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Decimals – Outcomes

- Represent addition, subtraction, multiplication, and division in \mathbb{Q} using number lines and decomposition.
- Perform addition, subtraction, multiplication, and division in \mathbb{Q} .
- Convert between fractions and decimals.
- Present numerical answers to a specified degree of accuracy (e.g. to two decimal places or three significant figures).

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Represent \mathbb{Q} Using Decomposition

- Most ancient cultures used different symbols for different-sized numbers.
- e.g. Romans used "I" to represent 1, "V" to represent 5, "X" to represent 10.
- e.g. Babylonians used "𐎶" to represent 1 and "𐎵" to represent 10.
- Combinations of these would give each other number.
- e.g. Romans would write 23 as "XXIII"
- e.g. Babylonians would write 23 as "𐎶𐎵𐎶"

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Represent \mathbb{Q} Using Decomposition

- Today, we use the **decimal system**.
- There are ten symbols: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9.
- Each symbol has a different value depending on where it is in the number:
- e.g. 297.5 means:
 - 2 hundreds
 - 9 tens
 - 7 units
 - 5 tenths
- We can **decompose** it by writing as the sum of these:
- $200 + 90 + 7 + \frac{5}{10}$

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Represent \mathbb{Q} Using Decomposition

Decompose each of the following:

- a) 3.3
- b) 6.5
- c) 1111
- d) 21.7
- e) 208.36
- f) 1 000 001
- g) 8765.4321

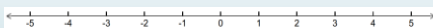
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Represent \mathbb{Q} on Number Lines

Recall number lines:

- Whole numbers equally spaced.
- Arrows at both ends.
- Positive numbers to the right, getting greater.
- Negative numbers to the left, getting lesser.

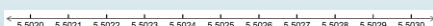
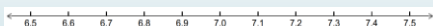
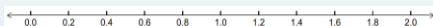
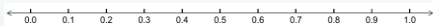


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Represent \mathbb{Q} on Number Lines

A number line can be broken down further to show decimals between numbers:



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Represent \mathbb{Q} on Number Lines

■ Draw a suitable number line which shows each of the following numbers and at least three numbers on each side of it:

- a) 3.3
- b) 6.5
- c) 1111
- d) 21.7
- e) 208.36
- f) 1 000 001
- g) 8765.4321

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Perform Arithmetic in \mathbb{Q}

■ Adding, subtracting, multiplying, and dividing decimals works the same way as for integers – we just need to keep the location of the decimal point in mind.

■ To add or subtract, line up the numbers so their place values match.

■ e.g. $5.3 + 7.28$ e.g. $12.85 - 5.2$

You may have to add zeroes to the start or end of a decimal so their place values match

$$\begin{array}{r} 5.30 \\ + 7.28 \\ \hline 12.58 \end{array} \qquad \begin{array}{r} 12.85 \\ - 5.20 \\ \hline 7.65 \end{array}$$

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Perform Arithmetic in \mathbb{Q}

■ To multiply, your answer has as many decimal places as the total number of decimal places in your multipliers.

■ e.g. 5.3×7.2 e.g. 3.85×2.4

There is no need to add zeroes when multiplying, but you can if you like.

$$\begin{array}{r} 5.3 \\ \times 7.2 \\ \hline 6 \\ 100 \\ 210 \\ \hline 3500 \\ 38.16 \end{array} \qquad \begin{array}{r} 3.85 \\ \times 2.4 \\ \hline 20 \\ 320 \\ 1200 \\ 100 \\ \hline 1600 \\ 6000 \\ \hline 9.240 \end{array}$$

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Perform Arithmetic in \mathbb{Q}

- To divide, your answer has as many decimal places as the difference between the decimal places in your divisors.
- e.g. $6 \div 1.2$

$$\begin{array}{r} 0.5 \\ 1.2 \overline{)6.0} \\ \underline{-0} \\ 60 \end{array}$$
- e.g. $1.7 \div 0.2$

$$\begin{array}{r} 0.8 \ .5 \\ 0.2 \overline{)1.7 \ 0} \\ \underline{-0} \\ 17 \\ \underline{-16} \\ 10 \end{array}$$

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Perform Arithmetic in \mathbb{Q}

