

2 Place Value

Here we concentrate on place value, both for whole numbers and for decimals, and look at the important techniques of rounding numbers to a given accuracy.

2.1 Place Value and Rounding

First note how we write and speak numbers.

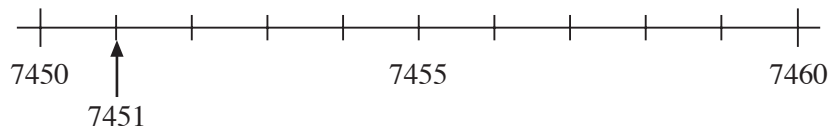
For the number 572 641 839,

<i>Hundreds of Millions</i>	<i>Tens</i>	<i>Units</i>	<i>Hundreds of Thousands</i>	<i>Tens</i>	<i>Units</i>	<i>Hundreds</i>	<i>Tens</i>	<i>Units</i>
5	7	2	6	4	1	8	3	9

We say

"Five hundred and seventy two million, six hundred and forty one thousand, eight hundred and thirty nine."

7451 is 7450 *to the nearest 10*, since it is nearer to 7450 than to 7460 (see the number line below).



7451 is 7500 *to the nearest 100*, since it is nearer to 7500 than to 7400.

7451 is 7000 *to the nearest 1000*, since it is nearer to 7000 than to 8000.



Note

The convention is that '5' rounds up to the nearest 10,
e.g. 35 to the nearest 10 is 40.



Example 1

Write 2716 to the nearest

- (a) 10 (b) 100 (c) 1000



Solution

- (a) 2720 (b) 2700 (c) 3000



Example 2

What is the value of the '6' in each of these numbers?

- (a) 167 (b) 2006 (c) 6423



Solution

- (a) '6' means 6 tens = 60
(b) '6' means 6 units = 6
(c) '6' means 6 thousands = 6000



Exercises

1. Write each of these numbers to the nearest 10.

(a) 89	(b) 45	(c) 72
(d) 12	(e) 9	(f) 2
(g) 4713	(h) 5629	(i) 4755
2. Write each of these numbers to the nearest 100.

(a) 376	(b) 1417	(c) 24699
(d) 101	(e) 149	(f) 251
3. Write each of these numbers to the nearest 1000.

(a) 1001	(b) 2500	(c) 3999
(d) 132400	(e) 56471	(f) 555511
4. A milkman delivered 109865 bottles of milk in one year.
Write the number of bottles to:

(a) the nearest 100,
(b) the nearest 1000,
(c) the nearest 10,
(d) the nearest 10000.
5. A school has 1256 pupils. Write this number to:

(a) the nearest 10,
(b) the nearest 100,
(c) the nearest 1000.

6. Explain what the '9' represents in each of these numbers.
- | | | |
|--------------|-------------|---------------|
| (a) 19 | (b) 91 | (c) 190 |
| (d) 1971 | (e) 19800 | (f) 2190 |
| (g) 91000019 | (h) 9001111 | (i) 900371423 |
7. Write these numbers in words.
- | | | |
|--------------|-------------|-------------|
| (a) 32 | (b) 14 | (c) 86 |
| (d) 124 | (e) 328 | (f) 1463 |
| (g) 30000000 | (h) 4713000 | (i) 3991001 |
8. Write each of the following in figures.
- (a) Twenty four
 - (b) Eighty six
 - (c) Nineteen
 - (d) One hundred and twenty
 - (e) Three hundred and four
 - (f) One thousand and twenty six
 - (g) Three million, four hundred thousand
 - (h) One thousand and five
9. For each statement below, explain whether it is likely to be *true* or *false*.
- (a) The average shoe size in your class is size 6.
 - (b) The average length of a car is 10 metres.
 - (c) The average height of an adult is 176 cm.
 - (d) The number of matches in a matchbox is 50.
 - (e) The average height of children in a class of Year 7 pupils is 138 cm.
 - (f) John counted 12 people on his bus this morning.
 - (g) Sarah saw 120 people get onto her bus on her way to school.
10. Place the numbers below in order, with the smallest first.
- (a) 147, 222, 316, 47, 32, 1004.
 - (b) 1472, 3416, 621, 3813, 1471, 15721.
 - (c) 6000, 60000, 3000, 30000, 4000000

11. (a) What is the largest possible number you can make using each of these digits once only: 4, 6, 3, 2 and 8 ?
- (b) What is the smallest number you can make using all the digits in (a)?
- (c) What do you notice about the order of the digits in your answers to (a) and (b)?
- (d) How do your answers change if you can use 0 as well?

12. You are given the number 1735. You are allowed to swap the positions of any two digits.

For example, $\overset{\curvearrowright}{1\ 7\ 3\ 5}$ gives 1375

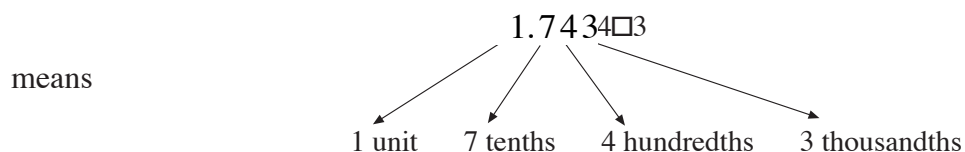
or, $\overset{\curvearrowright}{1\ 7\ 3\ 5}$ gives 5731

- (a) Explain how to make the *largest* possible number using one swap.
- (b) Explain how to make the *smallest* possible number with one swap.
13. Ramesh says that there are 120 pupils in his year at school. If he has rounded the number of pupils in his year to the nearest 10, how many pupils could there be in his school year? (Write *all* the possible answers.)
14. A newspaper report states that 42000 people watched a football match at Wembley. The actual number has been rounded to the nearest 1000.
- (a) What is the *largest* possible number of people that watched the match?
- (b) What is the *smallest* possible number of people that watched the match?
15. The table gives the results and attendances for some football matches. Answer these questions using the table.

