Writing Scientific English

A textbook of English as a Foreign Language for students of Physical and Engineering Sciences

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Contents

Preface
Author's Note

Unit 1 Introduction to Scientific Statements
Be and have in scientific statements 1
Statements requiring the Present Simple 4

Unit 2 Dimensions and Properties
Dimensions 11
Properties 16
'Fronted' statements 18
Qualified Statements of Dimensions 20

Unit 3 Comparisons and Modals
Simple statements of comparison 23
Qualified comparative statements 29
A note on modals in scientific English 33

Unit 4 Impersonal Scientific Statements—
The Passive
Form of the passive 37
Use of the passive 39
By and the agent 45
Must, should, and the passive 47
Passives and infinitives 49
Passive and active 51

Unit 5 More Informative Statements—
Relative Clauses
Passive relative clauses 55
Active relative clauses 59
Reduced relative clauses 60

Unit 6 Definitions
General definitions and a definition formula 66
Specific definitions 75
Expanded definitions 77
Unit 2 Dimensions and properties

Dimensions

The dimensions of an object are its length, height, volume etc.

A solid has three dimensions.
A surface has two dimensions.
A line has one dimension.
A point has no dimensions.

There are several different ways of describing dimensions in English. The simplest way—and the most common way outside the field of science and technology—uses be as the main verb. We will call it structure 1. Here are some examples:

<table>
<thead>
<tr>
<th>be</th>
<th>adjective</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>is 3</td>
</tr>
<tr>
<td>The mountain</td>
<td>is 2,150</td>
</tr>
<tr>
<td>The river</td>
<td>is 50</td>
</tr>
<tr>
<td>The well</td>
<td>is 45</td>
</tr>
<tr>
<td>The pipes</td>
<td>are 4.5</td>
</tr>
<tr>
<td>The river</td>
<td>is 50</td>
</tr>
</tbody>
</table>

You will meet two possible spellings of words like meter and centimeter. The -er spelling (which is American) is used here rather than the -re spelling (which is British). The -er spelling is easier and more logical. Wide and broad usually mean the same thing and can be used one instead of the other. This can be seen in the two statements about the river.

Tall and high also mean the same thing, but they cannot usually be used one instead of the other. Tall is used of physical objects which are much longer in height than in width.
High is used of rounder or squarer objects. Therefore we say a tall tower but a high dam.
Also notice that only high can be used when describing things which are not physical objects: a high speed, high pressure etc.

○ Exercise 1 Complete these sentences using a suitable adjective. The first one has already been done.

1. The mountain is 2.150 meters .......
2. The carpet is 3 meters .........
3. The carpet is 1 1/2 centimeters .........
4. The chimney is 15 meters .........
5. The telephone wires are 6 meters .........
6. The telephone poles are 6.5 meters .........
7. That tree is 20 meters .........
8. The box is 0.50 meters .........
9. Women are usually about 1.50 meters .........
10. The door is 7 feet ........., 2 1/2 feet ........., and 2 1/8 inches .........

○ Exercise 2 Here are some 'notes.' Write them out in full using structure 1. Here is an example:

this table—2 meters
This table is 2 meters long.

1. this ruler—30 centimeters
2. this ruler—3 centimeters
3. this ruler—0.3 centimeters
4. standard writing paper—0.1 millimeters
5. this river—15 meters
6. the river—2 meters— in the middle
7. the lake—7 kilometers— and 14 kilometers
8. size 16 nails—2 centimeters— and 0.2 centimeters
9. telephone poles—usually 7 meters— and 20 centimeters
10. recent types of transistor— only 0.4 centimeters
11. the pages of this book ....
12. the opposite wall ....
13. the nearest window ....
14. Mount Everest ....
15. the local railway track ....

△ Exercise 3 Write two short passages, one giving the dimensions of the box, the other the dimensions of the building. Continue to use structure 1. (Diagrams on the next page)

The other main way of giving dimensions uses the verb have. We will call it structure 2. Here are some examples:

<table>
<thead>
<tr>
<th>have</th>
<th>noun</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>has a length of 3 centimeters.</td>
</tr>
<tr>
<td>The mountain</td>
<td>has a height of 2,150 meters.</td>
</tr>
<tr>
<td>The river</td>
<td>has a width of 50 meters.</td>
</tr>
<tr>
<td>The well</td>
<td>has a depth of 45 meters.</td>
</tr>
<tr>
<td>The pipes</td>
<td>have a thickness of 20 centimeters.</td>
</tr>
</tbody>
</table>
Notice these points:

(a) The indefinite article is used with the noun of dimension.
(b) The noun from tall (tallest) is never used in this structure.

