EVALUATING
ACADEMIC READINESS
FOR APPRENTICESHIP TRAINING
Revised for
ACCESS TO APPRENTICESHIP

MATHEMATICS SKILLS
INTERPRETATION OF TABLES AND GRAPHS

AN ACADEMIC SKILLS MANUAL
for
The Horticulture Trades

This trade group includes the following trades:
Arborist, and
Horticulturist

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

Revised 2011

In preparing these Academic Skills 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.

MATHEMATICS SKILLS
INTERPRETATION OF TABLES AND GRAPHS

An academic skill required for the study of the Horticulture 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. As a horticulturist or arborist, you will refer to tables and charts to find what quantities of different products should be applied in a situation. Useful information such as the amount of usable nutrients in different kinds of fertilizer is presented in your textbook using a graph.

If you work as a landscape designer, you will need to understand and use a specialized type of graph – the blueprint. Although we don't usually refer to a blueprint as a graph, computer blueprints use the same ***Cartesian coordinate system*** that most graphs do. The Cartesian coordinate system uses a ***grid*** system to locate points on a graph.

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

- Tables
- The co-ordinate system
- Graphing a linear relationship
- Blueprint drawings as points on a grid

TABLES

Usually the information, or *data*, presented in a graph is first organized into a table. A table lists two or more sets of quantities, numbers or measurements in a way that shows the connection between them. The data is usually arranged in rows and columns.

As a horticulturalist or arborist, you have to be aware of the different pH levels of soils. Some plants require an acid soil while others prefer an alkaline soil. Certain plants grow best in a soil of a neutral pH. Table 1 shows the amount of limestone in pounds per 1000 square feet required to raise the pH of different types of soil from a pH of 5.5 to 6.5.

TABLE 1: Amount of limestone needed to raise the pH from 5.5 to 6.5 of different types of soil

Type of soil	Pounds of limestone per 1000 sq ft
Sandy	30
Sandy loam	55
Loam	85
Silty loam	105
Clay loam	120
Muck	225

You can see from the table that the amount of limestone needed varies considerably from 30 pounds to 225 pounds, depending on the type of soil.
A table can also show the relationship between two quantities in a formula. For example, the formula for the area of a circle is:

$$\text{Area} = \pi r^2$$

One quantity in the formula, area, varies as the length of the radius changes. For every value of radius in the formula, there is one value of area, found by multiplying π (3.14) times the radius squared. Table 2 compares area with different values of radius.

TABLE 2: Value of area as the radius changes

Radius	Area (πr^2)
2 cm	12.6 cm^2
3 cm	28.3 cm^2
4 cm	50.2 cm^2
5 cm	78.5 cm^2
6 cm	113.0 cm^2

Instead of a specific formula such as that for area of a circle, you can have a general equation such as $y = 2x + 3$. This equation, called a *function,* relates the value of *y* to every different value of *x* from 1 to 4.

- To find values for y, you substitute different values of x in the equation and solve for y.

TABLE 3: Value of x and y for the equation
y = 2x + 3

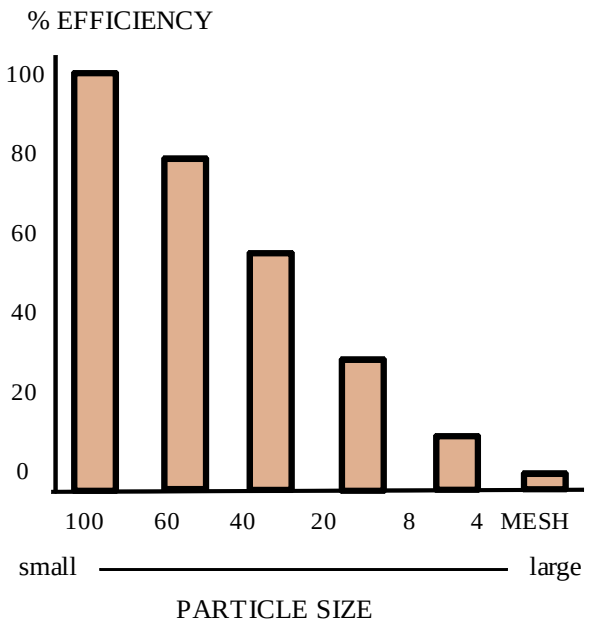
x	y (2x + 3)
1	(2x1 + 3) = 5
2	(2x2 + 3) = 7
3	(2x3 + 3) = 9

When numerical amounts of quantities are presented in a chart or table, the information can be presented as a graph. In a *line graph*, information is plotted as points on a grid. Graph 4 is a line graph. In a *bar graph*, information is presented as bars that can be visually compared. Graph 1 is a bar graph.

