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## Overview

This presentation will cover:

- ▶ Fraction definitions;
- ▶ Equivalent fractions;
- ▶ Mixed numbers and improper fractions;
- ▶ Addition and subtraction of fractions;
- ▶ Multiplication of fractions; and
- ▶ Division of fractions.

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## Fraction Definitions

- ▶ A fraction represents a part of a whole or, more generally, any number of equal parts.
- ▶ The **denominator** (the number on the bottom of the fraction) tells us how many parts the object is divided into.
- ▶ The **numerator** (the part on the top of the fraction) tells us how many of these parts we have.
- ▶ An **improper fraction** is a fraction where the numerator is larger than the denominator, for example,  $\frac{3}{2}$ .
- ▶ A **mixed number** has a whole number with a fraction, for example  $1\frac{1}{2}$ .

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## Fractions

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## Equivalent fractions



- ▶ **Equivalent fractions** have different names for the same value, for example  $\frac{1}{2}$  is equivalent to  $\frac{2}{4}$ .
- ▶ Equivalent fractions can be made by multiplying or dividing both the numerator and the denominator by the same number.
- ▶ The process of dividing the numerator and denominator by the same number is called simplifying fractions, for example  $\frac{6}{12}$  is equivalent to  $\frac{1}{2}$ , which is in **simplest form**.

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## Equivalent fractions: Exercise



Write equivalent fraction for each of the following by making the new denominator the number given in the brackets.

1.  $\frac{2}{3}$  (9)
2.  $\frac{4}{5}$  (20)
3.  $\frac{-3}{4}$  (8)
4.  $\frac{-2}{7}$  (28)
5.  $\frac{7}{12}$  (60)

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## Equivalent fractions: Answers



1.  $\frac{2}{3} = \frac{2 \times 3}{3 \times 3} = \frac{6}{9}$ .
2.  $\frac{4}{5} = \frac{4 \times 4}{5 \times 4} = \frac{16}{20}$ .
3.  $\frac{-3}{4} = \frac{-3 \times 2}{4 \times 2} = \frac{-6}{8}$ .
4.  $\frac{-2}{7} = \frac{-2 \times 4}{7 \times 4} = \frac{-8}{28}$ .
5.  $\frac{7}{12} = \frac{7 \times 5}{12 \times 5} = \frac{35}{60}$ .

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## Equivalent fractions: exercise



Simplify the following fractions, giving your answer in its simplest form.

1.  $\frac{9}{15}$
2.  $\frac{-3}{18}$
3.  $\frac{8}{10}$
4.  $\frac{-12}{16}$
5.  $\frac{30}{40}$
6.  $\frac{2\,000}{6\,000}$

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## Equivalent fractions: Answers



1. Dividing by 3:

$$\frac{9}{15} = \frac{\cancel{9}^3}{\cancel{15}^5} = \frac{3}{5}.$$

2. Dividing by 3:

$$\frac{-3}{18} = \frac{\cancel{-3}^{-1}}{\cancel{18}^6} = \frac{-1}{6}.$$

3. Dividing by 2:

$$\frac{8}{10} = \frac{\cancel{8}^4}{\cancel{10}^5} = \frac{4}{5}.$$

4. Dividing by 4:

$$\frac{-12}{16} = \frac{\cancel{-12}^{-3}}{\cancel{16}^4} = \frac{-3}{4}.$$

5. We are dividing by 10 but in practice we just cancel the zeros:

$$\frac{30}{40} = \frac{\cancel{30}^3}{\cancel{40}^4} = \frac{3}{4}$$

6. Cancel 3 zeros on the top and 3 zeros on the bottom:

$$\frac{2,000}{6,000} = \frac{\cancel{2,000}^2}{\cancel{6,000}^6} = \frac{\cancel{2}^1}{\cancel{6}^3} = \frac{1}{3}$$

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## Mixed numbers and improper fractions



Express these improper fractions as mixed numbers.

