International GCSE
MATHEMATICS
Extended

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Contents

1.1 Place value and rounding

- $<$ means less than
- $>$ means greater than
- $\leqslant$ means less than or equal to
- $\geqslant$ means greater than or equal to
- $\neq$ means *not* equal to

EXAMPLE

Place the correct symbol $<$, $>$ or $=$ between the numbers in each pair.

a 5.07   5.7   **b** 397   379   **c** -10 5   **d** -19 -24 **e** $\dfrac{3}{2}$ 1.5

a $5.07 < 5.7$ **b** $397 > 379$ **c** $-10 < 5$ **d** $-19 > -24$ **e** $\dfrac{3}{2} = 1.5$

- To round a number look at the next, smaller, digit
  - next digit = 0, 1, 2, 3 or 4 round down
  - next digit = 5, 6, 7, 8 or 9 round up.

Round down   Round up
2.1   2.2
2.10   2.15   2.20
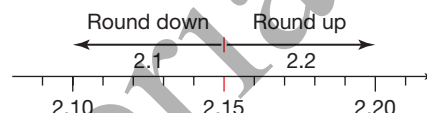
EXAMPLE

Round 72 456.0374 to the nearest

a ten   **b** hundred   **c** thousand   **d** tenth   **e** hundredth   **f** thousandth.

a 72 460   **b** 72 500   **c** 72 000   **d** 72 456.0 (1 dp)   **e** 72 456.04 (2 dp)   **f** 72 456.037 (3 dp)

- When rounding to **significant figures**, count from the first non-zero digit.

EXAMPLE

a Round these numbers to 2 dp.
  i 34.567   **ii** 3.887 126   **iii** 215.587 54

  dp means 'decimal places' and **sf** means 'significant figures'.

b Round these numbers to 2 sf.
  i 39.54   **ii** 217   **iii** 0.000 455   **iv** 12 019   **v** 25.505

a **i** 34.57   **ii** 3.89   **iii** 215.59
b **i** 40   **ii** 220   **iii** 0.000 46   **iv** 12 000   **v** 26

- Multiplying or dividing a number by a power of 10 changes the place value of each digit.

$\times 10$

| tens | units | • | tenths |

$\div 100$

Multiplying by 10 moves the digits one place to the left. Dividing by 100 moves the digits two places to the right.
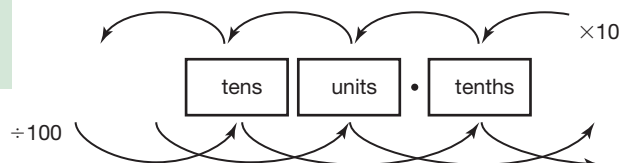
EXAMPLE

Work out   **a** $3.72 \div 100$ **b** $0.0349 \times 10\,000$ **c** $17.3 \div 1000$

