

Reading a scale can present problems, but many students find making up their own scale from scratch more difficult. This exercise will make that task a little easier.

The main point to remember is that the graph must not be of postage stamp size, but should take up a fair bit of the available paper (if being drawn by hand) and be clear.

Example 1a

Here are some lines as on graph paper. Fit a scale to them so that the numbers 0 to 437 will fit.



Solution:

The most important thing to remember is that a scale must be easy to read. So the numbers attached to the lines must go up in easy numbers, e.g. in 1s, 2s, 5s, 10s, 20s, 50s, 100s and so on. You never see a scale going up in 3s or 7s or 19s, and rarely will you see one going up in 15s or 30s.

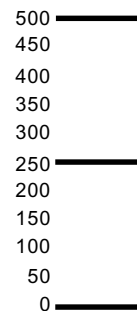


First, see how many intervals there are between the marked lines.

We have three bold lines with 10 intervals between each pair, making 20 intervals. The scale must cover a range of 0 to 437, difficult to do, but 0 to 500 is much easier.

20 intervals to cover 500 means 1 interval must represent 25 ($500 \div 20 = 25$)

We don't have the room (and it's a waste of time too) to write in every number, in intervals of 25, from 0 to 500, but we can mark off every second line in 50s instead.



And so we get this:

Note the most important features:

- (1) It is the lines, not the spaces, which are marked by the numbers.
- (2) The scale covers the entire range of numbers which are required.
- (3) The scale is regular. The marks represent equal steps. Every interval represents exactly the same distance.

Example 1b

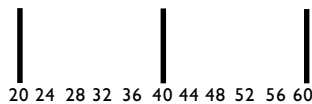
Fit the numbers 23 to 47 onto this scale; 0 is not necessary.

**Solution:**

Rather than trying to fit 23 to 47 exactly, it is better to round the lower number down and the higher number up and fit 20 to 50 instead i.e. a **range** of 30 ($50 - 20 = 30$).

Again we have 20 intervals between the two bolder lines, which makes each interval worth 1.5 ($30 \div 20 = 1.5$) or two intervals worth 3.

3 is not a nice number! But 4 is, so make two intervals worth 4, or one interval worth 2. This will mean part of the grid not being used, but it's the best we can do:



That's the theory. In practice, however, what most people do is use trial and error.

Then have a look at the size of the grid and start fitting numbers. If the numbers work, fine; if they don't, try something else.

On the next page I've tried to show you how to think your way through such a problem. You may not agree with the solution, but then there is rarely only one correct scale which can be applied.

Sorry, but here's a situation where you can have more than one correct answer.

Example 1c

Fit the numbers 7.6 to 8.7 onto a scale.

Solution:

Here is a typical trial and error attempt. Obviously I have had to write the attempts down, but you would normally do them in your head and only write down the final version.

(A) Here, each small space stands for 0.01, so the lines go 7.00, 7.01, 7.02, 7.03, 7.04, 7.05, 7.06 and so on. Clearly, each space represents too much, we can't even reach 7.5 let alone 8.7.

(B) Here, each small space stands for 0.02, so the lines go 7.00, 7.02, 7.04, 7.06, 7.08, 7.10, 7.12, and so on. Better than A but not good enough.

A	B	C	D
7.40 _____	7.80 _____	_____	9.00 _____
7.35 _____	7.70 _____	_____	8.75 _____
7.30 _____	7.60 _____	10.0 _____	8.50 _____

(C) Here we have adjusted too much. Each small space represents 0.1 and the lines go 7.0, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, and so on. We pass our maximum requirement of 8.7 and still have half the available grid to go.

7.25 _____	7.50 _____	9.5 _____	8.25 _____
7.20 _____	7.40 _____	9.0 _____	8.00 _____
7.15 _____	7.30 _____	8.5 _____	7.75 _____
7.10 _____	7.20 _____	8.0 _____	7.50 _____
7.05 _____	7.10 _____	7.5 _____	7.25 _____

(D) At last, each small space stands for 0.05 and the lines go 7.00, 7.05, 7.10, 7.15, 7.20, 7.25, 7.30 and so on. We cover the required range very comfortably.

7.00 _____	7.00 _____	7.0 _____	7.00 _____
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Notice that, because of the decimals we have to use, it is easier to write 7.0, or 7.00 than just the single digit 7. It makes the job of counting up that wee bit easier.

Some common errors

There are two very common errors. The first is understandable, and just a slip of the pen (I hope!). The second is horrendous and shows a complete lack of understanding of the basic principles of scales.

Error 1

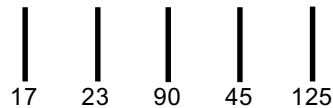
This simply involves getting one or two intervals different from all the rest, particularly at the very start. For instance marking consecutive lines something like:

0 1 2 4 6 8 10
 or
 0 5 10 20 40 60 80 100

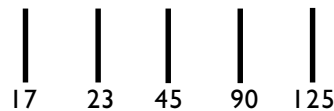
As you see the first couple of intervals are not the same as all the rest.

Error 2

One example will suffice. A student is trying to draw bars of heights 17, 23, 90, 45 and 125 on graph paper. The attempted scale looks like this:



or, only marginally better,



I hope you see just how wrong both of these are!



Get hold of some graph paper, preferably with the smallest grid being 1 mm or 2 mm.

Each axis should be longer than half the width of the page. We draw graphs to use up as much of the available paper as we can (unless the scale is very awkward and simply won't fit 'properly') because, as a rule,

the larger a graph or chart is,
 the more accurately it can be drawn,
 and the more accurately it can be read.

Draw a suitable scale for each of these:

- | | |
|---------------|-----------------|
| 1. 0 to 500 | 2. 0 to 37 |
| 3. 123 to 146 | 4. 0 to 7.3 |
| 5. 8.2 to 8.6 | 6. 342 to 597 |
| 7. 0 to 87.4 | 8. 54.9 to 87.4 |