1.  $\frac{5}{3}$
2.  $\frac{45}{20}$
3.  $\frac{-16}{7}$
4.  $\frac{40}{25}$
5.  $\frac{-35}{14}$

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## Mixed numbers and improper fractions



1.

$$\frac{5}{3} = 1\frac{2}{3}.$$

2.

$$\frac{\cancel{45}^9}{\cancel{20}^4} = \frac{9}{4} = 2\frac{1}{4}.$$

3.

$$\frac{-16}{7} = -2\frac{2}{7}.$$

4.

$$\frac{\cancel{40}^8}{\cancel{25}^5} = \frac{8}{5} = 1\frac{3}{5}.$$

5.

$$\frac{\cancel{-35}^{-5}}{\cancel{14}^2} = \frac{-5}{2} = -2\frac{1}{2}.$$

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## Mixed numbers and improper fractions



Express these mixed numbers as improper fractions.

1.  $3\frac{1}{4}$
2.  $9\frac{2}{11}$
3.  $-5\frac{2}{3}$
4.  $102\frac{5}{12}$
5.  $-21\frac{2}{5}$

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## Mixed numbers and improper fractions

1. 
$$3\frac{1}{4} = \frac{3 \times 4 + 1}{4} = \frac{13}{4}.$$

2. 
$$9\frac{2}{11} = \frac{9 \times 11 + 2}{11} = \frac{101}{11}.$$

3. 
$$-5\frac{2}{3} = -\left(\frac{5 \times 3 + 2}{3}\right) = -\frac{17}{3}.$$

4. 
$$102\frac{5}{12} = \frac{102 \times 12 + 5}{12} = \frac{1,229}{12}.$$

5. 
$$-21\frac{2}{5} = -\left(\frac{21 \times 5 + 2}{5}\right) = -\frac{107}{5}.$$



## Addition and Subtraction of Fractions



- ▶ To add or subtract fractions they need to have the same denominator.
- ▶ Remember that fractions should always be left in lowest form.
- ▶ When adding mixed numbers (whole number with a fraction), you add the whole numbers, then the fractions.
- ▶ When subtracting mixed numbers, convert to improper fractions, before doing the subtraction.

## Adding fractions: Example

For example:

$$\begin{aligned} & \frac{2}{5} + \frac{3}{8} \\ &= \frac{2 \times 8}{5 \times 8} + \frac{3 \times 5}{8 \times 5} \\ &= \frac{16}{40} + \frac{15}{40} \\ &= \frac{16 + 15}{40} \\ &= \frac{31}{40}, \end{aligned}$$

find the common denominator:  $5 \times 8 = 40$ ,

remember to check if it is in simplest form. Yes it is.



## Addition of fraction: mixed number example



$$\begin{aligned} 3\frac{2}{5} + 2\frac{3}{8} &= \frac{17}{5} + \frac{19}{8} \\ &= \left(\frac{17}{5} \times \frac{8}{8}\right) + \left(\frac{19}{8} \times \frac{5}{5}\right) \\ &= \frac{136}{40} + \frac{95}{40} \\ &= \frac{231}{40} \\ &= 5\frac{31}{40}. \end{aligned}$$

## Subtraction of fractions: example

Calculate:

$$\frac{1}{6} - \frac{7}{9}$$

Find the lowest common denominator: 18.

Now calculate:

$$\begin{aligned}\frac{1}{6} - \frac{7}{9} &= \left(\frac{1}{6} \times \frac{3}{3}\right) - \left(\frac{7}{9} \times \frac{2}{2}\right) \\ &= \frac{3}{18} - \frac{14}{18} \\ &= \frac{3 - 14}{18} \\ &= -\frac{11}{18}.\end{aligned}$$



## Multiplication of Fractions



- ▶ To multiply fractions, multiply the numerators and the denominators.
- ▶ Common factors can be cancelled either during the multiplication or at the end to give answer in simplest form.
- ▶ To multiply mixed numbers, convert them to improper fractions first.