a Move the digits 2 places right.
  0.0372

b Move the digits 4 places left.
  349

c Move the digits 3 places right.
  0.0173

Exercise 1.1S

1 Write these numbers in words.

a 1307 **b** 29 006

c 300 000 **d** 605 030

2 Write these numbers in figures.

a Eight thousand and forty-three

b Seventy million

c Two hundred thousand and fifty-one

d Two thousand and ten

3 Write these sets of numbers in ascending (increasing) order.

a 0.3, 3.1, 1.3, 2, 1, 0.1

b 607, 77.2, 27.6, 7.06, 6.07

c 7.83, 7.3, 7.8, 7.08, 7.03, 7.38

d 4.2, 8.24, 8.4, 4.18, 2.18, 2.4

4 Write these sets of numbers in descending (decreasing) order.

a 6008, 682.8, 862.6, 6000.8, 8000.6

b 47.9, 94.7, 49.7, 79.4, 74.9, 97.4

c 16.7, 18.16, 16.18, 17.16, 18.7, 17.6

d 1.06, 13.145, 1.1, 2.38, 13.2, 2.5

5 Use one of the symbols $<$, $>$ or $=$ to complete these statements.

a $250 \square 205$ **b** $1.377 \square 1.73$

c $\frac{3}{8} \square 0.4$ **d** $-17 \square -71$

e $-0.09 \square -0.089$ **f** $\frac{5}{8} \square 0.625$

6 Explain which number in each pair is bigger.

a 4.52 and 4.05 **b** 5.5 and 5.05

c 16.8 and 16.75 **d** 16.8 and 16.15

7 Say whether each statement is true or false.

a $4.1 < 4$ **b** $6.33 < 6.333$

c $0.23 \leqslant 0.24$ **d** $-2.3 \geqslant -2.4$

e $5.31 < 5.31$ **f** $5.31 \leqslant 5.31$

8 Round these numbers to the nearest

i 10 **ii** 100 **iii** 1000

a 3048 **b** 1763 **c** 294

d 51 **e** 43 **f** 743

g 2964 **h** 1453 **i** 17

j 24 598 **k** 16 344 **l** 167 733

9 Round these numbers to

i 1 decimal place **ii** 2 decimal places.

a 39.114 **b** 7.068 **c** 5.915

d 512.715 **e** 4.259 **f** 12.007

g 0.833 **h** 26.8813 **i** 0.082 93

10 Round these numbers to the nearest

i tenth **ii** hundredth **iii** thousandth.

a 0.07 **b** 15.9184 **c** 127.9984

d 887.172 **e** 55.144 55 **f** 0.007 49

11 Round these numbers to one significant figure.

a 157 **b** 2488 **c** 4.66

d 13.77 **e** 0.000 453 **f** 121 450

12 Round these numbers to two significant figures.

a 483 **b** 1206 **c** 488

d 13 562 **e** 533 **f** 14 511

g 0.355 **h** 0.421 **i** 0.0566

j 0.004 673 **k** 1.357 **l** 0.000 004 152

13 Round each number to the accuracy given in brackets.

a 9.732 (3 sf) **b** 0.362 18 (2 dp)

c 147.49 (1 dp) **d** 28.613 (2 sf)

e 0.5252 (2 sf) **f** 4.1983 (2 dp)

g 1245.4 (3 dp) **h** 0.004 25 (3 dp)

i 273.6 (2 sf) **j** 459.973 14 (1 dp)

14 Multiply these numbers by 10.

a 16.7 **b** 24.8 **c** 0.716

d 1.095 **e** 243 **f** 281.3

15 Divide these numbers by 10.

a 214 **b** 67.3 **c** 4106

d 200.7 **e** 6.025 **f** 86

16 Calculate

a 13.06×100 **b** $208.5 \div 100$

c 1.085×1000 **d** $2487 \div 1000$

e $0.008 \div 10$ **f** $0.006 19 \times 1000$

g $45.13 \div 1000$ **h** $0.000 045 \times 100$

17 Calculate

a $1.76 \times 10 \times 100$

b $9.3 \times 100 \div 10$

1.1 Place value and rounding

RECAP

- When rounding: five or more rounds up, four or less rounds down.
- For decimal places count from the decimal point.
- For significant figures count from the first *non-zero* digit.
- To multiply or divide by 10 use place value and move the digits one place to the left or right.

HOW TO

To solve a problem involving place value or rounding
1. Read the question and think what to do.
2. Apply your knowledge of place value and rounding.
3. Answer the question.

EXAMPLE

Ajani charges a customer £352.46, but has mixed up two digits. They should be swapped around. His mistake costs him £3.96. What should he have charged?

1. Since £1 < mistake < £10, the units column (2) must be wrong.

2. Swapping the 2 and 4 would leave the 6, so the mistake would end in zero. So it is the 6 and 2.

The correct amount is £356.42   3.

EXAMPLE

An engineer measures the thickness of four sheets of metal.
2.05 mm   2.033 mm   2.4 mm   2.303 mm
  a If she piled up 100 of the thinnest sheets, how high would the pile be?
  b If her measurement was inaccurate by 0.001 mm, between what limits would the pile be?

1. Put the measurements in ascending order.
   2.033   2.050   2.303   2.400
a 100 × 2.033 = 203.3 mm   2.
b 2.033 − 0.001 = 2.032,   100 × 2.032 = 203.2 mm
   2.033 + 0.001 = 2.034,   100 × 2.034 = 203.4 mm
   The pile is between 203.2 mm and 203.4 mm high.   3.

