Build your skills: Problem-solving – Part 1

This task has **three** parts to it.

Part 1

In this part, you will find information and activities to help you to feel more confident when you need to work out how to solve a problem and to decide what calculations you need to make.

N1/L1.3 tutor notes

Part 2

In Part 2 you can find suggestions of other free resources you can use to practise your skills.

Part 3

In Part 3 you can try out your skills on some practical activities and get practice in test-type questions. Part 3 also contains the answers to all the activities in parts 1–3.

Thinking about problem-solving

When you are working out a problem or thinking about how to make a calculation, it sometimes helps to use a problem-solving approach.

The approach helps you to:

- think through and make sense of the situation
- decide what you need to do
- make sense of the answer you get.

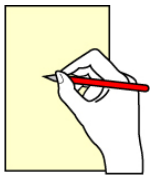
A problem-solving approach is made up of several stages, where you think in turn about each of the steps below:

Using a problem-solving approach:

1. **Making sense of the problem/situation**
2. **Choosing the right calculation**
3. **Making the calculation**
4. **Making sense of the answer**
5. **Checking your answer**

In this task, we will look at particular aspects of some of these steps.

- **Activity 1** focuses on how visualising the problem may help in making sense of the question and in thinking about what you need to work out.
- **Activity 2** will give you practice in sifting information to decide and use the 'key information' needed to work out the answer to a problem.
- In **Activity 3** we will look at making calculations that involve several steps.
- In **Activity 4**, we will think about how to interpret the answer we get from calculations to make sure it is appropriate to the situation involved.



Activity 1

This activity will ask you to read, think through and then try out ways of making sense of a question.

Making sense of the question

Sometimes it can be confusing to make sense of what a question is asking you, and to decide what you need to work out to solve it. You can use your experience of the world to help you think about this by asking yourself 'What does this mean in practical everyday terms?'

In particular, there may be many situations in which it might help to think of a way to visualise the problem:

If you are working on a practical problem in real life, you may find it useful to sketch yourself a diagram.

If you are working on a problem described in words, you may find it useful to:

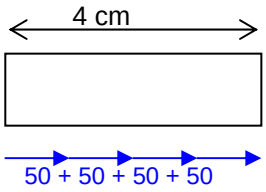
- relate it to real life and try to think about a way of representing the problem visually
- think about key words and phrases that give you clues about what you need to work out.

Example 1:

A flower bed is shown on a garden plan as 4 cm long.

If the scale of the plan is 1 cm on the plan = 50 cm in the real garden, how long is the flower bed in real life?

You could tackle this problem by drawing a sketch to help you think about the situation.

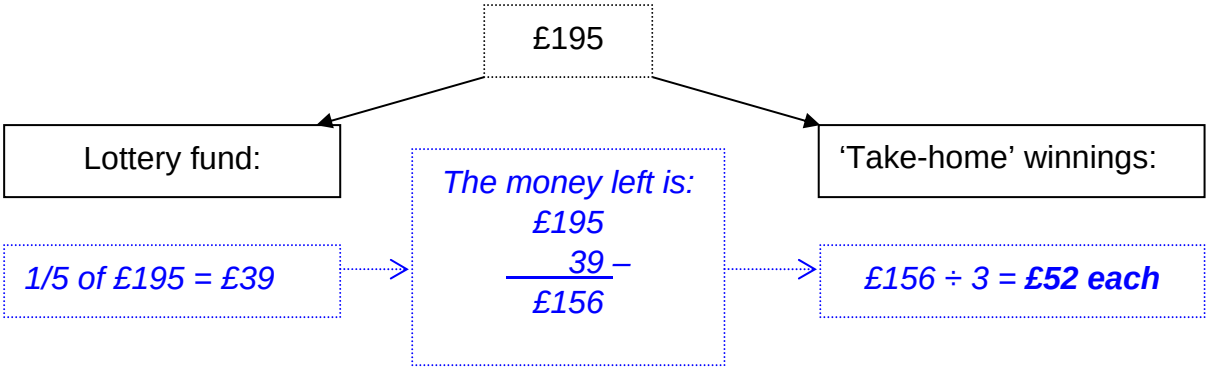


= 200 cm = 2 metres

Example 2:

Three workers are in a syndicate together to play on the national lottery. They have agreed that if they win a small amount they will put a fifth of the money into a 'lottery fund' to pay for tickets for future weeks and will split the rest between them (their 'take-home winnings').

