Entry Level Literacy and Numeracy Assessment for the Electrotechnology Trades

Enrichment Resource

UNIT 10: Reading and Interpreting Graphs
GRAPHS

An electrician works with many different types of equipment such as motors, circuit breakers, resistors, capacitors and switches.

The performance and characteristics of this equipment can be effectively communicated through the use of graphs.

It is important for an electrician to be able to read these graphs and ensure that the appropriate equipment is installed and that it is operating correctly.

LEARNING OUTCOME

- Can read, interpret and analyse information presented on a line graph

PERFORMANCE CRITERIA

- Identifies the features of a line graph
- Recognises and describes trends in a line graph.
- Accurately reads a line graph.
- Interprets and analyses data presented on a line graph.
WHY ARE GRAPHS USEFUL?

Graphs are useful because they are a visual way of recording and reading information.

- a graph shows high and low points
- a graph shows where changes occur and what type of changes are taking place
  eg. steady/ fluctuating
  slow/ fast
- a graph makes comparisons easy
- a graph can provide large amounts of information quickly
LINE GRAPHS

In the electrical trade line graphs are the type of graph most commonly used to visually show the relationship between two different items or quantities. These quantities are called variables.

A line graph identifies how a change in one variable effects another.

![Line Graph Example]

**Figure 1**

**FEATURES OF A LINE GRAPH**

- The **title** tells what it is about, eg. wattage consumption in a 10Ω resistor.
- The **vertical axis** defines one set of data, eg. power.
- The **horizontal axis** defines the other set of data eg. current.
- These axes (scales) give the units of measurement eg. watts and amperes.
- The two axes **intersect at zero**.
READING AND INTERPRETING LINE GRAPHS

Accurate figures are often lost on a graph. It is the overall impact highlighting any trends that is important.

EXERCISE 1

Match the following trend statements with the appropriate graphs on the next page. Write the selected statement under the graph.

- decreasing slowly at first, more rapidly later
- staying the same
- steadily decreasing
- increasing slowly at first, more rapidly later
- fluctuating
- steadily increasing
- increasing quickly at first, more slowly later
- decreasing rapidly at first, more slowly later

Use the answer sheet to check your work.
PROPORTION

If two variables are increasing or decreasing at a constant rate, then we say the variables are proportional.

For example:

The voltage is proportional to the speed.

The torque is proportional to the load.

EXERCISE 2

Use the graph to answer the questions below.

Figure 2. Resistance of a Coil of Copper Wire
The resistance of all conductors varies with temperature. For pure metals, an increase in temperature will give an increase in the level of resistance. The change in the level of resistance depends on the type of metal. Figure 2 shows how the resistance of a coil of copper wire changes with temperature.

a. Complete the statements below.

i. The resistance of the copper wire steadily .................. as the temperature rises.

ii. The resistance of the copper wire is .................. ohms at 0°C.

iii. If the temperature drops to -150°C the resistance will drop to approximately ............... ohms.

b. i. Complete the table below.

<table>
<thead>
<tr>
<th>Resistance (ohms)</th>
<th>Temperature (°C)</th>
<th>-200</th>
<th>-100</th>
<th>0</th>
<th>100</th>
<th>200</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Approximate resistance of Coil of Copper wire as temperature changes.

ii. For every increase of 100°C the resistance increases by approximately .................. ohms.

c. The resistance of the coil of copper wire is proportional to its temperature.

True or False ..........................

Use the answer sheet to check your work.
EXTRAPOLATION

With a line graph, readings can also be taken beyond the limits of the graph if we want to know what will happen if a certain trend continues. This is called extrapolation, which means calculating values beyond the ones we already know. In the case of a graph, this involves extending the graph, e.g. Volts and Load Graph.

Note: Extrapolation makes the assumption that trends will continue. This is not always the case - not all trends can continue indefinitely. Limits can be reached, so that a graph which previously appeared to be increasing or decreasing might curve and level out.

EXERCISE 3

a. Using extrapolation, what would you expect the resistance of the coil of copper wire (Figure 2) to be at:

i. 250°C
ii. 300°C
iii. 325°C

b. i. What would you expect the resistance of the coil of copper wire (Figure 2) to be at 700°C?

............................................................................................................................

ii. Can you think of a reason why it might is not possible to extrapolate beyond 1083°C?

............................................................................................................................
EXERCISE 4

Use the graph to answer the questions below.

