M1 Maths

N1-1 Whole Numbers

- whole numbers to trillions
- the terms: whole number, counting number, multiple, factor, even, odd, composite, prime, >, <
- divisibility rules, products of prime factors

Summary Learn Solve Revise Answers

Summary

Writing whole numbers

Whole numbers up to 999 are made up using base 10. So 452 is 4 hundreds, 5 tens and 2 ones, pronounced '*four hundred and fifty two*'.

Numbers bigger than 999 are written as a series of periods, each period consisting of a 3-digit number from 000 to 999 and separated by a space from other periods. From right to left the periods are the ones, the thousands, the millions, the billions, the trillions . . .

Whole numbers and counting numbers

The whole numbers are the numbers 0, 1, 2, 3, . . . The counting numbers are the numbers 1, 2, 3, 4, . . ., i.e. whole numbers excluding 0.

Multiples and factors

The multiples of a number are all numbers made by multiplying that number by a counting number. The factors of a number are all counting numbers that can be multiplied by a counting number to make that number.

Even and odd numbers

Even numbers are 0 and counting numbers that are multiples of 2. Odd numbers are counting numbers that are not multiples of 2.

Composite and prime numbers

A composite number is a counting number which has more than two factors. A prime number is a counting number with just two factors. The number 1 is neither prime nor composite.

< , >

'<' means 'is less than'. '>' means 'is greater than' or 'more than'.

Divisibility Rules

These are quick methods for determining whether a large number can be divided by a number from 1 to 10 without leaving a remainder.

Products of Prime Factors

Any counting number can be written as a product of prime factors.

Learn

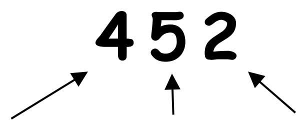
Writing and Pronouncing Whole Numbers

Whole numbers are numbers that are not negative and that do not have a fractional part.

Whole numbers up to 999 are made up using base 10. For example, the number 452 is made up of three digits or **places**.

The last place is the ones;
the second-last is the tens (ten is ten ones);
the third-last is the hundreds (a hundred is ten tens).

So 452 is 4 hundreds, 5 tens and 2 ones.



4 hundreds   5 tens   2 ones

This is pronounced '*Four hundred and fifty two*'.

Note that, although Australians and the British pronounce this 'Four hundred and fifty two', Americans leave out the 'and' and call it '*Four hundred fifty two*'.

Practice

Q1 Write the following numbers in words:

(a) 3 (b) 60 (c) 200 (d) 47 (e) 94 (f) 258 (g) 935 (h) 406 (i) 211

Q2 Write the following numbers in numerals:

(a) Nine
(b) Forty
(c) Five hundred
(d) Seventy two
(e) Four hundred and eighty seven
(f) Six hundred and thirty

(g) One hundred and five
(h) Three hundred and sixteen

Numbers bigger than 999 are written as a series of periods, each period consisting of a 3-digit number from 000 to 999 and separated by a space from other periods.

For example, the number 67 049 285 600 is made up of four **periods**.

The last period, 600, is the ones;
the second-last period, 285, is the **thousands** (a thousand is a thousand ones);
the third-last period, 049, is the **millions** (a million is a thousand thousands);
the fourth-last period, 67, is the **billions** (a billion is a thousand millions);
the fifth-last period, if there is one, is the **trillions** (a trillion is a thousand billions).

So 67 049 285 600 is 67 billion, 049 million, 285 thousand, 600.

67 049 285 600

67 billion   49 million   285 thousand   600

When you read a big number, start by counting the periods back from the ones: ones, thousands, millions, billions . . . Then you will know what the first period is and you can go through pronouncing each period as you go.

Of course, to write this entirely in words, it would be 'Sixty seven billion, forty nine million, two hundred and eighty five thousand, six hundred'. This is cumbersome and you already know how to write the three-digit numbers in words, so we will just write these big numbers in the form '67 billion, 349 million, 285 thousand, 600', i.e. just writing the period names in words.

Note that in the number above, the millions period was 049. We write this as 49 million and pronounce it the same way. When writing 521 million, 43 thousand and 12 in numerals, we have to include zeros: 521 043 012. Each period must always have three digits (except sometimes the first period).

