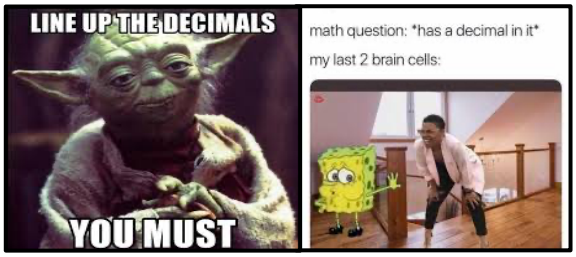
Adding And Subtracting Decimals



The steps below will make more sense once you look at them in conjunction with the examples below.

Step 1: We use the basic column method to start off
(Note: If you are not familiar with column method see my basic addition and subtraction cheat sheet before you go any further).
We must make sure to line up the decimals (the decimal point must line up with the decimal above it).
The reason we must line up the decimals is to line up the place values

Step 2: Fill in any gaps with zeros

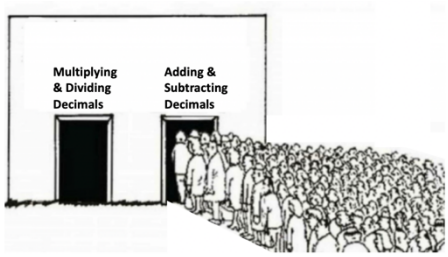
Step 3: Add or subtract as normal (making sure the decimal point in the answer also lines up with the decimals above it).

Let's see how these steps work with 3 examples

Example 1	Example 2	Example 3
$2.04 + 3.2$	$51.8 + .425$	$8 - 2.04$
Step 1: Turn into a column and line up the decimals $\begin{array}{r} 2.04 \\ +\ 3.2 \\ \hline \end{array}$	**Step 1:** Turn into a column and line up the decimals $\begin{array}{r} 51.8 \\ +\ .425 \\ \hline \end{array}$	**Step 1:** Turn into a column and line up the decimals Note: 8 is a whole number. The decimal is "hiding" at the end of a whole number, so we put it after the 8. $\begin{array}{r} 8. \\ -\ 2.04 \\ \hline \end{array}$
Step 2: Fill in any gaps with zeros and then add as normal $\begin{array}{r} 2.04 \\ +\ 3.20 \\ \hline \end{array}$	**Step 2:** Fill in any gaps with zeros and then add as normal $\begin{array}{r} 51.800 \\ +\ 00.425 \\ \hline \end{array}$	**Step 2:** Fill in any gaps with zeros and then subtract as normal $\begin{array}{r} 8.00 \\ -\ 2.04 \\ \hline \end{array}$
Step 3: We now add $\begin{array}{r} 2.04 \\ +\ 3.20 \\ \hline 5.24 \end{array}$	**Step 3:** We now add $\begin{array}{r} 51.800 \\ +\ 00.425 \\ \hline 52.225 \end{array}$	**Step 3:** We now subtract $\begin{array}{r} 8.00 \\ -\ 2.04 \\ \hline 5.96 \end{array}$

Multiplying Decimals

We <u>DO NOT</u> line up the decimals when multiplying



Again, the steps below will make more sense once you look at them in conjunction with the examples below.

Step 1: Ignore the decimal (multiply using the column method as if there is no decimal)
(Note: If you are not familiar with column multiplication see my basic multiplication cheat sheet before you go any further).

Step 2: Next, count the number of digits after the decimal in **EACH** of the numbers

Step 3: Start at the end of the number found in step 1 and go back (move to the left) by the number of decimals counted in step 2.
Where you end up is where the new decimal goes.

Let's look at 2 examples

Example 1
1.30×85

Step 1: Ignore the decimal (multiply as if there is no decimal)

$$1.30 \times 85$$

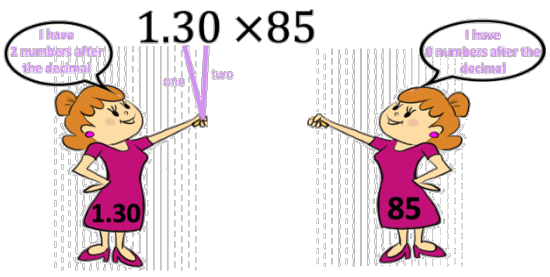
Without any decimals this becomes

$$130 \times 85$$

We now do the resulting calculation

$$130 \times 85 = 11050$$

Step 2: Next, count the number of digits after the decimal in **EACH** number.



There are 2 digits in total after the decimals

Step 3: Start at the end of the number found in step 1 and go back (move to the left) by the number of digits counted in step 2.
Where you end up is where the new decimal goes.

