Lesson - Place value, ordering and rounding

Year: Year 7

Number work depends on understanding place value. In this chapter you will order numbers, multiply and divide by powers of 10, round in several ways and estimate.

Starter activity

A newspaper says "Over 50 000 fans watched the match." The exact crowd was 49 874. Is the newspaper wrong? Discuss with a partner when it is acceptable to round and when it is important to give the exact number.

Place value

Definition: place value

Place value is the value of a digit because of its position. In 4 073.62 the 7 is worth 70, the 6 is worth 0.6 and the 2 is worth 0.02. The zero keeps the other digits in their correct places.

Example 1

Write down the value of the 5 in 35 072.48 and in 3.052.

In 35 072.48 the 5 is in the thousands column, so it is worth 5 000. In 3.052 the 5 is in the hundredths column, so it is worth 0.05.

Ordering integers and decimals

Method: ordering decimals

1. Line up the decimal points.
2. Write zeros to give each number the same number of decimal places.
3. Compare the digits from the left.

Example 2

Put 0.45, 0.405, 0.5 and 0.045 in order, smallest first.

With three decimal places: 0.450, 0.405, 0.500, 0.045. The order is 0.045, 0.405, 0.45, 0.5.

Example 3

Put -2.5, -2.05, 0 and -2.55 in order, smallest first.

For negative numbers, the larger the digits, the smaller the number. The order is -2.55, -2.5, -2.05, 0.

Multiplying and dividing by 10, 100 and 1000

Rule: powers of ten

To multiply by 10, 100 or 1000, each digit moves 1, 2 or 3 places left. To divide, each digit moves right. The decimal point stays where it is, the digits move.

Example 4

Work out 3.47×100 and $52 \div 1000$.

$3.47 \times 100 = 347$. $52 \div 1000 = 0.052$.

Rounding to a given place value

Rule: rounding

Find the digit in the place you are rounding to. If the next digit is 5 or more, round up. If it is 4 or less, round down. Replace the digits to the right with zeros (or drop them after the decimal point).

Example 5

Round 48 726 to the nearest 100 and to the nearest 1 000.

Nearest 100: the tens digit is 2, so round down to 48 700. Nearest 1 000: the hundreds digit is 7, so round up to 49 000.

Decimal places

Definition: decimal places

Decimal places (d.p.) are the digits after the decimal point. To round to 2 d.p., look at the third decimal digit.

Example 6

Round 6.7849 to 1, 2 and 3 decimal places.

1 d.p.: the next digit is 8, so 6.8. 2 d.p.: the next digit is 4, so 6.78. 3 d.p.: the next

digit is 9, so 6.785.

Watch out

Do not drop the zeros that hold a place. 5.098 to 2 d.p. is 5.10 (not 5.1) if you need two decimal places.

Significant figures

Definition: significant figures

Significant figures (s.f.) count from the first non-zero digit. In 0.00472 the first significant figure is 4. In 3 058 the digits 3, 0, 5, 8 are all significant.

Method: rounding to significant figures

1. Find the first non-zero digit. This is the 1st significant figure.
2. Count to the figure you need.
3. Look at the next digit and round up or down.
4. Fill with zeros if needed to keep the size of the number.

Example 7

Round 0.003 846 to 2 significant figures and 48 739 to 3 significant figures.

0.003 846: the first two significant figures are 3 and 8, the next digit is 4, so 0.0038.
For 48 739: the first three are 4, 8, 7, the next digit is 3, so 48 700.

Estimating

Rule: estimating

To estimate a calculation, round every number to 1 significant figure, then calculate.

Example 8

Estimate $\dfrac{4.8 \times 31}{0.52}$**.**

Round: $\dfrac{5 \times 30}{0.5} = \dfrac{150}{0.5} = 300.$

Note

An estimate checks that your answer is sensible, especially when you use a calculator.

Common mistakes

- Thinking 0.45 is bigger than 0.5 because it has more digits.
- Counting leading zeros as significant figures.
- Rounding down when the next digit is exactly 5.
- Forgetting to keep the size of the number: 48 739 to 2 s.f. is 49 000, not 49.

Worked example in context

A café sells 148 cups of tea a day for 5 days. Estimate the total number of cups, then find the exact total.

Estimate: $150 \times 5 = 750$. Exact: $148 \times 5 = 740$. The estimate is close, and it tells you that a calculator answer of 7400 or 74 must be wrong.

Common mistakes

- Saying 0.45 is bigger than 0.5 because 45 is bigger than 5.
- Rounding 6.395 to 6.39 because you only look at the last digit.
- Forgetting to write the zero when rounding 9.96 to 1 decimal place: the answer is 10.0, not 10.

Did you know?

The word *digit* comes from the Latin word for "finger", because people first counted on their fingers. Our place-value system came from India and was brought to Europe by Arab mathematicians over a thousand years ago.

Starter activity: the place value grid

Draw a place value grid with the headings millions, hundred thousands, ten thousands, thousands, hundreds, tens, ones, tenths, hundredths and thousandths. Write the number 3 405.27 in it, one digit per column. Now multiply it by 10 and write the answer in the row below. You will see that every digit moves one column to the left, while the decimal point stays exactly where it is. Dividing by 10 moves every digit one column to the right. This is a much more reliable way to think than “adding a zero”, which only works for whole numbers.

Method: rounding to significant figures

1. Find the first significant figure: the first digit, reading from the left, that is not zero.
2. Count along to the number of significant figures you need, including any zeros after the first non-zero digit.
3. Look at the next digit. If it is 5 or more, round up; if it is 4 or less, keep the digit as it is.
4. Fill any empty places before the decimal point with zeros so that the number

keeps its size, and drop any digits after the decimal point.

Example 1

Round 0.006 483 to 2 significant figures.

The zeros at the start are not significant; they only show the size of the number. The first significant figure is 6, and the second is 4. The next digit is 8, which is 5 or more, so the 4 rounds up to 5. The answer is 0.0065. Notice that we keep the zeros after the decimal point, because removing them would change the size of the number completely.

Example 2

Estimate the cost of 28 school jumpers at £19.75 each.

Round each number to one significant figure: 28 becomes 30 and £19.75 becomes £20. The estimate is $30 \times 20 = £600$. Both numbers were rounded up, so the real cost must be a little less than £600. The exact cost is $28 \times 19.75 = £553$, which agrees with our expectation. Knowing whether an estimate is too big or too small is just as useful as the estimate itself.

Example 3

Order these numbers from smallest to largest: 0.6, 0.06, 0.66, 0.606.

The easiest way is to give every number the same number of decimal places by adding zeros at the end, which does not change their value: 0.600, 0.060, 0.660 and 0.606. Now we can compare them like whole numbers of thousandths: 60, 600, 606, 660. So the order is 0.06, 0.6, 0.606, 0.66. Comparing the number of digits is a trap: 0.606 has more digits than 0.66 but it is smaller.

Watch out

When rounding a number like 3.97 to one decimal place, the 9 rounds up to 10, which carries into the ones column. The answer is 4.0, not 3.10 or 4. The zero after the decimal point must be written, because it shows that the answer is accurate to one decimal place.

Did you know?

Our place value system, with only ten digits and a symbol for zero, was developed in India around 1 500 years ago and reached Europe through Arabic scholars. The Italian mathematician Fibonacci helped to make it popular in 1202. Before that, Europeans used Roman numerals, which have no zero and no place value, making long multiplication almost impossible on paper. Merchants had to use an abacus or counting board for their sums instead.

Otto's tip

Line up the decimal point and fill with zeros. Then every comparison is just like whole numbers!