

## N2-7 Common Fraction Operations 2

- mental/written methods to add, subtract, multiply and divide common fractions

[Summary](#) [Learn](#) [Solve](#) [Revise](#) [Answers](#)

### Summary

To add or subtract common fractions with the same denominator, we just add the numerators, keeping the same denominator the same. To add or subtract common fractions with different denominators, we first change one or both to equivalent fractions such that they both have the same denominator, then add or subtract as before.

To multiply common fractions, multiply the numerators to get the numerator of the product; multiply the denominators to get the denominator of the product.

To divide by a fraction, just multiply by its reciprocal, which is the same fraction turned upside down.

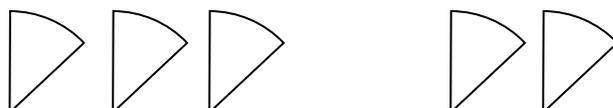
One way to perform operations on mixed numbers is to change them to improper fractions first.

### Learn

#### Adding and Subtracting Common Fractions

##### *Same denominators*

You already know how to add and subtract common fractions with the same denominator.



It's a bit of a no-brainer really.  $\frac{3}{7} + \frac{2}{7} = \frac{5}{7}$

Likewise with subtracting.  $\frac{3}{7} - \frac{2}{7} = \frac{1}{7}$

## Practice

Q1 Calculate each of the following without a calculator. Express answers in simplest form and, if  $>1$ , as mixed numbers.

(a)  $\frac{1}{5} + \frac{2}{5}$

(b)  $\frac{4}{5} - \frac{2}{5}$

(c)  $\frac{3}{4} - \frac{1}{4}$

(d)  $\frac{2}{7} + \frac{2}{7}$

(e)  $\frac{3}{10} + \frac{2}{10}$

(f)  $\frac{3}{5} - \frac{1}{5}$

(g)  $\frac{7}{8} + \frac{5}{8}$

(h)  $\frac{2}{4} + \frac{3}{4}$

(i)  $\frac{3}{8} + \frac{5}{8}$

(j)  $\frac{7}{4} - \frac{3}{4}$

(k)  $\frac{3}{8} - \frac{1}{8}$

(l)  $\frac{7}{9} + \frac{4}{9}$

### *Different denominators*

When you want to add common fractions with different denominators, all you have to do different is to first use equivalent fraction ideas to change one of both so they have the same denominator.

For example, suppose you wanted to add  $\frac{2}{5}$  to  $\frac{3}{10}$ . You can change the fifths to tenths by multiplying top and bottom by 2.  $\frac{2}{5} = \frac{4}{10}$ , so we just have to do  $\frac{4}{10} + \frac{3}{10}$ , which is  $\frac{7}{10}$ .

We can do this as long as one of the denominators is a multiple of the other. If not, like if we want to add  $\frac{2}{3}$  to  $\frac{4}{5}$ , we have to change both denominators.

The easiest way to do this is to multiply both fractions top and bottom by the denominator of the other fraction. In the case of  $\frac{2}{3} + \frac{4}{5}$ , we multiply  $\frac{2}{3}$  top and bottom by 5 and multiply  $\frac{4}{5}$  top and bottom by 3. So we have  $\frac{10}{15} + \frac{12}{15}$ , which can then be added to make  $\frac{22}{15}$ . This can then be cancelled down to  $\frac{9}{5}$  or put into mixed number form as  $1\frac{4}{5}$ .

**To add or subtract common fractions with different denominators, first multiply both fractions top and bottom by the denominator of the other fraction.**

Sometimes it is possible to find a smaller common denominator. For instance if we were adding or subtracting  $\frac{3}{4}$  and  $\frac{2}{6}$ , we could use 12 as a common denominator rather than 24. But this is optional. 24 will work fine.

## Practice

Q2 Calculate each of the following without a calculator. Express answers in simplest form and, if  $>1$ , as mixed numbers.