Also, in 25 446 000 200, the thousands period is zero. In this case, we leave it out when pronouncing it or writing it in words and just write '25 billion, 446 million, 200'.

Practice

Q3 Write the following numbers with the periods names in words:

(a) 28 721 300   (b) 4 062 521 190 200   (c) 338 000 027 400
(d) 21 997   (e) 4 000 000 001   (f) 22 005 302

Q4 Write the following numbers in numerals:

(a) 226 trillion, 58 billion, 305 million, 7 thousand, 212

(b) Forty nine billion, three hundred and eighty eight million, six hundred and nine

(c) Twenty eight trillion, four hundred billion

(d) Nine billion and ninety nine

(e) 214 million 12 thousand, 455

(f) 300 billion, 29 million, 112 thousand 500

Trillions is as far as you need to know, but, if you are interested in the names of bigger numbers, read the box.

For Interest Only

After trillions the next periods are: quadrillions, quintillions, sextillions, septillions, octillions, nonillions, decillions, ... One decillion is 1 000 000 000 000 000 000 000 000 000 000 000

12 007 638 000 200 004 is 12 quadrillion 7 trillion 638 billion 200 thousand and 4

Zillions and squillions are not real numbers, but just slang words for very big numbers.

Two other big numbers which are really used only for fun are a googol and a googolplex. A googol is 1 with 100 zeros after it. This is a lot more than there are atoms in the universe. A googolplex is 1 with a googol zeros after it. A googolplex is unimaginably big. Just to print the number using a 1 and a googol of zeros would take a huge amount of paper. If you printed in numerals that were just big enough to see covering all of both sides of A4 paper and packed the A4 paper into boxes and stacked the boxes, you wouldn't be able to fit the boxes into a classroom. In fact you wouldn't be able to fit them into Australia, even if you stacked them 10 km deep.

In fact they would take up a trillion times as much room as there is in the entire known universe – billions of light years of solidly stacked boxes of paper in every direction! And that's just a googol of zeros. Imagine printing a googolplex of zeros. Actually, you can't imagine it. It's unimaginable!

Whole numbers and counting numbers

The whole numbers are the numbers which aren't negative and don't have a fractional part, i.e. 0, 1, 2, 3, . . .

The **counting numbers** are the numbers we learn to count with. They are the whole numbers excluding 0, i.e. 1, 2, 3, 4, ...

Multiples

A counting number has **multiples**. These are numbers made by multiplying the counting number by any counting number. So the multiples of 3 are 3 (3×1), 6 (3×2), 9 (3×3), 12, 15, 18, 21 . . . and so on for ever. 21 is a multiple of 3 because it is 3×7, but 22 isn't. 14 is not a multiple of 5, but 500 is (because it is 5×100).

Factors

A counting number also has **factors**. A factor of say 30 is a counting number you can multiply by a counting number to make 30. The factors of 30 are 1 (because it can be multiplied by 30 to make 30), 2 (because it can be multiplied by 15 to make 30), 3 (3×10=30), 5 (5×6=30), 6 (6×5=30), 10 (10×3=30), 15 (15×2=30) and 30 (30×1=30).

It can also be thought of as a counting number you can divide the number by without leaving a remainder. For example, 5 is a factor of 30 because 30÷5 = 6 (no remainder), but 4 is not a factor of 30 because 30 ÷ 4 = 7.5 or 7 remainder 2.

The factors of 12 are 1, 2, 3, 4, 6 and 12. Note that 1 and 12 are factors of 12. Every counting number has 1 and itself as factors. The factors of 13 are just 1 and 13.

Practice

Q5 For each of the following numbers, say whether it is a factor of 24:
(a) 5 (b) 3 (c) 12 (d) 18 (e) 24 (f) 48 (g) 240 (h) 1

Q6 For each of the following numbers, say whether it is a multiple of 12:
(a) 1 (b) 6 (c) 9 (d) 12 (e) 24 (f) 30 (g) 100 (h) 120

Q7 List the 6 factors of 20 from smallest to largest.

Q8 List all the factors of 36 from smallest to largest.

Q9 List all the factors of 39 from smallest to largest.