EXAMPLE

The following distances were recorded in a long jump competition.
MacLane 5.89 m   Neyman 5.98 m   Ockham 6.12 m
Pell   6.03 m   Quillen 5.09 m   Ricci   5.8 m
  a Minh-Ha says 'the gap between first and last is over ten times the gap between first and second'. Is she correct?
  b Sze-Kie says 'if the results were given to 1 dp then there would be a joint second place'. Is she correct?

a 1. Put the results in descending order.
   6.12   6.03   5.98   5.89   5.80   5.09
   First − second = 6.12 − 6.03 = 0.09   2.
   First − last = 6.12 − 5.09 = 1.03
   10 × 0.09 = 0.90 < 1.03
   Minh-Ha is correct.   3.

b 1. Round the results to 1 dp
   6.1   6.0   6.0   5.9   5.8   5.1   2.
   Sze-Kie is correct.   3.

Exercise 1.1A

> Don't use a calculator for this exercise. Practise your arithmetic!

1 Soren has given a customer a bill for $356.28. He realises he has mixed up the 6 and the 2. How much does he have to pay back to the customer?

2 Veneer is a thin sheet of attractive wood. A joiner has a pile of 10 sheets of oak veneer. Each sheet is 0.5 mm thick.

  a How thick is the pile?

  b The joiner glues a sheet of veneer on to the top of different blocks of wood. What is the new overall thickness of

    i a 5 cm block

    ii a 3.5 cm block

    iii a 12.25 cm block?

  c What would be the new thicknesses of the blocks above if he glues veneer on all four sides of the blocks?

3 Votes for four politicians were declared.

  A 25 958   B 2705

  C 26 057   D 5651

The local newspaper decides to round these off to the nearest 1000 in its report.

  a What would each result be reported as?

  b What would each result be if they were rounded to the nearest 100?

4 These are the times recorded in a 100 m sprint race.

  Adams 12.37 s   Bolyai 12.35 s

  Carroll 13.72 s   d'Arcy 11.09 s

  Eckert 11.33 s   Fisher 11.9 s

  a Mikael says 'the winner is quarter of a second faster than their nearest rival'. Is this true?

  b Carroll's personal best time is 12.17 s. If he had run this time, what would have been his position?

  c Which two runners had the closest times?

5 Garvan is resizing photographs to make thumbnail pictures. He decides to divide lengths by 50 and then round to the nearest whole number.

What width and height would these pictures become as thumbnails?

  a 4288×2848 **b** 2197×1463

  c 3648×2746 **d** 6032×4502

  e His resize screen allows him to put in a "percentage of original width and height". What percentage would he put in the box to divide by 50?

> Scale
>
> Height `30%` ⬍   Width `70%` ⬍
>
> ☐ Lock aspect ratio

*6 Ian gets his homework back.

> Find $\sqrt{3} \times 25^3$, rounding your answer to 3 significant figures.
>
> $\sqrt{3} \times 25^3 = 1.73 \times 15\,600 = 26\,988$
>
> $= 27\,000 \ (3\,\text{sf})$

What mistake has Ian made?

7 How many correct statements can you make using one of these symbols

  $<$ $\leqslant$ $=$ $>$ $\geqslant$

and one of these pairs of numbers?

  3.118   and   3.112

  4.5   and $\dfrac{9}{2}$

  3.004 and   2.9961

8 A number x satisfies

  $x = 1.5$ (2 sf) and $x \neq 1.50$ (3 sf).

What possible values can x take?

9 A lift has a safe maximum load of 350 kg. Four people give their weights to these accuracies.

  80 kg (10 kg)   95 kg (2 sf)

  96.5 kg (1 dp)   72 kg (1 kg)

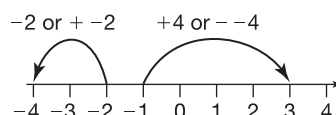Is it safe for them all to get into the lift together? Show your working.

1.2 Adding and subtracting

A number with a plus or minus sign is a **directed number**. You can extend the basic rules of addition and subtraction to include negative numbers.

−2 or +−2   +4 or −−4

−4 −3 −2 −1 0 1 2 3 4

- Adding a **negative** number counts as subtraction.
- Subtracting a negative number counts as addition.