- (a)  $\frac{2}{5} + \frac{1}{10}$       (b)  $\frac{5}{8} - \frac{1}{2}$       (c)  $\frac{3}{4} - \frac{1}{12}$       (d)  $\frac{2}{7} + \frac{1}{14}$   
(e)  $\frac{4}{5} + \frac{2}{3}$       (f)  $\frac{4}{5} - \frac{2}{3}$       (g)  $\frac{3}{4} - \frac{1}{3}$       (h)  $\frac{2}{7} + \frac{2}{5}$   
(i)  $\frac{3}{10} + \frac{2}{5}$       (j)  $\frac{1}{4} - \frac{1}{5}$       (k)  $\frac{3}{8} + \frac{5}{3}$       (l)  $\frac{2}{5} + \frac{3}{4}$   
(m)  $\frac{8}{5} + \frac{2}{3}$       (n)  $\frac{6}{4} + \frac{1}{5}$       (o)  $\frac{3}{8} - \frac{1}{4}$       (p)  $\frac{7}{3} + \frac{3}{4}$

## Multiplying Common Fractions

Let's say we wanted to multiply  $\frac{2}{5}$  by  $\frac{1}{4}$ . Multiplying by  $\frac{1}{4}$  is the same as finding  $\frac{1}{4}$  of  $\frac{2}{5}$ , which is the same as dividing  $\frac{2}{5}$  by 4.

We can divide  $\frac{2}{5}$  by 4 by dividing each fifth by 4. This will make each fifth into a twentieth.

$$\text{So } \frac{2}{5} \times \frac{1}{4} = \frac{2}{20}$$

If we wanted to multiply  $\frac{2}{5}$  by  $\frac{3}{4}$ , this is the same as taking  $\frac{3}{4}$  of  $\frac{2}{5}$ . This will be 3 times as much as  $\frac{1}{4}$  of  $\frac{2}{5}$ , which we know is  $\frac{2}{20}$ . 3 times  $\frac{2}{20}$  is  $\frac{6}{20}$ . So  $\frac{3}{4}$  of  $\frac{2}{5}$  is  $\frac{6}{20}$ .

Notice that in doing this we started with  $\frac{2}{5}$ , then we multiplied the denominator by 4 (the denominator of  $\frac{3}{4}$ , and multiplied the numerator by 3 (the numerator of  $\frac{3}{4}$ ).

Another way of looking at this is that we multiplied the numerators of  $\frac{2}{5}$  and  $\frac{3}{4}$  to get the numerator of the answer and we multiplied the denominators of  $\frac{2}{5}$  and  $\frac{3}{4}$  to get the denominator of the answer.

$$\frac{2}{5} \times \frac{3}{4} = \frac{6}{20}$$

This will work when multiplying any common fractions.

**To multiply common fractions, multiply the numerators to get the numerator of the product, multiply the denominators to get the denominator of the product.**

## Practice

Q3 Calculate each of the following without a calculator. Express answers in simplest form and, if  $>1$ , as mixed numbers.

- |                                      |                                      |                                      |                                       |
|--------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------|
| (a) $\frac{4}{5} \times \frac{2}{3}$ | (b) $\frac{4}{5} \times \frac{5}{6}$ | (c) $\frac{3}{4} \times \frac{1}{3}$ | (d) $\frac{2}{7} \times \frac{2}{5}$  |
| (e) $\frac{3}{5} \times \frac{2}{5}$ | (f) $\frac{1}{4} \times \frac{1}{5}$ | (g) $\frac{3}{8} \times \frac{4}{3}$ | (h) $\frac{2}{5} \times \frac{10}{4}$ |
| (i) $\frac{3}{5} \times \frac{2}{3}$ | (j) $\frac{5}{4} \times \frac{1}{5}$ | (k) $\frac{3}{8} \times \frac{1}{4}$ | (l) $(\frac{2}{3})^2$                 |
| (m) $(\frac{7}{5})^2$                | (n) $\frac{3}{4} \times 2$           | (o) $5 \times \frac{1}{4}$           | (p) $\frac{4}{3} \times 3$            |

## Dividing common fractions

Dividing a number by 2 is the same as taking half of the number, which is the same as multiplying the number by  $\frac{1}{2}$ .

$\frac{1}{2}$  is the reciprocal of 2. The reciprocal of a number is the number expressed as a common fraction then turned upside down.

The reciprocal of  $\frac{2}{3}$  is  $\frac{3}{2}$ ; the reciprocal of  $\frac{3}{8}$  is  $\frac{8}{3}$ ; the reciprocal of  $\frac{1}{6}$  is  $\frac{6}{1}$  which is 6; the reciprocal of 4 is  $\frac{1}{4}$  (because  $4 = \frac{4}{1}$ ).

