EVALUATING
ACADEMIC READINESS
FOR APPRENTICESHIP TRAINING
Revised for
ACCESS TO APPRENTICESHIP

MATHEMATICS SKILLS
INTERPRETATION OF TABLES AND GRAPHS

AN ACADEMIC SKILLS MANUAL
for
The Small Motor Service Trades
This trade group includes the following trades
Marine & Small Powered Equipment Mechanic
Motorcycle Mechanic, and Small Motor Mechanic

Workplace Support Services Branch
Ontario Ministry of Training, Colleges and Universities

Revised 2011

In preparing these Academic Skill Manuals we have used passages, diagrams and questions similar to those an apprentice might find in a text, guide or trade manual.

This trade related material is not intended to instruct you in your trade. It is used only to demonstrate how understanding an academic skill will help you find and use the information you need

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MATHEMATICS SKILLS
INTERPRETATIONS OF TABLES & GRAPHS

An academic skill required for the study of the Small Motor Service Trades

INTRODUCTION

Charts, tables and graphs present facts visually, making it easier to find and interpret information. You can see the relationship between different quantities, rather than having to analyse numbers to make comparisons.

In your trades you will need to read and understand code books, operating and procedures manuals and manufacturers' specifications, inspection sheets and warranties. You may also be required to communicate and explain to others what needs to be done. Some of this information may be in the form of tables or graphs; it will be important for you to be able to interpret these documents.

This skills manual looks at tables and graphs, including the following topics:

- Tables
- Graphs
- Graphing a linear relationship

TABLES

Usually the information, or *data*, presented in a graph is first organized into a table. In a table, the data is arranged in rows and columns so they can be easily referred to.

Table 1 lists four types of fuels, the amount of heat (in British thermal units, or Btu's) per gallon of fuel each gives and the energy content of each fuel as a percentage of the energy content of diesel fuel. You can clearly see that number 2 diesel fuel has the greatest heat value per volume while methanol has the lowest value.

TABLE 1: Heat Values of Different Fuels

Fuel type	Btu/gal	Energy content compared to diesel fuel
no. 2 diesel	130,000	100 %
gasoline	115,400	89 %
methanol	56,600	44 %
ethanol	75,700	58 %

GRAPHS

A graph is a diagram that is used to show the changes of quantities in relation to each other.

> **Example:** A graph could be used to show the relationship between the heat values of different fuels in Table1.

The Co-Ordinate System

A ***grid*** system is used to locate points on a graph. *A **grid** consists of a horizontal line crossed by a vertical line.*

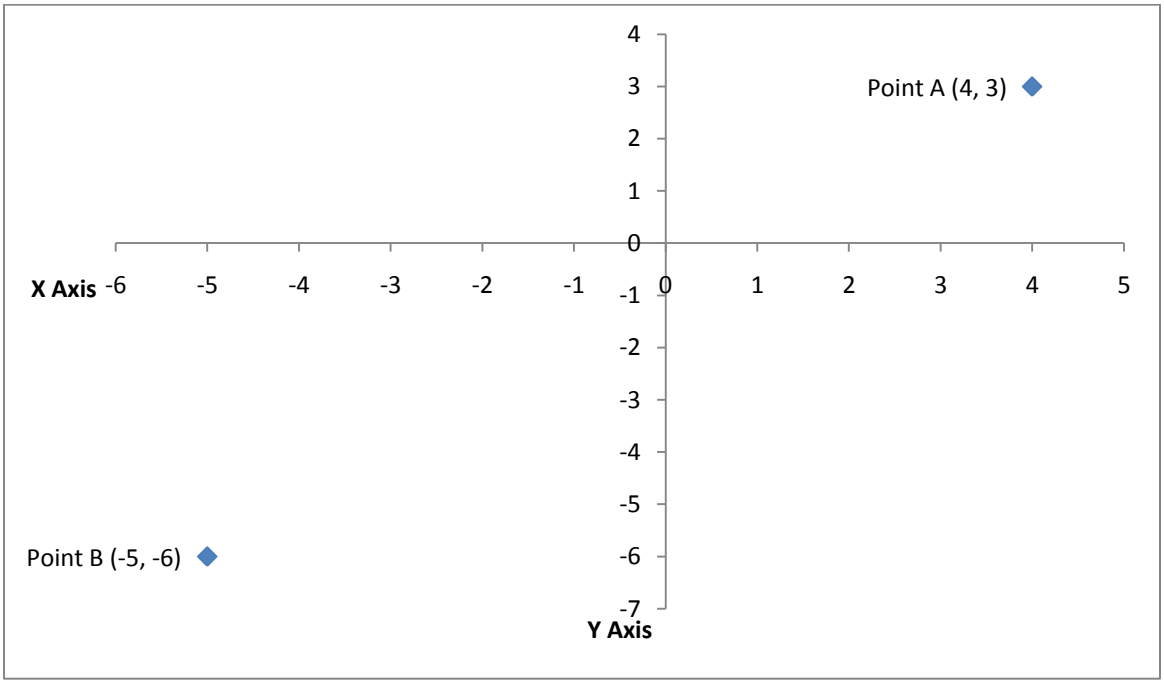
Graph 1, below, shows a grid.

