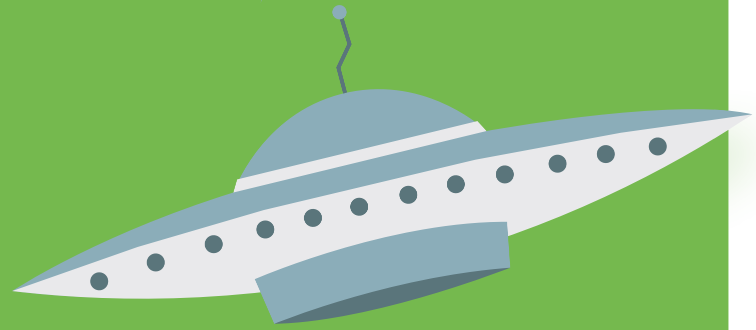
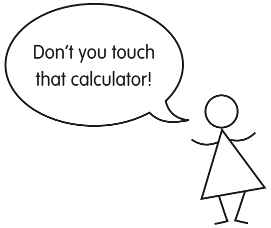


Maths Home Learning Pack:

Multiplication

DK

Long multiplication



Multiplying a large number by a single-digit number

This isn't as hard as it looks, but you will need to know your times tables up to **10 × 10** pretty well before you try this.

Write the large number above the small one.

```
 HTU
 786
× 2
```

Multiply the single-digit number on the bottom by the units, then tens, then hundreds of the number at the top.

Multiply by units

```
 786
×  2
  12 → 6 × 2 = 12
```

Multiply by tens

```
 786
×  2
  12
 160 → 80 × 2 = 160
```

Multiply by hundreds

```
  786
×   2
   12
  160
 1400 → 700 × 2 = 1,400
```

Finally, add up the answers to those three multiplications.

```
    12
   160
+ 1400
  1572
```

So: 786 × 2 = 1,572

Now let's try the fast way

A quicker way of doing this is to write the answer to each multiplication on the same line, going from right to left. If you get an answer of ten or more when you're multiplying the units, tens, or hundreds, you "carry" the first digit of that answer, adding it to the column to the left.

```
 285
×  3    5 × 3 = 15
   5
  1     Carry 1 to tens column.
```

```
 285    8 × 3 = 24
×  3
  55    24 + 1 = 25
 2 1    Carry 2 to hundreds column.
```

```
 285    2 × 3 = 6
×  3
 855    6 + 2 = 8
 2 1
```

Now have a go

385 × 2 | 723 × 4 | 210 × 3 | 974 × 8

Multiplying two large numbers together

If you are multiplying together two numbers that have more than one digit, things get a little trickier. Keep practising and you'll soon pick it up.

First concentrate on the unit digit at the bottom, and multiply it by each number on the top row in turn.

```
 HTU
 824
× 36
```

Ignore this 3 at first. Multiply 6 by 4, then 2, then 8.

```
 824
× 36    6 × 4 = 24
    4
    2   carry the 2
```

```
 824
× 36    6 × 2 = 12
   44   12 + 2 = 14
  1 2   carry the 1
```

```
  824
×  36   6 × 8 = 48
 4944   48 + 1 = 49
  1 2
```

Now look at the tens digit at the bottom, and multiply it by the units, tens and hundreds digits in the top row. But first you need to add a zero, because you're multiplying by numbers in the tens column.

```
  824
×  36   3 × 4 = 12
 4944
   20   Add a zero
   1    carry the 1
```

```
  824
×  36   3 × 2 = 6
 4944   6 + 1 = 7
  720
   1
```

```
  824
×  36   3 × 8 = 24
 4944
24720
   1
```

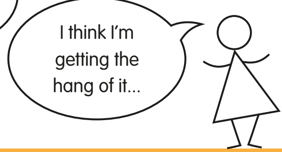
Finally, add together the two rows of numbers.

```
    824
×    36
   4944
+ 24720
  29664
```

The answer is 29,664.

Now have a go

285 × 23 | 628 × 71 | 457 × 18 | 767 × 58 | 526 × 99



Answers: Blue – 770. Red – 2,892. Green – 630. Yellow – 7,792.