So, dividing a number by 2 is the same as multiplying by its reciprocal.

This works for dividing by fractions.

**To divide by a fraction, just multiply by its reciprocal.**

So, to work out  $\frac{2}{5} \div \frac{3}{4}$ , just work out  $\frac{2}{5} \times \frac{4}{3}$ , which, of course, is  $\frac{8}{15}$ .

To work out  $\frac{3}{8} \div \frac{1}{3}$ , just work out  $\frac{3}{8} \times \frac{3}{1}$ , which is  $\frac{9}{8}$  or  $1\frac{1}{8}$ .

## Practice

Q4 Calculate each of the following without a calculator. Express answers in simplest form and, if  $>1$ , as mixed numbers.

- |                                    |                                    |                                    |                                    |
|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| (a) $\frac{4}{5} \div \frac{2}{3}$ | (b) $\frac{4}{5} \div \frac{5}{6}$ | (c) $\frac{3}{4} \div \frac{1}{3}$ | (d) $\frac{2}{7} \div \frac{2}{5}$ |
| (e) $\frac{3}{5} \div \frac{2}{5}$ | (f) $\frac{5}{4} \div \frac{1}{5}$ | (g) $\frac{3}{8} \div \frac{4}{3}$ | (h) $\frac{2}{5} \div \frac{3}{4}$ |
| (e) $\frac{6}{5} \div \frac{2}{3}$ | (j) $\frac{3}{4} \div \frac{1}{5}$ | (k) $\frac{3}{8} \div \frac{1}{4}$ | (l) $\frac{2}{3} \div \frac{2}{3}$ |
| (m) $\frac{3}{5} \div \frac{1}{4}$ | (n) $\frac{5}{4} \div 2$           | (o) $5 \div \frac{1}{4}$           | (p) $\frac{2}{3} \div 3$           |

## Mixed Numbers

The methods above are for proper fractions and improper fractions. If you need to add, subtract, multiply or divide mixed numbers, you can just change them to improper fractions first. This won't always be the quickest way, but it will always work.

### Practice

Q5 Calculate each of the following without a calculator. Express answers in simplest form and, if  $>1$ , as mixed numbers.

- |                                       |                                       |                                       |                                       |
|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| (a) $1\frac{4}{5} + \frac{2}{3}$      | (b) $2\frac{4}{5} - \frac{5}{6}$      | (c) $1\frac{3}{4} \div 1\frac{1}{3}$  | (d) $3\frac{2}{7} \times \frac{2}{5}$ |
| (e) $\frac{3}{5} + 4\frac{2}{5}$      | (f) $\frac{5}{4} \div 1\frac{1}{5}$   | (g) $3\frac{3}{8} \times \frac{4}{3}$ | (h) $2\frac{2}{5} - \frac{3}{4}$      |
| (i) $\frac{6}{5} \div 1\frac{2}{3}$   | (j) $\frac{3}{4} \times 6\frac{1}{5}$ | (k) $1\frac{3}{8} - 1\frac{1}{4}$     | (l) $2\frac{2}{3} \div 2\frac{2}{3}$  |
| (m) $3\frac{3}{5} \times \frac{1}{4}$ | (n) $1\frac{3}{4} \div 2$             | (o) $5 - 1\frac{1}{4}$                | (p) $2\frac{2}{3} + 4$                |

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### Solve

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- Q51 If you drink  $2\frac{1}{4}$  L of water a day and have  $3\frac{4}{5}$  L with you, how much more would you need to last you  $4\frac{1}{2}$  days?
- Q52 What is  $(-2\frac{1}{5} - 2\frac{1}{2} \times -\frac{3}{4}) \div (2\frac{3}{8} - 4)$
- Q53 Find three different common fractions which add to make  $-\frac{1}{2}$ .
- Q54 Solve  $2\frac{1}{2}x + 5\frac{1}{4} = 1\frac{1}{3}$ .

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### Revise

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#### Revision Set 1

Q61 Calculate each of the following without a calculator. Express answers in simplest form and, if  $>1$ , as mixed numbers.