One week they have a win of £195. How much of the win will each of them take home?



Now think about each of these situations.
Would a sketch or diagram help you to visualise the problem? If so, what might it look like?

1 A gardener is putting new fencing round a garden. The garden is 10 m long and 6 m wide.

a What length of fencing will he need altogether?

b How many 2 m fencing panels will he need to use?

2 The children's play area in a public park is shown on a plan as 7 cm long. Each cm on the plan represents 2 metres in the real park.

How long will the play area be in real life?

3 A section of a garden is divided into five equally sized beds. Two of the beds have been allocated to growing vegetables.

If the section of garden is 12 m long altogether, how many metres in length will the vegetables take up?

4 The 'Friends of the Village Green' have agreed to pay for some flower beds to go on the green. The villagers have decided that they want two beds: one bed 3 m long and the other 5 m long. The roses will be planted 1 metre apart from each other.

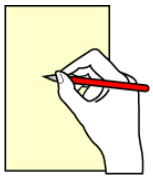
How many roses will be needed altogether for the two beds?

5 A gardener decides to re-treat her fence panels to keep them in good condition by painting them with wood preserver. The garden is 10 m long and 6 m wide. The panels are all 1.5 m high.

What area of fencing will she need to paint in order to treat the fencing on all four sides of the garden?

Tip: Think about each of the sides of the garden separately: What will the area of fencing be on each side?

Remember that the lengths of the sides of the garden are given in the question. It also tells you that the fencing is 1.5 m high.



Activity 2

Choosing the right calculation: Sifting information

When you are working out what calculation(s) to make, you have to think about whether you can work the problem out in a single step or whether you will need several steps. We will look at this a bit more in activity 3.

You also have to decide (for each step) whether you need to add (+), subtract (-), multiply (×) or divide (÷), and which numbers to use!

Sometimes when looking at a question described in words (like in the National Test questions), people feel that if a number is given in the question, they must be going to need to use it somehow. This is not always the case: part of the skill of choosing the right calculation can sometimes be feeling confident about sifting the information given to decide which information to use and which is 'additional (but unneeded) information'.

In the next activity you are going to practise identifying any information (especially any numbers) that you can ignore because it is not needed to answer the question asked.

Example:

Let's think again about the question given in the second example in activity 1. Say the question had been presented rather differently, so it read:

Three workers have been playing in a syndicate together on the national lottery for the past two years. Six months ago they had a small win of £50 and decided that if they won any more small amounts of money (less than £1000) they would put a fifth of the money they win into a 'lottery fund' to pay for tickets for future weeks and would split the rest between them (as their 'take-home winnings').

This week they have won £195. How much of this win will each of them take home?

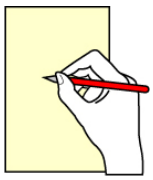
Essentially, this is the same question as before. It includes trying to work out the same thing as before: that is, their take-home winnings. The numbers involved that relate to their current win are also unchanged. So there is quite a bit of additional information given this time in the way the question is presented. Some of this material is not needed to work out the answer required.

The version of the question below shows in grey (but not underlined) the 'key information' (the information/numbers you need to work out the question).

Three workers have been playing in a syndicate together on the national lottery for the past two years. Six months ago they had a small win of £50 and decided that if they won any more small amounts of money (less than £1000) they would put a fifth of the money they win into a 'lottery fund' to pay for tickets for future weeks and would split the rest between them (as their 'take-home winnings').

This week they have won £195. How much of this win will each of them take home?

So, the information highlighted in grey and underlined is additional (unneeded) for the task.



In each example below, highlight any details (especially numbers) that are *not important* for the calculation(s) you need to make.

1 Nuah is making some flower beds to go in a garden. She decides to use treated wood that is 2 cm thick and 20 cm deep for the edging to the beds. She wants to make 5 beds, each 2.5 metres long and 1 metre wide.

What length of flower bed will she have altogether in the garden when she has made all the beds?

2 A gardener goes shopping for plants for a client's garden. She spends £42.55 in the first shop. In the next shop she gets some plants that have been reduced from £32.99 to £24.99. How much has she spent in total?

If she set off with £100, how much change will she have after the trip?

3 Two allotment holders want to save up to buy seeds for next year's crops. Each year they both sell their produce to local householders and last year they earned £270 and £500 respectively.

They decide to buy the seeds between them as this will save them each wasting seeds they don't want. They contribute £25 and £35 respectively to the joint 'seed fund'.

