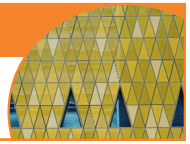
DIY
MATHS

What's the Project?



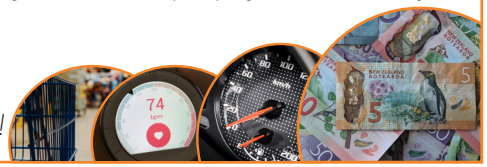
How to calculate rates and unit rates.

The Why Behind the What

Being able to recognise and work out rates and unit rates is a handy real-life skill. One day you're going to be earning your own money and need to go shopping for food. You'll probably have a set budget for how much you can spend, so understanding how to work out and compare unit rates for different products can save you money in the long run and keep you on budget!

You'll also find rates being used in things like how many dollars per hour you can earn, or how many beats per minute your heart is pumping, or how many kilometres per hour you can travel.

Those are just some examples. Rates are everywhere if you know what to look for!



What You Need to Know

Rates are a type of ratio that describe things in the real world.

Rates are the **relationship or comparison between two numbers by division** (just like ratios), but in rates the **numbers represent different units of measurement**, usually units of time or weight.

Here are some examples of rates in the real world:

$\frac{18 \text{ dollars}}{1 \text{ hour}}$ **or** 18 dollars per hour

$\frac{100 \text{ kilometres}}{1 \text{ hour}}$ **or** 100 kilometers per hour **or** 100 km/h

$\frac{4 \text{ dollars}}{1 \text{ kilogram}}$ **or** 4 dollars per kilogram

$\frac{70 \text{ words}}{1 \text{ minute}}$ **or** 70 words per minute

Getting to Grips with Unit Rates

All of the rates you've just seen have one thing in common. The bottom number for all of them is 1 because they show **1 unit of measurement**: 1 hour, 1 kilogram, 1 minute.
The word **unit** means a **single** thing or the number **one**.

These kinds of rates are called **unit rates** because you are comparing the top number to the bottom number 1, which tells you there is one unit of measurement.

The Formula

To make rates easier to compare with each other, we need to change them to an equivalent unit rate with 1 as the bottom number. $\frac{\#}{1}$
But not all rates that you come across will be unit rates (with a 1 as the bottom number showing 1 unit of measurement). Here is what to do if you have a rate like this:

$\frac{90 \text{ metres}}{1 \text{ seconds}}$ $\qquad \frac{90\text{m}}{9\text{s}} = \frac{?\text{m}}{1\text{s}}$

It's so simple! Just **divide the top number by the bottom number.**

$\div \frac{90\text{m}}{9\text{s}} = \frac{10\text{m}}{1\text{s}}$ The unit rate is 10 metres per second.

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Installing the Formula

Get the formula installed in your brain by working out the unit rates and then compare them to see which is the fastest, best deal, etc.

1

Sports Car: 120 kms / 3 hours

vs

Race Car: 150 kms / 5 hours

Working Out:

Fastest Car? _____

2

Matt: 237 words / 3 minutes

vs

Amelia: 304 words / 4 minutes

Working Out:

Fastest Texter? _____

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Technical Vocabulary

If you had to explain these mathematical terms to someone else, what would you say? Write your definitions of these mathematical terms. You may want to add an example to some of your definitions. Check online if you're not sure.

Handy Hint: Don't forget to add the measurement information to your final answer, e.g. km per hour, beats per second, dollars per kg, etc. Without this information, it is just a number, not a rate!

Ratio:

Rate:

Unit:

Unit rate:

Equivalent:

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Job Share

Create two different rates comparison problems for a buddy, then see if they can solve it. If they don't know how to work out unit rates, show them what to do. When you can teach it, you'll know you've learnt it.

Optional Extension: Foreign Currency Rates of Exchange

Let's say you're going on holiday to a foreign country and you want to change your New Zealand dollars into their currency. How does that work? It's another example of rates in action in the real world!

Do some research into the New Zealand dollar and rates of exchange for foreign currency.

- How does it work?
- How are the rates decided for each currency?
- What does it mean when currencies are weaker or stronger than the New Zealand dollar?
- What is the calculation used to change $1 New Zealand dollar into a foreign currency? Yes, there are online calculators that do it all for you, but what is the actual calculation that is being done?

Using the rates of exchange information, take $1000 New Zealand dollars and compare them with 3 foreign currencies that are weaker and 3 foreign currencies that are stronger. How much do you get for your New Zealand dollars? Show your information and calculations on a table.

