9-14-11

Sunday, September 11, 2011
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3.3 Subtraction, Order, and Applications

OBJECTIVES

a	Subtract using fraction notation.
b	Use < or > with fraction notation to write a true sentence.
c	Solve equations of the type $x + a = b$ and $a + x = b$ where a and b may be fractions.
d	Solve applied problems involving subtraction with fraction notation.

a Subtract using fraction notation.

To subtract when denominators are the same,

a) subtract the numerators,

b) keep the denominators, and

c) simplify, if possible.

$$\frac{7}{10}-\frac{4}{10}=\frac{7-4}{10}=\frac{3}{10}$$

a Subtract using fraction notation.

To subtract when denominators are different:

a) Find the least common multiple of the denominators. That number is the least common denominator, LCD.

b) Multiply by 1, using an appropriate notation, n/n, to express each number in terms of the LCD.

c) Subtract the numerators, keeping the same denominator.

d) Simplify, if possible.

a Subtract using fraction notation.

EXAMPLE C Subtract: $\frac{5}{12}-\frac{1}{16}$.

Solution

b Use < or > with fraction notation to write a true sentence.

EXAMPLE E Use < or > for ☐ to form a true sentence:

$$\frac{49}{100}\square\frac{5}{10}$$

Solution

a Subtract using fraction notation.

EXAMPLE A Subtract and, if possible, simplify:

1. $\frac{8}{15}-\frac{4}{15}$ 2. $\frac{27}{45}-\frac{9}{45}$ 3. $\frac{15}{30}-\frac{6}{30}$

Solution

1.)_____

2.)_____

3.)_____

a Subtract using fraction notation.

EXAMPLE B Subtract: $\frac{4}{5}-\frac{3}{7}$.

Solution

The LCM of 7 and 5 is 35, so the LCD is 35.

Find equivalent numbers with denominators of 35.

$$\frac{4}{5}-\frac{3}{7}=\frac{4}{5}\cdot\frac{7}{7}-\frac{3}{7}\cdot\frac{5}{5}$$

Think: $5 \times \square = 35$. The answer is 7, so we multiply by 1, using 7/7.

Think: $7 \times \square = 35$. The answer is 5, so we multiply by 1, using 5/5.

EXAMPLE B Subtract: $\frac{4}{5}-\frac{3}{7}$.

We subtract:

$$=\frac{28}{35}-\frac{15}{35}=\frac{28-15}{35}=\frac{13}{35}$$

(continued)

b Use < or > with fraction notation to write a true sentence.

To determine which of two number is greater when there is a common denominator, compare the numerators:

$$\frac{4}{5},\ \frac{3}{5};\qquad 4>3;\qquad \frac{4}{5}>\frac{3}{5}.$$

When denominators are different, we cannot compare numerators. We multiply by 1 to make the denominators the same.

c Solve equations of the type $x + a = b$ and $a + x = b$ where a and b may be fractions.

EXAMPLE F Solve: $x+\frac{3}{4}=\frac{4}{5}$.

Solution

$$x+\frac{3}{4}=\frac{4}{5}$$

EXAMPLE E Use < or > for □ to form a true sentence:

$$\frac{49}{100} \square \frac{5}{10}$$

Solution

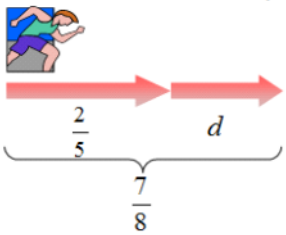
EXAMPLE F Check. $x + \frac{3}{4} = \frac{4}{5}$.

$\frac{1}{20} + \frac{3}{4}$	
$\frac{1}{20} + \frac{3}{4} \cdot \frac{5}{5}$	
$\frac{1}{20} + \frac{15}{20}$	
$\frac{16}{20}$	
$\frac{4}{5} \cdot \frac{5}{5}$	$\frac{4}{5}$ True

EXAMPLE A Find Distance Left to Run

Solution

Familiarize. Use a sketch. Let d represent the distance yet to run.



(continued)

EXAMPLE G Find Distance Left to Run

Check. To check, we return to the original problem and add:

$$\frac{2}{5} + d = \frac{7}{8}$$

$$\frac{2}{5} + \frac{19}{40} = \frac{7}{8}$$

$$\frac{2}{5} \cdot \frac{8}{8} + \frac{19}{40} = \frac{7}{8}$$

$$\frac{35}{40} = \frac{7}{8}$$

State. Miguel needs to run 19/40 of a mile more.

c Solve equations of the type $x + a = b$ and $a + x = b$ where a and b may be fractions.

EXAMPLE F Solve: $x + \frac{3}{4} = \frac{4}{5}$.