This gives our answer

$$110.50$$

We can write this as 110.5

Example 2
2.18×5.4

Step 1: Ignore the decimal (multiply as if there is no decimal)

$$2.18 \times 5.4$$

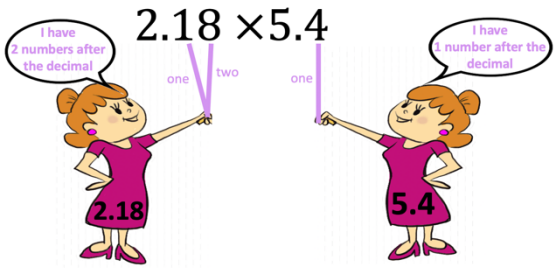
Without any decimals this becomes

$$218 \times 54$$

Now we now do the resulting calculation

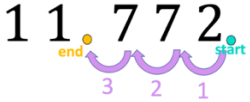
$$218 \times 54 = 11772$$

Step 2: Next, count the number of digits after the decimal in **EACH** number



There are 3 digits in total after the decimals

Step 3: Start at the end of the number found in step 1 and go back (move to the left) by the number of digits counted in step 2.
Where you end up is where the new decimal goes.

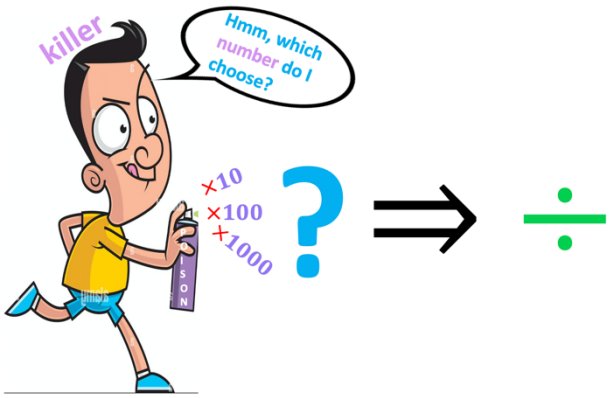


This gives our answer

$$11.772$$

Dividing Decimals

We get rid of ("kill") the decimals by multiplying each number by 10 or 100 or 1000 etc (we need to decide which is the correct one of these to choose) and then do the resulting division.



Step 1: Decide what number to multiply by
We must make sure to multiply by the correct number above, not just any of the numbers!
We base this on wanting to get rid of ("kill") BOTH decimals

Step 2: Do the multiplication to both numbers

Step 3: Do the resulting division (this calculation will have no decimals in it)

See my multiplying/dividing by 10, 100, 1000 cheat sheet before you go further if you struggle with how to multiply by 10, 100, 100 etc.

Let's look at the steps in more detail:

Step 1:

How do we know which correct number to choose out of 10, 100 or 1000? First of all we must realise that

- If there is 1 number after the decimal we need to multiply by 10 to kill the decimal
- If there are 2 numbers after the decimal we need to multiply by 100 to kill the decimal
- If there are 3 numbers after the decimal we need to multiply by 1000 to kill the decimal
  etc

We choose the number that will kill BOTH decimals when we multiply by it.
For example,
For $4.2 \div 2.2$. If we multiply both numbers by 10, both of the decimals will disappear.
However, for $1.24 \div 0.2$, multiplying by 10 will not get rid of the decimal in 1.24, so we need to multiply both numbers by 100 instead to get rid of both decimals

Step 2:

Let's recall how we multiply by 10, 100, 1000 etc. The number of zeros tells us how many places we should move the decimal to the **right.**
For example,

- multiplying by 10 moves the decimal one place to the right
- multiplying by 100 move the decimal 2 places to the right
- multiplying by 1000 move the decimal 3 places to the right
  etc

Step 3:

Once the decimals are gone, we are now ready to do the resulting division which will give us the answer. We don't have to do anything else after unlike with multiplication where we put the decimals back after. See my basic division cheat sheet if you struggle with basic division.

