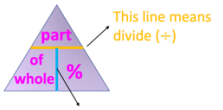
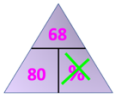
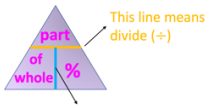
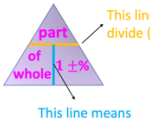
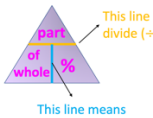
Type	Way 1: Pyramid	Way 2: Algebra	Way 3: Formulaic	Way 4:	Examples © mymathscloud
Type 1: One amount as a % of the other amount **(wants answer as a %)** **To help recognise:** **Look for the words:** **write "… as a percent(age) of …"** **OR** **write " … out of … " as a percentage** 	**Way 1:**  Cross off what you want and do the resulting operation (multiplication or division) 	**Way 2:** $\frac{\%}{100} = \frac{\text{part}}{\text{of whole}}$ Fill into what you know into the template above and call the unknown x (we are given part of the total and the whole/total amount and want to find the percent) Cross multiply and use algebra to solve for the unknown %	$\frac{\text{part}}{\text{whole}} \times 100$ There are 3 ways to simply this Option 1: write as $\frac{\text{part}}{\text{whole}} \times \frac{100}{1}$ and then multiply the fractions using fraction multiplication knowledge Option 2: simplify $\frac{\text{part}}{\text{whole}}$ first if possible, turn into a decimal and then multiply by 100 Option 3: Type straight into a calculator if allowed a calculator		**Paul got 68 out of 80 in a science test. Work out 68 out of 80 as a percentage** **Way 1:**  $\frac{68}{80} = 0.85 = 85\%$ **Way 2:** Part is 68 and whole is 80 $\frac{x}{100} = \frac{68}{80}$ Cross multiply $80x = 6800$ $x = \frac{6800}{80} = 85$ **Way 3:** $\frac{68}{80} \times 100$ Option 1: $\frac{68}{80} \times \frac{100}{1} = \frac{6800}{80} = \frac{680}{8} = \frac{340}{4}$ $= \frac{170}{2} = 85\%$ Option 2: $\frac{68}{80} = \frac{34}{40} = \frac{17}{20}$ Turn into a decimal using short division $20\overline{)17.00}$ 0.85 $0.85 \times 100 = 85\%$ Option 3: Type into a calculator $\frac{68}{80} \times 100 = 85\%$
Type 2: Find a percentage of an amount **To help recognise:** **Look for the words:** **" find % of …"** **75% of students are good at Math**  I belong to the rest 14%	**Way 1:**  Where % is the decimal form Where % is the decimal form i.e. $\frac{\%}{100}$ Cross off what you want and do the resulting operation (multiplication or division) 	**Way 2:** $\frac{\%}{100} = \frac{\text{part}}{\text{of whole}}$ Fill into what you know into the template above and call the unknown x (we are given the % and the whole/total amount and want to find part of the total) Cross multiply and use algebra to solve for the unknown "part"	**Way 3:** $\text{amount} \times \frac{\%}{100}$ There are 3 ways to simply this Option 1: write as $\frac{\text{amount}}{1} \times \frac{\%}{100}$ and then multiply using fraction multiplication knowledge Option 2: Turn $\frac{\%}{100}$ into a decimal and then multiply by the amount Option 3: Type straight into a calculator if allowed a calculator	**Way 4:** Find combinations of percentages and add them together Step 1: Find an easy percentage of the number such as 10% or 1%. Note: To find 10% we divide by 10 and to find 1% we divide by 100. Step 2: Think of a combination of percentages that add to make the percentage you're asked for. Note: We find these percentages by either multiplying or dividing what we got in step 1. Step 3: Add the percentages found in step 2	**900 people attended a festival. 16% of them were children. Work out the number of children at the festival** This question is asking us to find 16% of 900. **Way 1:**  $900 \times 0.16 = 144$ **Way 2:** Part is unknown and whole is 900 $\frac{16}{100} = \frac{x}{900}$ Cross multiply $100x = 14400$ $x = 144$ **Way 3:** $900 \times \frac{16}{100}$ Option 1: write as $\frac{900}{1} \times \frac{16}{100}$ $= \frac{14400}{100} = 144$ Option 2: $\frac{16}{100} = 0.16$ $0.16 \times 900 = 144$ Option 3: Type into calculator $\frac{16}{100} \times 900 = 144$ **Way 4:** We know that $100\% = 900$ Find an easy percentage like 10% (divide by 10) $10\% = 90$ We need a combination that adds up to 16% 10% +5%+1% So, let's find 5% and 1% now $10\% = 90$ $(\div 2)$ $5\% = 90 \div 2 = 45$ $(\div 5)$ $1\% = 90 \div 10 = 9$ $16\% = 90 + 45 + 9 = 144$