Solution

$$x + \frac{3}{4} = \frac{4}{5}$$

$$x + \frac{3}{4} - \frac{3}{4} = \frac{4}{5} - \frac{3}{4}$$ Using the addition principle: Subtracting 3/4 from both sides.

$$x + 0 = \frac{4}{5} - \frac{3}{4}$$

$$x = \frac{4}{5} \cdot \frac{4}{4} - \frac{3}{4} \cdot \frac{5}{5}$$ Multiplying by 1 to obtain the LCD, 20

$$x = \frac{16}{20} - \frac{15}{20} = \frac{1}{20}$$

d Solve applied problems involving subtraction with fraction notation.

EXAMPLE G Find Distance Left to Run

Miquel has run for 2/5 of a mile and will stop when he has run 7/8 of a mile. How much further does he have to go?

EXAMPLE G Find Distance Left to Run

Translate. $\frac{2}{5} + d = \frac{7}{8}$

Solve. To solve the equation, we subtract 2/5 from both sides.

$$\frac{2}{5} + d = \frac{7}{8}$$

$$\frac{2}{5} + d - \frac{2}{5} = \frac{7}{8} - \frac{2}{5}$$

$$d + 0 = \frac{7}{8} \cdot \frac{5}{5} - \frac{2}{5} \cdot \frac{8}{8}$$

$$d = \frac{35}{40} - \frac{16}{40}$$

$$d = \frac{19}{40}$$

(continued)

3.4 Mixed Numerals

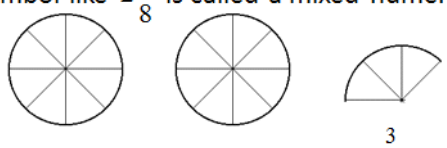
OBJECTIVES

a	Convert between mixed numerals and fraction notation.
b	Divide whole numbers, writing the quotient as a mixed numeral.

a Convert between mixed numerals and fraction notation.

What is a mixed numeral?

A symbol like $2\frac{3}{8}$ is called a mixed numeral.



1 1 $\frac{3}{8}$

$2\frac{3}{8}$ means $2 + \frac{3}{8}$

whole number; fraction less than 1

a Convert between mixed numerals and fraction notation.

EXAMPLE B Convert to fraction notation: $8\frac{7}{8}$

Solution

$$8\frac{7}{8} = 8 + \frac{7}{8}$$
$$= \frac{8}{1} + \frac{7}{8}$$
$$= \frac{8}{1}\cdot\frac{8}{8} + \frac{7}{8} \quad \text{Finding a common denominator}$$
$$= \frac{64}{8} + \frac{7}{8} = \frac{71}{8} \quad \text{Adding}$$

a Convert between mixed numerals and fraction notation.

EXAMPLE C Convert to fraction notation: 1. $6\frac{4}{5}$ 2. $8\frac{2}{7}$

Solution

_____

_____

a Convert between mixed numerals and fraction notation.

EXAMPLE D Convert to a mixed numeral: $\frac{9}{4}$

Solution

_____

_____

b Divide whole numbers, writing the quotient as a mixed numeral.

EXAMPLE F Divide. Write a mixed numeral for the quotient: $9\overline{)6335}$

Solution

$$\begin{array}{r} 703 \\ 9\overline{)6335} \\ \underline{6300} \\ 35 \\ \underline{27} \\ 8 \end{array}$$

The answer is 703 R 8 or $703\frac{8}{9}$.

a Convert between mixed numerals and fraction notation.

EXAMPLE A Convert to a mixed numeral: $3 + \frac{4}{9}$

Solution

$$3 + \frac{4}{9} = 3\frac{4}{9}$$

a Convert between mixed numerals and fraction notation.

To convert from a mixed numeral to fraction notation:

a. Multiply the whole number by the denominator: $4 \cdot 10 = 40$.

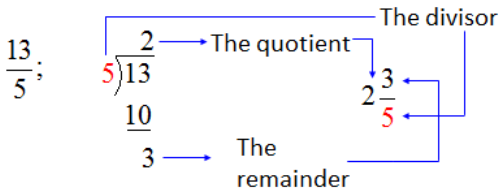
b. Add the result to the numerator: $40 + 3 = 43$.

c. Keep the denominator.

(b) (a) $4\frac{3}{10} = \frac{43}{10}$

a Convert between mixed numerals and fraction notation.

To convert from fraction notation to a mixed numeral, divide.



a Convert between mixed numerals and fraction notation.