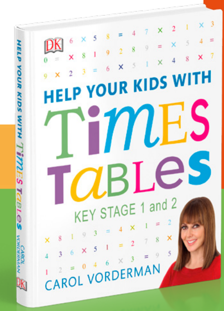
Answers: Blue – 6,555. Purple – 44,588. Yellow – 8,226. Red – 44,486. Green – 52,074. Pink – 38,682.

DK

Take a look at the Now have a go sections, and practice using the method explained above. Answers are at the bottom of the page. Did you get them right?

Suitable for 7–9 years

Content from: *Help Your Kids With Times Tables*
Available now



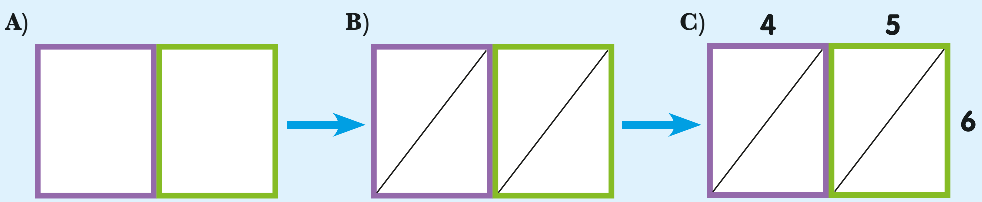
Window-frame multiplication

Here's another way of multiplying large numbers together.
Some people find this easier than standard long multiplication.

Say, for example, you want to multiply 45 by 6.

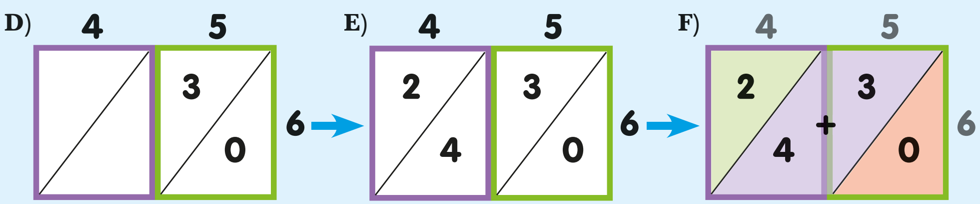
A) The number **45** has **2** digits, so draw **2** rectangular boxes side by side.
B) Draw a diagonal line across each box, from the bottom left-hand corner to the top right-hand corner.
C) Write the numbers you want to multiply along the top and right-hand side of the boxes.

The number **6** is only one digit long, so only one row of boxes is needed.



D) Multiply the digits along the top and side, starting from the right. **5 × 6 = 30**, so write **3** and **0** on either side of the diagonal line.
E) Now do the multiplication in the next box along. **4 × 6 = 24**, so write **2** and **4**.
F) Look at the numbers in each diagonal column. These give you the answer to **45 × 6**. If there are two numbers in a diagonal column, add them together.

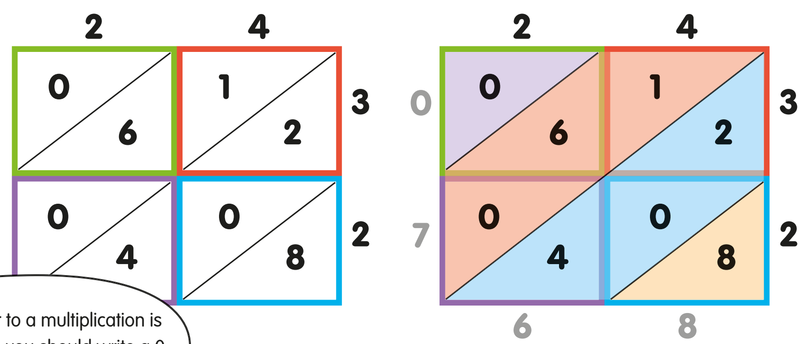
Add together the numbers in the purple column.



45 × 6 = 270

Window-frame multiplication works for larger numbers, too. Read the answers down the left-hand side and across the bottom of the boxes.