Type 3: Increase/decrease an amount by a % 	**Way 1:**  Where % is the decimal form i.e. $\frac{\%}{100}$ Notice the 1 ± in the bottom right box for this type since we are increasing/decreasing. Use + if increase − if decrease 	**Way 2:** $\frac{100 \pm \%}{100} = \frac{\text{part}}{\text{of whole}}$ Fill into what you know into the template above and call the unknown x (we are given the % and the whole/total amount and want to find the part of the total amount) Use: + if increase − if decrease Notice the 100+% in the numerator now, not just % like the 2 types before. We use ± since we increase or decrease. Cross multiply and use algebra to solve for the unknown "part"	**Way 3:** $\text{amount}\left(1 \pm \frac{\%}{100}\right)$ Use: + if increase − if decrease Note: The reason we have 1 is because it is the "decimal form" of 100% $\frac{100}{100} = 1$ So, we could have also written: $\text{amount}\left(\frac{100}{100} \pm \frac{\%}{100}\right)$	**Way 4:** Find the percent using any of the 4 ways in the row above and then add or subtract it on	**The price of a TV was £80. The price increases by 15%. Work out the new price of the TV?** **Way 1:**  This is an increase hence we use a + sign $80\ (1 + 0.15) = 92$ **Way 2:** Part is unknown and whole is 900 $\frac{100+15}{100} = \frac{x}{80}$ $\frac{115}{100} = \frac{x}{80}$ Cross multiply $100x = 9200$ $x = 92$ **Way 3:** $80\left(1 + \frac{15}{100}\right)$ $= 92$
Type 4: Reverse Percentage **Given % of an amount, find the full amount** This is the direct reverse of type 2. Here we are basically given the answer to type 2 and want to work backwards to work out the total amount (i.e. given the answer to type 2 and want to work out the amount we took the percentage of) 	**Way 1:**  Where % is the decimal form i.e. $\frac{\%}{100}$ Cross off what you want and do the resulting operation (multiplication or division) 	**Way 2:** $\frac{\%}{100} = \frac{\text{part}}{\text{of whole}}$ Fill into what you know into the template above and call the unknown x (we are given the % and part of the total i.e. given the amount after the percentage has been taken and want to find the whole amount/total amount BEFORE the percentage was taken) Cross multiply and use algebra to solve for the unknown "of whole" © mymathscloud	**Way 3:** $\frac{\text{amount}}{\frac{\%}{100}}$ This should make sense that we divide here, since it is the opposite type 2 and division is the opposite of multiplication	**Way 4:** Step 1: set the percent equal to the amount that you are given Step 2: Build back up to 100% (the full amount by multiplying or dividing only)	**Paul got 75 marks in a maths test. 75 is 30% of the total marks. Work out the total number of marks** This question is telling us what 30% represents and asking us to find what the full amount was (i.e.100%) is. **Way 1:**  $\frac{75}{0.30} = 250$ **Way 2:** $\frac{30}{100} = \frac{75}{x}$ Cross multiply $30x = 7500$ $x = 250$ **Way 3:** $\frac{75}{\frac{30}{100}}$ $75 \div \frac{30}{100} = 75 \times \frac{100}{30}$ $= \frac{7500}{30} = 250$ **Way 4:** Given $30\% = 75$ We want to build back to 100% $(\div 3)$ $10\% = 75 \div 3$ $= 25$ We multiply by 10 to find 100% $100\% = 25 \times 10 = 250$

