

Running Rates

Purpose:

The purpose of this activity is to engage students in solving a problem involving fractions (time in hours, minutes and seconds) and decimals (distance in km) to find a rate.

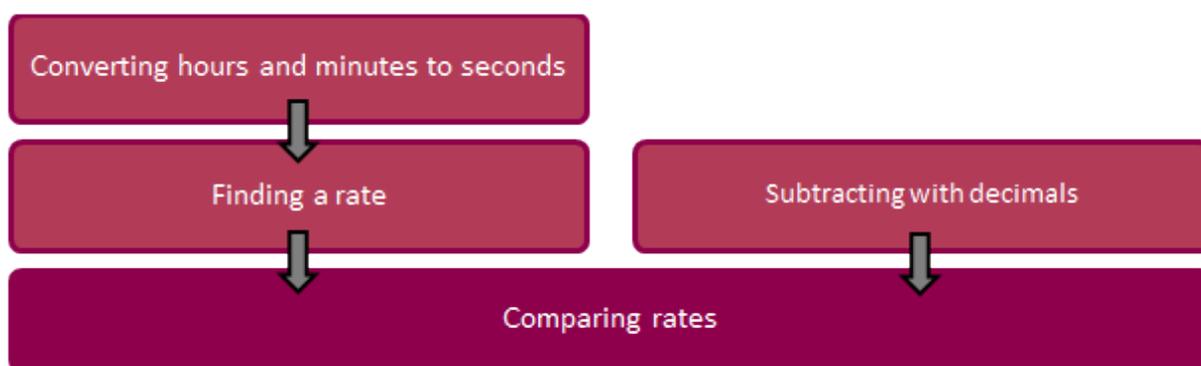
Achievement Objectives:

NA4-4: Apply simple linear proportions, including ordering fractions.

NA4-5: Know the equivalent decimal and percentage forms for everyday fractions.

Description of mathematics:

The background knowledge and skills that need to be established before and/or during this activity are outlined in the diagram below:



Converting hours and minutes to seconds

How many seconds elapse in two hours, fifteen minutes?

Subtracting with decimals

Find $26.0042 - 13.892$

Finding a rate

If I drive 350 km in 5 hours, what is my speed in km/h?

Comparing rates

A red car covers 250 km in 180 minutes and a blue car is travelling at 20 ms^{-1} . Which car is travelling at a faster speed?

This activity may be carried out with step by step guidance, or by allowing the student to follow their own method of solution. With the values involved, tools such as a calculator could be provided, so that ability in numeracy might not become a barrier to the problem solving skills being developed through this activity. The approach should be chosen in sympathy with students' skills and depth of understanding.

Activity:

In the 2014 Auckland marathon, the average time was 4:27:15 for the full and 2:22:53 for the half.

A full marathon is 42.195 km in length. How much faster (in minutes or seconds per km) was the average full marathon pace than the half?



The procedural approach

The student is able to make the appropriate calculations, with guidance, in order to solve the problem.

Prompts from the teacher could be:

1. Find the average time to complete the full marathon, in seconds.
2. If I cover 2 km in 10 minutes, what is my run rate in minutes per km? How did you work that out? What does the per mean you do mathematically?
3. Calculate the average run rate of the full marathon in seconds per km.
4. Find the average time to complete the half marathon, in seconds.
5. Find the distance covered in the half marathon (in km).
6. Calculate the average run rate of the half marathon in seconds per km.
7. Compare the average run rates of the full and half marathons.

seconds per km
(÷)

Full
mm

$$\begin{array}{r} 4 \text{ hours} = 4 \times 60 \times 60 = 14400 \\ 27 \text{ mins} = 27 \times 60 = 1620 \\ \hline 15 \\ 16035 \\ \div 42.195 = 380 \text{ seconds per km} \\ (6.33 \text{ minutes per km}) \end{array}$$

Half
mm

$$\begin{array}{r} 2 \text{ hours} = 2 \times 60 \times 60 = 7200 \\ 22 \text{ mins} = 22 \times 60 = 1320 \\ \hline 53 \\ 8573 \\ \div (42.195 \div 2) = 406 \text{ seconds per km} \\ (6.77 \text{ minutes per km}) \end{array}$$

The average time for the full was
 $406 - 380 = 26$ seconds per km faster.

T: I notice you've written a symbol under the 'per'.

S: Yes. I wasn't sure how to work everything out, but when I got that per means "divided by" it told me what to do. So I wrote that in to remind me to divide seconds by kilometres.

The conceptual approach

The student is able to make the appropriate calculations in order to solve the problem.

Prompts from the teacher could be:

1. If I cover 2 km in 10 minutes, what is my run rate in minutes per km? How did you work that out? What does the per mean you do mathematically?
2. Are the times given in a form that is immediately useful for your calculations?
3. How will you compare the average time for the full marathon with the average time for half that distance?

2:22:53 2:13.45

21. ~~098~~ 098\$ ~~min~~

21.098 nearest m

9 min 9 sec

548 sec

$548 \div 21.098$

26 seconds per km faster

T: Can you run through your working with me?

S: I wanted to do as little as possible so I took away the difference before so I only had one equation.

T: What difference?

S: I halved the full time so I could compare the two averages. I found the difference was 9 minutes and then I only needed to divide by the distance once. I like finding the easiest way to do things.