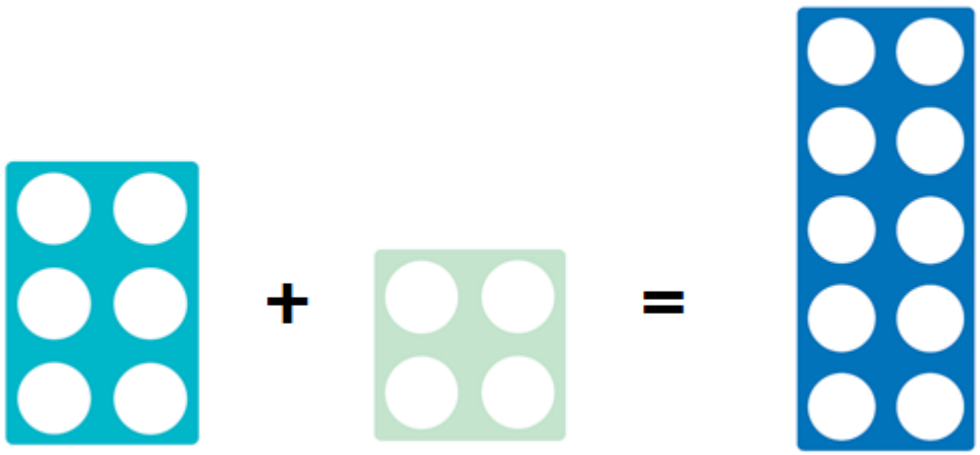
St Margaret's Lee

Church of England School Diocese of Southwark

Calculation Policy

This policy is intended to guide teachers, children and parents towards a consistent approach to the teaching and learning of arithmetic. We have created a series of videos for each aspect of the calculation policy for reference, that model each teaching point in greater detail. These are available from the school website **learning** section.



September 2016

Addition and Subtraction

Y1

Use Numicon (and other apparatus) to add and subtract

6 + 2 = 8

Add the shape to make a new Numicon shape

6 – 2 = 4

Cover the shape with the smaller number and count the how much you have left

4 + 2 = 6

When counting objects make sure you move them as you count to ensure you don't miscount

Put the larger number in your head and count on (add) or back (take away)

Counting on

Put the larger number in your head and add fingers to count on

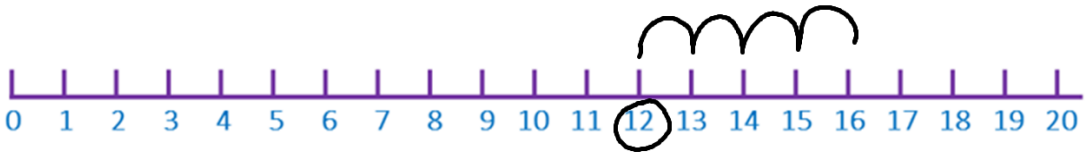
Counting back

Put the larger number in your head and the smaller number on your fingers

Then take away fingers to count back

Use a number line to calculate addition and subtraction for TU +/- U

12 + 4 = ?



Find the biggest number on the number line

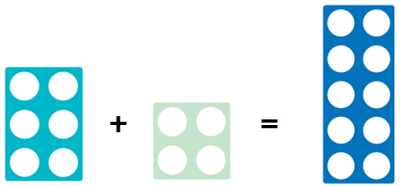
Say 'weeee' for the first bounce (to stop misconception of counting the biggest number as the first jump)

Then bounce on/back the smaller number

**Children could then use their knowledge of number bonds, doubling, or adding 9 by + 10 – 1 to bounce further in fewer steps*

Read and write number sentences and 'make' using Numicon

6 + 4 = 10

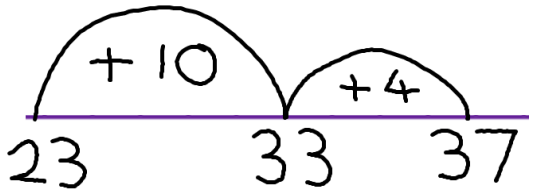


Use and understand calculation vocabulary:
add, plus, sum, more than, total, altogether (+), takeaway, subtract, minus, less than, left (–), equal to, equals (=), greater, greatest, larger, largest, fewer, fewest, halfway, estimate, double, halve

Y2

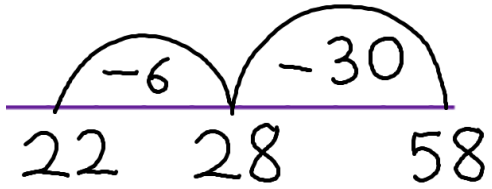
Progress from 'numbered' number line to 'blank' number line for TU+/-U, TU+/-TU

23 + 14 = ?



Put the bigger number at the start
Bounce on the 10s
Bounce on the units

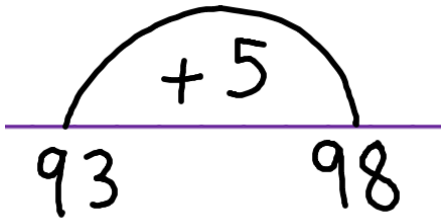
58 – 36 = ?



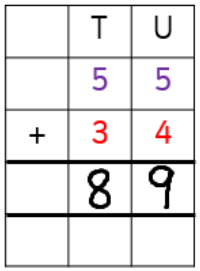
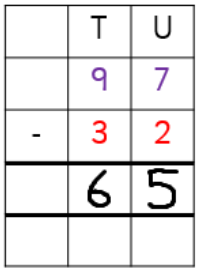
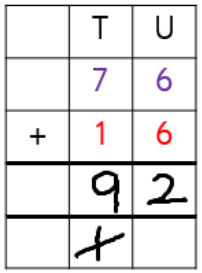
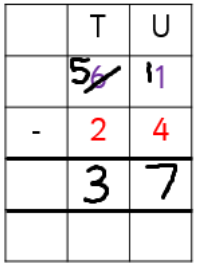
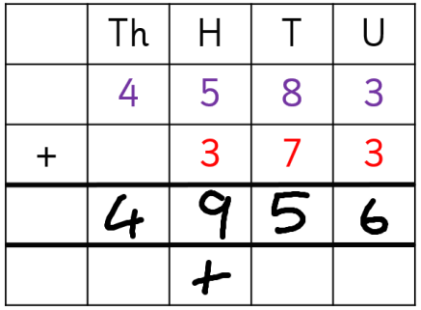
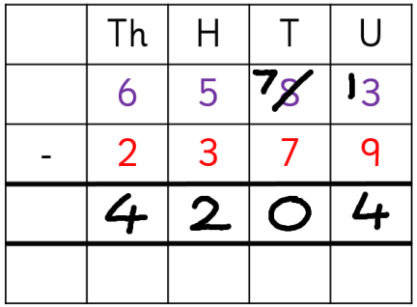
Put the bigger number at the end
Bounce back the 10s
Bounce back the units

**If bouncing on/back multiple 10s, you could break this down into separate 10s (e.g. 30 becomes 10 and 10 and 10)*

98 – 93 = ?