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|-----------------------------------|-----------------------------------|---------------------------------------|------------------------------------|
| (a) $\frac{3}{8} + \frac{7}{8}$   | (b) $\frac{4}{5} - \frac{1}{3}$   | (c) $\frac{4}{9} \times \frac{3}{5}$  | (d) $\frac{3}{8} \div \frac{2}{7}$ |
| (e) $2\frac{3}{5} + 1\frac{1}{4}$ | (f) $6\frac{1}{5} - 2\frac{3}{4}$ | (g) $2\frac{3}{5} \times \frac{5}{8}$ | (h) $5 \div 2\frac{1}{4}$          |

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## Answers

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- Q1 (a)  $\frac{3}{5}$  (b)  $\frac{2}{5}$  (c)  $\frac{1}{2}$  (d)  $\frac{4}{7}$   
(e)  $\frac{1}{2}$  (f)  $\frac{2}{5}$  (g)  $1\frac{1}{2}$  (h)  $1\frac{1}{4}$   
(i) 1 (j) 1 (k)  $\frac{1}{4}$  (l)  $1\frac{2}{9}$
- Q2 (a)  $\frac{1}{2}$  (b)  $\frac{1}{8}$  (c)  $\frac{2}{3}$  (d)  $\frac{5}{14}$   
(e)  $1\frac{7}{15}$  (f)  $\frac{2}{15}$  (g)  $\frac{5}{12}$  (h)  $\frac{24}{35}$   
(i)  $\frac{7}{10}$  (j)  $\frac{1}{20}$  (k)  $2\frac{1}{24}$  (l)  $1\frac{3}{20}$   
(m)  $2\frac{4}{15}$  (n)  $1\frac{7}{10}$  (o)  $\frac{1}{8}$  (p)  $3\frac{1}{12}$
- Q3 (a)  $\frac{8}{15}$  (b)  $\frac{2}{3}$  (c)  $\frac{1}{4}$  (d)  $\frac{4}{35}$   
(e)  $\frac{6}{25}$  (f)  $\frac{1}{20}$  (g)  $\frac{1}{2}$  (h) 1  
(i)  $\frac{2}{5}$  (j)  $\frac{1}{4}$  (k)  $\frac{3}{32}$  (l)  $\frac{4}{9}$   
(m)  $12\frac{4}{25}$  (n)  $1\frac{1}{2}$  (o)  $1\frac{1}{4}$  (p) 4
- Q4 (a)  $1\frac{1}{5}$  (b)  $\frac{24}{25}$  (c)  $2\frac{1}{4}$  (d)  $\frac{5}{7}$   
(e)  $1\frac{1}{2}$  (f)  $6\frac{1}{4}$  (g)  $\frac{9}{32}$  (h)  $\frac{8}{15}$   
(i)  $1\frac{4}{5}$  (j)  $3\frac{3}{4}$  (k)  $1\frac{1}{2}$  (l) 1  
(m)  $2\frac{2}{5}$  (n)  $\frac{5}{8}$  (o) 20 (p)  $\frac{2}{9}$
- Q5 (a)  $2\frac{7}{15}$  (b)  $1\frac{29}{30}$  (c)  $1\frac{5}{16}$  (d)  $1\frac{11}{35}$   
(e) 5 (f)  $1\frac{1}{24}$  (g)  $4\frac{1}{2}$  (h)  $1\frac{4}{5}$   
(i)  $\frac{18}{25}$  (j)  $4\frac{13}{20}$  (k)  $\frac{1}{8}$  (l) 1  
(m)  $\frac{9}{10}$  (n)  $\frac{7}{8}$  (o)  $3\frac{3}{4}$  (p)  $6\frac{2}{3}$
- Q51  $6\frac{13}{40}$  L      Q52  $-\frac{1}{5}$       Q53 Many possibilities      Q54  $-1\frac{17}{30}$
- Q61 (a)  $1\frac{1}{4}$  (b)  $\frac{7}{15}$  (c)  $\frac{4}{15}$  (d)  $1\frac{5}{16}$   
(e)  $3\frac{17}{20}$  (f)  $3\frac{3}{5}$  (g)  $1\frac{5}{8}$  (h)  $2\frac{2}{9}$