Table 1 illustrated how the texture of the soil influences the amount of limestone needed to change the pH. The size of the limestone particles, as measured by what size of mesh they go through, also influences the efficiency of the limestone in neutralizing soil acidity.

The bar graph, Graph 1, illustrates this relationship. You can easily see from this graph that the smaller the limestone is, the more efficiently it can be utilized by the soil you are treating.

Line graphs use a grid system to present information. We will look at the co-ordinate grid system first before examining line graphs.



GRAPH 1: The efficiency of limestone in neutralizing acidity depends on the particle size.

THE CO-ORDINATE SYSTEM

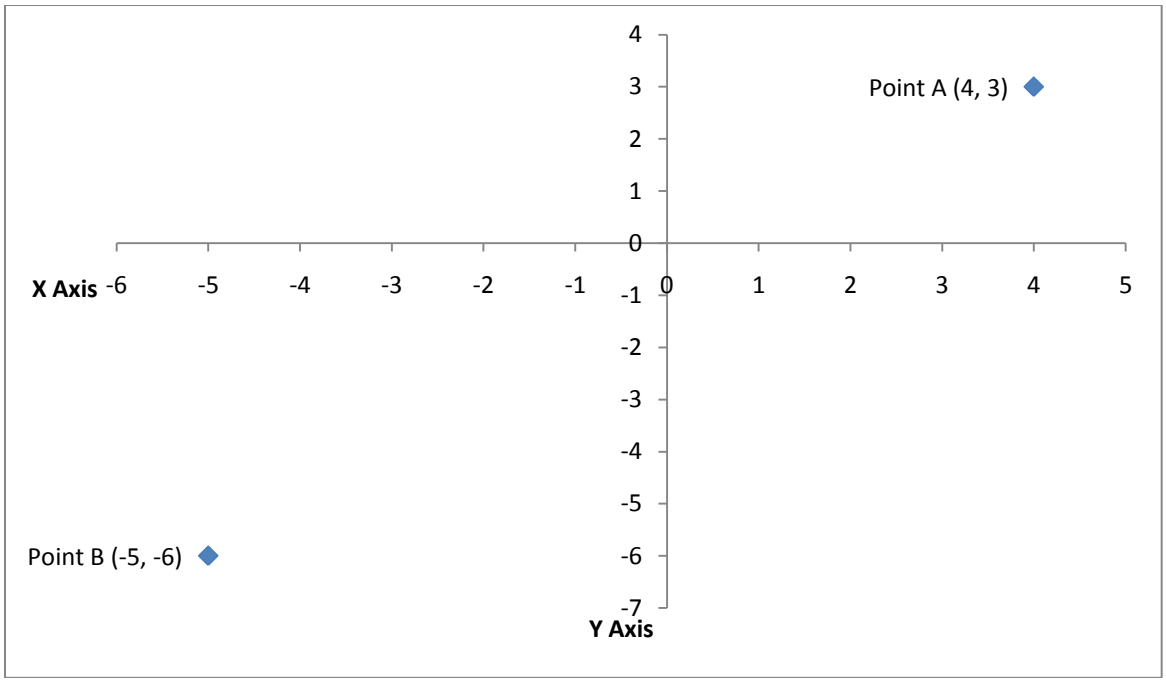
A ***grid*** system is used to locate points on a graph. A grid consists of a horizontal line crossed by a vertical line.
Graph 2 below, shows a grid.

- 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 2: 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 2. 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.

The origin is listed as the point (0,0). The x co-ordinate of the origin is 0, as is the y co-ordinate.