When the numbers are close, it's easier to subtract by counting on, rather than taking away

	Use column addition and subtraction for TU+/-U, TU+/-TU leading onto calculations involving carrying and stealing  Put the larger number on top and always start with the units   Carry the 'extra 10' Cross out the 'extra 10' when added  Steal a '10' **Use and understand calculation vocabulary:** add, plus, sum, more than, total, altogether (+), takeaway, subtract, minus, less than, left (–), equal to, equals (=), greater, greatest, larger, largest, fewer, fewest, halfway, estimate, double, halve
Y3	**Use place value to calculate addition and subtraction for HTU+U, HTU+T, HTU+H** e.g. 236 + 2 = 526 + 30 = 452 + 400 = *Children should learn to recognise the number of units, 10s or 100s and add this to the relevant column mentally **Use column addition and subtraction up to 4 digits involving carrying and stealing**  Larger number on top Always start with the units Carry the 'extra 10' Cross out the 'extra 10' when added  Larger number on top Always start with the units Steal a '10'

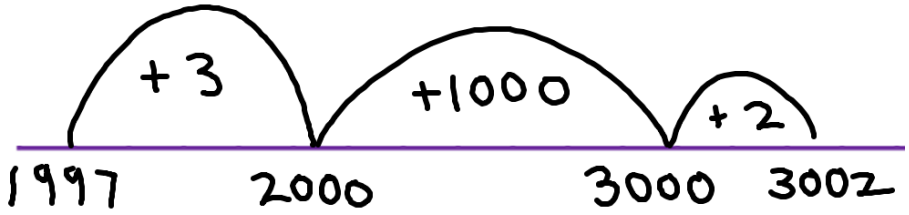
Y4

Use column addition and subtraction up to and beyond 4 digits including decimal calculations for money or measurement

**If adding or subtracting decimals make sure you line up the decimal point*

Y5 Y6

Use the blank number line to calculate addition and subtraction when appropriate e.g. finding the difference between 1997 and 3002



Often it is better to count on, starting with the smaller number
Bounce to the nearest 10s/100s/1000s number
Bounce in 10s/100s/1000s
Bounce any extra
How much have you bounced? = 1005

Use column addition and subtraction up to and beyond 4 digits (involving double carrying and stealing) including decimal calculations for money or measurement

	Th	H	T	U
	5	3	4	6
+		9	8	7
	6	3	3	3
	+	+	+	

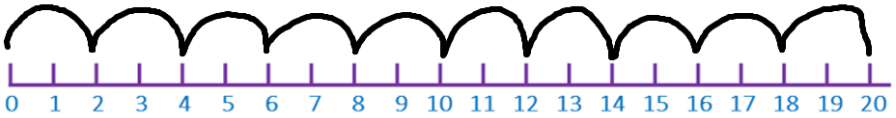
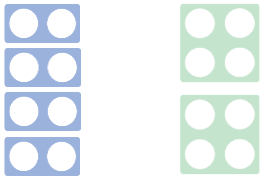
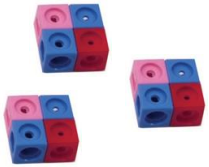
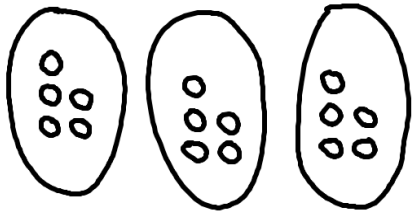
	Th	H	T	U
	~~6~~ 5	~~5~~ 15	~~4~~ 3	10 6
-	4	9	5	4
	2	6	5	2

Steal a '100'
Steal a '1000'

	Th	H	T	U
	6	~~8~~ 7	~~9~~ 8	10
-	2	3	7	9
	4	5	2	1

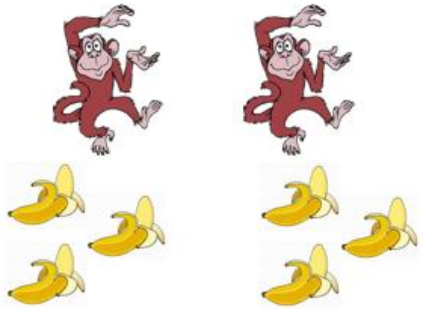
Steal a '100'
Steal a '10'

**If adding or subtracting decimals make sure you line up the decimal point*

	Multiplication and Division
Y1	**Explore multiplication as repeated adding on a number line** Counting in 2s  **Introduce multiplication as grouping using Numicon (and other apparatus), using related vocabulary e.g. 2 lots of 3, 2 groups of 3, 2 sets of 3, 2 threes (not 2 times 3 at this stage)**  4 groups of 2 2 lots of 4  3 sets of 4 **Use 'grouping circles' as an informal written method for grouping** **3 x 5 = 15**  Choose the smallest number (3) and draw that many groups (circles) Make groups by adding dots to each group Make sure the dots look like the Numicon shape so they are easy to visualise or count Finally count the dots

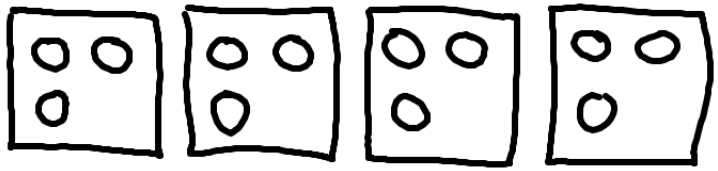
Explore the concept of division as sharing and explore practically, using vocabulary (shared equally, divided equally into, divided equally between)

6 ÷ 2 = 3



Use 'share in a square' as an informal written method for sharing

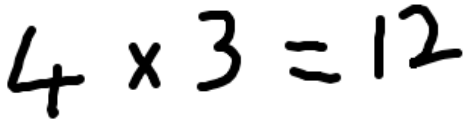
12 ÷ 4 = 3



Choose the smaller number and draw that number of boxes (4)
Share the bigger number (12) into the boxes
Make sure the dots look like a Numicon shape so it is easy to count
Then ask yourself…how many are in each box?

