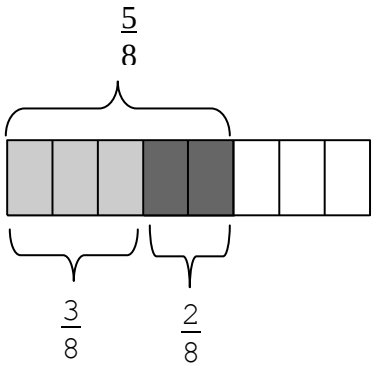
WILLIAM D. LAW, JR. LEARNING COMMONS

Subtracting Fractions and Mixed Numbers

I. Subtracting Fractions With the Same Denominator



$$\frac{5}{8}-\frac{2}{8}=\frac{3}{8}$$

To subtract fractions with the same denominator:

a. Subtract the numerators.
b. Place the difference over the common denominator.
c. Simplify the answer.

1-3. Subtract and simplify.

1. $\frac{5}{9}-\frac{2}{9}$ 2. $\frac{15}{16}-\frac{3}{16}$ 3. $\frac{17}{25}-\frac{8}{25}$

II. Subtracting Fractions With Unlike Denominators

Just as we must add with the same denominator, we must subtract with the same denominator. To subtract fractions with unlike denominators:

a. Find the Least Common Multiple of the denominators.
b. Build equivalent fractions.
c. Subtract the numerators; keep the denominators.
d. Simplify

EXAMPLE: $\frac{13}{20}-\frac{5}{12}$

(a) Find the LCM of 20 and 12

$20=2\cdot 2\cdot 5$ $12=2\cdot 2\cdot 3$ LCM = $2\cdot 2\cdot 3\cdot 5=60$

(b) Build equivalent fractions

$$\frac{13}{20}\cdot\frac{3}{3}=\frac{39}{60} \qquad\qquad \frac{5}{12}\cdot\frac{5}{5}=\frac{25}{60}$$

(c) Subtract numerators; keep denominator

$$\frac{39-25}{60}=\frac{14}{60}$$

(d) Simplify: $$\frac{2\times 7}{2\times 30}=\frac{7}{30}$$

5- 9. Subtract and simplify: (You must have common denominators. Only subtract the numerators.)

5. $\frac{17}{30}-\frac{1}{3}$ 6. $\frac{5}{7}-\frac{3}{8}$ 7. $\frac{1}{2}-\frac{3}{10}$

8. $\frac{15}{16}-\frac{1}{4}$ 9. $\frac{2}{25}-\frac{2}{35}$

III. Subtracting Mixed Numbers With No Borrowing

In addition of mixed numbers (once they have the same denominators), we add the fractions, then we add the whole numbers. Similarly, in subtraction of mixed numbers, we subtract the fractions (once they have the same denominators), and we subtract the whole numbers.

EXAMPLE:

$$\begin{array}{r} 3\frac{4}{5}=3\frac{12}{15} \\ -2\frac{7}{15}=2\frac{7}{15} \\ \hline 1\frac{5}{15} \end{array}$$

LCM of 5 and 15 is 15. Only one fraction must be written differently.

PROBLEMS 1–3 Subtract:

1. $7\frac{3}{4} - 2\frac{1}{4}$

2. $6\frac{3}{5} - \frac{1}{3}$

3. $8\frac{5}{14} - 2\frac{9}{28}$

IV. Subtracting With Borrowing

When subtracting a fraction from a whole number, or sometimes when subtracting two mixed numbers, we will have to borrow from the ones' column in order to subtract the fractional parts.

REMEMBER $5\frac{3}{8}$ means $5 + \frac{3}{8}$ and $\frac{4}{4}$ means 1.

EXAMPLE: Subtract $6 - 3\frac{1}{4}$

To subtract $6 - 3\frac{1}{4}$, we must borrow 1 from the 6. The borrowed 1 is written as a fraction which has the **same denominator as the subtrahend's fraction.**

We can write 6 as 5 + 1, or as $5 + \frac{4}{4}$ or $5\frac{4}{4}$

$$\begin{array}{rcl} 6 & = & 5\frac{4}{4} \\ -3\frac{1}{4} & = & 3\frac{1}{4} \\ \hline & & 2\frac{3}{4} \end{array}$$

Now subtract as before.

1–5 Subtract:

1. $8 - 2\frac{3}{5}$

2. $12 - 6\frac{5}{12}$

3. $4 - 3\frac{3}{7}$

4. $1-\frac{7}{9}$ 5. $8-\frac{3}{20}$

B. Mixed Number Subtraction With Borrowing

IT IS IMPORTANT TO REMEMBER THAT SUBTRACTION IS NOT COMMUTATIVE.

3 – 5 is **not** equivalent to 5 – 3.