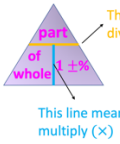
Type 5: Reverse percentage

Given % of an amount after an increase or decrease and want find the original/full amount

To help recognise:
Look for the words: "originally/at the beginning/before…"

This is the reverse of type 3. Here we are basically given the answer to type 3 and want to work backwards to work out the total amount (i.e. we are given what the amount AFTER the percentage has been added or subtracted and want the original/full amount.

Way 1:



Where % is the decimal form i.e. $\frac{\%}{100}$

Notice the $1 \pm$ in the bottom right box for this type, like with type 2. Use

$+$ if increase
$-$ if decrease

Way 2:

$$\frac{100 \pm \%}{100} = \frac{\text{part}}{\text{of whole}}$$

Fill into what you know into the template above and call the unknown x (we are given the % and part of the total i.e. given the amount after the percentage has been added or subtracted and want to find the whole amount/total/ original amount BEFORE the percentage was added to or subtracted from the total)

Use:
$+$ if increase
$-$ if decrease

Notice the 100+% in the numerator now like with type 3 since we increase or decrease. (unlike types 1,2,4 where we just have the %)

Cross multiply and use algebra to solve for the unknown "of whole"

Way 3:

$$\frac{\text{amount}}{1 \pm \frac{\%}{100}}$$

Use:
$+$ if increase
$-$ if decrease

This should make sense that we divide here, since it is the opposite type 3 and division is the opposite of multiplication

Way 4:

Step 1:
Add/subtract the percent that you are given from 100% and set equal to the amount that you are given

Step 2:
Build back up to 100% (the full amount by multiplying or dividing only

Amanda has some pocket money. She spends 60% of it and is left with £6.00. How much money did she start off with?

This question is telling us what 40% represents and asking us to find what the full amount was (i.e. 100%) is.

Way 1:

This is an increase hence we use a $-$ sign

$$\frac{6}{1-0.60} = 15$$

Way 2:

$$\frac{100-60}{100} = \frac{6}{x}$$

$$\frac{40}{100} = \frac{6}{x}$$

Cross multiply

$$40x = 600$$

$$x = 15$$

Way 3:

$$\frac{6}{1-\frac{60}{100}} = 15$$

Way 4:

Spends 60% so we take this away from 100%

$$100\% - 60\% = 40\%$$

$$40\% = 6$$

We need to build back up to 100%
$(\div 2)$ $20\% = 3$
$(\times 5)$ $100\% = 15$

Type 6: Percentage gain/loss

(wants answer as a %)

To help recognise:
Look for the words: "percentage gain/ loss/ increase/ decrease"

Use the formula $\frac{\text{difference}}{\text{original}} \times 100$

There are 3 ways to simply this

Option 1:
write as $\frac{\text{difference}}{\text{original}} \times \frac{100}{1}$

And then multiply using fraction multiplication knowledge

Option 2:
simplify $\frac{\text{difference}}{\text{original}}$ first if possible and turn into a decimal before multiplying the 100

Option 3:
Type straight into a calculator if allowed a calculator
$\frac{60-54}{60} \times 100 = 10\%$

Nyali paid £60 for a bicycle. She sold is later for £54. What was her percentage loss?

$$\frac{60-54}{60} \times 100$$

Option 1:
write as

$$\frac{60-54}{60} \times 100$$

$$\frac{6}{60} \times \frac{100}{1} = \frac{3}{30} \times \frac{100}{1} = \frac{3}{3} \times \frac{10}{1} = 10\%$$

Option 2:

$$\frac{60-54}{60} = \frac{6}{60} = \frac{1}{10} = 0.1$$

$$0.1 \times 100 = 10\%$$

Option 3:

Type the following into a calculator

$$\frac{60-54}{60} \times 100 = 10\%$$

Type 7: Simple Interest

Look for the words: "simple interest"

Simple interest is based on the principal amount of a loan or deposit. You do not get interest on your interest, you only get interest on the original amount

You can memorise the formulae:

- Interest: = initial amount $\times \frac{\%}{100} \times$ time
- Future amount = initial amount + interest = initial amount + $\left(\text{initial amount} \times \frac{\%}{100} \times \text{time}\right)$

Note: Make sure time and % are same unit of time. It is easiest to edit the time to make sure it matches the % time

You are sometimes asked for time, initial amount or % for harder types of questions. You'll need to re-arrange to find these.

Example 1: Meg has £1200 in her savings account. The account pays 5% simple interest per year. How much **interest** will she earn in 4 years?

Example 2: Chris borrows £6000 at a simple interest rate of 10% per year. He pays the money back after 4 years. How much does he pay back in **total?**

Interest= $6000 \times \frac{10}{100} \times 4 = 2400$

6000+2400=8400

Example 3: Match units
Celine invests £800 for 5 **months** at 3% simple interest per year. Calculate the interest she receives.

Interest = amount x rate x time $= 800 \times \frac{3}{100} \times \frac{5}{12} = 10\%$

Example 4: Finding %
Neil invested £8000 in a savings account for 2 years. He earned £640 simple interest over the two years. What was the interest rate?