"How many in that box? **3** How many in that box? **3** How many in that box? **3** How many in that box? **3** …so the answer is? **3**"

Begin to record as number sentences

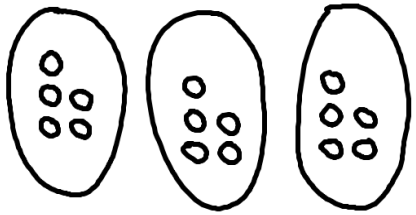


Use and understand calculation vocabulary :
Lots of, groups of, sets of (X), share, spilt, divide (÷)

Y2

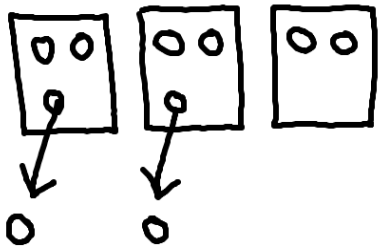
Use 'grouping circles' and 'share in a square' as an informal written method for sharing leading onto remainders

3 x 5 = 15



Choose the smallest number (3) and draw your groups (circles)
Make groups by adding dots to each group
Make sure the dots look like a Numicon shape so it is easy to count
Finally count the dots

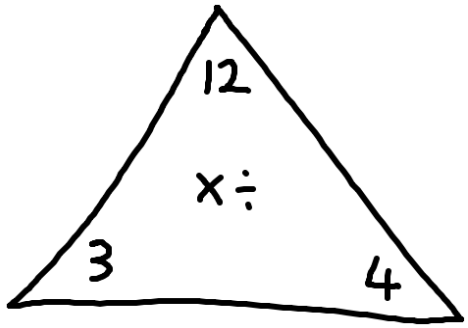
8 ÷ 3 = 2 r2



For remainders, share as normal following the sharing strategy
Then ask yourself…how many are in each box?
If they are not equal, remove the extras and draw them outside
" How many in that box? **2** How many in that box? **2** How many in that box? **2"**
So the answer is? **2** …but how many are left over? **2** = 2 r2

Introduce concept of 2 x 4 as 2 times 4 (e.g. 4+4) and that this is equal to 4 x 2 (2+2+2+2) - multiplication can be done in any order (but division cannot)

Begin to record x and ÷ number families. e.g.3 x 4 = 12, 4 x 3 = 12, 12 ÷ 3 = 4, 12 ÷ 4 = 3



Use and understand calculation vocabulary :
Lots of, groups of, sets of, times, multiply (X), share, spilt, divide, give, between (÷)

Y3	**Introduce ‘formal written method’ for multiplication for TU x U, HTU x U**

	H	T	U
		4	3
x			2
		8	6

Largest number on top
2 x 3 …then 2 x 4

	H	T	U
	2	4	2
x			4
	9	6	8

Carry the ‘extra 100’ on the line

Introduce formal written 'bus shelter method' for division for TU ÷ U, leading onto remainders

	T	U	
	2	3	
3	6	9	

How many 3s in 6? = 2
How many 3s in 9? = 3
= 11

	T	U	
	1	3	
4	5	12	

How many 4s in 5? = 1 r1
Put the remainder next to the second digit
How many 4s in 12? = 3
= 13

	T	U	
	1	8	r1
2	3	17	

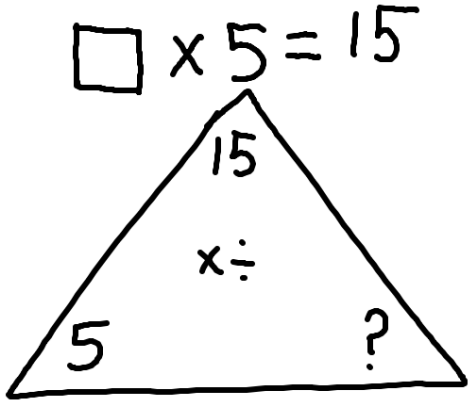
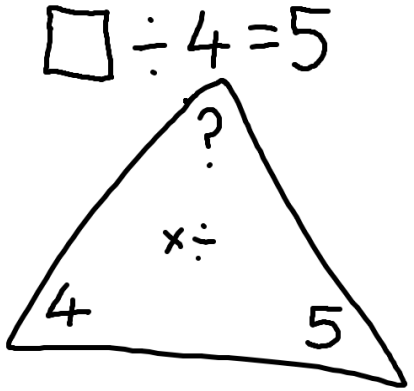
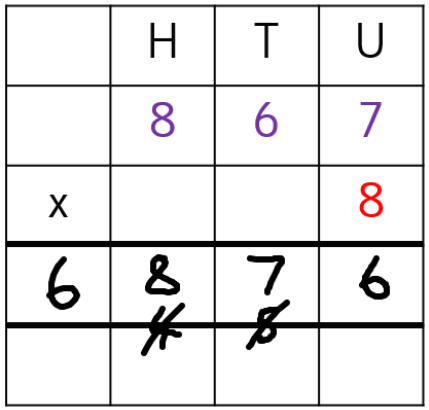
How many 2s in 3? = 1 r1
How many 2s in 17? = 8 r1
= 18 r1

**If children are struggling with the concept of 'how many 4s in 5?', they could use Numicon or the following strategy*

Draw 5 dots (Numicon shape)

Circle 4

So there is one 4 in 5 and 1 left over e.g. 1 r1

	Use 'number families' to work out missing number problems  **So 15 ÷ 5 = 3**  **So 4 x 5 = 20**
Y4	**Use 'formal written method' for multiplication for HTU x U when digits are larger (applying harder x table knowledge)** 

	H	T	U
	8	6	7
x			8
6	8 ~~4~~	7 ~~8~~	6

Use formal written 'bus shelter' method for division for HTU ÷ U with remainders when the divisor doesn't fit into the first number

	H	T	U	
	0	7	2	r1
9	6	4	19	

	H	T	U	
	1	4	0	r1
5	7	20	1	

Y5

Use 'formal written method' for multiplication for TU x TU, HTU x U, HTU x TU

	Th	H	T	U	
		1	4	3	
x			4	3	
		4	2	9	x3
					x40

	Th	H	T	U	
		1	4	3	
x			4	~~3~~	
		4	2	9	x3
	5	7	2	0	~~x40~~

	Th	H	T	U	
		1	4	3	
x			4	~~3~~	
		4	2	9	x3
	5	7	2	0	~~x40~~
	6	1	4	9	

Step 1
Partition the smaller number and write it at the side
x the units of the larger number by the bottom number
Start with units of the top number, then 10s, 100s etc.
Carry on the line and cross out when added