What is **24 × 32**?

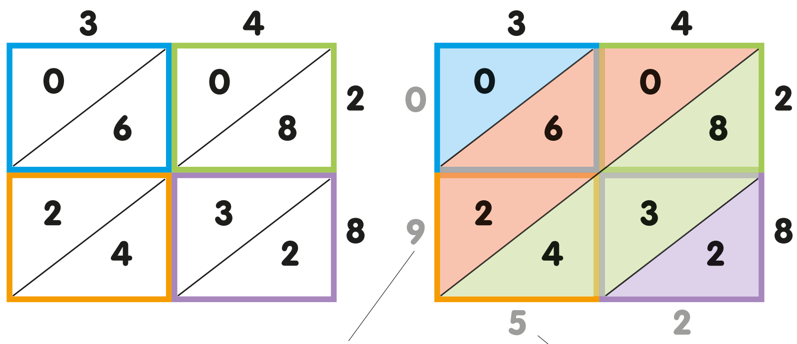


If the answer to a multiplication is a single digit, you should write a 0 first, for example 2 × 2 = 04.

24 × 32 = 768

If a diagonal column adds up to a two-digit answer, you should carry the first digit, adding it to the number on the left.

What is **34 × 28**?



1 has been carried from the next column along.
0 + 6 + 2 + 1 = 9

8 + 3 + 4 = 15, so write 5 and add 1 to the next diagonal column.

34 × 28 = 952

Now you have a go!

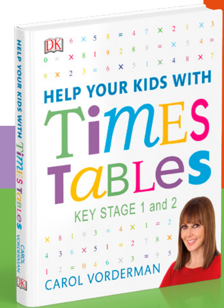
26 x 14 **324 x 5** **18 x 92**

Answers: 26 × 14 = 364. 324 × 5 = 1,620. 18 × 92 = 1,656.

DK

Now it's your turn! Give a try to the Now you have a go sections.
Answers are at the bottom of the page. Did you get them right?

Suitable for 7–9 years



HOW TO BECOME A TRILLIONAIRE

What comes next: 1, 2, 4, 8, 16...? The answer is 32. Each new number in this ordered list of numbers, or "sequence", is found by multiplying the previous number by 2. What seem like small increases in the sequence at first soon start to become enormous, as this Indian legend about a King's defeat during a game of chess shows...

1 After losing a game of chess to a wise traveller, the King offered a reward to the victor, who modestly requested some rice for each square of the chessboard. He asked for one grain of rice for the first square, two for the next, and so on, doubling every time.

2 At first, this sounded reasonable enough to the King. However, as the numbers continued to double, the piles of rice he owed the victor started to become enormous.

3 The King eventually owed his opponent 18 million trillion grains of rice – enough to bury his entire Kingdom in rice!

DID YOU KNOW?

Folding paper

If you fold an imaginary piece of paper in half, and repeat the process 54 times, it will eventually be thick enough to reach the Sun. It's impossible to fold a real piece of paper that many times though – because it will become too thick to bend!

Doing the maths

GEOMETRIC SEQUENCES

The amount of rice on each square of the chessboard is found by multiplying the amount on the previous square by a fixed amount (in this case, 2), known as the common ratio. A sequence that increases by multiplying each number by a common ratio is known as a geometric sequence.

×2 ×2 ×2 ×2

Multiplying grains of rice

1 2 4 8 16

×2 ×2 ×2 ×2

If you swap the rice for numbers, you can see how the sequence works. It only takes four steps to get from 1 to 16, and another four steps would take you all the way to 256! You can see how the victor's piles of rice became so huge so quickly.

Answers: / 3: 1, 3, 9, 27, 81, 243, 729, 2,187. / 4: 1, 4, 16, 64, 256, 1,024, 4,096, 16,384. / 5: 1, 5, 25, 125, 625, 3,125, 15,625, 78,125.

DK

Can you work out how much rice would be in the first eight chessboard squares if the geometric sequence were multiplied by 3, 4, or 5?

Suitable for 9-12 years

THE ROYAL CHESSBOARD

Here's the number of rice grains on each chessboard square written out in figures. Now you can see just how quickly the numbers increase!