Therefore, the two correct sentences are:

This man is 1.75 meters tall.
This man has a height of 1.75 meters.

(c) With structure 2 it is now possible to make statements about how heavy something is:

This stone has a weight of 85 grams.
This type of car has a weight of 950 kilograms.

Exercise 4 Complete these sentences. Use structure 2. Here is an example:

This pen .... 11 centimeters.
This pen has a length of 11 centimeters.

1 The road outside .... 6 meters.
2 The tallest building in the street .... 12 meters.
3 This pen .... 0.8 centimeters.
4 The contents of the test-tube .... 250 grams.
5 The top-soil in this area .... 15 centimeters.
6 The sample .... 9 kilos.
7 The walls of the glass container .... 15 millimeters.
8 This room .... 7 meters and .... 4 meters.
9 3 liters of water ....
10 1 liter of petrol ....

These `dimension' nouns are difficult to spell. Look at the following list, cover A and choose one of the five spellings in B for each of the nouns. Then check them against the correct spellings in A. If you make a mistake write the word out correctly at least three times.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>length</td>
<td>length length length length length</td>
</tr>
<tr>
<td>height</td>
<td>height height height height height</td>
</tr>
<tr>
<td>width</td>
<td>width width width width width</td>
</tr>
<tr>
<td>depth</td>
<td>depth depth depth depth depth</td>
</tr>
<tr>
<td>weight</td>
<td>weight weight weight weight</td>
</tr>
</tbody>
</table>

Exercise 5 Complete these sentences using the information given:

Circle A has a radius of 3 cm.
1 Circle A .... 6 cm.
2 Circle A .... 18.84 cm.
3 Circle A .... 28.26 cm².

Box B: length = 3m; height = 1.5 m; width = 2 m.
4 Box B .... 9 m³.
5 Box B .... 27 m³.

Sphere C has a diameter of 10 cm.
6 Sphere C .... 5 cm.
7 Sphere C .... 31.4 cm.
8 Sphere C .... 528 cm³.

Cylinder D has a cross-sectional area of 28.26 cm² and a height of 12 cm.
9 Cylinder D ....
10 Cylinder D ....

Exercise 6 Describe the dimensions of the car and the steel pipe. Write a short passage on each. In (b) include a statement about the amount of steel used in the pipe. (In order to avoid repeating the same structure all the time it is a good idea to use both structures 1 and 2.) (Diagrams on the next page)
These *have* sentences have one thing in common; they all describe properties. Consider this pair of sentences:

*Water boils at 100° C.*
*Water has a boiling point of 100° C.*

The first sentence states that some action (boiling) takes place at a certain temperature. However, it may be more scientific not to think of water actually doing something (in this case, boiling), but of having certain properties such that certain things occur at a certain temperature. This is why the second sentence may be preferred even though it is longer.

△ *Exercise 8* Complete ten of the following, using sentences of your own:

1. .... *have* a boiling point of .... .
2. .... a freezing point of .... .
3. .... a density of .... .
4. .... a velocity of .... .
5. .... a mass of .... .
6. .... a voltage of .... .
7. .... a breaking strain of .... .
8. .... an average life of .... .
9. .... an average temperature of .... .
10. .... a resistance of .... .
11. .... a diameter of .... .
12. .... a force of .... .
13. .... a cost of .... .
14. .... a thermal conductivity of .... .
15. .... the property of .... .

There are several possible ways of putting structure 2 statements in the negative. Look at the following:

Common in spoken British English
*Pure water hasn’t got a smell.*
*Pure water hasn’t got any smell.*

Common in spoken American English
*Pure water doesn’t have a smell.*
*Pure water doesn’t have any smell.*
Common in written scientific English

*Pure water has no smell.*
*A point has no dimensions.*

**Exercise 9** Look at the table below. You will see that it is not complete, but you probably know some of the missing information. Write as much as you can about each of the six substances. (Notice that you cannot use *have* when describing the form.) Join some of the statements together. Here is an example:

*Aluminium is a metal which has a melting point of 660° C.*
*It is silver in colour and it has a specific gravity of 2.8.*
*It has no smell.*