Step 2
Cross out the units of the smaller number
Add a zero in the units column to show that we are multiplying by 40 not 4
x the 10s of the smaller number by the top number
Start with units of the top number, then 10s, 100s etc.
Carry on the line and cross out when added

Step 3
Then add the two numbers together
Follow the rules of column addition

Use formal written 'bus shelter' method for division for THTU ÷ U with remainders

	Th	H	T	U	
	1	0	6	1	r5
8	8	4	9	13	

Y6

Use 'formal written method' for multiplication for HTU x HTU, THTU x THTU

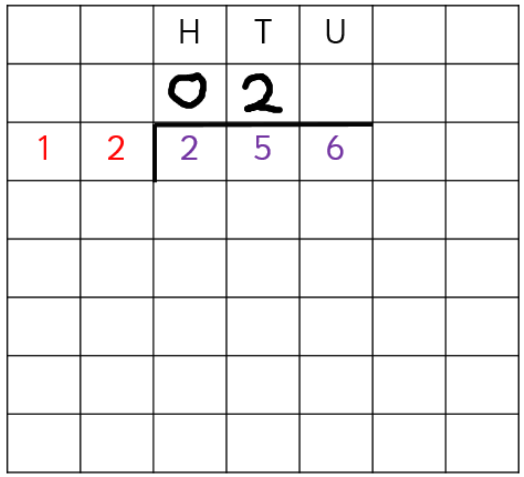
		Th	H	T	U	
		2	1	8	3	
	x		4	~~2~~	~~6~~	
	1	3	0	9	8	x 6
	4	3	6	6	0	x20
8	7	3	2	0	0	x400
9	2	9	9	5	8	

For larger numbers, follow the same steps as before
Make sure you add two zeros when multiplying by 100s, three when multiplying by 1000s etc.

Introduce 'long division' for HTU ÷ TU with remainders (leading onto representing remainders as decimals or fractions)

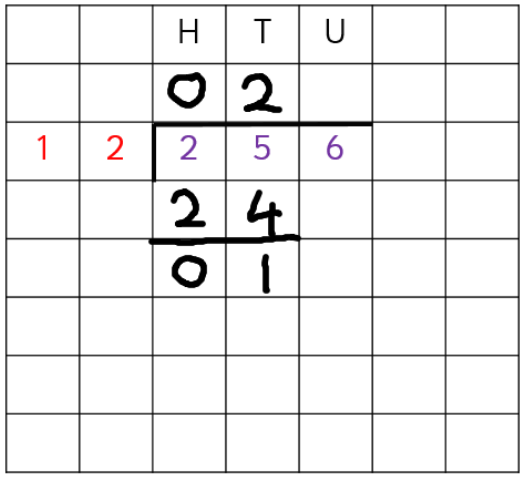
To remember the steps of long division use the 'kung fu maths idea' to help (making the shapes of the symbols in the air)

- Punch ÷ (the numbers are coming at you so punch (divide) them away)
- Block x (the numbers retaliate so block (multiply) them)
- Slice – (then slice attack (subtract))
- Bring it down ↓ (then chop attack (bring the number down))
- Repeat!



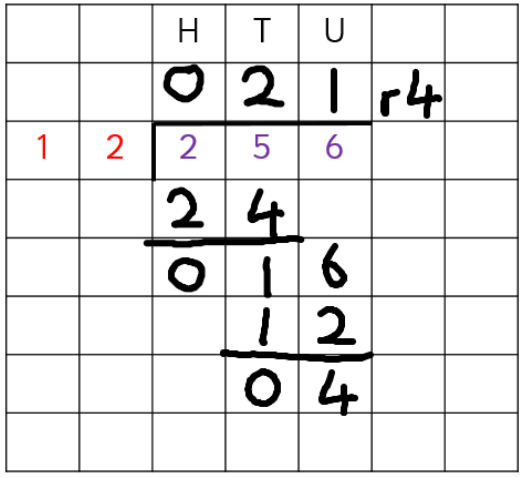
Step 1

Punch (÷)
How many 12s in 2? = 0 (write above)
How many 12s in 25? = 2 (write above)



Step 2

Block (x)
2 x 12 = 24 (write below)
Slice (-)
Draw a line and do 25 – 24 = 1



Step 3

Bring it down (↓)
Bring the 6 down to make '16'
Punch (÷)
How many 12s in 16? = 1
Block (x)
1 x 12 = 12 (write below)
Slice (-)
Draw a line and do 16 – 12 = 4
How many 12s in 4? = You can't do it so 4 is the remainder

Representing remainders as fractions

		H	T	U		
		0	2	1		
1	2	2	5	6		
		2	4			
		0	1	6		
			1	2		
			0	4		

This example could be turned into a fraction by putting the remainder over the divisor
This could then be simplified as below

When the remainder is… $4 = \frac{4}{12} = \frac{1}{3}$

Answer = $21\frac{1}{3}$

Representing remainders as decimals

		H	T	U		
		0	1	7		
2	5	~~3~~	13	5		
		2	5			
		1	8	5		
		1	7	5		
		0	1	0		

Step 1
Follow the normal steps until the divisor can't fit

		H	T	U		
		0	1	7	.4	
2	5	~~3~~	13	5	.0	
		2	5			
		1	8	5		
		1	7	5		
		0	1	0	0	

Step 2
Now add a decimal point and a zero to the dividend as this does not change the value of the dividend
Then bring the zero down to make 100
How many 25s in 100? = 4
Answer = 17.4

Use ‘formal written method’ for multiplying a decimal number by a whole number e.g. 3.7 x 6

	T	U .	$\frac{1}{10}$	
		3 .	7	
x		6 .		
	2	2 .	2	
		4		

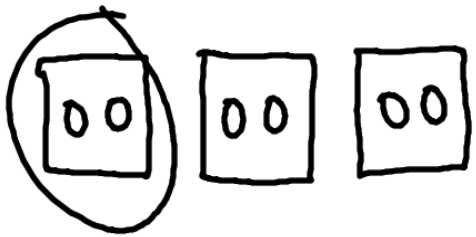
Remember to line up the decimal point
Use your ‘place value rules’

Fractions, Decimals and Percentages

Y1 Y2

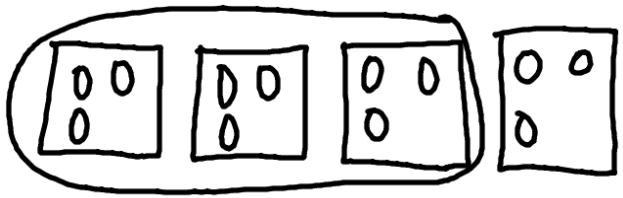
Finding a $\frac{1}{2}, \frac{1}{4}, \frac{2}{4}, \frac{3}{4}, \frac{1}{3}$ of a quantity

$\frac{1}{3}$ of 6 = ?