Now gather up everything you've learned and present your knowledge on a poster or create a digital presentation on the platform of your choice. Remember to make your presentation engaging using pictures and graphics as well as your information.

3

Brand A Lollies: $\frac{30 \text{ dollars}}{120 \text{ lollies}}$ vs Brand B Lollies: $\frac{36 \text{ dollars}}{150 \text{ lollies}}$

Working Out:

Best Deal? _____

4

Apple Orchard 1: $\frac{204 \text{ kg apples}}{6 \text{ trees}}$ vs Apple Orchard 2: $\frac{480 \text{ kg apples}}{15 \text{ trees}}$

Working Out:

Best Yielding Orchard? _____

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Practical Project

The heart is a muscle. It pushes blood through the arteries, causing them to expand and contract in response to the flow of your blood. You can feel the expansions and contractions (your pulse or heartbeat) in many places throughout the body where an artery passes close to the skin.

Taking your pulse means measuring how many times the heart beats in a minute or the **rate per minute**. It helps make you aware of your heart rhythm and the strength of your heartbeat. One of the easiest places to take your pulse is on your wrist – this is called the **radial pulse**.

Simply lay your index and third fingers on the inside of your wrist below the base of your thumb, between the bone and the tendon. This spot is over the radial artery. **When you feel the thump of your pulse, count the beats for 15 seconds**. If you're having trouble, maybe look up a video online about how to take your pulse.

Make sure you're taking the **resting pulse rate, which means the person has not been doing any strenuous physical exercise.

Take the resting pulse rates of 4 other friends and a teacher, then compare them. Rate them in order from 1 (lowest resting pulse rate) to 6 (highest resting pulse rate).

Use the same formula, but there is an extra step included to get the unit rate or beats per minute. An example has been done for you to follow.

Top Tip: If you have decimals in your calculations, write them to 2 decimal places.

Using your knowledge of time, can you spot a different calculation you could make to work out the beats per minute from the number of beats per 15 seconds? Use Bob's pulse rate as the example and show your working out here.

	Name	How many pulse beats in 15 seconds?	Unit Rate Beats Per Minute	Order 1 (lowest) – 6 (highest)
Example	Bob	12	$\frac{12}{15} = \frac{0.8}{1}$ beats / minutes ÷ 15 0.8 x 60 second = 48 beats per minute	
You				
Friend 1				
Friend 2				
Friend 3				
Friend 4				
Friend 5				
Friend 6				
Teacher				

Teacher Guidance

Hi there,

This DIY Maths resource is designed to be used independently by your Year 7-8 students. It could be used as a follow up after explicit teaching or a task for students to work through and problem solve as they go. There are a variety of tasks, including basic practice, practical skills, mathematical vocabulary, buddy teaching and extension activities.

Print it out as an A4 or A5 booklet in colour or black and white. The back page of the booklet is deliberately blank so that students can glue it easily into their maths books. Alternatively, you could also use this resource on a digital platform.

The answers to the questions for the 'Installing the Formula' section of the booklet are included at the bottom of this page so you can print them, cut them off and give them to students to self-mark.

We hope you and your students enjoy using this resource.

Team Twinkl

Answers for 'Installing the Formula'

1. Sports Car: $\frac{120}{3} \div \frac{40}{1}$ or 40km per hour

   Race Car: $\frac{150}{5} \div \frac{30}{1}$ 30km per hour

   Fastest Car: Sports Car

2. Matt: $\frac{237}{3}$ or 79 words per minute

   Amelia: $\frac{304}{4}$ 76 words per minute

   Fastest Texter: Matt

3. Brand A Lollies: $\frac{30}{120}$ or 0.25c per lolly

   Brand B Lollies: $\frac{36}{150}$ 0.24c per lolly

   Best Deal: Brand B

4. Apple Orchard 1: $\frac{204}{6}$ or 34kg apples per tree

   Apple Orchard 2: $\frac{480}{15}$ 32kg apples per tree

   Best Yielding Orchard: Orchard 1

Answers for 'Practical Project' Question

The alternative is to use your knowledge of time to make the calculation.

There are 4 x 15 seconds in 1 minute. So you can take the number of pulse beats in 15 seconds and simply multiply it by 4.

For example:

Bob 12 beats per 15 seconds

12 x 4 = 48 beats per minute

You should get the same answer by following the formula to get the unit rate for 1 second and multiplying it by 60 to get beats per minute.