![Graph showing Power in watts vs. Current in amperes for wattage consumption in 10 Ω resistors.](image)

a. The two variables on the single curve graph in Figure 3 are

...................................................and .....................................................

b. Tick the true statement.

i. The current is in direct proportion to the power.  

   □

ii. The wattage consumption steadily decreases as the amperes increase.  

   □

iii. The power consumption increases more rapidly as the current in the resistor increases.  

   □
c. Complete the statements.

i. If the current in the 10Ω resistor is 4 amps then the power used is 

........................................ watts

ii. If the power used by the 10Ω resistor is.......................... watts 
then the current in the resistor is 5.5 amps.

iii. If an electrician wants a 10Ω resistor to consume 50 watts the current through 
the resistor would need to be ...................... amps
EXERCISE 5

Use the above multiple curves graph to answer the questions below.

a. The three variables on the multiple curves graph are:

   i. ..............................................................
   
   ii. ..............................................................
   
   iii. ..............................................................

b. Tick the true statements.

   i. As the speed (r/min) increases the power output (kW) decreases. □
   
   ii. The power curve increases quickly at first, more slowly later. □
   
   iii. The power output scale increases in units of 20. □
   
   iv. The torque (Newton metres, Nm) increases steadily as the speed (r/min) increases. □
   
   v. The torque (Nm) curve intersects with the power (kW) curve. □
c. Complete the statements

i. If the engine is operating at a speed of 1000 r/min then the power output is..................kW.

ii. When the torque is 200 Nm the speed is..................r/min or......................r/min.

iii. The power output is 40kW at a speed of.....................r/min.

iv. At a speed of approximately...................r/min the torque begins to decrease.

d. The torque curve indicates the range at which the engine is designed to operate.

What is the lowest speed that the engine is designed to operate?

.................................r/min.

Use the answer sheet to check your work.
ANSWERS:

EXERCISE 1

a. steadily increasing

b. steadily decreasing

c. increasing quickly at first, more slowly later

d. increasing slowly at first, more rapidly later

e. decreasing slowly at first, more rapidly later

f. decreasing rapidly at first, more slowly later

g. staying the same

h. fluctuating
**EXERCISE 2**

a. i. The resistance of the copper wire steadily **increases** as the temperature rises.

   ii. The resistance of the copper wire is **100 ohms** at 0°C.

   iii. If the temperature drops to -150°C the resistance will drop to **40 ohms**.

b. i. 

<table>
<thead>
<tr>
<th>Resistance (ohms)</th>
<th>20</th>
<th>60</th>
<th>100</th>
<th>140</th>
<th>180</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>-200</td>
<td>-100</td>
<td>0</td>
<td>100</td>
<td>200</td>
</tr>
</tbody>
</table>

Resistance of Coil of Copper Wire as Temperature Changes

ii. For every increase of 100°C the resistance increases by **40 ohms**.

c. The resistance of the coil of copper wire is proportioned to its temperature.

   **TRUE**

**EXERCISE 3**

a. i. **200 ohms**

   ii. **220 ohms**

   iii. **230 ohms**

b. i. The expected resistance of the coil of copper wire at 700°C would be **380 ohms**.

   ii. Copper melts at 1083°C.
EXERCISE 4

a. The two variables on the single curve graph in Fig 3 are **Power** in watts and **Current** in amperes.

b. True statement.
   iii. The power consumption increases more rapidly as the current in the resistor increases.

c. i. If the current in the 10Ω resistor is 4 amps, then the power used is **150** watts.
   
   ii. If the power used by the 10Ω resistor is **300** watts then the current in the resistor is 5.5 amps.
   
   iii. If an electrician wants a 10Ω resistor to consume 50 watts the current through the resistor would need to be **2.5** amps.
EXERCISE 5

a. The three variable on the graph are:
   i. Engine r/min (or speed)
   ii. Power output in kW
   iii. Torque Nm.

b. True statements
   ii. The power curve increases quickly at first, more slowly later.
   v. The torque (Nm) curve intersects with the power (kW) curve.

c. i. If the engine is operating at a speed of 1000 r/min then the power output is 30 kW
   ii. When the torque is 200 Nm the speed is 1000 r/min or 2400 r/min.
   iii. The power output is 40 kW at a speed of 1500 r/min.
   iv. At a speed of approximately 1750 r/min the torque begins to decrease.

d. The lowest speed that the engine is designed to operate is approximately 450 r/min.