Can you say the number in the bottom right square of the chessboard out loud?

REAL WORLD

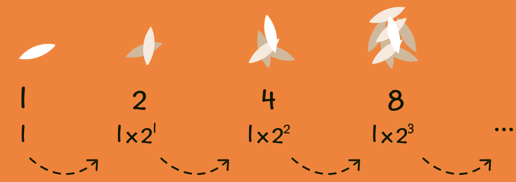
Carbon-14 dating

Scientists use geometric sequences to figure out how long ago plants and animals lived. With each 5,730 years that passes, the quantity of a substance called carbon-14 left in an organism's remains falls by half. By knowing how much carbon-14 was in the organism when it died, scientists can tell when it lived by how much is left in its remains now.

1	2	4	8	16	32	64	128
256	512	1,024	2,048	4,096	8,192	16,384	32,768
65,536	131,072	262,144	524,288	1,048,576	2,097,152	4,194,304	8,388,608
16,777,216	33,554,432	67,108,864	134,217,728	268,435,456	536,870,912	1,073,741,824	2,147,483,648
4,294,967,296	8,589,934,592	17,179,869,184	34,359,738,368	68,719,476,736	137,438,953,472	274,877,906,944	549,755,813,888
1,099,511,627,776	2,199,023,255,552	4,398,046,511,104	8,796,093,022,208	17,592,186,044,416	35,184,372,088,832	70,368,744,177,664	140,737,488,355,328
281,474,976,710,656	562,949,953,421,312	1,125,899,906,842,624	2,251,799,813,685,248	4,503,599,627,370,496	9,007,199,254,740,992	18,014,398,509,481,984	36,028,797,018,963,968
72,057,594,037,927,936	144,115,188,075,855,872	288,230,376,151,711,744	576,460,752,303,423,488	1,152,921,504,606,846,976	2,305,843,009,213,693,952	4,611,686,018,427,387,904	9,223,372,036,854,775,808

POWERS

Powers tell you how many times to multiply a number by itself. You can show how the rice increases each time using powers. They are written as small numbers at the top right of the number you want to multiply by itself. So 2^2 is the same as saying 2 x 2, and 4^3 is the same as 4 x 4 x 4.



$$1 \times 2^{(n-1)}$$

This is the number at the start of the sequence.

n means the position of the number in the sequence.

The common ratio in this sequence is 2.

You have to subtract 1 from n, because the first number in the sequence isn't multiplied by the common ratio.

Use n-1 to find the 6th number in the sequence, which is 6-1 or 5.

$$1 \times 2^{(6-1)} = 1 \times 2^5 = 32$$

The 6th number in the sequence is 32.

You can find out the number for any position in the King's chessboard sequence using this formula. You need to know three things – the number at the start of the sequence (in this case, 1), the common ratio (the number it's being multiplied by – in this case, 2), and the position of the number in the sequence minus 1.

Can you find out what the 20th number in the sequence is? You might need a calculator!

TRY IT OUT

HOW TO BOOST YOUR SAVINGS

You have two coins. You save them in a bank with a very generous interest rate. By year 2 you have six coins. How many will you have by year 5?

The number of coins follows a growth pattern from one year to the next. To figure out each year's coin total, the previous total is multiplied by three.

So by year 5 the total will be 2×3^4 = 162 coins.

Using the formula $2 \times 3^{(n-1)}$, can you work out how much money you'd have saved by year 15?

Answers: / 1) Nine quintillion, two hundred and twenty-three quadrillion, three hundred and seventy-two trillion, thirty-six billion, eight hundred and fifty-four million, seven hundred and seventy-five thousand, eight hundred and eight! / 2) $1 \times 2^{(20-1)} = 1 \times 2^{19}$ = 524,288 / 3) $2 \times 3^{(15-1)} = 2 \times 3^{14}$ = 9,565,938 coins

DK

Read this page and have a go at the activities. Answers are at the bottom of the page. Can you complete them all?

Suitable for 9–12 years

Content from: *What's The Point of Maths*
Available now