(a) Which match had the largest attendance?	BLACKBURN	1	ARSENAL	4
	28,212			
(b) Find the total attendance at all the matches to the nearest 1000.	DERBY	4	BOLTON	0
	29,126			
(c) How many more people watched Newcastle than watched Wimbledon, to the nearest 100?	LIVERPOOL	2	CRYSTAL PALACE	1
	43,007			
	NEWCASTLE	2	BARNSELY	1
	36,534			
	SHEFFIELD WED	1	WEST HAM	1
	28,036			
	TOTTENHAM	1	COVENTRY	1
	33,463			
	WIMBLEDON	0	EVERTON	0
	15,131			

2.2 Decimals and Place Value

Note that the number



We *round* numbers when all we need is a *reasonable approximation* rather than the exact value.

The number 8.4236 can be rounded to a specified number of *decimal places*:

8.4236 → 8.424 to 3 decimal places

8.4236 → 8.42 to 2 decimal places

8.4236 → 8.4 to 1 decimal place

The number 173.265 can be rounded to a specified number of *significant figures*:

173.265 → 173.27 to 5 significant figures

173.265 → 173 to 3 significant figures

173.265 → 200 to 1 significant figure

A particular digit in a number will *round up* if the digit that follows it is 5, 6, 7, 8 or 9.

For example, $52.36\overline{8} = 52.37$ (to 2 decimal places).

The digit will *remain unchanged* if the following digit is 0, 1, 2, 3 or 4.

For example, $6.74\overline{3} = 6.74$ (to 3 significant figures).



Example 1

Write these numbers in order, smallest first.

0.5, 0.95, 0.905, 0.59, 0.509, 0.6, 0.9



Solution

0.5, 0.509, 0.59, 0.6, 0.9, 0.905, 0.95



Example 2

Write 8.4751 correct to

- (a) 3 decimal places,
- (b) 2 decimal places,
- (c) 1 decimal place.

**Solution**

- (a) 8.475, since 8.4751 is nearer to 8.475 than to 8.476.
- (b) 8.48, since 8.4751 is nearer to 8.48 than to 8.47.
- (c) 8.5, since 8.4751 is nearer to 8.5 than to 8.4.

**Example 3**

Write 13.68952 correct to:

- (a) 1 decimal place,
- (b) 3 decimal places,
- (c) 2 decimal places.

**Solution**

- (a) 13.7 to 1 decimal place.
- (b) 13.690 to 3 decimal places.
- (c) 13.69 to 2 decimal places.

**Example 4**

Write:

- (a) 3.642 correct to 2 significant figures,
- (b) 314269 correct to 3 significant figures,
- (c) 0.00723 correct to 1 significant figure.

**Solution**

- (a) 3.6 correct to 2 significant figures.
- (b) 314000 correct to 3 significant figures. *(Note the need for zeros to replace the remaining digits of the original number, to give a rounded number of comparable size.)*
- (c) 0.007 to 1 significant figure. *(Note that the zeros before the 7 are not significant, so they are not counted. The 7 is the first significant figure, i.e. it is the first digit that really determines the size of the number.)*



Exercises

1. What is the value of the '5' in each of these numbers?
(a) 0.45 (b) 0.54 (c) 5.74
(d) 3.415 (e) 4.258 (f) 3.502
2. Write the numbers in order, smallest first.
0.85, 0.9, 0.8, 0.58, 0.6, 0.5, 0.87
3. Write each of these numbers correct to 1 decimal place.
(a) 1.47 (b) 3.68 (c) 0.45
(d) 3.751 (e) 4.08 (f) 5.005
4. Write each of these numbers correct to 2 decimal places.
(a) 3.444 (b) 8.555 (c) 0.321
(d) 4.7612 (e) 0.3002 (f) 4.1050
5. Sally is given a number correct to 3 decimal places. She writes it to 2 decimal places as 4.71.
Write down a list of the numbers she could have been given.
6. Write these numbers in figures.
(a) Four and six tenths
(b) Five and four hundredths
(c) Sixteen, three tenths and four hundredths
(d) One hundred and five hundredths
(e) One thousand and twenty six and five thousandths
7. Write these numbers in words.
(a) 5.7 (b) 5.006 (c) 3.02
8. What is the difference between four tenths and forty hundredths? Explain your answer.
9. Write these numbers in order, largest first.
0.7, 0.2991, 1.05, 1.508, 0.58, 2.4
10. You are given the digits 3, 4, 0, 7 and a decimal point. Using each number only once, what is
(a) the *largest* number you can make,
(b) the *smallest* number you can make?

11. Write each of these numbers correct to 2 significant figures:
- (a) 1.473 (b) 6.254 (c) 3.216
(d) 10.68 (e) 142 (f) 1374
12. Write the number 147.52 correct to:
- (a) 4 significant figures, (b) 3 significant figures,
(c) 2 significant figures, (d) 1 significant figure.
13. Write the number 104.735 correct to:
- (a) the nearest whole number, (b) 2 decimal places,
(c) 2 significant figures, (d) 1 decimal place,
(e) 1 significant figure.
14. Write each of the numbers below correct to 3 significant figures:
- (a) 18.47 (b) 0.003265 (c) 147300
(d) 62.999 (e) 0.036247 (f) 0.00036945