Plotting points on a grid

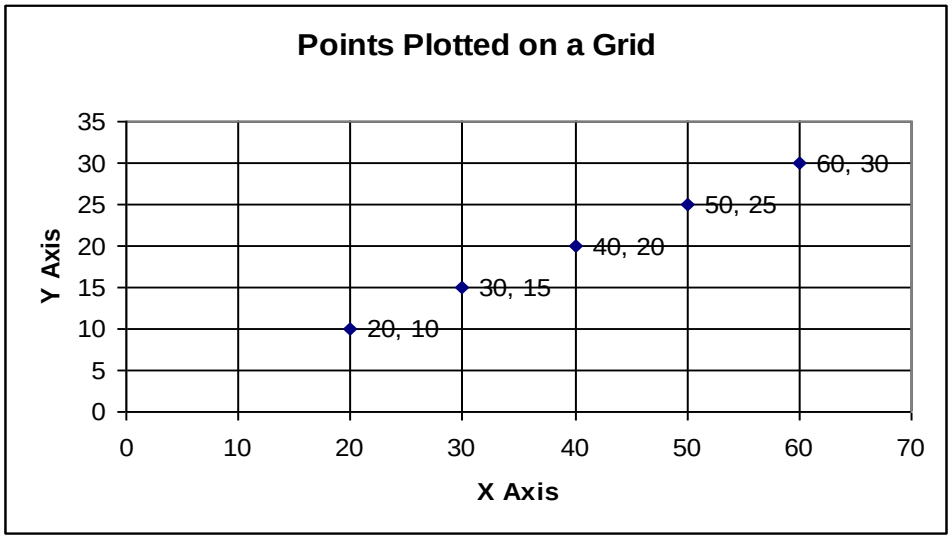
In general, the information that is used to form the points on a grid comes from a table such as Table 4. The table lists two sets of numbers or measurements in a way that shows the connection between them.

Look at Table 4, which lists related x and y values, and see how this table can be used to plot points on a grid.

TABLE 4: List of x and y values

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

These points can be plotted on a grid with an x and y-axis, as shown on Graph 3, by putting a point on the grid each place where the y value and the x value meet. For example, we put the point (20, 10) on the grid where the x value, 20, meets the y value, 10. The next point, (30, 15) goes where x = 30, y = 15. Another point, (40, 20) goes where x = 40, y = 20, and so on.



GRAPH 3 Points Plotted on a Grid

The grid in Graph 3 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 3. 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 3:

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 often 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***.

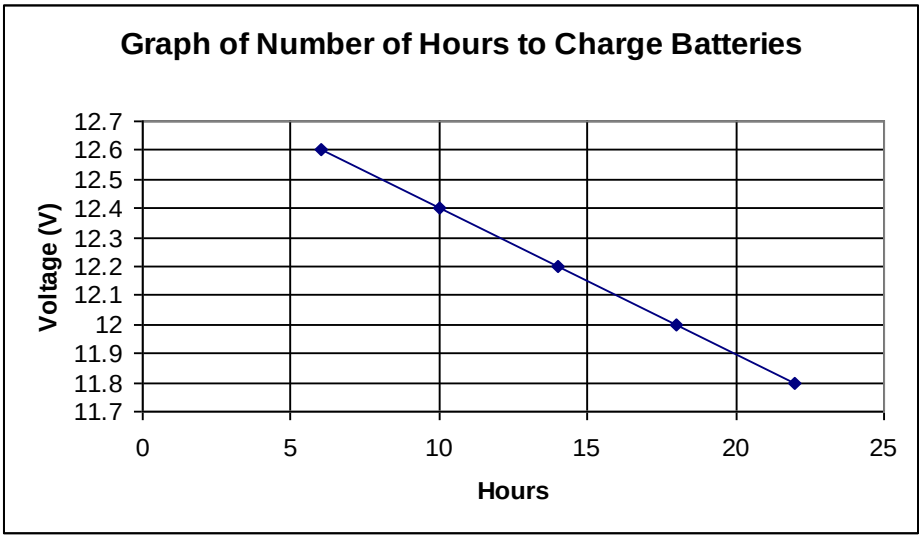
To graph the relationship between the open circuit voltage of a battery and the hours required to charge it using a 10 amp charger, follow these steps:

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 4.
5. Draw a line to link the points.



GRAPH 4: Number of Hours to Charge Batteries
When you look at Graph 4, 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.*

BLUEPRINT DRAWINGS AS POINTS ON A GRID

You can think of a two dimensional blueprint or working drawing as a series of points drawn on a grid.