Type 8: Compound Interest

Look for the words: "compound interest" or "compounded"

Compound Interest is based on the principal amount and the interest that accumulates on it in every period. You DO get interest on your interest

You can memorise the formulae:

- Future amount = Initial Amount $\left(1 \pm \frac{\%}{100}\right)^t$
- Initial Amount = $\frac{\text{Future Amount}}{\left(1 \pm \frac{\%}{100}\right)^t}$
- Interest = Initial Amount $\left(1 \pm \frac{\%}{100}\right)^t$ − Initial Amount

i.e. subtract the initial amount from the future amount found

You are sometimes asked for time, initial amount or % for harder types of questions. You'll need to re-arrange to find these.

Note: Make sure t and % are the same unit of time.

Note: The formulae for future amount and initial amount are basically the same as for increasing/decreasing by a % and reverse percentage, except we now have a power of time since the percent is applied more than once (compounded)

Future Amount: $\text{amount}\left(1 \pm \frac{\%}{100}\right) \Rightarrow \text{amount}\left(1 \pm \frac{\%}{100}\right)^t$

Initial Amount: $\frac{\text{amount}}{1 \pm \frac{\%}{100}} \Rightarrow \frac{\text{Amount}}{\left(1 \pm \frac{\%}{100}\right)^t}$

More generally:

New amount = Initial amount $\left(1 + \frac{\%}{100 \times k}\right)^{kt}$ where k = number of times invest per 1 unit of time t

Yearly k=1
Biannually k=2
Quarterly k=4
Monthly k=12
Weekly k=52
Daily k=365

Continuously: $(\text{intial amount})e^{\frac{\%}{100}t}$

Example 1: Finding Future Amount (most common type)
Tony invests £3000 for 6 years at 4% per annum compound interest. How much money is in the account after 6 years?

$$3000\left(1 + \frac{4}{100}\right)^6 = £3{,}795.96$$

Example 2: Finding Future Amount (match units)
Henry places £6000 in an account which pays 4.6% compound interest **quarterly**. Calculate the amount in his account after 2 years.

$$6000\left(1 + \frac{4.6}{100 \times 4}\right)^{2\times4} = 6000\left(1 + \frac{4.6}{400}\right)^8 = £6{,}574.74$$

Example 3: Finding Interest
Susan places £7900 in an account which pays 2.4% compound interest per year. How much **interest** does she earn in 3 years?

New amount $= 7900\left(1 + \frac{2.4}{100}\right)^3 = £8482.56$

Interest= $£8482.56 - 7900 = £582.56$

Example 4: Finding Future Amount (repeated)
Liam invests £8000 in a savings account for 4 years. The savings account pays compound interest at a rate of 4.5% for the first year 2.75% for all subsequent years. Work out the value of Liam's investment at the end of 4 years

Example 5: Finding initial Amount
Spencer wants to save £10,000 for a holiday in 3 years' time. How much does he need to invest at 6.8% per annum compounded annually to make this happen?

$$x\left(1 + \frac{6.8}{100}\right)^3 = 10000$$

$$x(1.21819) = 10000$$

$$x = £8208.92$$

Note: Could have used the formula $\frac{\text{Future Amount}}{\left(1 \pm \frac{\%}{100}\right)^t} = \frac{10000}{\left(1 + \frac{6.8}{100}\right)^3} = £8208.92$

