Introduction

You will have met percentages before. They are very useful because they are easier to work with than fractions and make it easy to compare things, for example, test results when there are different numbers of questions.

There is often more than one way of working out a percentage. In this activity you will compare different methods, and decide which is the most efficient in a variety of situations.

Try these

1 A savings account gives 4% interest per annum.
If £3000 is invested in this account, how much will be in the account at the end of 5 years?

Think about …

What is the best way to work this out?

2 A new car costs £16 000 and its value falls by 15% per year.

a What will it be worth when it is 5 years old?

b What will it be worth when it is 20 years old?

Think about …

Can you work out the answers to **a** and **b**?

Is the car's value likely to go down by the same percentage each year?
What do you think will happen in the long run?

3 A company's sales of a product are falling by 6% per annum.
They sold 45 000 this year.

If sales continue to fall at the same rate, estimate the annual sales 6 years from now.

Think about …

What is the quickest way to work this out?

4 A shareholder owns 2000 shares in a company.
She expects to get 3% more shares in a share issue and then plans to sell 25% of her shareholding.

a How many shares will she have after these transactions?

b What percentage is this of her original shareholding?

5 A shop marks up the goods it sells by 30%.
In a sale it reduces its normal prices by 25%.

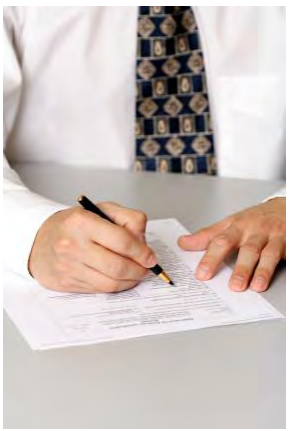
What is the overall percentage profit or loss on goods it sells in the sale?

Think about…

Can you combine these percentage changes without knowing the prices?

6 The price of a train fare increased by 2.5% recently.
It now costs £66.42.

What was the cost before the price rise?



7 After a 12.5% discount, insurance costs £25.90.
What was the cost before the discount?

Think about…

Questions 6 and 7 are called 'reverse percentage' problems.
Can you see why?

Reflect on your work

What are the most efficient ways of working with percentages?

Can a graphic calculator or spreadsheet help?

Information sheet A Compound interest

Suppose you invest £3000 in a savings account at a fixed rate of 4% per annum and leave the money in the account. Assume interest is added at the end of each year. There are a variety of ways you can work out the interest and the amount in the account at a later date.

1 Using a step-by-step method

Amount invested £3000

Interest at end of Year 1 = 4% of £3000 = 0.04 x £3000 = £120

Amount at end of Year 1 = £3120

Interest at end of Year 2 = 4% of £3120 = 0.04 x £3120 = £124.80

Amount at end of Year 2 = £3244.80 and so on.

Think about…

Are the interest values the same each time if you divide by 100, then multiply by 4?

2 Repeating calculations using a multiplier

Amount invested £3000

Amount at end of Year 1 = 104% of £3000 = 1.04 x £3000 = £3120

Amount at end of Year 2 = 1.04 x £3120 = £3244.80 and so on

Remember: Total = 100% of original amount + 4% interest

Repeated calculations can be done quickly on your calculator.
Use your calculator to complete this table.

End of year n	**Amount £ A**
0	3000.00
1	3120.00
2	3244.80
3	
4	
5	

3 Using indices

Amount invested £3000
Amount at end of Year n = $1.04^n \times$ £3000

For example, Amount at end of Year 2 = $1.04^2 \times$ £3000 = £3244.80

Amount at end of Year 5 = $1.04^5 \times$ £3000 = £3649.96

Think about…

After 5 years what will the amount have been multiplied by?

Try this A

A savings account gives 3% interest per annum.
£5000 is invested in this account.

How much will be in the account at the end of 6 years?

Work out the answer using each method.

Think about…

What are the advantages and disadvantages of each method?

Information sheet B Depreciation

When a quantity is reduced by a percentage, the multiplier is less than 1.

Suppose a car costs £16 000 when new, but its value falls by 15% per year.

In this case the car's value each year is 85% of its value the previous year, and the multiplier is 0.85.

Use this multiplier to complete the table.

Age of car n years	**Value (£)**
0	16 000
1	
2	
3	
4	
5	

You can also find the value of the car at n years old from this formula:

Value when the car is n years old = $0.85^n \times$ £16 000

Use this formula to check the car's value when it is 5 years old.
What will the car be worth when it is 20 years old?

Think about…

What assumption is being made by using this method?
Is this realistic? What will happen in the long run?

Try this B

A company's sales of a product are falling by 6% per annum.
The number sold this year was 45 000.

1 Write down a formula for annual sales n years from now.

2 Use your formula to find the estimated sales 6 years from now.

3 Check your answer by using repeated calculations.

Information sheet C Combining percentage changes

You can combine percentage changes by using one multiplier followed by another.

Suppose that a shareholder owns 2000 shares in a company, and that she expects to get 3% more in a share issue. Then she plans to sell 25% of her shareholding.

After receiving the extra 3%, the number the shareholder will have is
$1.03 \times 2000 = 2060$ shares

After selling 25%, she will have $0.75 \times 2060 = 1545$

As a percentage of her original shareholding, this is $\frac{1545}{2000} \times 100 = 77.25\%$

Multiplying multipliers gives a quicker way to work this out.

Check that $1.03 \times 0.75 = 0.7725$

This method allows you to combine percentage changes without knowing the quantities.

Try this C

A shop marks up the goods it sells by 30%.
In a sale it reduces its normal prices by 25%.
What is the overall percentage profit or loss on goods it sells in the sale?

Information sheet D Reversing percentage changes

You can reverse a percentage change by dividing by the multiplier.

Suppose that, after a 2.5% rise, a train fare costs £66.42

This is 102.5% of the original price, that is, 1.025 times the original price.

So the original price was £66.42 ÷ 1.025 = £64.80

You can also reverse reductions.

Try this D

After a 12.5% discount, insurance costs £25.90

What was the cost before the discount?