Example: If you were making a rectangular box, you might have a blueprint showing three rectangular pieces:

- the top,
- the long side,
- and the short side.

Any of the rectangular pieces can be drawn as a series of points on a grid.

Graphs are created by drawing programs to generate working drawings and blueprints. The actual program for creating computer designed blueprints is, of course, very complex. However, it is based on the same grid system that simple graphs use.

Example: A CADD (computer-aided drafting and design) drawing is based on these principles.

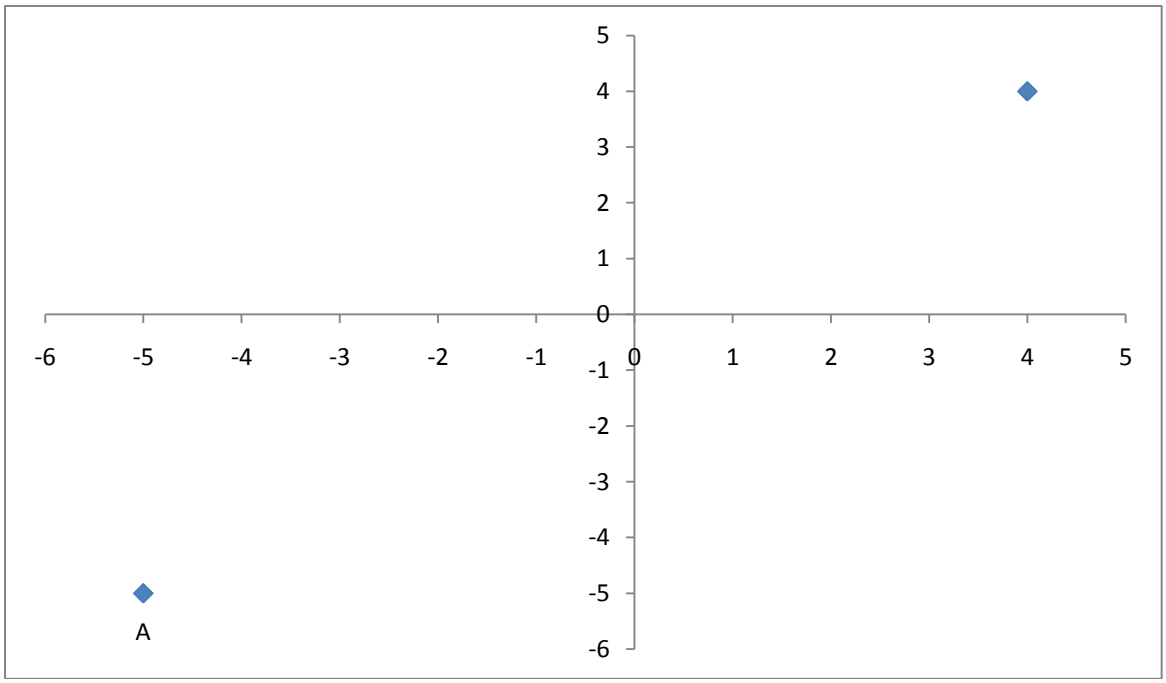
- Every line on the drawing is defined by the relevant points.
- If the computer is given the needed information, such as the center point of a circle and the radius, it can draw that circle.

Example: CADD can also generate three dimensional diagrams using a third axis, the z-axis.