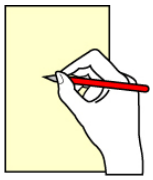
The seeds they agree to buy cost £53 in total. Have they got enough in the 'fund' to pay for them? If not, how much more do they need to find?

4 A landscape gardener is putting a new patio in a client's garden. He agrees to make it 6 patio slabs wide. The client's garden measures 21 m by 16 m and she wants the patio to be 10 metres long.

If the landscape gardener uses slabs that are each 50 cm square, how many will be needed for the 10 m length of patio?

5 Three neighbours live in a historic house which four years ago was divided to create 7 separate apartments. The neighbours decide they want to refurbish the area of ground by their flats to create a communal garden area. The cost of the materials they need comes to £522 altogether, including VAT at 15%.

How much will each neighbour contribute to the cost if they share it equally between them?



Activity 3

Making the calculation: multi-step calculations

As discussed briefly in activity 2, you may sometimes need to take several steps to calculate the answer to a problem.

Example 1:

Maya is supervising a project to make changes to a park area and has been given a budget of £1 000 to complete the project.

She spends £135.50, £254.90, £144.50, £112 and £115.10 on different elements of improving the park.

How much of her original budget has she got left?

We might work this problem out using two steps:

(1) Firstly we work out how much Maya has spent in total:

£135.50 + £254.90 + £144.50 + £112 + £115 10 = £762

(2) Then we take this from the original budget to find out the amount she has left:

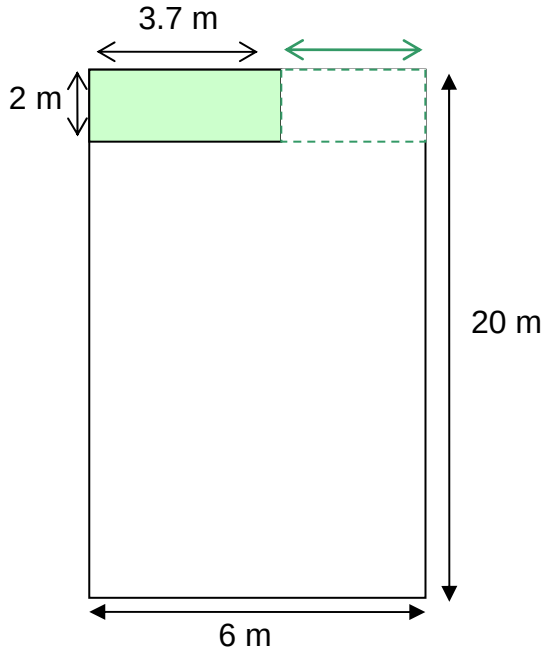
£1 000
762 –
£238 left

Sometimes you may need some additional information to be able to work out the answer. So you might need to use information you already have in the question to *work out* this extra information. Think about what information you know already and how you can use this to help you work out the extra information you need.

Example 2:

A home owner moves into a house with a garden 6 metres wide and 20 metres long. At the end of the garden there is a flower bed that is currently 3.7 metres wide and 2 metres deep. They decide they want to extend this bed so that it runs across the whole width of the garden. What additional area of ground will they need to dig over to make this extension to the bed?

This is an example where drawing a sketch might help. The sketch might look something like this:



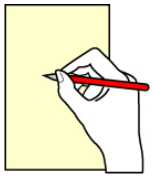
The area in green shows the existing flower bed. The area surrounded by dotted green lines shows the proposed extension to the existing bed.

To be able to work out the area of the extension to the flower bed, we need to work out the width of the additional section of the bed (marked with a green arrow in the sketch above). The information in the question tells us that:

- the garden is 6 metres wide (this is shown by the arrow at the bottom of the sketch)
- the bed is currently 3.7 metres wide.

So the additional width for the extended bed will be: *6.0 m – 3.7 m* = *2.3 m*

The **area of the bed extension** will be *2.3 m × 2 m* = ***4.6 m²***



For each of these questions **decide what steps to take** to work out the calculations needed **to find the answer requested**

1 Maya is supervising a project to make agreed changes to a park area and has been given a budget of £1 000 to complete the project. She consults with the local park users and they all decide that they would like to create five individual themed flower beds at different points around the park area.

She orders from five different nurseries, spending altogether £135.50, £254.90, £144.50, £112 and £115.10 on the plants needed to stock the beds.

How much is the actual cost of the project *per flower bed*?

