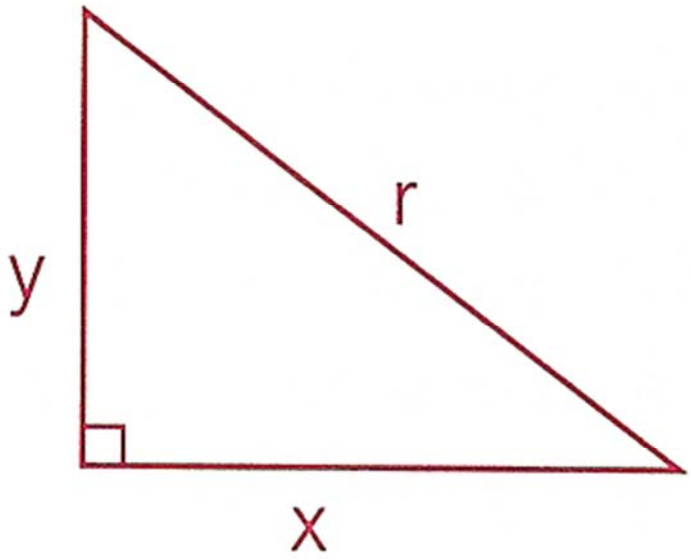
b $x^2 = 10x$

$x^2 - 10x = 0$

$x(x-10) = 0$

$x=0 \quad x=10$

9 If, in the given figure, $x^2 + y^2 = r^2$,



a Find x if $y = 21$ and $r = 29$

$x^2 + 21^2 = 29^2$

$x^2 + 441 = 841$

$x^2 = 400$

$x = \pm 20$

b Find y, in simplified radical form, if $x = 2$ and $r = 4$

$x^2 + y^2 = r^2$

$2^2 + y^2 = 4^2$

$4 + y^2 = 16$

$y^2 = 12$

$y = \pm 2\sqrt{3}$

c Find r to the nearest tenth if $x = 4.1$ and $y = 7.1$

$4.1^2 + 7.1^2 = r^2$

$16.81 + 50.41 = r^2$

$67.22 = r^2$

$\pm 8.2 = r$

10 Solve for x.

a $3x^2 + 5x - 7 = 1x^2 + 8x + 28$

$-x^2 \quad -8x \quad -28 \quad -x^2 \quad -8x \quad -28$

$2x^2 - 3x - 35 = 0$

$2(-35) = -70$

$(+7)(-10) = -3$

$(2x^2 - 10x) + (7x - 35) = 0$

$2x(x-5) + 7(x-5) = 0$

$(2x+7)(x-5) = 0$

$2x+7=0 \quad x=5$

$2x = -7$

$x = -7/2$

$12(-15) = -180$

b $12x^2 - 15 = -11x$

$12x^2 + 11x - 15 = 0$

$(12x^2 - 9x) + (20x - 15) = 0$

$3x \qquad 5$

$3x(4x-3) + 5(4x-3) = 0$

$(4x-3)(3x+5) = 0$

$4x-3=0 \quad 3x+5=0$

$4x=3 \quad 3x=-5$

$x = 3/4 \quad x = -5/3$

c $8x^2 - 7x + 9 = 2x^2 + 6x + 7$

$-2x^2 \quad -6x \quad -7 \quad -2x^2 \quad -6x \quad -7$

$6(2) = 12$

$6x^2 - 13x + 2 = 0$

$(6x^2 - 12x) + (-1x + 2) = 0$

$6x \qquad -1$

$6x(x-2) - 1(x-2) = 0$

$(x-2)(6x-1) = 0$

$x = 2 \quad \& \quad 6x - 1 = 0$

$x = 1/6$

Factoring trinomials Using Grouping

Example: $20x^2 + 5x - 15$

$5(4x^2 + x - 3)$

$a = 4, b = 1, c = -3$