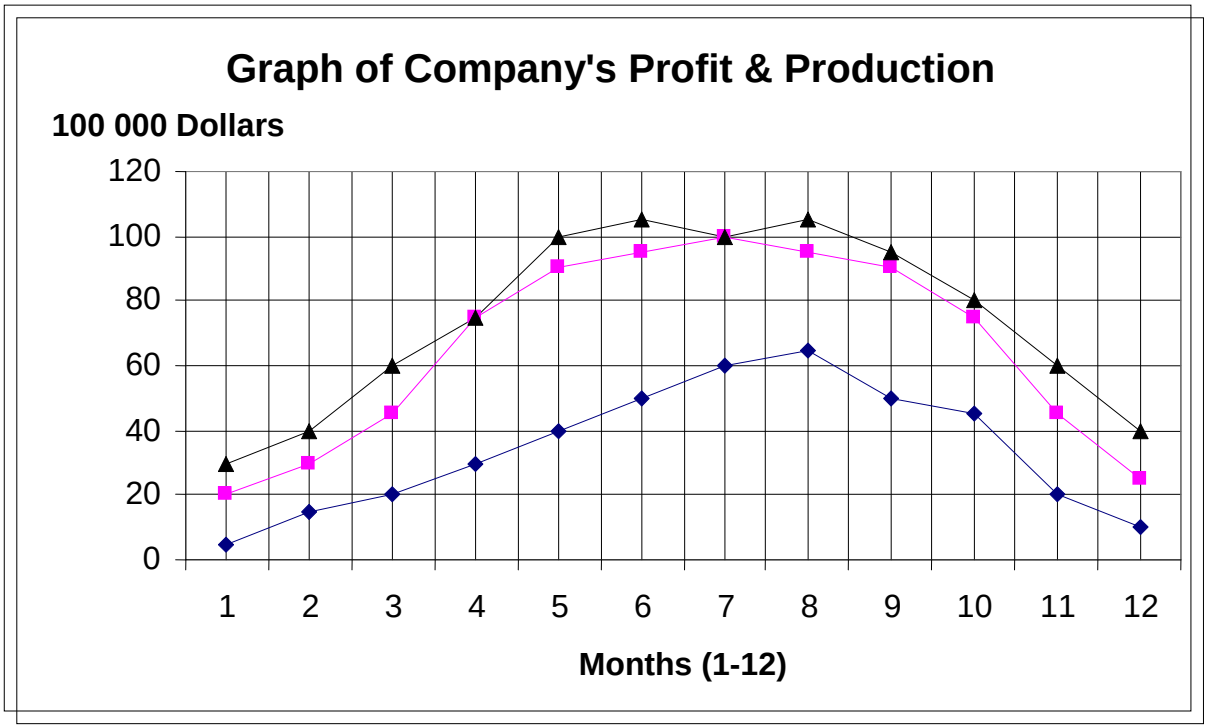
- The z-axis extends upwards and downwards at right angles from the point of origin.
- A point in a three dimensional diagram is named by the x, y, and z coordinates.

Answer the questions based on the graphs shown. Answers are on the last page.

1. a) Give the coordinates of Point A, located on the Graph below.
   b) Find the location and draw point C (3, -2) on the Graph below.



2. In the graph below:
   - A company's projected production is represented by the line which has the symbol (Δ) at each of its points.
   - Actual production is represented by the graph line with ■ at its point.
   - Net profit is represented by the line with the symbol (◊) for each month of one year.



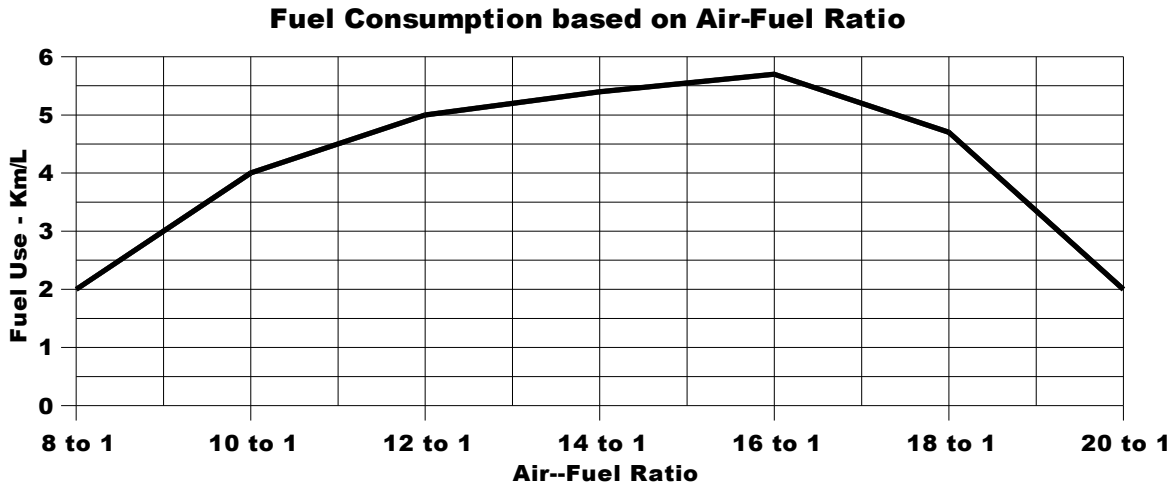
a. What month was the value of units produced the highest?

b. What months was the actual production the same as the projected production?

c. What month were profits the greatest?

d. Would you say that the company was fairly accurate in its prediction for the year?