Q10 List the first 6 multiples of 20.

Q11 What numbers are factors of both 20 and 24?

Q12 What is the largest number that is a factor of both 24 and 36?

Q13 What is the smallest number that is a multiple of 6 and of 8?

Even and odd numbers

A counting number is **even** if it is a multiple of 2. Even numbers end in 0, 2, 4, 6 or 8. 0 is also an even number. A counting number is odd if it is not a multiple of 2. **Odd** numbers end in 1, 3, 5, 7 or 9. When you count in 1s even numbers and odd numbers alternate. When you count in 2s, you usually use just the even numbers.

Prime and composite numbers

A **composite** number is a counting number which has more than two factors. It can be made by multiplying two other counting numbers together. For example 14 is composite because it is 2×7.

A **prime** number is a counting number which has just two factors. It cannot be made by multiplying two other counting numbers together. 11 is prime because no two other counting numbers can be multiplied to make it.

The number 1 has just one factor and so is neither prime nor composite. 2, 3, 5, 7 and 11 are the first five prime numbers; 4, 6, 8, 9 and 10 are the first five composite numbers.

Practice

Q14 For each of the following numbers, say whether it is even or odd or neither:
(a) 5 (b) 8 (c) 2 (d) 1 (e) 76 (f) 397 (g) 26 005 (h) 4.7

Q15 List the first 10 prime numbers.

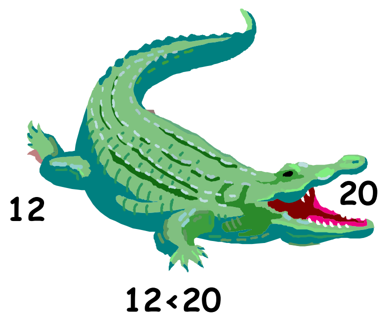
Q16 List the first 10 composite numbers.

Q17 For each of the following numbers, decide whether it is prime or composite or neither:
(a) 17 (b) 46 (c) 57 (d) 1 (e) 31 (f) –4 (g) 101 (h) ½

Q18 The following statement is nearly correct. Re-write it so it is correct: 'All counting numbers with exactly two factors are prime and all counting numbers with other numbers of factors are composite'.

The symbols > and <

The symbol **>** means *greater than* or *more than* and the symbol **<** means *less than*. So 5 > 3, but 11.2 < 12. If you have trouble remembering which symbol is which, remember that the bigger end of the symbol faces the bigger number. Some people like to think of the symbols as the jaws of a crocodile. The crocodile is greedy so it's trying to eat the bigger number.



Practice

Q19 Insert >, < or = to make the following true
(a) 6 . . . 5 (b) 2 . . . 15 (c) 31 . . . 31 (d) 12+5 . . . 20 (e) 9+7 . . . 30–16

Divisibility Rules

How can you tell if 48 567 132 is a multiple of 4, i.e. is **divisible** by 4 (without leaving a remainder)? Well, you can divide it and see. But there is a quicker way. Look at the last two digits: they make the number 32. 32 is divisible by 4 and so we know that 48 567 132 is divisible by 4.

[Note that, strictly speaking, 27 is divisible by 4 – it gives 6.75. But the word 'divisible' is often used to mean 'divisible exactly', i.e. without leaving a remainder. We will use the word in this sense here.]

This is the divisibility rule for 4. A divisibility rule is a quick way of telling if a number is divisible. You should learn the divisibility rules for 1, 2, 3, 4, 5, 6, 8, 9 and 10, i.e. all the counting numbers up to 10 except 7. The rules are as follows:

1: All counting numbers are divisible by 1.

2: If the number ends in 0, 2, 4, 6, or 8, it is divisible by 2.

3: Add the digits of the number. If the sum is divisible by 3, then the number is also divisible by 3. For example, take the number 79 251; the sum of the digits is 7+9+2+5+1 = 24. 24 is divisible by 3, so 79 251 is divisible by 3.

4: If the number made by the last two digits is divisible by 4, then the whole number is also.

5: If the number ends in 5 or 0, then it is divisible by 5.

6: If the number if divisible by 2 and by 3, then it is divisible by 6.