Look at the denominator and draw that many squares
Share out the whole number
Look at the numerator and circle that many squares
Answer = 2

$\frac{3}{4}$ of 12 = ?



Look at the denominator and draw that many squares
Share out the whole number
Look at the numerator and circle that many squares
Answer = 9

Y3

Adding and subtracting fractions with the same denominator within one whole

$$\frac{2}{4} + \frac{1}{4} = \frac{3}{4}$$

Add the numerators
Denominators stay the same

$$\frac{7}{8} - \frac{4}{8} = \frac{3}{8}$$

Subtract the numerators
Denominators stay the same

Y4

I can find fractions of quantities or objects with larger denominators

$\frac{3}{7}$ of 21 = ?

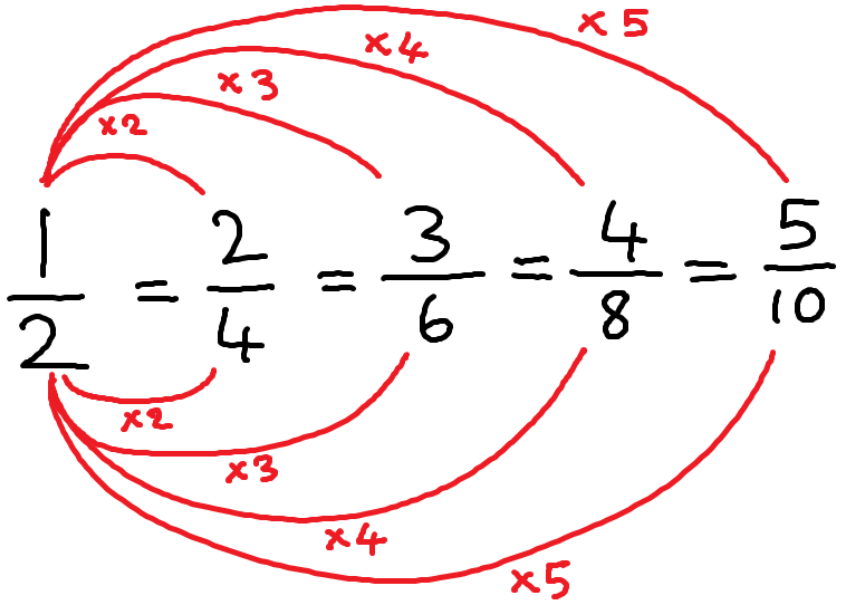
$21 \div 7 = 3$

Step 1
Divide the number by the denominator (bottom)

$3 \times 3 = 9$

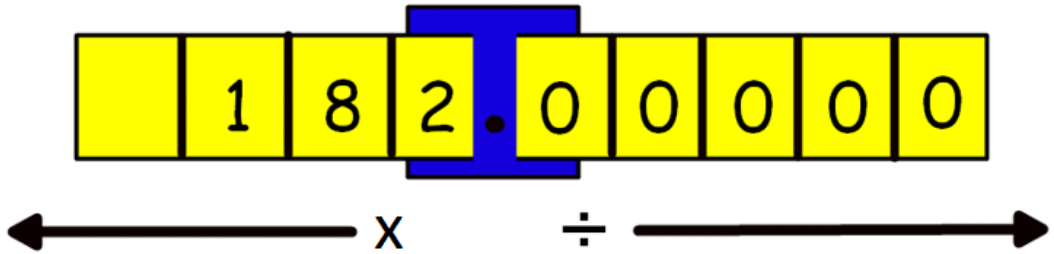
Step 2
Then times by the numerator (top)

Recognising and showing families of equivalent fractions by multiplying denominators and numerators by the same number



You are finding all the equivalent fractions by multiplying the numerator and denominator by the same number
* Remember, whatever you do to the top, you do to the bottom

Multiplying and dividing a decimal number by 10 and 100



Simple Steps

Remember to move the number, not the decimal point (multiply = Left and divide = Right)

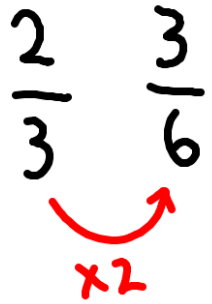
If multiplying or dividing by 10 = move the number 1 place

If multiplying or dividing by 100 = move the number 2 places

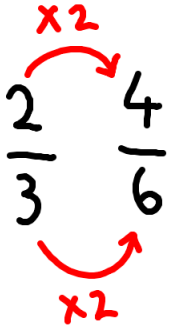
Y5

Comparing and ordering fractions whose denominators are all multiples of the same number

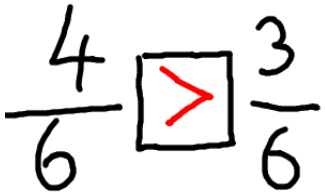
Which fraction is bigger $\frac{2}{3}$ or $\frac{3}{6}$?