2 Maya has been asked to supervise a project to make five new flower beds in a park area. She makes an estimate of the likely costs and tells the committee that the project will cost about £200 per bed. She spends £135.50, £254.90, £144.50, £112 and £115.10 in total on plants for the beds.

How much more or less <u>per bed</u> did the refurbishments cost *than the original budget she estimated*?

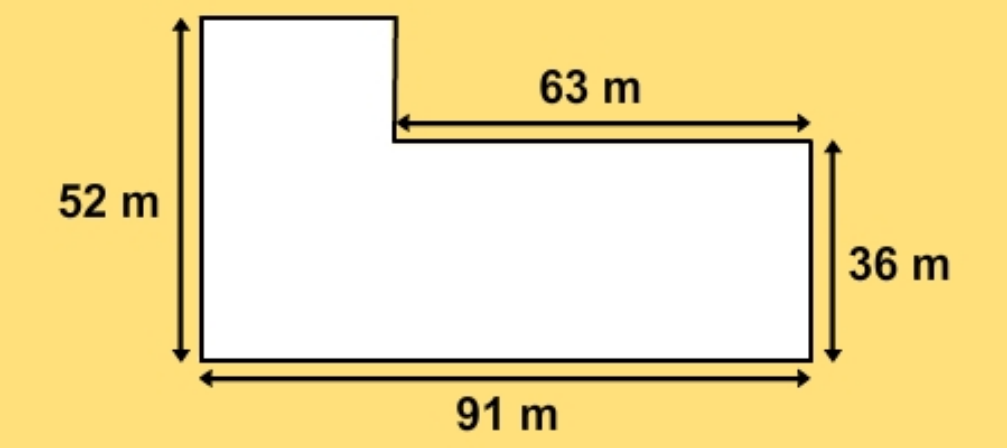
3 A home owner is saving up to redo the garden of his newly bought house. He has recently received a pay bonus of £162, and then decides to put aside £10 each week to save up for the work. How many weeks will it take him to save up for the new garden if he expects it to cost about £250?

4 A community project is hoping to create a new children's play area. They already have £1 200 in a community fund, and can put this towards the cost of the scheme. They have researched play equipment and have seen items they would like to buy costing £2 495. They do some further fundraising and collect another £645. They decide to apply to a charity for a grant of £500.

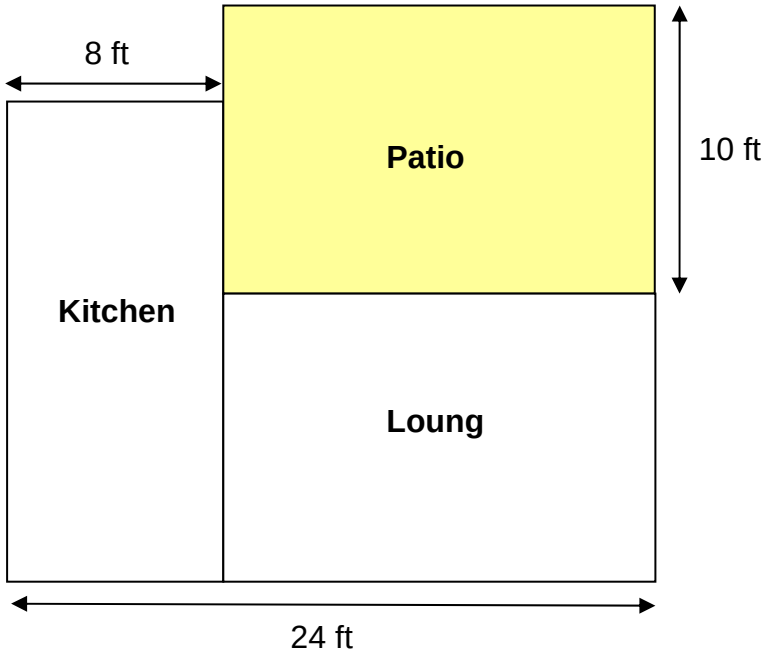
If there are 10 families in the project, how much would each need to contribute to the project fund to be able to afford the equipment they want?

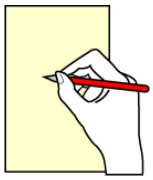
5 A gardener is making a new vegetable plot in her garden. The garden is 24 metres long and 16 metres wide in total. She decides to site the vegetable plot at the far end of the garden and make it 6 metres deep. How far will the front edge of the plot be from the house?

