26 Graphs

Tuning-in

In engineering, graphs and charts are a common way of giving information. They allow a great deal of data to be presented easily in visual form.

Task 1

Label the following graphic displays with the correct term from this list:

- graph
- pie chart
- bar chart
- bar chart (column chart)

(a) Pie chart
(b) Bar chart
(c) Washing machines, dishwashers, colour TVs, vacuum cleaners, tumble-driers, fridge-freezers, chest freezers, upright freezers
(d) Graph showing typical daily load curves for a power station

Task 2

Study the graph opposite which shows typical daily load curves for a power station. Answer these questions about the graph for weekdays.

1. When is the peak load?
2. When is there least demand?
3. When is the load 65% of capacity?
4. What is the load at 1 p.m.?
Describe changes in load for these periods:

5 Between 6 a.m. and 10 a.m.
6 Between 7 p.m. and midnight.
7 Between 3 p.m. and 5 p.m.

**Language study** Describing graphs

Look at the period 6 a.m. to 10 a.m. We can describe the change in load in two ways:

1. *The load rises.*
2. *There is a rise in load.*

We can make our description more accurate like this:

3. *The load rises sharply.*
4. *There is a sharp rise in load.*

Study this table of verbs and related nouns of change. The past form of irregular verbs is given in brackets.

<table>
<thead>
<tr>
<th>Direction</th>
<th>Verb</th>
<th>Noun</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up</td>
<td>climb</td>
<td>increase</td>
</tr>
<tr>
<td></td>
<td>go up (went up)</td>
<td>rise</td>
</tr>
<tr>
<td></td>
<td>increase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>rise (rose)</td>
<td></td>
</tr>
<tr>
<td>Down</td>
<td>decline</td>
<td>decline</td>
</tr>
<tr>
<td></td>
<td>decrease</td>
<td>decrease</td>
</tr>
<tr>
<td></td>
<td>dip</td>
<td>dip</td>
</tr>
<tr>
<td></td>
<td>drop</td>
<td>drop</td>
</tr>
<tr>
<td></td>
<td>fall (fell)</td>
<td>fall</td>
</tr>
<tr>
<td></td>
<td>go down (went down)</td>
<td>no change</td>
</tr>
<tr>
<td>Level</td>
<td>not change</td>
<td>no change</td>
</tr>
<tr>
<td></td>
<td>remain constant</td>
<td></td>
</tr>
</tbody>
</table>
These adjectives and adverbs are used to describe the rate of change:

<table>
<thead>
<tr>
<th>Adjective</th>
<th>Adverb</th>
</tr>
</thead>
<tbody>
<tr>
<td>slight</td>
<td>slightly</td>
</tr>
<tr>
<td>gradual</td>
<td>gradually</td>
</tr>
<tr>
<td>steady</td>
<td>steadily</td>
</tr>
<tr>
<td>steep</td>
<td>steeply</td>
</tr>
<tr>
<td>sharp</td>
<td>sharply</td>
</tr>
<tr>
<td>sudden</td>
<td>suddenly</td>
</tr>
<tr>
<td>fast</td>
<td>fast</td>
</tr>
</tbody>
</table>

**Task 3**

Study this graph which shows the load at weekends.

![Graph showing load at weekends](image)

*Fig. 2*

Write sentences to describe the load during these periods.

1. Saturday, 8 a.m. to noon.
2. Saturday, 6 p.m. to 10 p.m.
3. Saturday, noon to 5 p.m.
4. Saturday, noon to 1 p.m.
5. Sunday, 2 a.m. to 8 a.m.
6. Sunday, 8 a.m. to 9 a.m.
7. Sunday, noon to 3 p.m.
8. Sunday, 5 p.m. to 10 p.m.

**Task 4**

Look at Fig. 1 and Fig. 2. Make comparisons of these periods. For example:

Sunday, 4 a.m. to 8 a.m./weekdays at the same time.

*On Sunday the load remains constant between 4 a.m. and 8 a.m. but on weekdays it rises sharply.*

1. Sunday, noon to 3 p.m./Saturday at the same time.
2. Weekdays, 10 p.m. to 11 p.m./Saturday at the same time.
3. Saturday peak load/Sunday peak load.
4. Sunday, noon to 1 p.m./the rest of the week at the same time.
**Word study** Common verbs in engineering

Study this list of common verbs in engineering which you have studied in this book. They all have the sense of 'make something happen'.

- lower  make low
- raise     make high
- heat      make hot
- release   make free
- compress  make smaller volume
- reduce    make smaller
- increase  make larger

**Task 5**

Fill in the blanks in these sentences with suitable verbs from the list above.

1. When thermoplastics are ________, they soften.
2. If a gas is ________, it heats up.
3. Refrigeration preserves food by ________ its temperature.
4. A heater ________ the temperature of the water.
5. The rising piston ________ the fuel mixture.
6. Designers try to ________ the weight of a structure.
7. When the push button is ________, the valve spring pushes up the spool.
8. Pumping fluid into the main cylinder gradually ________ the jack.
10. The motor starts up slowly, then gradually ________ speed.
11. At intermediate substations, power is ________ to 11 kV for light industry.
12. When the child ________ the handle, the seat swings back under the weight.

**Writing** Describing a graph

An important mechanical test of a metal is the tensile test to destruction. Increasing loads are applied to a specimen of the metal until it breaks. For a mild steel specimen, a graph of load against extension looks like this:
Task 6

The following sentences describe the most important stages of the test. With the help of the graph:

- put the stages in the correct sequence to form a text describing the graph,
- fill in the missing references (O, P, E, Y, U, F)

a From _____ to _____ the specimen extends in direct proportion to the load applied.

b This rapid extension continues until point _____, the maximum load, is reached.

c From _____ there is a rapid increase in length for each increase in load.

d At _____ the specimen finally fractures.

e After _____ the specimen lengthens further but the load falls.

f Soon after P the material reaches its elastic limit, marked on the graph as point _____.

Task 7

Add this extra information to your text.

a Up to the elastic limit, the steel will regain its original length when the load is removed.

b Up to U there is no change in the cross-section of the steel.

c After the elastic limit, the steel will not regain its original length.

d After U the specimen undergoes ‘waisting’.

e Y is the yield point.

Task 8

Refer to each of these figures at an appropriate place in your text. Use expressions such as these:

As shown in Figure A.
See Figure A.
(Figure A)

A

B

C
Technical reading  Properties and applications of carbon steels

Task 9

Study the diagram below which shows how tensile strength, hardness, and ductility vary with the percentage of carbon in carbon steels. Answer these questions:

1. What percentage of carbon gives the greatest tensile strength?
2. What happens to ductility between 0.08% and 0.87% carbon?
3. How does increased carbon affect hardness?
4. What is the effect on tensile strength of increasing carbon beyond 0.84%?
5. What happens to ductility beyond 0.87% carbon?

Task 10

Now study the diagram below for extra information and answer these questions.

1. What is high carbon steel?
2. How much carbon does tool steel contain?
3. Compare the properties of mild steel and hard steel.
4. What kind of steel is tin plate made from?
5. What kind of steel are car springs made from?

Properties of carbon steels