Step 1
Make the denominators the same.
Does the smaller denominator go into the larger one?
How many times? Answer = 2



Step 2
Multiply the smaller denominator by that number (x2)
Whatever you do to the bottom, you do to the top
so multiply the numerator by the same number (x2)



Step 3
Now you can compare and/or order
The larger the numerator, the larger the fraction

Converting between improper fractions and mixed numbers

Converting the improper fraction $\frac{23}{8}$ into a mixed number

$\frac{23}{8}$ $= 2\frac{\ }{8}$

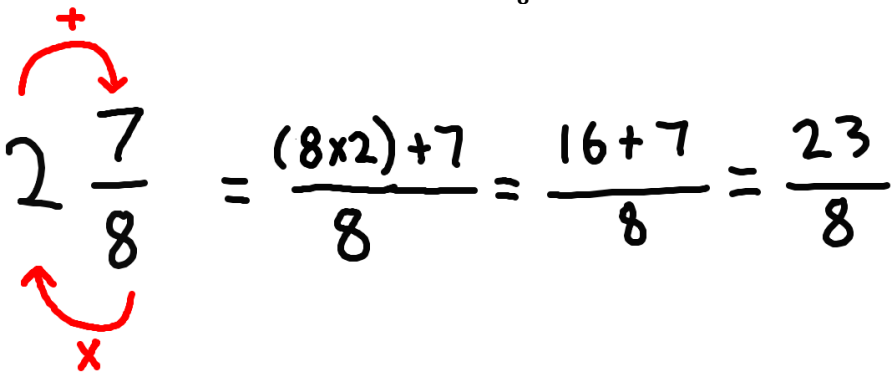
Step 1
How many times does 8 go into 23? Answer = 2 (this is your whole number)

Step 2
Write your whole number then your denominator (8) and draw the line above it

$= 2\frac{7}{8}$

Step 3
What is your remainder from 8 going into 23? Answer = 7
This becomes your numerator. So… $\frac{23}{8} = 2\frac{7}{8}$

Converting the mixed number $2\frac{7}{8}$ to an improper fraction



Step 1
The denominator always stays the same

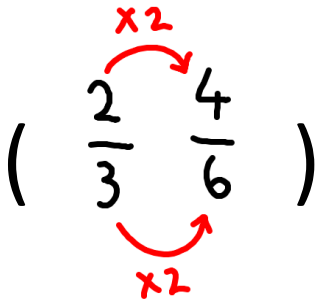
Step 2
x denominator by the whole number
(8 x 2)

Step 3
+ the numerator
(+ 7)

Adding and subtracting fractions whose denominators are multiples of the same number

$$\frac{2}{3} + \frac{1}{6} =$$

$\frac{2}{3} + \frac{1}{6} =$



$\frac{4}{6} + \frac{1}{6} =$

Step 1
Make the denominators the same.
Does the smaller denominator go into the larger one?
How many times? Answer = 2

Step 2
Multiply the smaller denominator by that number.
(3 x 2 = 6)
Whatever you do to the bottom, you do to the top so multiply the numerator by the same number (2).
(2 x 2 = 4)

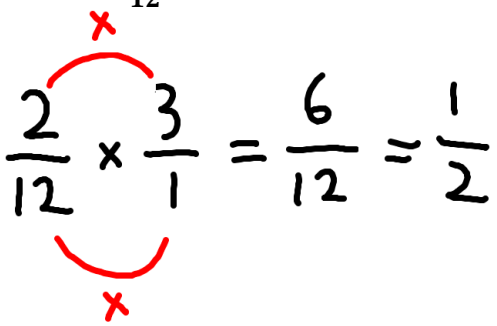
$\frac{4}{6} + \frac{1}{6} = \frac{5}{6}$

Step 3
Now add the numerators together
(4 + 1 = 5)

Multiplying proper and improper fractions by whole numbers

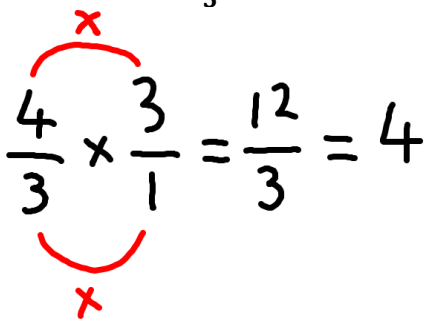
Proper

$\frac{2}{12}$ **x 3 = ?**



Improper

$\frac{4}{3}$ **x 3 = ?**

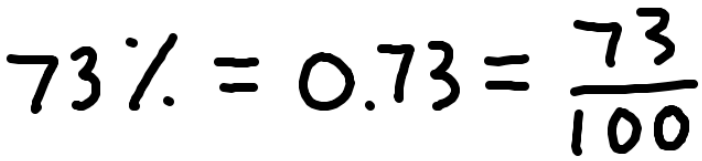


Step 1
Write the whole number as a fraction (put the whole number over 1)

Step 2
Multiply the numerators and denominators together

Step 3
Simplify

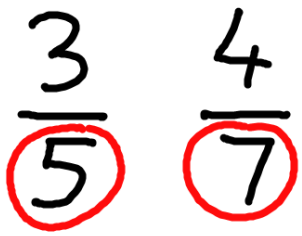
Converting between fractions, decimals and percentages whose denominators are factors of 100



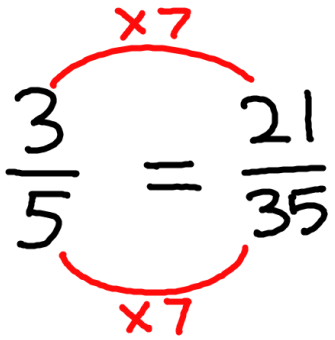
Y6

Comparing and ordering fractions using common multiples

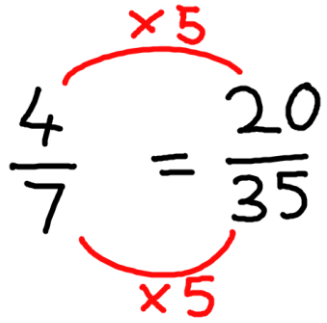
Which fraction is bigger $\frac{3}{5}$ or $\frac{4}{7}$?



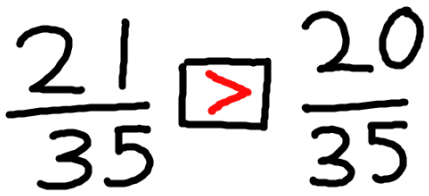
Step 1
Look at the 2 numerators.
Using the 5 and 7 x tables, find a number that appears in both x tables (common multiple) = 35



Step 2
What do you have to times 5 by to get 35? = 7
If you do it to the bottom, you do it to the top
So 3 x 7 = 21



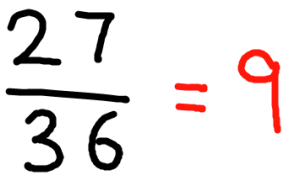
Step 3
Repeat ‘Step 2’ with the other fraction



Step 4
Compare or order the fractions
The larger the numerator, the larger the fraction

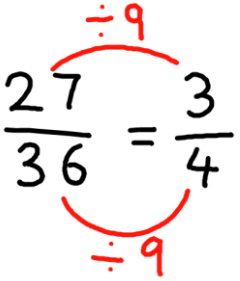
Using common factors to simplify fractions

Simplify $\frac{27}{36}$



Step 1

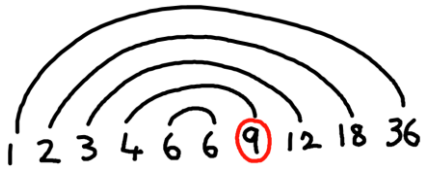
Use your x tables. What is the largest common factor (the largest number) that goes into both the numerator and denominator? = 9



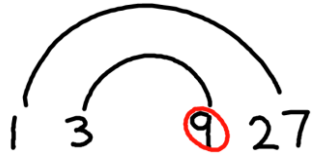
Step 2

Divide the numerator and denominator by the largest common factor (9)

To help with finding the **largest** common factor you could use the 'factor pair rainbow'.