Easy Example	Medium Example	Hard Example
Example 1: $315 \div 0.9$ $315 \div 0.9$ There is only 1 decimal here to worry about. Multiplying by 10 will kill the decimal in 0.9 We multiply **BOTH** numbers by 10 $3150 \div 9$ Now do the division as normal and we are done (see my basic division cheat sheet if you struggle with this step) 350 Note: we don't have to put back the decimal at the end like we did with multiplication	**Example 2:** $6.12 \div 0.003$ $6.12 \div 0.003$ Multiplying by 100 will kill the decimal in 6.12 and multiplying by 1000 will kill the decimal in 0.003 We want to multiply by a number that will kill BOTH decimals at the same time. This means we need to multiply by 1000 so that we kill BOTH decimals. Multiplying by 100 will not kill the decimal in 0.003. We multiply **BOTH** numbers by 1000 $6120 \div 3$ Now do the division as normal and we are done (see my basic division cheat sheet if you struggle with this step) 2040 Note: we don't have to put back the decimal at the end like we did with multiplication	**Example 3:** $1.24 \div 0.2$ $1.24 \div 0.2$ Multiplying by 100 will kill BOTH decimals. We multiply **BOTH** numbers by 100 $124 \div 20$ Now do the division as normal This division is a bit harder to do. This is fine though. If we write it as a fraction first, we can simplify first in order to make the numbers smaller and then divide $\frac{124}{20} = \frac{62}{10} = \frac{31}{5}$ Now that the numbers are more manageable we can easily do the division using short division (see my basic division cheat sheet if you struggle with this) 6.2

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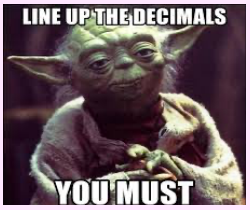
Summary Chart:

Adding & Subtracting



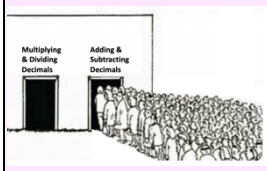
Step 1: Turn into column method and line up the decimals

Step 2: Fill in any gaps with zeros

Step 3: Add or subtract as normal

$2.04 + 3.2$	$51.8 + .425$	$8 - 2.04$
2.04 $+\ 3.20$ 5.24	51.800 $+\ 00.425$ 52.225	8.00 $-\ 2.04$ 5.96

Multiplying



Unlike with adding/subtracting, we DO NOT line up the decimals this time.

Step 1: Completely ignore the decimals, so write the numbers as they would look without the decimal. For example,
2.3 and 2.52 look like 23 and 252 without the decimals
0.002 and 0.34 look like 2 and 34 without the decimals

Step 2: Do the multiplication as you normally would for any whole numbers

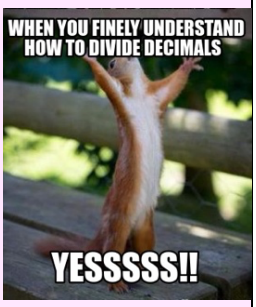
Step 3: Count how many digits you have after the decimal for EACH number
For example,
2.4 has 1 digit after the decimal
2.42 has 2 digits after the decimal
23.0002 has 4digits after the decimal

Step 4: Add the number of digits from step 3 together to get the total number of digits after the decimal. For example,
4.23 and 2.8 have 3 digits in total after the decimal

Step 5: Start at the end of the number that you found in step 2 (since this is where the decimal is for a whole number) and move to the left by the total number of places found in step 4. Put the decimal where you end up.

2.4×2	1.2×4.2
Ignoring the decimal: Our numbers are 24 and 2 24 $\times\ 2$ 48 2.4 has 1 digit after the decimal 2 has no places after the decimal So, in total we only have 1 digit Start at the end of 48: 48. Move 1 place to the left 4.8 The answer is 4.8	Ignoring the decimal: Our numbers are 12 and 42 12 $\times\ 42$ 24 $+\ 480$ 504 1.2 has 1 digit after the decimal 4.2 has 1 digit after the decimal So, in total we only have 2 digits Start at the end of 504: 504. Move 2 place to the left 5.04 The answer is 5.04

Dividing



We treat division of decimals completely differently multiplying! We don't count the decimals, nor do we put them back at the end. Once we get rid of them in step 2 below, we don't worry about them anymore.

Step 1: Write the division as a fraction. You can do this since $a \div b$ means the same thing as $\frac{a}{b}$. Hence $a \div b = \frac{a}{b}$. For example,
$0.42 \div 0.5 = \frac{0.42}{0.5}$

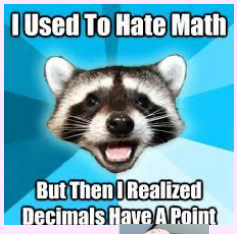
Step 2: We want to get rid of the decimal from BOTH numbers (numerator and denominator). To do this we must choose a number (10,100, 1000 etc) that will get rid of ("kill") both decimals when we multiply by it. It should make sense that we have to multiply BOTH as otherwise the result would not be an equivalent fraction. You should already know that the number of zeros in the number that we multiply by tells us how many places we should move the decimal to the **right**).
For example, $\frac{4.2}{2.2}$. We will need to multiply both the numerator and denominator by 10 which gives $\frac{42}{22}$.
However, for $\frac{1.24}{0.2}$, multiplying by 10 will not get rid of the decimal in the numerator, so we need to multiply both numbers by 100 instead to get rid of both decimals and we end up with $\frac{124}{20}$