8: If the number made by the last three digits is divisible by 8, then the whole number is also.

9: Add the digits of the number. If the sum is divisible by 9, then the number is also divisible by 9.

10: If the number ends in 0, then it is divisible by 10.

There is a divisibility rule for 7, but it is so complicated, that it's easier just to divide by 7 and see.

Practice

Q20 Copy and complete this table by inserting ticks and crosses to show what these numbers are divisibly by.

	1	2	3	4	5	6	8	9	10
165	✓	×	✓						
24 312									
4 551									
1 880									
465 239 816									
92 574									

Products of Prime Factors

It is sometimes useful to write a composite number as a **product of prime factors**. For instance, the composite number 12 can be written as 2×2×3 (2 and 3 are prime). Usually we write the prime numbers in ascending order.

To do this with a larger number like 924, we have to find the prime factors. The divisibility rules come in handy here. We start with the smallest prime, i.e. 2, and see if 924 is divisibly by 2. It is, so we divide by 2 to get 462. So 924 = 2×462.

Then we try 2 again. 462 is divisible by 2. Dividing we get 231. So 462 = 2×231 and so 964 = 2×2×231.

Then we try 2 again. 231 doesn't divide by 2. So we go on to the next smallest prime, 3, and we see if 231 is divisible by 3. 2+3+1 = 6, so 231 does divide by 3. Dividing gives 77, so 231 = 3×77 and 924 = 2×2×3×77.

Then we try 3 again. 77 doesn't divide by 3, so we go on and try 5. That doesn't work either, so we try the next prime, 7. There is no easy rule for 7, so we just divide to see. It works: 77 = 7×11. 11 is prime, so our answer is:

$$924 = 2\times2\times3\times7\times11$$

A good way to lay this out is like this:

$$\begin{aligned} &924 \\ &= 2\times462 \\ &= 2\times2\times231 \\ &= 2\times2\times3\times77 \\ &= 2\times2\times3\times7\times11 \end{aligned}$$

Practice

Q21 Write these numbers as products of primes:
(a) 140 (b) 490 (c) 165 (d) 650 (e) 3213 (f) 7150

Solve

Q51 Write the following numbers properly in digits and in words:
(a) two and a half million
(b) seventeen hundred
(c) the number which is one less than a billion

Q52 If you listed the multiples of 30 from smallest to largest, what would be the 25th one?

Q53 What number has the most one-digit multiples?

Q54 What is the smallest number that has 1, 2, 3, 4, 5, and 6 as factors?

Q55 Can a number have 6 as a factor, but not 3? Explain.

Q56 1 and 9 have odd numbers of factors, 2 and 6 have even numbers of factors. What other numbers have an odd number of factors?

Q57 Explain why multiplying an even number by an odd number will always give an even number and why multiplying an odd number by an odd number will always give an odd number.

Q58 If you multiply two prime numbers together then add 1, can the result ever be composite? Explain.

Q59 If you multiply a prime number by all the prime numbers less than it then add 1, can the result ever be composite?

Revise

Revision Set 1

Q61 Write the following numbers in words:
(a) 329 (b) 43 000 488 300

Q62 Write the following numbers in numerals:
(a) Seventy nine million, five hundred and eighty one thousand, six hundred and nine
(b) Two trillion, six hundred and forty million, two hundred thousand

Q63 (a) List 8 factors of 30
(b) List 8 multiples of 30

Q64 Which of the following are counting numbers?
(a) 12 (b) 0 (c) –4 (d) 1 (e) 5.6 (f) ¾ (g) 2 388 136

Q65 For each of the following numbers, say whether it is even, odd or neither:
(a) 1 (b) 178 (c) 52 (d) 156 099

Q66 For each of the following numbers, say whether it is prime, composite or neither:
(a) 1 (b) 178 (c) 31

Q67 Insert >, < or = to make the following true:
(a) 4 . . . 8 (b) 9+5 . . . 30–20

Q68 Use the divisibility rules to tell which of 1, 2, 3, 4, 5, 6, 8, 9 and 10 are factors of 7140.

Q69 Write 5320 as a product of primes.

Revision Set 2

Q71 Write 34 095 527 000 200 in words.