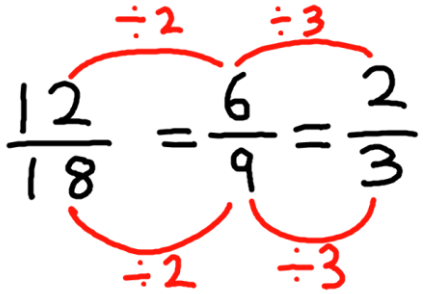
Ask yourself, does 1 go into 36? Answer: yes, 36 times
Ask yourself, does 2 go into 36? Answer: yes, 18 times
Continue until you can't go any further



Ask yourself, does 1 go into 27? Answer: yes, 27 times
Ask yourself, does 2 go into 27? Answer: No
Continue until you can't go any further

The largest common factor is 9 as it appears in both

* Tip: If both numbers are even, divide them both by 2 to make things easier and then follow step 1 and 2



Adding and subtracting mixed numbers where one denominator is a multiple of the other

$$1\frac{2}{3}+2\frac{1}{6}=$$

$$\frac{2}{3}+\frac{1}{6}=$$

$$\left(\frac{2}{3}\ \ \frac{4}{6}\right)$$

x2 x2

$$\frac{4}{6}+\frac{1}{6}=$$

Step 1
Make the denominators the same.
Does the smaller denominator go into the larger one?
How many times? Answer = 2

Step 2
Multiply the smaller denominator by that number.
(3 x 2 = 6)
Whatever you do to the bottom, you do to the top so multiply the numerator by the same number.
(2 x 2 = 4)

$$\frac{4}{6}+\frac{1}{6}=\frac{5}{6}$$

$$3\frac{5}{6}$$

Step 3
Now add the numerators together
(4 + 1 = 5)

Step 4
Add the whole numbers together (1 + 2 = 3)
Then add them to the fraction

*If your fraction is improper, convert to a mixed number and then add/take away

$$1\frac{9}{7}-\frac{3}{14}=$$

$$1\frac{9}{7}=2\frac{2}{7}=2\frac{4}{14}$$

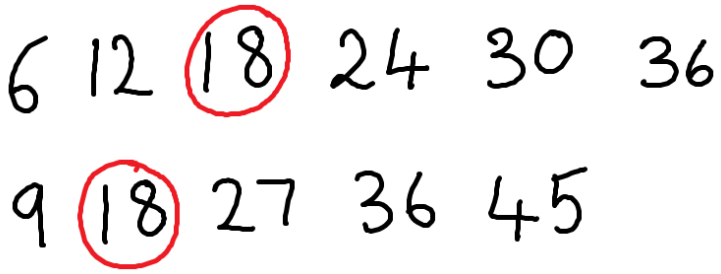
$$2\frac{4}{14}-\frac{3}{14}=2\frac{1}{14}$$

Convert improper fraction to mixed number
Make the denominators the same

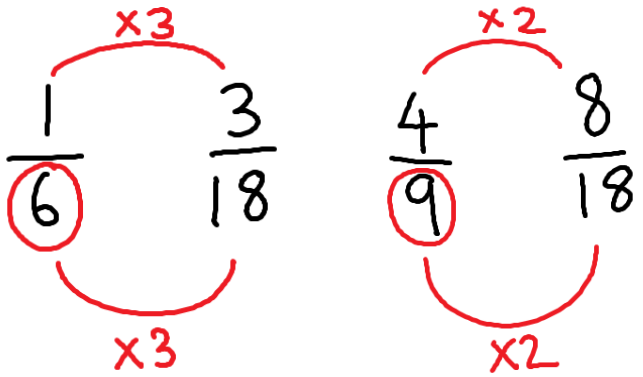
Then take away the remaining fraction

Adding and subtracting mixed numbers where lowest common denominator is required

$$2\frac{1}{6} + 3\frac{4}{9} =$$



Step 1
Find the common denominator by writing out the times tables for both denominators (6x and 9x)
Then find the smallest number that appears in both (= 18)



Step 2
Convert both fractions so the denominator is the same
6 x 3 = 18 (so times the top by 3) 9 x 2 = 18 (so times the top by 2)

$$\frac{3}{18} + \frac{8}{18} = \frac{11}{18}$$

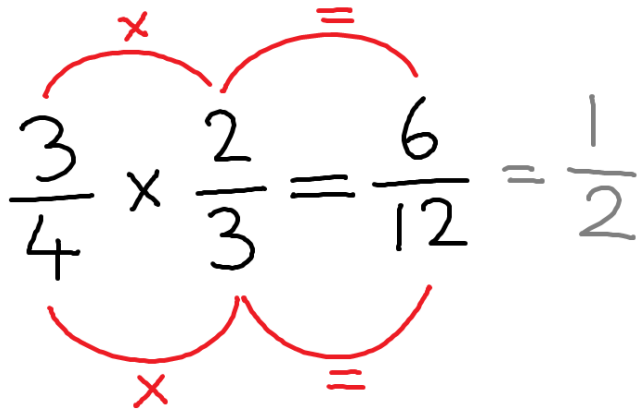
Step 3
Now the denominators are the same it is easy to add then together
Add the numerators but keep the denominators the same

$$2 + 3 = 5$$
$$5 + \frac{11}{18} = 5\frac{11}{18}$$

Step 4
Finally, add the whole number together and add the fraction
So $2\frac{1}{6} + 3\frac{4}{9} = 5\frac{11}{18}$