EXAMPLE

Calculate **a** $-5 + -6$ **b** $4 - -2$

a $-5 + -6 = -5 - 6 = -11$ **b** $4 - -2 = 4 + 2 = 6$

Think of a negative number as a debt. Adding a debt makes you worse off. Taking away a debt makes you better off.

There are a number of 'tricks' you can use to help you do a calculation in your head.

- In **partitioning** you split the number into smaller parts.
- In **compensation** you 'round' the number and include a correction.

EXAMPLE

a Use partitioning to calculate
   i $61.9 + 7.2$ **ii** $61.9 - 7.2$

b Use compensation to calculate
   i $21.6 + 3.8$ **ii** $21.6 - 3.8$

a $7.2 = 7.0 + 0.2$
  i $61.9 + 7 + 0.2$
    $= 68.9 + 0.2$
    $= 69.1$
  ii $61.9 - 7 - 0.2$
    $= 54.9 - 0.2$
    $= 54.7$

b $3.8 = 4.0 - 0.2$
  i $21.6 + 4 - 0.2$
    $= 25.6 - 0.2$
    $= 25.4$
  ii $21.6 - 4 + 0.2$
    $= 17.6 + 0.2$
    $= 17.8$

You might know 'tricks' of your own. Can you say how they work?

- Always use an estimate to check the result of a written calculation.

EXAMPLE

Calculate these using a written method.

a $102.773 + 28.47$ **b** $26.44 - 1.105$

a Estimate = $100 + 30 = 130$

$$\begin{array}{r} 102.773 \\ + 28.470 \\ \hline 131.243 \end{array} \approx 130 \checkmark$$

b Estimate = $26 - 1 = 25$

$$\begin{array}{r} 26.44^{3}4^{1}0 \\ - 1.105 \\ \hline 25.335 \end{array} \approx 25 \checkmark$$

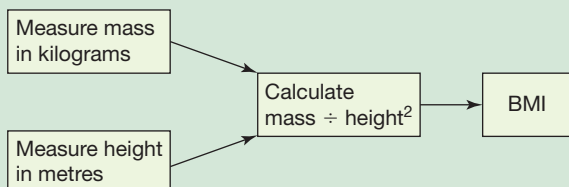Add zeros to help you line the digits up in the correct columns.

Assessment 1

1 Carli tries to order each set of numbers from smallest to largest.
   One pair of numbers in each list is in the wrong order.
   Say where Carli has made a mistake and put each list of numbers in order,
   starting with the smallest.

   a 0.8 1.9 3.3 44 303 57.6 [2]

   b −0.07 −2.19 30 43.56 188.0 194.7 [2]

2 Carli then tries to put these numbers in ascending order
   $42 \div 100$, 0.3×10, $4\,236 \div 1\,000$, $516 \div 10$, 42×100, $216 \times 1\,000$
   Has she ordered the numbers correctly? Give your reasons. [4]

3 The world's tallest man, Robert Wadlow, was 271.78 cm (2 dp) tall.
   The world's tallest woman, Yao Defen, is 233.34 cm (2 dp) tall.

   a A challenger to the world's tallest man record measured his height as 271.8 cm
   to one decimal place.
   Has the challenger definitely beaten the world record? Give your reasons. [1]

   b A challenger to the world's tallest woman record measured her height as 233.341 cm.
   Has the challenger definitely beaten the world record? Give your reasons. [1]

4 Dave is 36 and Nadya is 44. Nadya says that she and Dave are the same age to one significant figure.

   a Is Nadya correct? [1]

   b Will Dave and Nadya be the same age to one significant figure in one year's time?
   Give your reasons. [2]

   c How old will Dave and Nadya be the next time their ages are the same to
   one significant figure? [2]

5 As the Earth spins on its axis, everything on the
   Earth's surface moves with it.
   The distance travelled in one day due to the Earth's rotation
   is $3.142x$, where x is the diameter of the circular path.
   Abena lives on the equator and Edward lives in the UK.
   $x = 12\,756$ for Abena and $x = 8\,134$ for Edward.