In the problem $8\frac{2}{5} - 2\frac{3}{4}$, the $\frac{3}{4}$ is to be subtracted from the $\frac{2}{5}$. We must first get equivalent fractions with the LCM of 5 and 4 as their denominator.

$$\begin{array}{rcl} 8\frac{2}{5} & = & 8\frac{8}{20} \\ -2\frac{3}{4} & = & 2\frac{15}{20} \\ \hline \end{array}$$

The subtraction of the numerators says 8 – 15, NOT 15 – 8.

After the fractions have the same denominator, if the numerator of the minuend is the smaller number, it is necessary to borrow 1 from the whole number. The borrowed one is written as a fraction with the same denominator as the other fractions and added to the fraction in the minuend.

HOW TO BORROW:

Think of $8\frac{8}{20}$ as $8 + \frac{8}{20}$, and think of 8 as 7 + 1:

$$(7+1) + \frac{8}{20} = 7 + \left(1 + \frac{8}{20}\right) = 7 + \left(\frac{20}{20} + \frac{8}{20}\right) = 7 + \frac{28}{20} = 7\frac{28}{20}$$

NOW SUBTRACT:

$$\begin{array}{r} 8\frac{2}{5} = 8\frac{8}{20} = 7\frac{28}{20} \\ -2\frac{3}{4} = 2\frac{15}{20} = 2\frac{15}{20} \\ \hline 5\frac{13}{20} \end{array}$$

NOTICE the whole number of the subtrahend stays the same!

THINK: If an addition answer was $\frac{28}{20}$, wouldn't you write it as $1\frac{8}{20}$ or $1\frac{2}{5}$? (This is a way of checking your top line!)

Another way to do this is to think of $8\frac{8}{20}$ as $7 + 1 + \frac{8}{20}$ or $7 + 1\frac{8}{20}$. Remember a mixed number implies addition. $1\frac{8}{20}$ is $1 + \frac{8}{20}$! Now write the mixed number as an improper fraction: $1\frac{8}{20} = \frac{1\times 20+8}{20} = \frac{28}{20}$.

STUDY THE COMMENT ABOUT BORROWING at the end of the answers for this lab.

EXERCISES: Subtract and Simplify: Borrow only if it is necessary!

6. $7\frac{2}{3} - 3\frac{5}{8}$

7. $6\frac{3}{7} - 2\frac{16}{21}$

8. $11\frac{1}{4} - 10\frac{5}{8}$

9. $16\frac{3}{4} - 12$

10. $16 - 12\frac{3}{4}$

11. $16\frac{7}{12} - 12\frac{3}{4}$

12. $16\frac{3}{4} - 12\frac{7}{12}$

13. $25\frac{3}{25} - 14\frac{1}{2}$

ANSWERS:

I.

1. $\frac{3}{9}=\frac{1}{3}$ 2. $\frac{12}{16}=\frac{3}{4}$ 3. $\frac{9}{25}$

II.

5. $\frac{7}{30}$ 6. $\frac{19}{56}$ 7. $\frac{2}{10}=\frac{1}{5}$ 8. $\frac{11}{16}$ 9. $\frac{4}{175}$

III. 1. $5\frac{1}{2}$ 2. $6\frac{4}{15}$ 3. $6\frac{1}{28}$

IV. 1. $5\frac{2}{5}$ 2. $5\frac{7}{12}$ 3. $\frac{4}{7}$ 4. $\frac{2}{9}$ 5. $7\frac{17}{20}$ 6. $4\frac{1}{24}$

7. $3\frac{2}{3}$ 8. $\frac{5}{8}$ 9. $4\frac{3}{4}$ 10. $3\frac{1}{4}$ 11. $3\frac{5}{6}$ 12. $4\frac{1}{6}$

13. $10\frac{31}{50}$

IV. Something to think about:

When we subtract $\begin{array}{r} 42 \\ -\,26 \\ \hline \end{array}$ we write $\begin{array}{r} {}^{3}\not{4}{}^{1}2 \\ -\,26 \\ \hline \end{array}$

We borrow 1 from the 4, and put a one in front of the 2 getting 12 in the ones' place. The reason this works is 4 is in the tens' place, 1 ten is 10 ones.

$42 = 40 + 2 = (30 + 10) + 2 = 30 + (10 + 2) = 30 + 12$

When we subtract $\begin{array}{r} 8\frac{2}{9} \\ -\,2\frac{6}{9} \\ \hline \end{array}$, we cannot put a one in front of the 2 getting $\frac{12}{9}$: $\frac{12}{9} \neq 1\frac{2}{9}$

We borrowed one, which is the same as $\frac{9}{9}$. ADD: $\frac{9}{9}$ to $\frac{2}{9}$. It is $\frac{11}{9}$, not $\frac{12}{9}$!

$$8+\frac{2}{9}=7+1+\frac{2}{9}=7+\frac{9}{9}+\frac{2}{9}=7\frac{11}{9}$$