6 A contractor is fencing the L-shaped field area shown below. What length of fencing does he need?



7 A landscape gardener is making a patio area next to a client's house as shown below. What will be the area of the patio?





Activity 4

Making sense of the answer: Interpreting the answer

When you have worked out the calculations for your answer it is important to think about what your answer means – and whether this seems reasonable.

You can use your 'common sense maths' and knowledge of the world to think, 'Does that seem like the right sort of answer?' (Is it roughly the right size? Does it make sense when you think about how the question relates to real life?)

Be careful to write the answer down accurately, especially the size of the answer and the position of decimal point (if there is one).

Sometimes when you tackle a problem you will need to think about whether you need to work out the answer *exactly* or whether it will be OK to give an *approximate* answer. Similarly, when you have an answer, you may need to think about whether to round the answer in some way and if so, whether to round up or down.

Example:

Three work colleagues win £260 between them in a lottery syndicate.

If they share it equally, how much will they each get?

When you work out 260 ÷ 3 you get the answer: 86.6666.

To make sense of this answer, you need to think about what this means.

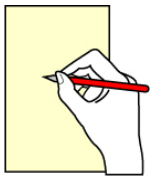
'The answer to this question will be an amount of money. . .'

Often we might round this amount of money and call it £86.67 (rounding up to the nearest penny), but in this case, the three colleagues *only have £260* to share between them. If they round *up* when working out how much they will each get, they would need winnings of:

3 × £86.67 = *£260.01* to be able to pay them all (and they only have £260!)

So, this is an example where it isn't appropriate to round to the nearest penny. Instead they will need to round *down* the amount, so they each get: ***£86.66***.

Checking this gives: 3 × £86.66 = £259.98
. . . and they will have 2p left which doesn't share equally between them.



Work out the following calculations and think about whether to round up or down to give an appropriate answer.

*Tip: If you are **sharing** a fixed amount, you need to round down (to make sure you don't use more than the amount you have – as in the above example).*

*On the other hand, if you are **collecting** to reach a minimum amount needed, you may need to round up (to make sure you collect enough).*

1 Three members of a grounds maintenance team receive a tip from a client of £20 between them. How much can they each have?

2 Someone working in a garden centre is leaving. The other nine people who work at the centre decide they want to buy him a leaving present costing £22. How much do they each need to contribute if they all pay the same amount?

3 After a community project to refurbish an area of land is finished, there are 29 plants left over, which are not needed on the project. The three people who did the work on the project share the plants between them. How many will they each take home?

4 A gardener is painting his fence with wood preserver. Each tin covers 10 square metres of fencing. How many tins will he need in order to paint 65 square metres of fencing?

5 A park area has three identical flower beds, which are going to be planted up using the same planting scheme as part of the park's planting design. One type of plant that will make up the display comes in trays of 25 plants. How many of this plant will there be in each of the beds?

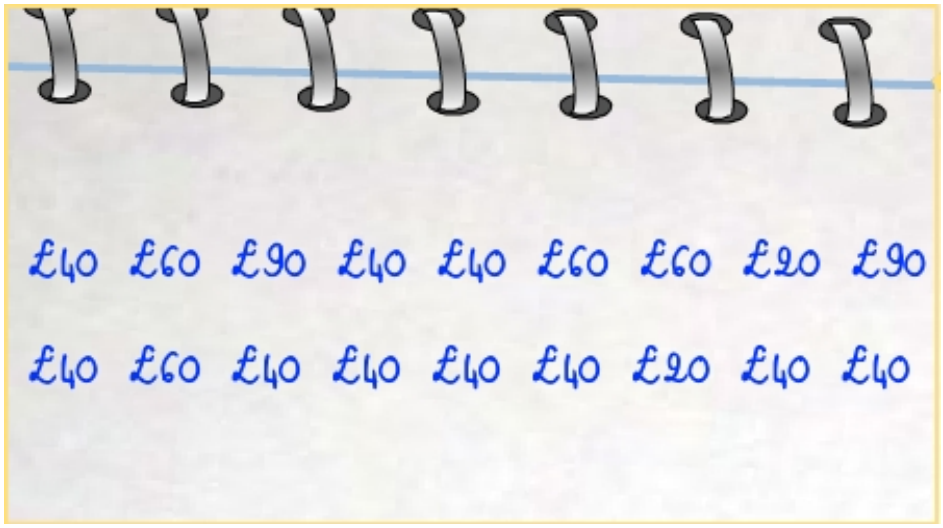
Activity 5

It can be very useful sometimes to understand about how the different types of calculation (adding, subtracting, multiplying and dividing) relate to each other. This can sometimes help you to see alternative ways to make calculations, which might be more efficient. It can also be very useful to help in checking calculations.

