M1 Maths

A3-2 Choosing the Unknown

- write and solve equations where the choice of unknown is not obvious

Summary Learn Solve Revise Answers

Summary

In some problems there is more than one unknown. In such cases, we need to choose just one of them to be the unknown in our equation; then we express the other unknowns in terms of the unknown we chose; then we write the equation and solve it to find the chosen unknown. Finally we work out the other unknowns from the chosen one.

In other problems, there may be more than one unknown quantity, but we only need to find one of them. However, it might be easier to find one of the other quantities first, then find the quantity we need to know from that.

In both cases, we need to choose the unknown for our equation so as to make the equation as easy as possible to write and to solve.

Learn

In some of the following problems, there is more than one quantity to be found. You need to make one quantity the unknown, then write the other quantities in terms of that unknown. You can pick any of the quantities, but some choices will make the equation easier than others. Generally, it is best to pick the one which is added to or whatever to get the other one.

Here is an example. The length of a rectangle is 4 cm greater than its width. If the perimeter is 93 cm, what are the length and width?

We could take either the length or width as the unknown here, but, as we have to add to the width to get the length, it is easier to choose the width.

Let the width be w. Then the length is $w + 4$ and the perimeter is $2w + 2(w + 4)$.

$$\begin{aligned} 2w + 2(w + 4) &= 93 \\ 2w + 2w + 8 &= 93 \\ 4w + 8 &= 93 \\ 4w &= 85 \\ w &= 21.25 \end{aligned}$$

The length is 4 cm more than the width, which would be 25.24 cm.
So the width is 21.25 cm, the length is 25.25cm.

Note that we left out the −8, ÷4 etc. between the lines of working. You have been putting these in for quite a while to remind yourself of what operation you are performing on both sides. From here on, they are optional: you can leave them out or put them in as you please.

In other problems, there may be more than one unknown, but you may only be asked for one. And it may be that the one you are asked for is more difficult to use as the unknown than one of the others. In such a case, it is often worth making the simpler one the unknown, finding the value of that, then finding the value of the one you were asked for.

Here is an example.

Gran went for a walk on Monday, then walked twice as far on Tuesday. On Wednesday she walked 4 km further than on Tuesday. If she walked 49 km in the three days, how far did she walk on Wednesday.

We could make the number of kilometres she walked on Wednesday the unknown here, but the equation is easier to write and solve if we make the number of kilometres she walked on Monday the unknown. If you're not convinced, try to solve the problem both ways.

In the first example with the rectangle, if you had been asked for the area instead of the length and width, it would have been easiest to make the width the unknown (as we did), find the width, work out the length, then work out the area.

Practice

Q1 Solve the following by writing and solving an equation.

(a) Grubel thinks of 2 numbers. One is 4 more than the other. When added together, they made 16. What are the 2 numbers?

(b) Rosie and Spike are 3 years different in age. The sum of their ages is 37. How old are they?

(c) Hungel's pool is rectangular. Its length is 6m greater than its width. Its perimeter is 28m. What are its length and width?

(d) Gargoil picked 3 lotto numbers. The second number was 7 less than the first; the last was 7 more than the first. The sum of the three was 45. What were the numbers?

(e) Theodore drew a line, then another one 2cm longer, then another 2cm longer than that and so on until he had 6 lines. The total length was 1.2m. How long was each line?

(f) Jodi's bank account had twice as much in it as Charlene's. Jodi then deposited another $20. Between them they then had $110. How much of that was Jodi's?

(g) Mama had $8 more than Pop who had 3 times as much as Grandpa. Between the three of them they had $152. How much did Pop have?

(h) Alf's weasel weighs 200g more than his 2 identical guinea pigs put together. His hamster weighs 40g less than one of his guinea pigs. The weasel, the hamster and one of the guinea pigs weigh 800g between them. How much does the weasel weigh by itself?

(i) Tulie once had 5 rats but they all escaped before she could weigh them.

Q2 Solve the following by writing and solving an equation.

(a) A rectangle is 20 cm longer than it is wide. If its perimeter is 120 cm, what is its area?

(b) Fifi's rectangular pool is twice as long as it is wide. If its perimeter is 30m, what is its length?

(c) Perdy painted a rectangular picture. Its length was 10 cm more than twice its width. If its perimeter was 1.4 m, what was its area?

(d) Rasputin thought of a first number, then a second number 6 more than the first, then a third number 3 times the second, then a fourth number 20 less than the third. He then added them all up and got 24. What was the fourth number?

(e) Lara had some money in the bank. Greta had $25 more than Lara. Prudence had twice as much as Lara. Giles had 3 times as much as Greta plus another $8. Between the four of them they had $192. If Giles gave half his money to Greta, how much would Greta then have?

(f) Ergo worked for 6 days. Each day he got paid $5 more than the previous day. His total wage for the 6 days was $180. How much was he paid on the 4th day?

(g) Fegg earnt $34 a day. He then got a pay increase. Not satisfied with this he changed jobs to one that paid twice as much as his new pay. He worked one day at this rate then got another pay rise of $4 a day. He then worked 3 days at the higher rate, then got the sack. He earnt a total of $274 at the new job. How much did he earn on the first day there?

(h) Kayleen made up some maths problems on Tuesday. On Wednesday she made up 3 times as many. On Thursday she made up 6 less than on Wednesday. On Friday she made up 7 more than on Tuesday. If she made up 165 on the last 2 days, how many did she make up on the first 2 days?

(i) Kayleen needs to get a life.

Solve

Q51 Scarlet did 5 km in 35 minutes. She spent twice as long jogging as sprinting and 10 minutes more walking than jogging. She sprints at 8 km/h more than her jogging speed and jogs at 1.5 times her walking speed. What was her jogging speed?

Revise

Revision Set 1

Q61 Solve the following. Show working.

(a) Lucy worked for 4 days and earned twice as much each day as on the previous day. She also got a $100 bonus at the end, making her total pay $278.50. How much did she earn on the third day?

(b) Lenin had an average number of customers on Monday. He had 5 more than average on Tuesday. On Wednesday he had twice as many as Tuesday. On Thursday he had 7 less than Wednesday and this was 3 times as many as average. How many did he have on Thursday?

Answers

Q1	(a) 6, 10	(b) 17, 20	(c) 4m, 10m	(d) 8, 15, 22	(e) 15, 17, 19, 21, 23, 25 cm	
	(f) $80	(g) $56	(h) 520 g	(i) -		
Q2	(a) 800 cm^2	(b) 10 m	(c) 1000 cm^2	(d) –1.25	(e) $96.50	(f) $32.50
	(g) $65.50	(h) 164	(i) -			
Q51	9.18 km/h					
Q61	(a) $47.60	(b) 9				