<table>
<thead>
<tr>
<th>Substance</th>
<th>Form</th>
<th>Colour</th>
<th>Smell</th>
<th>Melting Point</th>
<th>Boiling Point</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>chlorine</td>
<td>gas</td>
<td>none</td>
<td>none</td>
<td>−218</td>
<td>−183</td>
<td>0.0032</td>
</tr>
<tr>
<td>oxygen</td>
<td>none</td>
<td>none</td>
<td>character-istic</td>
<td>78.5</td>
<td></td>
<td>0.0014</td>
</tr>
<tr>
<td>ethyl-alcohol</td>
<td>none</td>
<td>none</td>
<td>characteristic</td>
<td>78.5</td>
<td></td>
<td>0.0014</td>
</tr>
<tr>
<td>water</td>
<td>liquid</td>
<td>none</td>
<td>none</td>
<td>−218</td>
<td>−183</td>
<td>0.0032</td>
</tr>
<tr>
<td>iron</td>
<td>solid</td>
<td>yellow</td>
<td>yellow</td>
<td>1535</td>
<td>2800</td>
<td></td>
</tr>
<tr>
<td>sulphur</td>
<td>solid</td>
<td>yellow</td>
<td>yellow</td>
<td>113</td>
<td>445</td>
<td>2.07</td>
</tr>
</tbody>
</table>

**Fronted’ statements**

Look at these examples of ‘fronted’ statements (structure 3):

<table>
<thead>
<tr>
<th>noun</th>
<th>be</th>
</tr>
</thead>
<tbody>
<tr>
<td>The length</td>
<td>of x is 3 cm.</td>
</tr>
<tr>
<td>The width</td>
<td>of this river is 50 m.</td>
</tr>
<tr>
<td>The height</td>
<td>of the hill is 750 m.</td>
</tr>
<tr>
<td>The depth</td>
<td>of this well is 45 m.</td>
</tr>
<tr>
<td>The thickness</td>
<td>of this tree is 1½ m.</td>
</tr>
</tbody>
</table>

Notice the difference between structure 2 and structure 3 (the subjects have been underlined):

structure 2   | The well has a depth of 45 meters.       |
structure 3   | The depth of the well is 45 meters.      |

In structure 3 more information is put into the subject. This way of building up the subject is common in scientific and technical writing. It can be called ‘fronting’ because more words are put in front of the main verb. Here are some more examples:

*The specific gravity of benzene is 0.78.*
*The distance between the two contacts is 2.5 mm.*
*The coefficient of expansion of brass is 0.000026 per °C.*
*The diameter of the cheaper kinds of household electric wire is approximately 1.3 mm.*

**Exercise 10** Rewrite these sentences using structure 3. Here is an example:

*This pen is 11 cm long.*
*The length of this pen is 11 cm.*

1. The bottle weighs 160 gm.
2. Water freezes at 0° C.
3. The water-towers have a height of 35 m.
4. Sound has a speed of 333 m per sec.
5. The water-tower has a capacity of 50,000 gallons.
6. The sea 100 m from the shore has an average depth of 15 m.
7. The cheaper kinds of household electric wires are 1.3 mm across.
8. The two cylinders of oxygen are 38 kg and 41 kg in weight.
9. The temperature in the furnace averages 900° C.
10. Under these circumstances, gravity has no effect.

**Summary of structures for stating dimensions and properties**

structure 1: *x is 3 cm long.*
structure 2: *x has a length of 3 cm.*
structure 3: *The length of x is 3 cm.*

It is also possible to describe dimensions using a variation of structure 1:

structure 1(a): *x is 3 cm in length.*

**Exercise 11** Write a passage describing the lay-out of a football field. (Be careful not to confuse the three structures.) (Diagram on the next page)
Qualified statements of dimensions

If a dimension is not given exactly, the fact that it is not exact should be made clear. In non-scientific English we usually use the word *about*:

\[ x \text{ is about } 3 \text{ centimeters long.} \]

In more technical writing *approximately* may be used instead:

\[ x \text{ is approximately } 3 \text{ cm long.} \]
\[ x \text{ is approximately } 3 \text{ cm in length.} \]

Here are some other typical qualifying words and phrases:

(a) \[ x = 3 \text{ cm} \]
   \[ x \text{ is } 3 \text{ cm long.} \]