Multiplying proper fractions

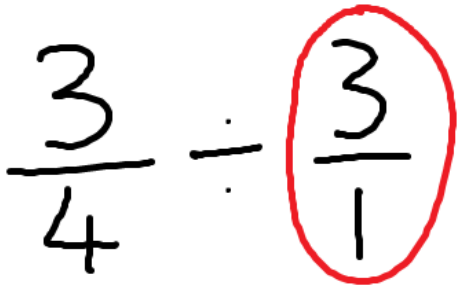
$\frac{3}{4} \times \frac{2}{3} =$



Simply multiply the numerators together and denominators together
Then simplify if necessary

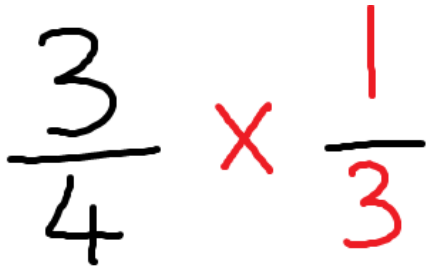
Dividing proper fractions by whole numbers

$\frac{3}{4} \div 3 =$



Step 1

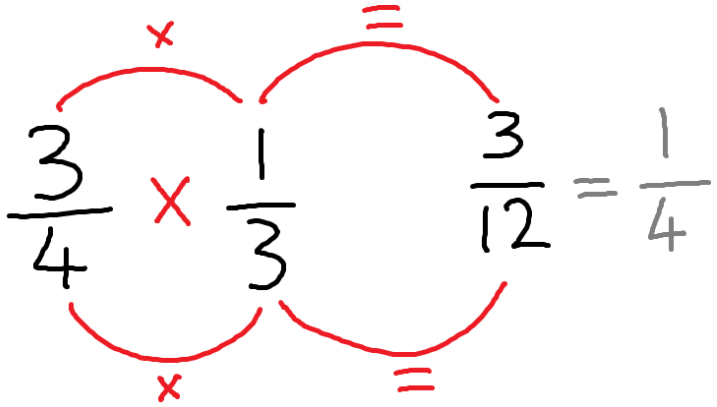
Write the whole number as a fraction = $\frac{3}{1}$



Step 2

Turn the ÷ into x and invert the second fraction.

Dividing by 3 is the same as finding a $\frac{1}{3}$ of a number. Therefore, to find a $\frac{1}{3}$ we multiply by a $\frac{1}{3}$



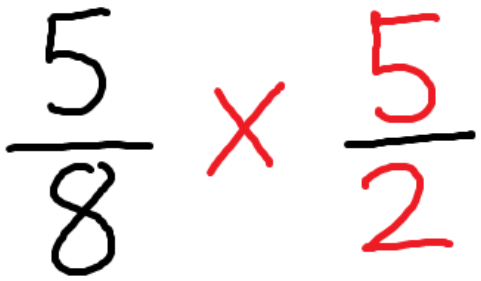
Step 3

Multiply the numerators together and the denominators together $\frac{3}{4} \times \frac{1}{3} = \frac{3}{12}$

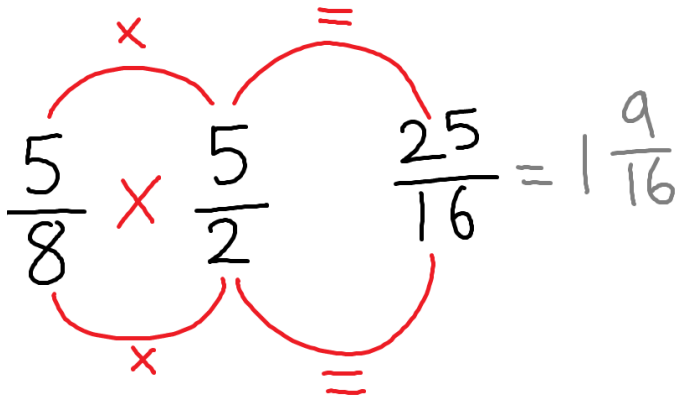
* Remember to simplify if necessary $\frac{3}{12} = \frac{1}{4}$

Dividing one fraction by another

$\frac{5}{8} \div \frac{2}{5} =$



Step 1
Turn the ÷ into x and invert the second fraction.



Step 2
Multiply the numerators together and the denominators together
* This is an improper fraction so convert it to a mixed number

Finding 25%, 50%, 75% and multiples of 10% of a quantity

Remember, percent means out of one hundred so 100 is our magic number.

Finding 50% of a number
50% of 120 =

$120 \div 2 = 60$

There are two 50s in 100 so divide your number by 2.

Finding 25% of a number
25% of 160 =

$160 \div 4 = 40$

There are four 25s in 100 so divide your number by 4.

Finding 75% of a number
75% of 50 =

$50 \div 2 = 25$
$50 \div 4 = 12.5$
37.5

Find 50% of your number.
Then find 25% of your number then add them together.

Finding 10% of a number
10% of 190 =

$190 \div 10 = 19$

There are ten 10s in 100 so divide your number by 10.

Finding 5% of a number
5% of 70 =

$70 \div 10 = 7$
$7 \div 2 = 3.5$

Find 10% then halve it.

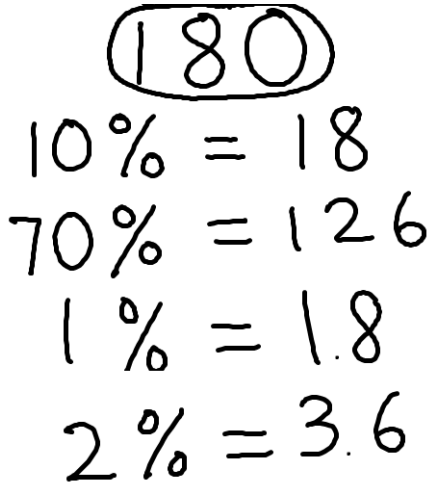
Finding multiples of 10% of a quantity
20% of 60 =

$60 \div 10 = 6$
$6 \times 2 = 12$

Find 10% then multiply by the multiple of 10.
To find 70%, find 10% and multiply by 7/To find 30%, find 10% and multiply by 3

Finding any percent of a quantity by dividing by 100 first

72% of 180 =



Find 10% then multiply by 7 to find 70%
To find 1% you need to divide the number (180) by 100 (as there are one hundred 1s in 100)
Then find 2% by multiplying 1% by 2
Then you need to add 70% and 2% together to find 72%
So 72% of 180 = 129.6

* If you have a calculator you simply need to find 1% and multiply it by the percentage you need to find.