Q72 (a) Write 'One hundred and fifty nine billion, three hundred and eighty eight million, two hundred and nine thousand' in numerals.

(b) Write 13.6 million as a numeral.

Q73 (a) List the whole numbers in this list:

0 1 2.5 3¼ 17 –21

(b) List the counting numbers in this list:

0 4 0.1 ½ 42 699 –1

Q74 (a) Write six factors of 20

(b) Write six multiples of 11

Q75 How many of these numbers are odd?

5 8 2 1 76 397 26 005

Q76 List the next 4 composite numbers after 18.

Q77 Sort the following list into prime numbers, composite numbers and those which are neither:

17 46 57 1 31 –4 101 ½ 0

Q78 Copy the following, inserting >, < or = to make each statement true

(a) 16 . . . 5 (b) 12 . . . 5 (c) 4 . . . 2+2 (d) 16+5 . . . 20 (e) 4+7 . . . 30–18

Q79 Write 1305 as a product of primes.

Revision Set 3

Q81 Write in numerals: Forty five billion, six hundred thousand.

Q82 Write in words: 3 228 061 000 902.

Q83 Write the meanings of the following:

(a) Counting number
(b) Whole number
(c) Multiple
(d) Factor
(e) Even
(f) Odd
(g) Composite
(h) Prime
(i) >
(j) <

Q84 What number is a factor of all counting numbers?

Q85 What counting number is neither prime nor composite?

Q86 Use the divisibility rules to tell which of 1, 2, 3, 4, 5, 6, 8, 9 and 10 are factors of 17 150.

Q87 Write 2750 as a product of primes.

Revision Set 4

Q91 Write in numerals: Sixty five trillion, two hundred million.

Q92 Write in words: 25 774 000 300.

Q93 Copy and complete this table:

	24	6	2	0	1.2	17	20	12
Whole number	✓							
Counting number		✓			×			
Multiple of 12							×	
Factor of 12								
Even			✓					
Odd			×					
Composite								
Prime								
> 6								
< 8								

Q94 Write 6426 as a product of primes.

Answers

Q1
(a) Three
(b) Sixty
(c) Two hundred
(d) Forty seven
(e) Ninety four
(f) Two hundred and fifty eight
(g) Nine hundred and thirty five
(h) Four hundred and six
(i) Two hundred and eleven

Q2 (a) 9 (b) 40 (c) 500 (d) 72 (e) 487 (f) 630 (g) 316

Q3
(a) 28 million, 721 thousand, 300
(b) 4 trillion, 62 billion, 521 million, 190 thousand, 200
(c) 338 billion, 27 thousand, 400
(d) 21 thousand, 997
(e) 4 million and 1
(f) 22 million, 5 thousand, 302

Q4
(a) 226 058 305 007 212
(b) 49 388 000 609
(c) 28 400 000 000 000
(d) 9 000 000 099
(e) 214 012 455
(f) 300 029 112 500

Q5 (a) no (b) yes (c) yes (d) no (e) yes (f) no (g) no (h) yes
Q6 (a) no (b) no (c) no (d) yes (e) yes (f) no (g) no (h) yes
Q7 1, 2, 4, 5, 10, 20
Q8 1, 2, 3, 4, 6, 9, 12, 18, 36
Q9 1, 3, 13, 39
Q10 20, 40, 60, 80, 100, 120
Q11 1, 2, 4
Q12 12
Q13 24
Q14 (a) odd (b) even (c) even (d) odd (e) even (f) odd
(g) odd (h) neither
Q15 2, 3, 5, 7, 11, 13, 17, 19, 23, 29
Q16 4, 6, 8, 9, 10, 12, 14, 15, 16, 18
Q17 (a) prime (b) composite (c) composite (d) neither (e) prime (f) neither
(g) prime (h) neither
Q18 All counting numbers with exactly two factors are prime; the only counting number with just one factor is neither prime nor composite; all counting numbers with other numbers of factors are composite.
Q19 (a) > (b) < (c) = (d) < (e) >
Q20