- The horizontal line is called the ***x-axis***.
- The vertical line is called the ***y-axis.***
- The x-axis represents one set of measurements and the y-axis represents another set.

The x- and y-axis each have a ***scale***, *a graduated series of numbers that include the measurements of the quantities used on the graph.*

The point where the x and y-axis cross, called the point of intersection or the ***origin***, usually has the value of 0.

- Numbers to the right of 0 on the x-axis are positive, while numbers to the left of the origin are negative.
- Numbers above 0 on the y-axis are positive, while numbers below the origin are negative.



GRAPH 1: A grid with an X axis and a Y axis

Often only positive quantities are shown on a graph.

- A graph like this will not show negative numbers.
- The y-axis will be at the left hand side and the x-axis is at the bottom of the graph.

Points on a grid

A vertical line can be drawn from any point on the x-axis to meet a horizontal line drawn from any point on the y-axis. *Where the two lines meet, a **point** is formed on the grid.*

- A point can be formed at every place where a vertical line from the x-axis crosses a horizontal line extending from the y-axis,.

Coordinates

Every point has two ***coordinates*** *that describe where, on the graph, each point is*:

- The first coordinate shows the measurement on the x-axis.
- The second shows the measurement on the y-axis.
- Point coordinates are listed inside brackets.

Example: Look back to Graph 1. Point A on the graph is listed as Point A (4, 3).

1. If you look down to the x axis below Point A, you will see the point is directly above 4 on the axis.
   - 4 is the x coordinate.
2. If you look across to the Y axis you will see that Point G is directly across from the 3.
   - 3 is the y coordinate.

Point A (4,3) is the point where 4 is the x co-ordinate and 5 is the y co-ordinate.

Plotting points on a grid

In general, the information that is used to form the points on a grid comes from a table. The table will list two sets of numbers or measurements in a way that shows the connection between them.

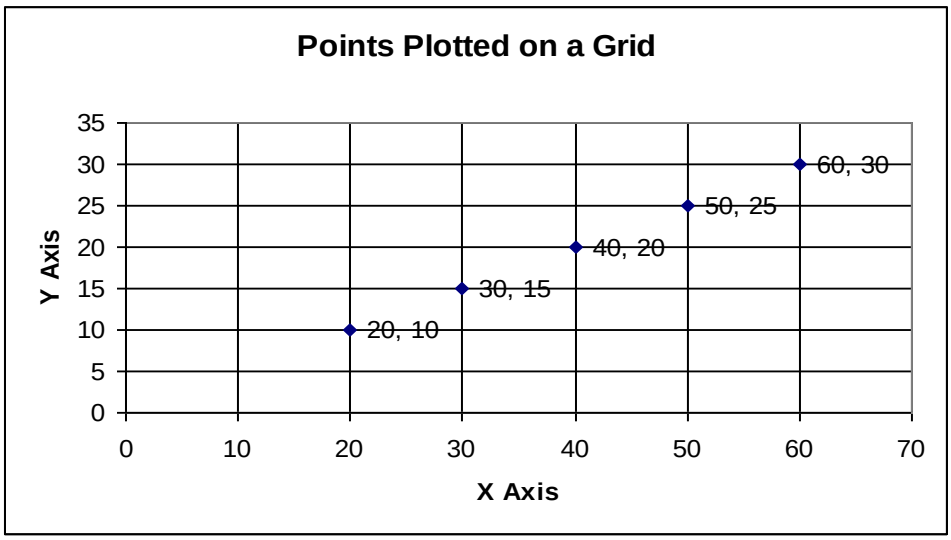
Table 2 lists related x and y values. This table can be used to plot points on a grid.