3. In older vehicles with carburetors, the carburetor was set to regulate the amount of air admitted to the engine in a ratio with the amount of gasoline mixed with it. 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 air-fuel ratio.



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

b. What is the fuel consumption when the air-fuel ratio is 12? _____

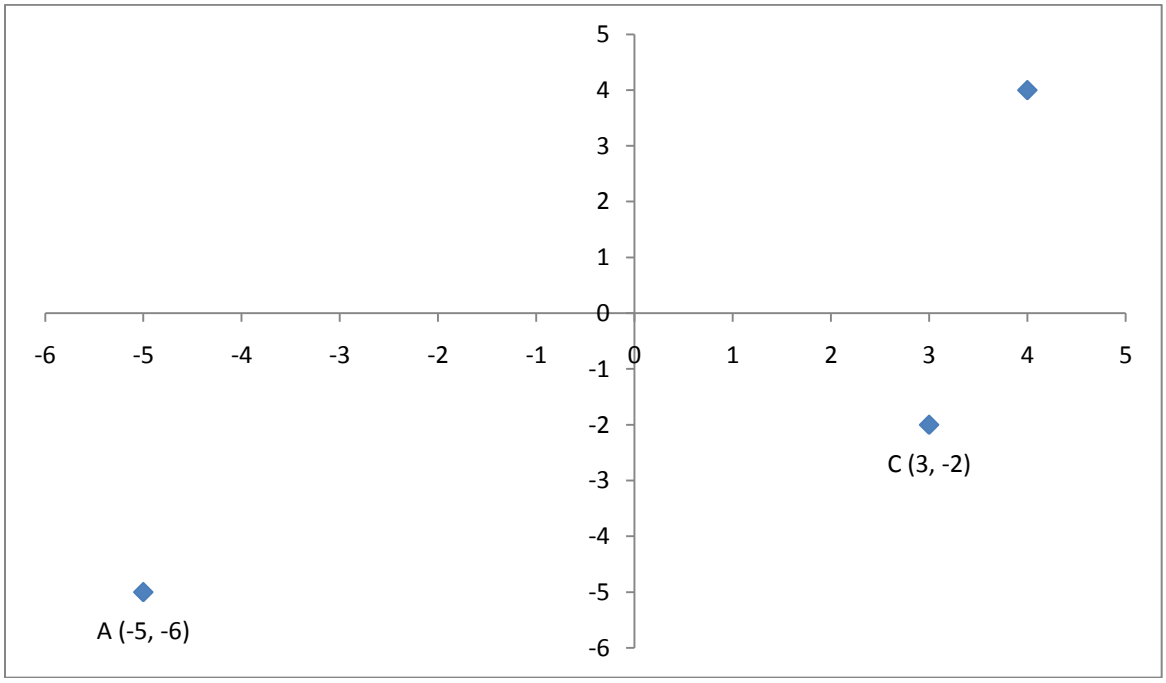
c. At what air-fuel ratio is the gas consumption the most economical? (When do you get the most kilometers per liter of gas?) _____

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

ANSWER PAGE

1. a) The x co-ordinate of point A is -5 and the y co-ordinate is -6.
The location of Point A is (-5, -6).

b) The location of Point C (3, -2) is shown below.



2. a) The value of units produced was the greatest in June.

b) The projected value was the same as the actual production in March, July and September.

c) Profits were greatest in August.

d) This question requires you to make a value judgement. The graph lines for the value of actual units produced and the projected value are close so it would be fair to say the company made an accurate prediction for the year.

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

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

c. Most economical consumption is at air-fuel ratio of **16 to 1.**

d. Fuel consumption is least economical at the ratios of **8 to 1** and **20 to 1**.