	1	2	3	4	5	6	8	9	10
165	✓	✗	✓	✗	✓	✗	✗	✗	✗
24 312	✓	✓	✓	✓	✗	✓	✓	✗	✗
4 551	✓	✗	✓	✗	✗	✗	✗	✗	✗
1 880	✓	✓	✗	✓	✓	✗	✓	✗	✓
465 239 816	✓	✓	✗	✓	✗	✗	✓	✗	✗
92 574	✓	✓	✓	✗	✗	✓	✗	✓	✗

Q21 (a) 2×2×5×7 (b) 2×5×7×7 (c) 3×5×11 (d) 2×5×5×13
(e) 3×3×3×7×17 (f) 2×5×5×11×13

Q51 (a) 2 500 000, Two million, five hundred thousand
(b) 1700, One thousand, seven hundred
(c) 999 999 999, Nine hundred and ninety nine million, nine hundred and ninety nine thousand, nine hundred and ninety nine
Q52 750 Q53 1 Q54 60
Q55 No, dividing by 6 is the same as dividing by 3 then by 2
Q56 4, 16, 25, 36, 49, 64, . . . all the square numbers
Q57 An even number consists of a number of pairs with none left over. Any number of even numbers will consist just of pairs with none left over.
An odd number consists of a number of pairs plus one left over. In an even number of odd numbers, the left-overs will be paired up into pairs, but if we add one more odd number to make an odd number of odd numbers, there will be one left over again.
Q58 Yes, e.g. 3×5+1=16
Q59 No

Q61 (a) Three hundred and twenty nine
(b) 43 billion, 488 thousand, 300
Q62 (a) 79 581 609 (b) 2 000 640 200 000
Q63 (a) 1, 2, 3, 5, 6, 10, 15, 30 (b) e.g. 30, 60, 90, 120, 150, 180, 210, 240
Q64 (a) yes (b) no (c) no (d) yes (e) no (f) no (g) yes
Q65 (a) odd (b) even (c) even (d) odd
Q66 (a) neither (b) composite (c) prime
Q67 (a) < (b) >
Q68 1, 2, 3, 4, 5, 6
Q69 2×2×2×5×7×19

Q71 34 trillion, 95 billion, 527 million, 200

Q72 (a) 159 388 209 000 (b) 13 600 000

Q73 (a) 0, 1, 17 (b) 4, 42 699

Q74 1, 2, 4, 5, 10, 20 (b) e.g. 11, 22, 33, 44, 55, 66

Q75 4

Q76 20, 21, 22, 24

Q77 prime: 17, 31, 101 composite: 46, 57 neither: 1, −4, ½, 0

Q78 (a) 16 > 5 (b) 12 > 5 (c) 4 = 2+2 (d) 16+5 > 20 (e) 4+7 < 30–18

Q79 3×3×5×29

Q81 45 000 600 000

Q82 3 trillion, 228 billion, 61 million, 902

Q83 (a) 1, 2, 3, 4, . . . etc.

(b) 0, 1, 2, 3, 4, . . . etc.

(c) The multiples of a number are all numbers made by multiplying that number by a counting number.

(d) The factors of a number are all counting numbers that can be multiplied by a counting number to make that number.

(e) Even numbers are counting numbers that are multiples of 2.

(f) Odd numbers are counting numbers that are not multiples of 2.

(g) A composite number is a counting number with more than two factors.

(h) A prime number is a counting number with just two factors.

(i) > means greater than

(j) < means less than

Q84 1

Q85 1

Q86 2, 5, 10

Q87 2×5×5×5×11

Q91 65 000 200 000 000

Q92 25 billion, 774 million, 300

Q93

	24	6	2	0	1.2	17	20	12
Whole number	✓	✓	✓	✓	×	✓	✓	✓
Counting number	✓	✓	✓	×	×	✓	✓	✓
Multiple of 12	✓	×	×	×	×	×	×	✓
Factor of 12	×	✓	✓	×	×	×	×	✓
Even	✓	✓	✓	✓	×	×	✓	✓
Odd	×	×	×	×	×	✓	×	×
Composite	✓	✓	×	×	×	×	✓	✓
Prime	×	×	✓	×	×	✓	×	×
> 6	✓	×	×	×	×	✓	✓	✓
< 8	×	✓	✓	✓	✓	×	×	×

Q94 2×3×3×3×7×17