TABLE 2: List of x and y values

x value	y value
20	10
30	15
40	20
50	25
60	30

The points on Table 2 can be plotted on a grid with an x and y-axis, as shown on Graph 2 below.

1. To make the graph we assign each axis numbers that are in the range of the information on the table.
   - X values in the table start at 20 end at 60,
     - So the x axis will start at 0 but it must include that range of values.
   - Y values range between 10 and 30
     - The Y axis also starts at 0 and must include that range of values.
2. We put a point on the grid each place where the y value and the x value meet.
   - We put a point on the grid where the x value, 20, meets the y value, 10.
   - The next point goes where x = 30, y = 15.
   - Another point goes where x = 40, y = 20, and so on.
3. The result is Graph 2, below.



GRAPH 2 Points Plotted on a Grid

The grid in Graph 2 shows the horizontal x-axis and the vertical y-axis. The x and y scales are simple number intervals without any units such as centimeters or feet.

- Notice that the y scale is smaller or closer together than the x scale on the graph.
- Also note that only positive values are shown in this graph.

The points are plotted on the grid like this: Look at the third point on Graph 2. It has an x coordinate of 40 and a y coordinate of 20. It is named as point A (40, 20).

Finding Points on a Grid

To locate a point on a grid, use the x and y numbers listed in the co-ordinate pair for that point.

- The order of the numbers is important.
- The first number gives the x coordinate. The second number is the y coordinate.

To find the point (30,45) on Graph 2:

1. Draw a vertical line extending up from the number 30 on the x-axis.
2. Then draw a horizontal line extending over from the number 45 on the y-axis.
3. The point (30,45), is where the two lines meet.
4. Note that this point has no relation to the other points on the graph.

GRAPHING A LINEAR RELATIONSHIP

Graphs are used to show a relationship between two quantities, such as the relationship between the numbers of hours required to charge a battery and the voltage required. *If a line is drawn connecting the points, the graph is called a* ***line graph****.*

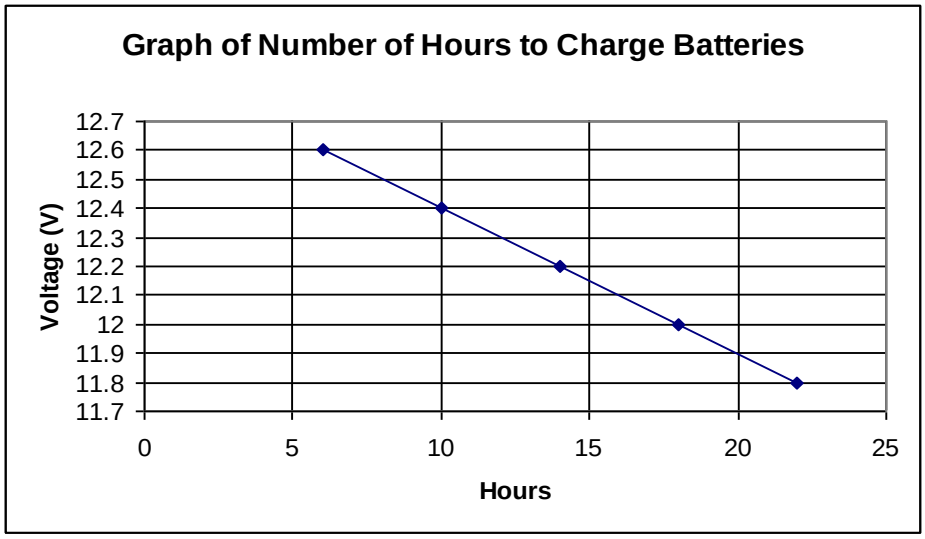
To graph the relationship between the open circuit voltage of a battery and the hours required to charge it using a 10 amp charger, Start by making a table that shows the relationships between the hours and the voltage. Follow these steps, using Table 5 and Graph 3:

1. List the voltage of different batteries and the hours required to recharge each battery.
   - Table 5 lists the measurements.

TABLE 5: Number of hours to charge batteries with a 10 amp charger

hours to charge	open circuit voltage
6	12.6 V
10	12.4 V
14	12.2 V
18	12.0 V
22	11.8 V

2. The number of hours forms the scale on the x-axis.
   - The time scale goes from 6 to 22 hours.
3. The voltage measurements form the scale on the y-axis.
   - The voltage scale goes from 11.8 V to 12.6 V.
4. Use the quantities listed in the table to form the points on Graph 3.
5. Draw a line to link the points.

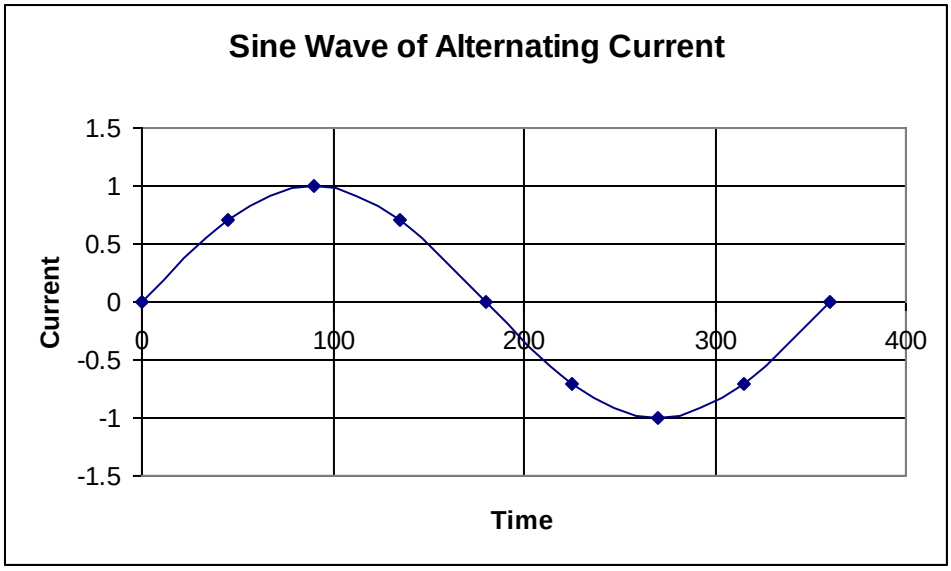


GRAPH 3: Number of Hours to Charge Batteries
When you look at Graph 3, you can see that the higher the voltage of a battery, the less time that is required to charge it, using a 10 amp charger.

*When the points are joined, a straight line is formed. If a straight line results when the points plotted on a graph are joined, a **linear relationship** exists between the two quantities.*

Graphs with Curved Lines
Some of the graphs in your work will form a curved line.

Example: Below is the graph of a sine wave. The current in power lines is supplied as an alternating current. This current moves in one direction, stops and then moves in the opposite direction. Graph 4 shows a sine wave of one cycle of an alternating current.