Step 3: Simplify/cancel down the fraction (if possible). This is important to make the numbers more manageable.
For example, $\frac{128}{20}$. Simplifying this fraction gives $\frac{64}{10} = \frac{32}{5}$. It is obvious that $\frac{32}{5}$ is easier to deal with than $\frac{128}{20}$.

Step 4: This next step is about turning a fraction into a decimal, so if you're not comfortable with doing this see the row below "Fraction to decimal."

$0.4 \div 0.2$	$0.022 \div 0.2$	$0.038 \div 0.4$	$0.24 \div 0.44$
Write as a fraction $\frac{0.4}{0.2}$ Multiply numerator and denominator by 10 to get rid of the decimals $\frac{4}{2}$ Simplify the fraction $\frac{2}{1}$ $= 2$ Note: We didn't need to simplify $\frac{4}{2}$ first as its obvious that it is just 2 since 2 goes into 4 nicely	Write as a fraction $\frac{0.022}{0.2}$ Multiply numerator and denominator by 1000 to get rid of the decimals $\frac{22}{200}$ Simplify the fraction $\frac{11}{100}$ It is now easy to turn this fraction into a decimal. (see type 1 below if stuck) $11 \div 100 = 0.11$	Write as a fraction $\frac{0.038}{0.4}$ Multiply numerator and denominator by 1000 to get rid of the decimals $\frac{38}{400}$ Simplify the fraction $\frac{19}{200}$ To turn this fraction into a decimal we write as an equivalent fraction over 100 to turn into a decimal easily (see type 2 below if stuck) $\frac{9.5}{100}$ $= 9.5 \div 100$ $= 0.095$	Write as a fraction $\frac{0.24}{0.44}$ Multiply numerator and denominator by 100 to get rid of the decimals $\frac{24}{44}$ Simplify the fraction $\frac{12}{22} = \frac{6}{11}$ It is not so easy to turn this fraction into a decimal (see type 3 below if stuck) We must use short division $11\overline{)6}$ $11\overline{)6.0000}$ (0.5454) $0.\dot{5}\dot{4}$

Fraction to Decimal



There are 3 Types of questions that can come up.

Type 1: Easy
The fraction is already over 10, 100, 100 etc. This is easy since $\frac{a}{b}$ means $a \div b$ and you should already know how to divide by 10, 100, 1000 etc. The number of zeros tells us how many places we should move the decimal to the left. For example, dividing by 10 just means moving the decimal one place to the left, dividing by 100 means moving the decimal 2 places to the left etc
e.g. $\frac{2}{100} = 2 \div 100 = 0.02$

Type 2: Medium
The fraction is not over 10,100, 1000 etc, but you can write as an equivalent fraction over 10,100,1000 etc and then it becomes type 1 above.
e.g. $\frac{2}{5} = \frac{4}{10} = 4 \div 10 = 0.4$
Note: If you struggle with equivalent fractions see the cheat sheet called fraction rules

Type 3: Hard
The fraction is not over 10,100, 1000 etc and you CANNOT write as an equivalent fraction over 10,100,100 etc. We must then use short division instead using the fact that $\frac{a}{b}$ is the same as $b\overline{)a}$

Always remember that $\frac{a}{b}$ and $b\overline{)a}$ mean the same thing!

Careful not to divide the wrong way around. Notice that the numerator goes underneath: $\frac{a}{b} = b\overline{)a}$ and then we continue with the division

Example: Type 2

$\frac{3}{20}$

We can write as an equivalent fraction over 100 or over 10
Let's do both ways

If write over 100 (easier)	If write over 10 (harder)
$\frac{3}{20} = \frac{?}{100}$ We need to multiply 20 by 5 to get 100 so we multiply 3 by 5 which is 15 $\frac{15}{100}$ This means $15 \div 100$ Dividing by 100 means we need to move 2 places to the left 15 is the same a writing 15. so moving two places to the left gives 0.15	$\frac{3}{20} = \frac{?}{10}$ We need to divide 20 by 2 to get 10 so we divide 3 by 2 which is 1.5 $\frac{1.5}{10}$ This means $1.5 \div 10$ Dividing by 10 means we need to move 1 place to the left. moving one place to the left on the number 1.5 gives 0.15