(b) \[ x = 3.00 \text{ cm} \]
   \[ x \text{ is exactly } 3 \text{ cm long.} \]

(c) \[ x = \pm 3 \text{ cm} \]
   \[ x \text{ is approximately } 3 \text{ cm long.} \]

(d) \[ \begin{align*}
   x_1 &= 3 \text{ cm} \\
   x_2 &= 3 \text{ cm} \\
   x_3 &= 2.8 \text{ cm} \\
   x_4 &= 3.2 \text{ cm}
\end{align*} \]
   \[ x \text{ is } 3 \text{ cm long on average.} \]

(e) \[ x = 3.3 \text{ cm} \]
   \[ x \text{ is over } 3 \text{ cm long.} \]

(f) \[ x = 2.7 \text{ cm} \]
   \[ x \text{ is under } 3 \text{ cm long.} \]

(g) \[ x = 3.1 \text{ cm} \]
   \[ x \text{ is slightly over } 3 \text{ cm long.} \]

(h) \[ x = 2.9 \text{ cm} \]
   \[ x \text{ is under } 3 \text{ cm long.} \]
   \[ x \text{ is slightly under } 3 \text{ cm long.} \]

What structure was used in the examples you have just read?

Of course the above examples are only approximate. It is not possible to say exactly when these qualifying words or phrases are to be used.

- **Exercise 12** Write ten sentences as indicated below. Here is an example:

  The length of \[ AB = 9.03 \text{ cm (just over)} \]
  \[ AB \text{ is just over } 9 \text{ cm long.} \]

  1. \[ x = 3.07 \text{ cm long} \]
     \[ (a) \text{ (exactly)} \]
     \[ (b) \text{ (approximately)} \]

  2. The value of \[ \pi = 3.14159 \]
     \[ (a) \text{ (approximately)} \]
     \[ (b) \text{ (slightly under)} \]
     \[ (c) \text{ (to two decimal places)} \]

  3. The width of the pipe \[ = 0.216 \text{ meters} \]
     \[ (a) \text{ (under)} \]
     \[ (b) \text{ (just over)} \]
     \[ (c) \text{ (exactly)} \]

  4. The speed of the plane \[ = 523 \text{ kph} \]
     \[ (a) \text{ (very approximately)} \]
     \[ (b) \text{ (a little over)} \]

The qualifying phrases *under, over, just under, a little over, etc.* can be used in the same way with structures 2 and 3:

structure 2 \[
\begin{align*}
  x &\text{ has a length of } 3 \text{ cm.} \\
  x &\text{ has a length of slightly under } 3 \text{ cm.} \\
  x &\text{ has a length of a little over } 3 \text{ cm.}
\end{align*}
\]

structure 3 \[
\begin{align*}
  \text{The length of } x &\text{ is } 3 \text{ cm.} \\
  \text{The length of } x &\text{ is slightly under } 3 \text{ cm.} \\
  \text{The length of } x &\text{ is a little over } 3 \text{ cm.}
\end{align*}
\]

However, there are two possible forms with other qualifications:

structure 2 \[
\begin{align*}
  x &\text{ has an approximate length of } 3 \text{ cm.} \\
  x &\text{ has a length of approximately } 3 \text{ cm.}
\end{align*}
\]

structure 3 \[
\begin{align*}
  \text{The approximate length of } x &\text{ is } 3 \text{ cm.} \\
  \text{The length of } x &\text{ is approximately } 3 \text{ cm.} \\
  \text{The average length of } x &\text{ is } 3 \text{ cm.}
\end{align*}
\]

\[ \text{...} \]
\[ \text{The exact length of } x \text{ is } 3 \text{ cm.} \]
Exercise 13  Rewrite these sentences qualifying them.

1. The mountain is 2045 m high.
2. The height of the mountain is 2045 m.
3. The foundations of the building are 3.9 m deep.
4. The samples have weights of 18.6, 21.1, and 19.5 kilograms.
5. The nerve is 0.009 mm in breadth.
6. Diamond has an index of refraction of 2.47.
7. The moon has a radius of 1736 km.
8. Light has a speed through water of 224 million meters per second.
9. Under stated conditions atmospheric pressure equals 14.72 psi.
10. The escape velocity of the moon is 2.38 km per sec. and for the earth 11.2 km per sec.

Exercise 14  Describe the dimensions of this syringe. Include a statement about the approximate amount of liquid the syringe can contain.