GRAPH 4 Sine Wave of Alternating Current

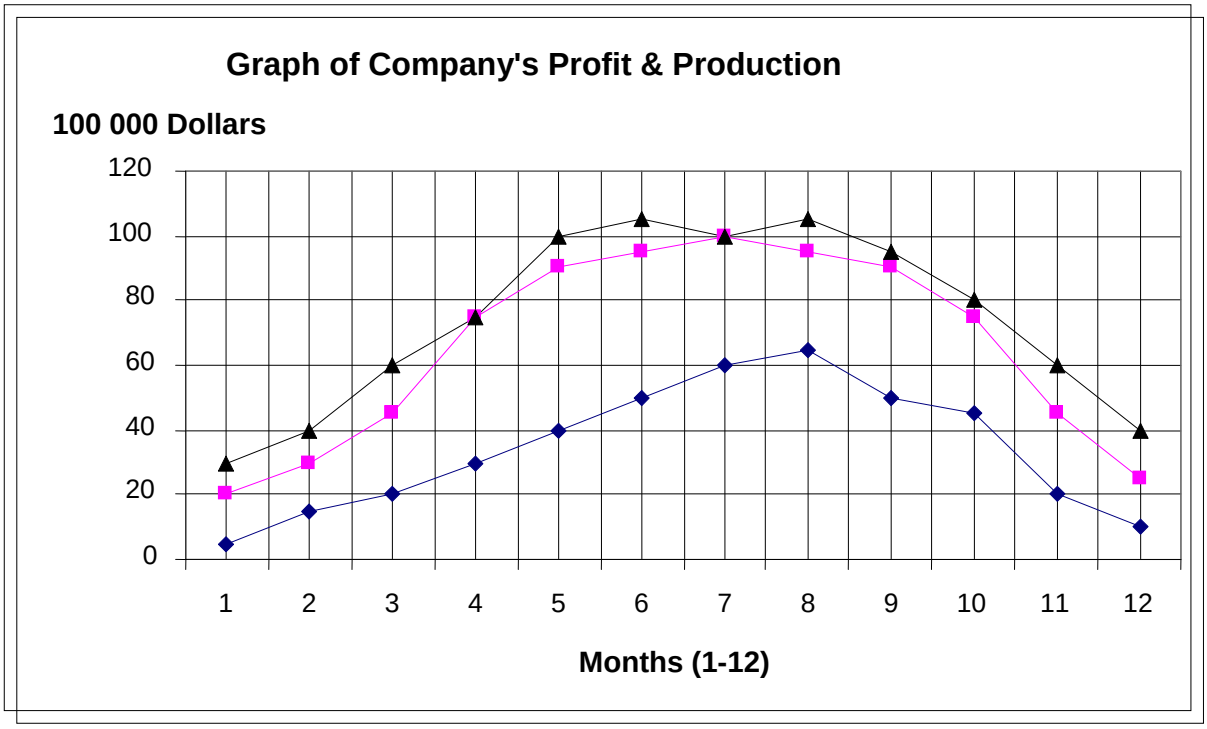
In Graph 4:

- The scale of the x-axis is the time it takes to make a complete cycle.
- The scale of the y-axis is the amount of current.
  - When the current is moving forward, the scale is positive.
  - When the current is moving in the reverse direction, the scale is negative.
- The graph does not show exact numbers for the current and time scale:
  - It does show how the amount, and direction of the current changes through one cycle.

Line graphs with more than one line

Line graphs with more than one line can compare several related quantities.

Example: A company might make a graph, like Graph 5, with three different lines, one showing the value of actual units produced, one showing projected value and one showing the profit. (The projected value is what the company anticipated it would produce before the year actually began.)



GRAPH 5: Graph Of Company's Profit And Production

In Graph 5:

1. The y-scale represents values for units produced in hundred-thousands of dollars.
   - This means that 20 represents 20 x $100 000 = $2 000 000 worth of units.
2. The x-scale represents the months of the year.
3. The company's projected production is represented by the line which has the symbol (Δ) at each of its points.
4. Actual its actual production is represented by the graph line with ■ at its point.
5. Net profit is represented by the line with the symbol (◊) for each month of one year.

Looking at Graph 5 we can learn the following:

1. The difference in the actual production line and the projected production line shows how close the company was to meeting its target.
2. We can see whether the company produced more or fewer units than it had hoped to.
3. We can see how the company's profits were distributed through the year.