Example 1:

A community project is saving up to buy plants for its 'garden' area. The different families in the street each contribute what they can to a 'community garden fund'. The families discuss what level of contributions they need to make to save up enough money to complete the project, and they agree together that families will try to contribute £40 if they can afford to. However, there are a few families who will not be able to give this amount and a few others who are able to donate more than £40.

The contributions made so far are:



How much is there in the community garden fund?

Essentially this is a problem that involves *adding up* all the amounts contributed. However, we could also work it out by using the fact that:

Adding the same thing several times is the same as: *Multiplying.*

i.e. *£40 + £40 + £40 + £40 + £40 + £40 + £40 + £40 + £40 + £40 = 10 × £40*

So we could work out the total amount in the community garden fund like this:

10 × £40	=	*£400*
4 × £60	=	*£240*
2 × £90	=	*£180*
2 × £20	=	*£40* +
		£860

Tip: we can also check that we have counted all the contributions in our calculation by checking that the number of contributions we've added up is the same as the number of entries on the original list.

In this case we've added up 10 + 4 + 2 + 2 = 18 contributions.

This is right – as there were 18 amounts on the original list of contributions from families (shown on the notebook above).

Example 2:

A quarter of a garden area is taken up by an orchard.

If the whole garden is 34 m^2 what is the area of the orchard?

The area of the orchard is ¼ of the area of the whole garden, so we need to divide by 4:

34 ÷ 4 = 8.5 m^2

To check this answer we can use the fact that multiplying and dividing are 'opposites' (inverse) of one another.

8.5 × 4 = 34

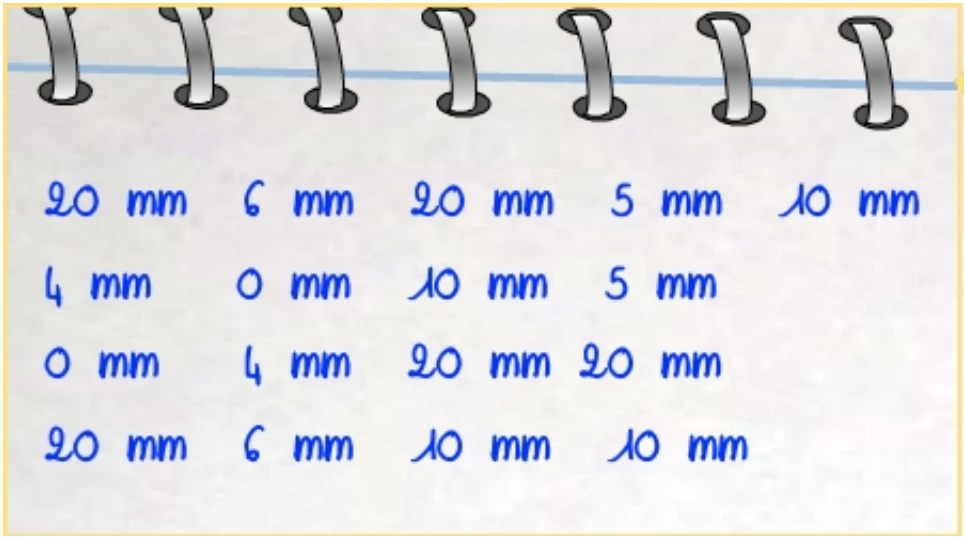
The main relationships between the different types of calculation that might be useful are:

- Adding the same thing several times is the same as: multiplying.
- Subtracting the same thing several times is the same as: dividing.
- Adding and subtracting are 'opposites' of one another.
- Multiplying and dividing are 'opposites' of one another.

Build your skills: Problem-solving – Part 1

Use the information in the box above and approaches like those in the examples to answer these questions.