## Fractions — Multiplication and division

Calculate:

1.  $\frac{7}{8} \times \frac{16}{21}$ ;

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



## Multiplication of fractions: example



For example:

$$\begin{aligned}\frac{7}{8} \times \frac{16}{21} &= \frac{7 \times 16}{8 \times 21} \\ &= \frac{\cancel{7}^1 \times \cancel{16}^2}{\cancel{8}^1 \times \cancel{21}^3} \\ &= \frac{1 \times 2}{1 \times 3} \\ &= \frac{2}{3}.\end{aligned}$$

## Multiplication of fractions: example



$$\begin{aligned} -3\frac{1}{3} \times -7\frac{1}{2} &= -\frac{10}{3} \times -\frac{15}{2} \\ &= \frac{-10^{\cancel{5}} \times -15^{\cancel{5}}}{3^1 \times 2^1} \\ &= \frac{-5 \times -5}{1 \times 1} \\ &= 25. \end{aligned}$$

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## Division of Fractions



- ▶ Dividing by a fraction is the same as multiplying by its reciprocal (fraction turned upside down);
- ▶ If dividing with mixed numbers, remember to convert to improper fractions first.

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## Division of fractions: example



$$\begin{aligned} \frac{3}{4} \div \frac{2}{3} &= \frac{3}{4} \times \frac{3}{2} \\ &= \frac{3 \times 3}{4 \times 2} \\ &= \frac{9}{8} \\ &= 1\frac{1}{8}. \end{aligned}$$

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## Exercise



Evaluate the following without a calculator.

1.  $\frac{3}{4} \div \frac{9}{20}$
2.  $-\frac{21}{25} \div \frac{35}{30}$
3.  $4\frac{2}{5} \div 2\frac{7}{10}$
4.  $7\frac{5}{8} \div -3\frac{1}{2}$
5.  $-2\frac{1}{4} \div -\frac{3}{8}$

Check your answers on the calculator.

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## Answers

1.

$$\begin{aligned}\frac{3}{4} \div \frac{9}{20} &= \frac{3}{4} \times \frac{20}{9} \\ &= \frac{3^1 \times 20^5}{4^1 \times 9^3} \\ &= \frac{1 \times 5}{1 \times 3} \\ &= \frac{5}{3} \\ &= 1\frac{2}{3}.\end{aligned}$$



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## Answers (cont)

2.

$$\begin{aligned}\frac{-21}{25} \div \frac{35}{30} &= \frac{-21}{25} \times \frac{30}{35} \\ &= \frac{\cancel{-21}^{-3} \times \cancel{30}^6}{25 \times \cancel{35}^5} \\ &= \frac{-3 \times 6}{25} \\ &= -\frac{18}{25}.\end{aligned}$$



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## Answers (cont)

3.

$$\begin{aligned}4\frac{2}{5} \div 2\frac{7}{10} &= \frac{22}{5} \div \frac{27}{10} \\ &= \frac{22}{5} \times \frac{10}{27} \\ &= \frac{22 \times \cancel{10}^2}{5^1 \times 27} \\ &= \frac{22 \times 2}{1 \times 27} \\ &= \frac{44}{27} \\ &= 1\frac{17}{27}.\end{aligned}$$



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## Answers (cont)

4.

$$\begin{aligned}7\frac{5}{8} \div -3\frac{1}{2} &= \frac{61}{8} \div \frac{-7}{2} \\ &= \frac{61}{8} \times \frac{-2}{7} \\ &= \frac{61 \times \cancel{-2}^{-1}}{8^4 \times 7} \\ &= \frac{61 \times -1}{4 \times 7} \\ &= \frac{-61}{28} \\ &= -2\frac{5}{28}.\end{aligned}$$



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## Answers (cont)



5.

$$\begin{aligned} -2\frac{1}{4} \div \frac{-3}{8} &= \frac{-9}{4} \div \frac{-3}{8} \\ &= \frac{-9}{4} \times \frac{8}{3} \\ &= \frac{\cancel{-9}^{-3} \times \cancel{8}^{-2}}{4^1 \times 3^1} \\ &= \frac{-3 \times -2}{1 \times 1} \\ &= 6. \end{aligned}$$



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