Information such as how many months the value of actual units produced was greater than projected units, can be obtained from the graph.

1. The graph shows that in April, May, June, October, November and December actual production was greater than the projected production. July's value was the same as the projected value.

Graph 5 lets you quickly find information about your company's production and profit over the last 12 months.

Example: What month was the value of units produced the highest?

The graph shows that in June the value of units produced was the greatest.

Example: Which rose faster in the spring, the value of units or profit?

The heavy line showing the value of units rose more quickly in the spring than the dotted line showing profit.

Example: What month were profits the greatest?

Profits were the greatest in August.

Example: Would you say that the company was fairly accurate in its prediction for the year?

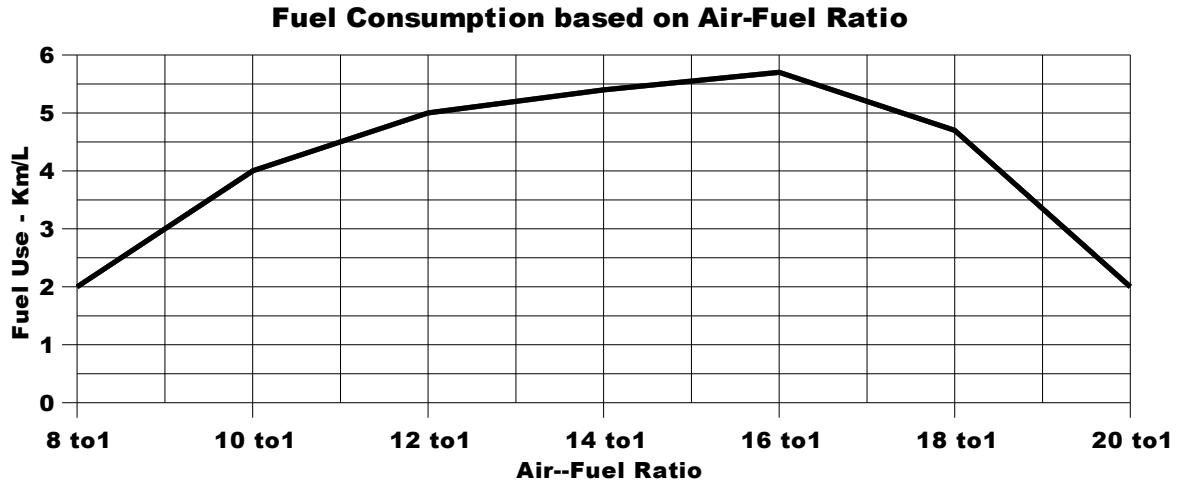
The graph lines for the value of actual units produced and the projected value are close, but production generally fell a bit short of what was projected.

The company made a fairly accurate prediction for the year, but did not exactly meet its targets..

Being able to predict accurately is important if a company has to order materials and hire workers ahead of time.

Answer the questions based on the graph which follows. Answers are on the last page.

In engines with carburetors, the carburetor is set to regulate the amount of air and fuel admitted to the engine in a changing ratio. The ratios vary from 8:1 to 20:1. When the ratio is properly set, complete combustion takes place and the most economical fuel consumption occurs. Use the graph below to answer the questions on fuel consumption and the air-fuel ratio.



1. What is the air-fuel ratio when the fuel consumption is 4 km/L? _____

2. What is the fuel consumption when the air-fuel ratio is 12:1? _____

3. At what air-fuel ratio is the gas consumption the most economical? (When do you get the most kilometers per liter of gas?) _____

4. At what two ratios is fuel consumption the least economical? _____ and _____

ANSWER PAGE

1. Air-fuel ratio is **10:1** when the fuel consumption is 4 km/L.

2. The fuel consumption is **5 km/L** when the air-fuel ratio is 12:1.

3. Most economical consumption is at air-fuel ratio of **16:1.**

4. Fuel consumption is least economical at the ratios of **8:1** and **20:1.**