Example: Type 3

$\frac{5}{11}$

We can't write this over 10 or 100 etc
Use short division instead:
Set up as: $11\overline{)5}$
Remember we might need to fill in the decimal and any extra zeros that we need after when doing the division

$11\overline{)5.0000}$ (0.4545)
$= 0.\dot{4}\dot{5}$

Exercises

Multiplication

1) 4×0.5
2) 2.4×0.2
3) 0.002×1.4
4) 9.2×1.2
5) 1.4×0.8
6) 0.02×1.3
7) 15×0.02
8) 1.42×0.3
9) 0.4×0.6
10) 0.02×0.006
11) 0.07×3
12) 0.01×0.05
13) 2.5×6
14) 0.11×0.4
15) 0.12×5
16) 2.01×0.07
17) 0.005×0.4
18) 5×0.25
19) 0.002×0.003
20) 3.20×0.0002
21) 1.22×0.52
22) 0.04×0.2
23) 52×0.8
24) 0.0022×0.002
25) 0.033×0.75
26) 0.4352196×0.3
27) 34.2×23
28) 3.458×0.6

Division

1) $12 \div 0.2$
2) $4.2 \div 0.3$
3) $0.4 \div 0.2$
4) $0.35 \div 0.5$
5) $19.2 \div 0.03$
6) $26 \div 0.4$
7) $5 \div 0.2$
8) $6.12 \div 0.003$
9) $0.035 \div 0.7$
10) $0.6 \div 0.04$
11) $0.04 \div 0.02$
12) $0.00828 \div 0.09$
13) $0.006 \div 0.0015$
14) $0.056 \div 0.04$
15) $24 \div 5$
16) $7.8 \div 5$
17) $22.572 \div 9$
18) $0.08 \div 0.2$
19) $0.8 \div 0.002$
20) $0.24 \div 0.3$
21) $3.5 \div 0.5$
22) $1.5 \div 2$
23) $0.24 \div 0.3$
24) $0.8 \div 0.002$
25) $10.2 \div 0.2$
26) $7.5 \div 0.5$
27) $8 \div 0.25$
28) $0.24 \div 0.0002$

Multiplication

a) 4x0.5
b) 2.4x0.2
c) 0.002x1.4
d) 9.2x1.2
e) 1.4x0.8
f) 0.02x1.3
g) 15x0.02
h) 1.42x0.3
i) 0.4x0.6
j) 0.5x0.06
k) 0.02x0.006
l) 0.07x3
m) 0.5x0.2
n) 0.1x0.4
o) 0.01x0.05
p) 1.4x1.2
q) 2.7x0.4
r) 3.5x2
s) 0.5x0.4
t) 2.5x6
u) 0.11x0.4
v) 0.26x0.3
w) 0.52x3
x) 0.12x5
y) 2.4x0.4
z) 4.8x5
aa) 5.5x0.12
bb) 2.01x0.07
cc) 0.005x0.4
dd) 0.305x0.3
ee) 5x0.25
ff) 0.45x2.2
gg) 1.42x0.4
hh) 1.5x0.7
ii) 0.2x0.3
jj) 0.002x0.003
kk) 3.20x0.0002
ll) 1.22x0.52
mm) 0.04x0.2
nn) 52×0.8
oo) 0.0022×0.00
pp) 0.54×0.88
qq) 0.033×0.75
rr) $0.0000005\times 0.00000002$
ss) 57x0.08
tt) $0.000000001\times 0.00000005$
uu) 0.4352196×0.3
vv) 34.2x23
ww) 0.005x0.62
xx) 3.458x0.6

Division

a) 12÷0.2
b) 4.2÷0.3
c) 0.4÷0.2
d) 0.35÷0.5
e) 19.2÷0.03
f) 26÷0.4
g) 5÷0.2
h) 6.12÷0.003
i) 0.035÷0.7
j) 0.6÷0.04
k) 0.04÷0.02
l) 0.00828÷0.09
m) 0.006÷0.0015
n) 0.056÷0.04
a) $24\div 5$ (leave answer as decimal)
b) $7.8\div 5$
c) $22.572\div 9$
d) $0.08\div 0.2$
e) $0.8\div 0.002$
f) $0.24\div 0.3$
g) $3.5\div 0.5$
h) $1.5\div 2$
i) $0.24\div 0.3$
j) $0.8\div 0.002$
k) $10.2\div 0.2$
l) $7.5\div 0.5$
m) $8\div 0.25$
n) $0.24\div 0.0002$