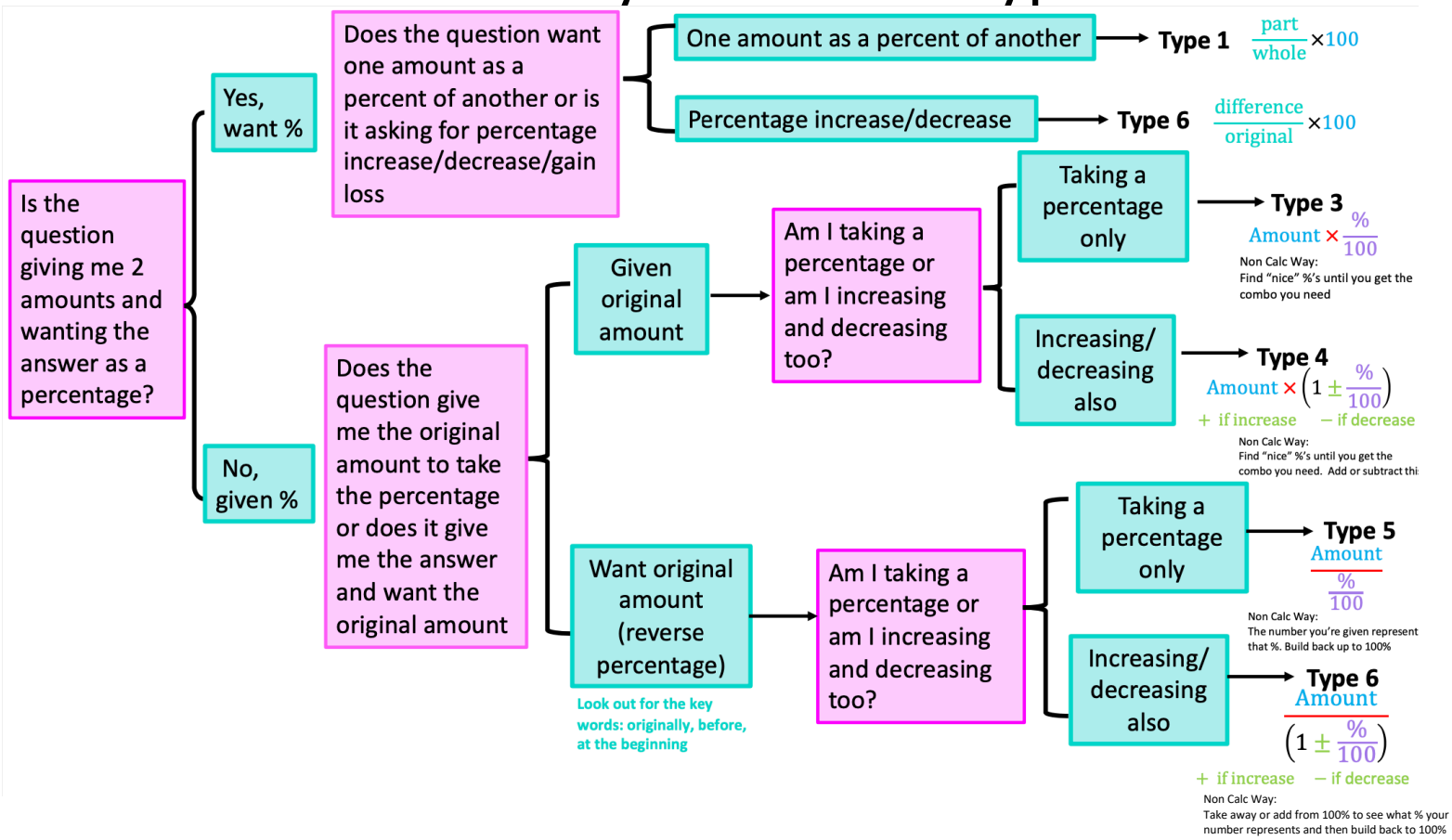
Example 6: Finding Time (use trial and error)
When Ruby invested £2800 at 4.5% per annum compounded annually, she earnt £1000 interest. How long was her money invested?