EXAMPLE E Convert to a mixed numeral: $\frac{174}{8}$

Solution

_____

_____

3.5 Addition and Subtraction Using Mixed Numerals: Applications

3.5 Addition and Subtraction Using Mixed Numerals; Applications

OBJECTIVES

a	Add using mixed numerals.
b	Subtract using mixed numerals.
c	Solve applied problems involving addition and subtraction with mixed numerals.

a Add using mixed numerals.

Adding Mixed Numbers

First add the fractions.

Then add the whole numbers and, if possible, simplify the fraction part.

a Add using mixed numerals.

EXAMPLE A Add: $6\frac{3}{8}+3\frac{3}{4}$. Write a mixed numeral for the answer.

Solution The LCD is 8.

$$\begin{array}{rl} 6\frac{3}{8} & = 6\frac{3}{8} \\ +\,3\frac{3}{4}\cdot\frac{2}{2} & =+\,3\frac{6}{8} \\ \hline & 9\frac{9}{8}=9+\frac{9}{8} \\ & =9+1\frac{1}{8} \quad =10\frac{1}{8} \end{array}$$

To find a mixed numeral for 9/8, we divide: $8\overline{)9}\ =1\frac{1}{8}$, remainder 1.

a Add using mixed numerals.

EXAMPLE B Add: $4\frac{2}{3}+3\frac{4}{5}$. Write a mixed numeral for the answer.

Solution:

_____

_____

_____

b Subtract using mixed numerals.

EXAMPLE C Subtract: $9\frac{5}{6}-2\frac{1}{6}$.

Solution

$$\begin{array}{rl} 9\frac{5}{6} & = 9\frac{5}{6} \\ -\,2\frac{1}{6} & =-\,2\frac{1}{6} \\ \hline \frac{4}{6} & 7\frac{4}{6}=7\frac{2}{3} \end{array}$$

Subtract the fractions. Subtract the whole numbers. Simplify.

b Subtract using mixed numerals.

EXAMPLE D Subtract: $10\frac{5}{6}-4\frac{2}{5}$.

Solution The LCD is 30.

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_____

b Subtract using mixed numerals.

To subtract fractions, we may need to "borrow" from the whole number.

This enables us to write an equivalent expression in which the fractions are more easily subtracted.

b Subtract using mixed numerals.

EXAMPLE E Subtract: $12-4\frac{2}{3}$.

Solution

$$\begin{array}{rl} 12 & = 11\frac{3}{3} \\ -\,4\frac{2}{3} & =-\,4\frac{2}{3} \\ \hline & 7\frac{1}{3} \end{array}$$

$12 = 11 + 1 = 11 + \frac{3}{3}$

b Subtract using mixed numerals.

EXAMPLE F Subtract: $8\frac{1}{9}-3\frac{5}{6}$.

Solution

$$\begin{array}{rlll} 8\frac{1}{9}\cdot\frac{2}{2} & = 8\frac{2}{18} & = 7\frac{20}{18} & \text{We need to borrow 1, or 18/18 from 8.} \\ -\,3\frac{5}{6}\cdot\frac{3}{3} & =-\,3\frac{15}{18} & =-\,3\frac{15}{18} & 8 = 7 + 1 + 2/18 \\ \hline & & & 7+\frac{18}{18}+\frac{2}{18}=7\frac{20}{18} \end{array}$$

$$-\frac{3}{} \quad = -4\frac{}{3}$$

$$7\frac{1}{3}$$

$$-3\frac{5}{6}\cdot\frac{3}{3} = -3\frac{15}{18} = -3\frac{15}{18}$$

$$4\frac{5}{18}$$

$8 = 7 + 1 + 2/18$

$7 + \frac{18}{18} + \frac{2}{18} = 7\frac{20}{18}$

c Solve applied problems involving addition and subtraction with mixed numerals.

EXAMPLE G Total Amount of Meat Bought

Penny bought lunch meat for sandwiches. She purchased $2\frac{1}{4}$ pounds of ham, and $3\frac{1}{3}$ pounds of turkey. How many pounds to lunch meat did she buy?

Solution

Familiarize. We let t = the total amount of lunch meat.

Translate.

Ham	+	Turkey	=	Total
$2\frac{1}{4}$	+	$3\frac{1}{3}$	=	t

EXAMPLE G Total Amount of Meat Bought

Solve. The LCD is 12

$$2\frac{1}{4}\cdot\frac{3}{3}$$

$$+\ 3\frac{1}{3}\cdot\frac{4}{4}$$

$$2\frac{3}{12}$$

$$+\ 3\frac{4}{12}$$

$$5\frac{7}{12}$$

EXAMPLE G Total Amount of Meat Bought

Check. Approximate 2 + 3 = 5 pounds

State. Penny bought $5\frac{7}{12}$ pounds of lunch meat.