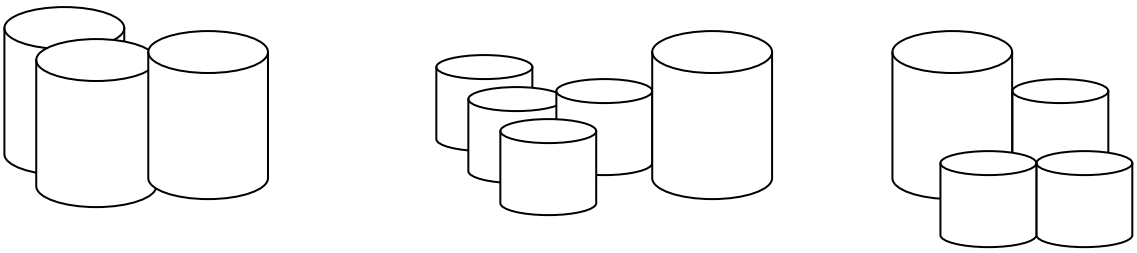
1 A gardener measures the amount of rain that falls each week. His record of the weekly amounts over the past four months is:



How much rain has fallen in total over these 4 months?

2 A gardener has a 25 kg bag of potting compost. Each time she pots a new plant that she has bought or been given, she uses some of the compost to fill the pot. She knows from past experience that her bag of compost will contain about 100 handfuls of compost.

Over one weekend she uses the following pots:

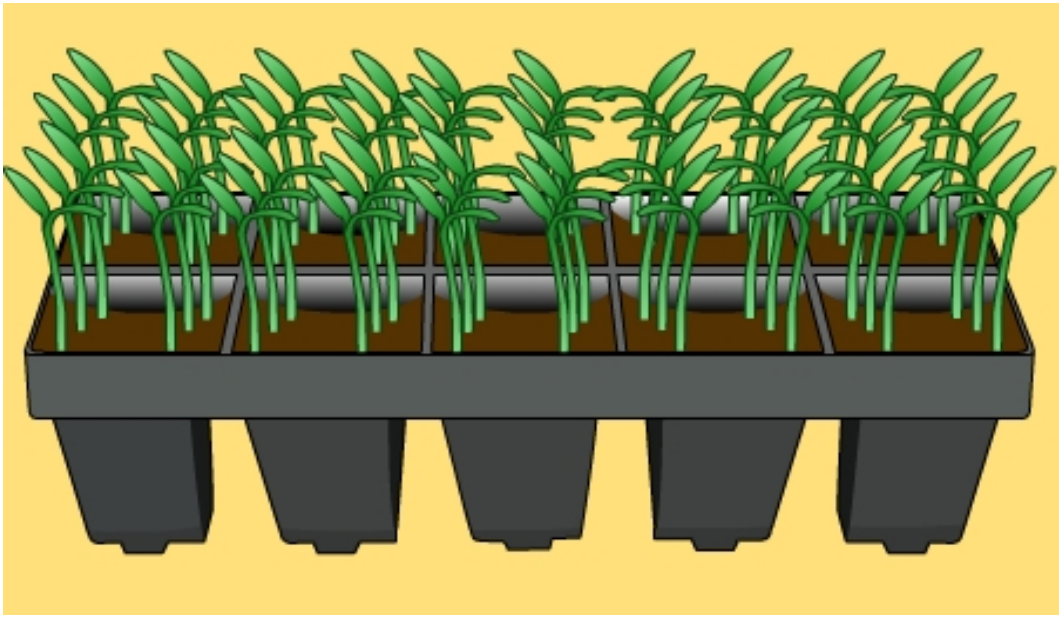


Each large pot uses about 8 handfuls of potting compost and each smaller one about 5 handfuls.

How much will be left in the original bag of compost?

3 A nursery grows seedlings in trays. They sell the seedlings either by the tray or as single seedlings depending on how many the customer wants to buy.

Each tray contains 10 rows, with 6 seedlings in each row:



For each item they grow, the nursery records the sales of seedlings sold singly and the number of whole trays sold on a stock sheet.

For example, if one day they sell 6 seedlings to one person, 4 to another, 10 to another and then 2 whole trays to a local gardening contractor, these sales would be recorded on the stock sheet for that item as:

Date	***Sales of item***
06/04	*6 4 10 2 trays*

The total number of that type of seedling sold that day would be:

6 + 4 + 10 + 60 + 60 = 80

(Remember that the seedlings come in trays of 10 × 6, so there will be 60 seedlings in each whole tray.)

The stock record for one item shows that they have made the following sales:

Home & Gardens

Stocklist

Date	Sales of item	
10/04	6 6 6 6 12 6 12	2 trays
11/04	6 12 2 6 2 6 12	1 tray
12/04	6 2 2 2 2 6 12	1 tray
13/04	12	3 trays
14/04	6 6 2 2 6 12	2 trays

How many of this type of seedling did they sell over the five days of sales recorded?