- Calculate each of the following:

| | |
|--------------------|-------------------------|
| a) $4.9 + 1.7$ | k) 5.9×5.8 |
| b) $7.2 + 7.6$ | l) 6.5×8.5 |
| c) $9.47 + 6.48$ | m) 6.96×1.14 |
| d) $1.16 + 8.93$ | n) 6.62×3.73 |
| e) $31.63 + 42.87$ | o) 23.37×70.77 |
| f) $8.5 - 6.4$ | p) $4.2 \div 2.1$ |
| g) $6.3 - 5.8$ | q) $9.1 \div 1.3$ |
| h) $9.43 - 5.41$ | r) $42.6 \div 7.1$ |
| i) $6.58 - 5.65$ | s) $6.82 \div 6.2$ |
| j) $41.72 - 25.83$ | t) $7.344 \div 6.12$ |

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Convert from Fractions to Decimals

- Since fractions represent division, it is straightforward to convert from fractions to decimals by dividing.
- e.g. $\frac{2}{8} = 2 \div 8 = 0.25$
- Convert each of the following fractions to decimals:

| | |
|--------------------|----------------------|
| a) $\frac{6}{5}$ | f) $\frac{16}{5}$ |
| b) $\frac{9}{12}$ | g) $\frac{7}{2}$ |
| c) $\frac{32}{20}$ | h) $\frac{983}{100}$ |
| d) $\frac{19}{25}$ | i) $\frac{110}{25}$ |
| e) $\frac{13}{10}$ | j) $\frac{463}{50}$ |

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Convert from Fractions to Decimals

■ Your calculator can do this conversion for you.

1. Type the fraction in as usual or using the division sign.
2. Press the "=" button.
3. Press the "S \leftrightarrow D" button.



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Convert from Decimals to Fractions

■ As decimal places represent fractions of powers of ten, we can write a simple fraction with the largest necessary power of ten, then simplify if required.

■ e.g. $5.34 = \frac{534}{100} = \frac{267}{50}$

■ Convert each of the following decimals to fractions:

- | | |
|---------|----------|
| a) 0.9 | f) 0.44 |
| b) 0.83 | g) 5.25 |
| c) 5.06 | h) 10.55 |
| d) 6.78 | i) 6.02 |
| e) 0.48 | j) 7.8 |

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Convert from Decimals to Fractions

■ Your calculator can do this conversion for you.

1. Type the decimal in to your calculator as normal.
2. Press the "=" button.
3. Press the "S \leftrightarrow D" button if necessary.



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Round a Number

- **Rounding** a number is when you approximate a number to one with fewer digits.
- Rounding is a decision about what is the closest approximation you can make.
- e.g. copy the number line below and plot 5.135 as accurately as you can.

5.1 5.11 5.12 5.13 5.14 5.15 5.16 5.17 5.18 5.19 5.2

- Is 5.135 closer to 5.1 or closer to 5.2 on the number line?

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Round a Number

- You may be asked to round to a particular place value (e.g. to nearest hundred or to two decimal places) or to a number of significant figures.
- Decimal places start counting from the tenths position.
- Significant figures start counting from the first non-zero digit.

d.p. = decimal place
s.f. = significant figure

first s.f.

↓

1234.56789

↑

first d.p.

first s.f.

↓

0.0004567

↑

first d.p.

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Round a Number

- Significant figures stop counting at the last non-zero digit if it is before the decimal point or the last digit if it is after the decimal point.

last s.f.

↓

12300

last s.f.

↓

1.2300

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Round a Number

- To round without a number line, look at the digit **after** the rounding digit.
- If it is between 0 and 4, round left / down.
- If it is between 5 and 9, round right / up.

- e.g. round 5.135 to one decimal place.
- Look at the **second** decimal place: 5.1**35**
- It is between 0 and 4, so we round left / down: 5.1

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Round a Number

- e.g. round 51350 to the nearest hundred.
- Look at the **tens** place: 51**35**0
- It is between 5 and 9, so round right / up: 51400

- e.g. round 123.456 to four significant figures.
- Look at the **fifth** significant figure: 123.**456**
- It is between 5 and 9, so round right / up: 123.5

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Round a Number

- Round each of the following to the specified accuracy:
- a) 62 to the nearest ten.
- b) 671 101 to the nearest hundred thousand.
- c) 9 289 459 to the nearest hundred.
- d) 1.174 to two decimal places.
- e) 1.083 to one decimal place.
- f) 1.2837 to three decimal places.
- g) 89 768 to three significant figures.
- h) 6 438.846 to four significant figures.
- i) 396 to two significant figures.

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