$$2800\left(1 + \frac{4.5}{100}\right)^t = 3800$$

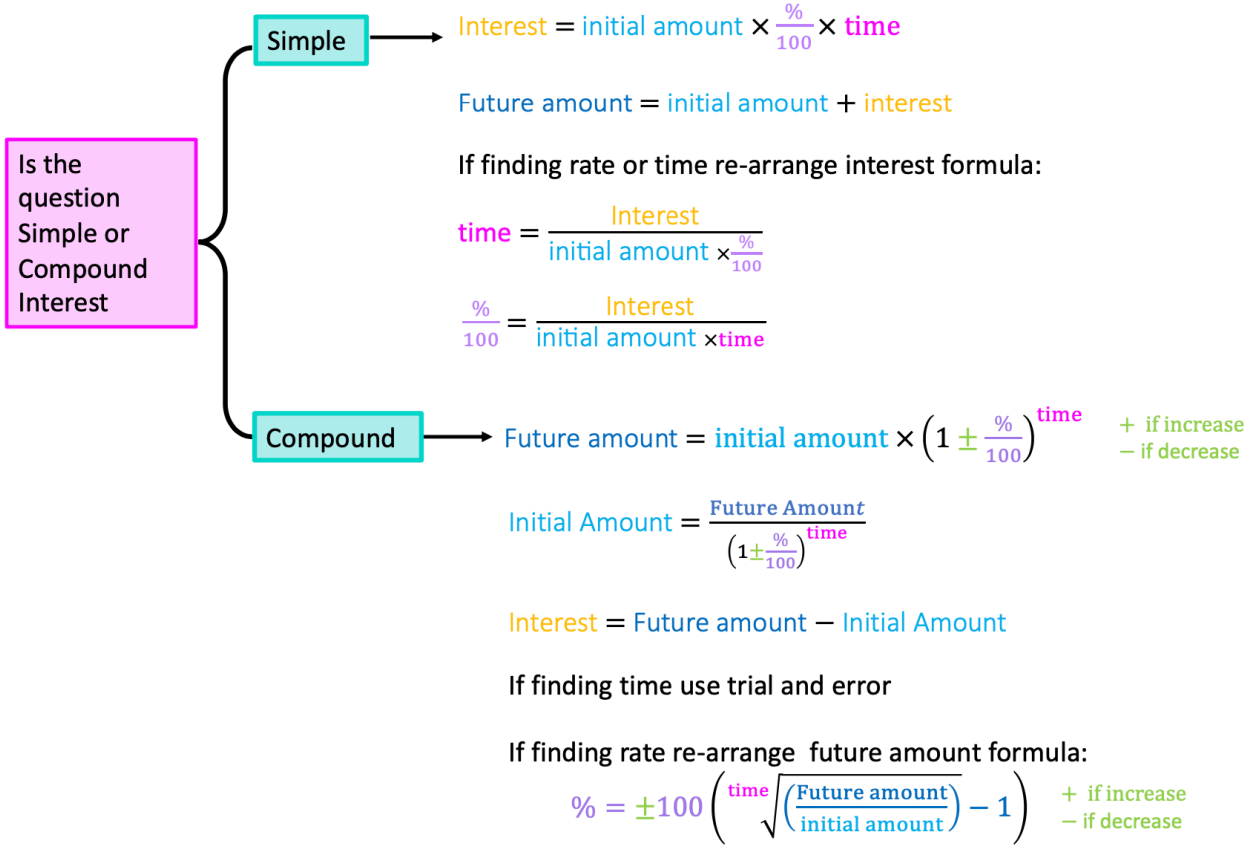
$$2800(1.045)^t = 3800$$

Try $t = 2$: $2800(1.045)^2 =$ too small
Try $t = 6$: $2800(1.045)^6 =$ too small
Try $t = 7$: $2800(1.045)^7 =$
Hence 7 years

Summary Of 6 Basic Types



Note: Simple and compound interest have not been included in the flow chart above as they are obvious when to use



Formula

Type 1 $\frac{\text{part}}{\text{whole}} \times 100 = ?$

Type 2 $\text{amount} \times \frac{\%}{100} = ?$

Type 3 $\text{amount}\left(1 \pm \frac{\%}{100}\right) = ?$

Type 4 $\frac{\text{amount}}{\frac{\%}{100}} = \text{given}$

Type 5 $\frac{\text{amount}}{1 \pm \frac{\%}{100}} = \text{given}$

Type 6 $\frac{\text{difference}}{\text{original}} \times 100 = ?$

Type 6 is like type 1 but we want the difference/change/gain/lose/increase/decrease

Given/Want

$\frac{\text{given}}{\text{given}} \times 100 = \text{want}$

Given part and whole and want the percent

Note: For harder questions you might have to use type 2, 3 or 4 to get the numerator

$\text{given} \times \frac{\text{given}}{100} = \text{want}$

Given original amount and percent, **want answer**

$\text{given}\left(1 \pm \frac{\text{given}}{100}\right) = \text{want}$

Given original amount and percent, told to INCREASE or DECREASE and **want answer**

$\frac{\text{want}}{\frac{\text{want}}{100}} = \text{given}$

Given answer (given what increase or decrease represents want original amount).

- Kazia spends £204 a week on rent. £204 is 30% of her weekly pay. Work out her weekly pay
- An airline increases the price of its flights by 8%. The increase in price of a flight to Mumbai was £48. Work out the price of a flight to Mumbai after the increase.

$\frac{\text{want}}{1 \pm \frac{\text{want}}{100}} = \text{given}$

Given answer (given amount after increase or decrease has been applied to the original amount, want original amount)

- Kelly bought a boat. Later she sold the boat for £9519. She made a profit of 14%. Work out the original price of the boat.

$\frac{\text{given}}{\text{given}} \times 100 = \text{want}$

Give both parts and want the percent

Note: For harder questions you might have to use type 2, 3 or 4 to get the numerator