One final thought:

Don't let lack of confidence with a particular topic in maths get in the way when you need to work something out. Using the sorts of problem-solving approaches described in the activities above, you can often think through a problem and find alternative ways to tackle a question – even if you feel you can't remember exactly what you learnt about that topic!

Often when you are working out a calculation it is useful to find different ways of thinking about the situation, or to look for a pattern in the numbers involved and think about how the numbers relate to one another.

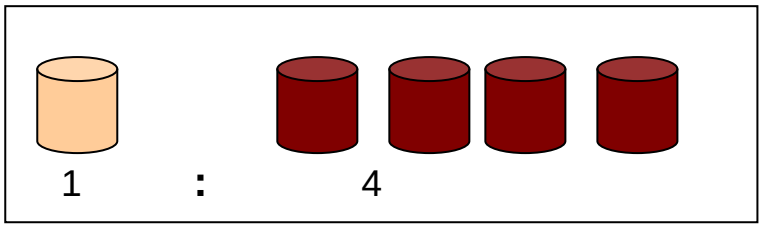
Example:

Peat and sand are mixed in a ratio of 4 : 1 to make up a special potting compost.

How much sand will I need for 12 spades of peat?

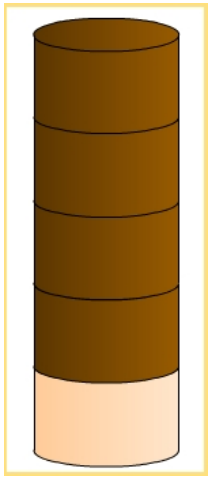
You could think about the relationship between the amount of peat and the amount of sand in a visual way:

e.g. *The compost is mixed by using a ratio of sand to peat of 1 **:** 4.*



OR

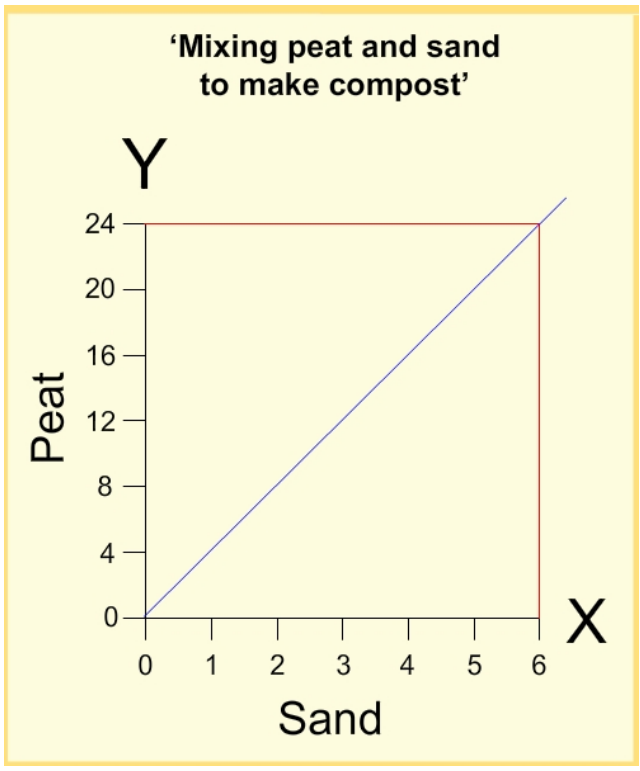
The mix is one part sand to four parts peat.



OR

The sand and peat are mixed together 4 parts of peat to every 1 part sand.

sand	1	*2*	*3*	*4*	*5*	*6*
peat	*4*	*8*	*12*	*16*	*20*	*24*



Or you could think about it numerically, looking at the relationships between the different numbers involved.

For example:

The amount of sand needed is a quarter of the amount of peat.

1

peat	:	sand
4	:	1
	÷ 4	
12	:	??

12 ÷ 4 = 3

Or (saying the same thing in a slightly different way)

The amount of peat is four times the amount of sand.

2

peat	:	sand
4	:	1
	× 4	
12	:	??

?? × 4 = 12

OR you could think about how the amount of peat changes.

I have three times as much peat as before . . .

. . . so the amount of sand will change by the same proportion.

3

peat	:	sand
4	:	1
	× 3	
12	:	??

1 × 3 = 3

Now print out Part 2 of this task to find suggestions of other free resources you might want to use to practise these skills.