   Edward's path

   Abena's path

   a Write both values of x to two significant figures. [2]

   b Use your answers to part **a** to estimate how much
   further Abena travels than Edward in one day. [3]

   c Explain how using values of x correct to one significant figure would affect
   the estimate in part **b**. [3]

6 Jasmine's bike has wheels of circumference (i.e. perimeter) 2.5 m.
   When Jasmine cycles to school, the wheels go round 850 times.
   How far does Jasmine cycle to school? [2]

7 Work out these problems and include units in your answer.

   a A bag of sweets weighing 113 g includes wrappings totalling 0.5 g.
   Each sweet weighs 4.5 g.
   How many sweets are in the bag? [2]

   b A football stadium has 135 400 m² of seating for its fans. Each fan is allowed 5.4 m² of space.
   How many fans, to the nearest 1000, is the stadium capable of holding? [2]

8 There are 10 questions in a quiz.
A *correct* answer scores 3 points. A *wrong* answer *loses* 2 points.
Any question not answered loses 1 point. A negative total is possible.

    a Write down the maximum and minimum points any player can score. [2]

    b Rabiyah answers eight of the ten questions. Five are correct. How many points does Rabiyah score? [3]

   **c** Describe three different ways of scoring -10 points. [3]

9 To find your BMI (Body Mass Index) you use this process:

Name	Mass (kg)	Height (m)	BMI
Sue	57.5	1.7	
Clive	105.8	1.95	
Kivi		1.77	19.7
Henry	71.3		21.3

Measure mass in kilograms → Calculate mass ÷ height² → BMI
Measure height in metres →

Copy and complete the table. Give your answers to 1 decimal place. [6]

10 A supermarket stocks packets of the new breakfast cereal Maltibix.
Each packet of Maltibix holds 650 g inside a cardboard box weighing 68 g.
Fifty boxes, each holding 36 of these packets are delivered to the supermarket.
Does the mass of the delivery exceed 1000 kg? [4]

11 In the number grids shown, the number in each cell is the sum of the two cells above it.
Copy and complete the grids shown.

    a 2.3, [ ], [ ]
    [ ] ⊕ −12.3
    −14.5 [3]

    b [ ], [ ], 2.45
    [ ] ⊕ −1.37
    2.3 [3]
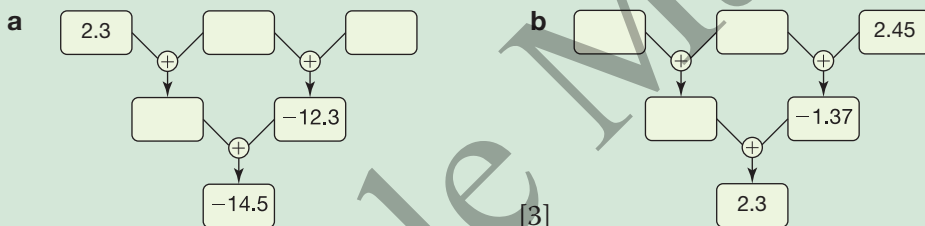
12 A magic square is a square grid of numbers where each number is *different*. The sum of the numbers in each row, each column and each diagonal is the same.
Fill in the missing values in the magic square. [4]

−2			5
	4	−1	2
7		1	
	−3		−5

13 Lana's garden is rectangular and measures 12.5 m by 9.2 m.
The garden is to be sown with grass seed.
The gardener needs 25 g of grass seed for each square metre of ground.
Grass seed costs \$5.35 per kg. The gardener estimates that he will
need \$20 to buy the grass seed.
Lana disagrees with the gardener's estimate.
She gives the gardener \$15 to buy the grass seeds.
Which estimate do you agree with? Explain your answer. [4]

14 The *reciprocal* of a number n is $1 \div n$.

    a What is the only number which is the same as its reciprocal? [1]

    b What is the only number which has no reciprocal? Explain your answer. [1]

    c Nisreen says that every positive number is greater than its reciprocal.
Find an example that disproves Nisreen's claim. [1]

15 Write one pair of brackets in each calculation to make the answer correct.

    a $3 + 4 \times 5 = 35$ [1]   **b** $4 \div 3 + 5 = 6\frac{1}{3}$ [1]   **c** $5(2^3 + 0.4) \div 4 - 3 \times -1 = 6$ [2]