Chapter 4 / **Example 4**

Modeling with linear functions

If you have travelled between lower and higher altitudes, you may have noticed that the air pressure changes. Air pressure at sea level (0 km) is defined as 1 atmosphere (atm). At an altitude of 5000 feet, or 1.524 km, above sea level, air pressure is 83.7% of the pressure at sea level, or 0.837 atm. Assume that the relationship between air pressure and altitude is linear.

a Find an equation to express air pressure P (in atm) as a function of altitude a (in km).

b Interpret the gradient and y-intercept of $P(a)$ in context.

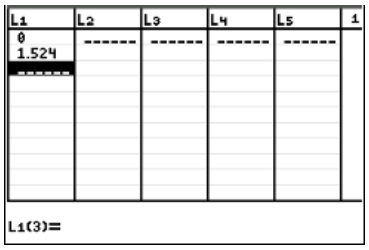
c If $(k, 0.5)$ is a point on the graph of $P(a)$, find the value of k and interpret its meaning in context.

Find the linear function through the points (0, 1) and (1.524, 0.837).

Press [STAT] 1:Edit and press [ENTER]

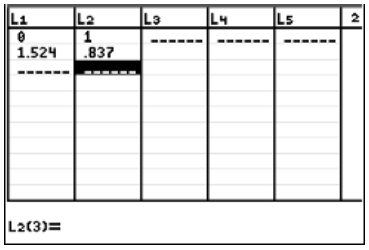
Enter the x-coordinates of the two points in the first column.

Press [ENTER] or [▼] after each number to move to the next cell.



Press [▶] to move to the next column.

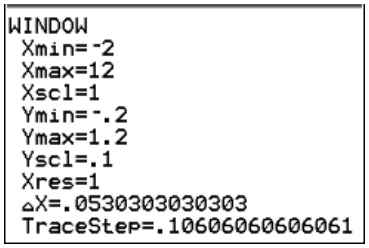
Enter the y-coordinates of the two points in the second column.



Press [F2] [WINDOW]

Set the axes to show $-2 \leq x \leq 12$ with a scale of 1 and $-0.2 \leq y \leq 1.2$ with a scale of 0.1

You can leave the last three items as they are.

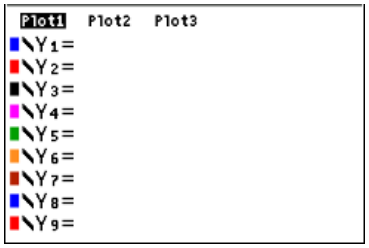


Press [F1] [Y=] to display the equation entry screen.

Press [▲] to navigate to Plot1 at the top of the screen.

Press [ENTER].

Press [F5] [GRAPH].

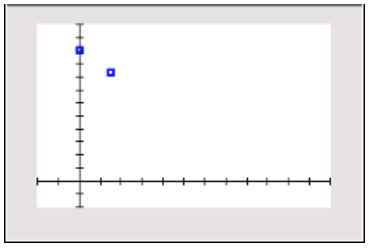


Chapter 4 / **Example 4**

Modeling with linear functions

Press [F5] GRAPH.

The GDC displays the two points.



To find the equation of the line through the points, calculate the equation of the regression line.

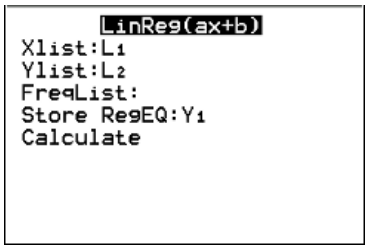
Press STAT and ▶ to access the CALC menu.

Select 4:LinReg(ax+b) and press ENTER.

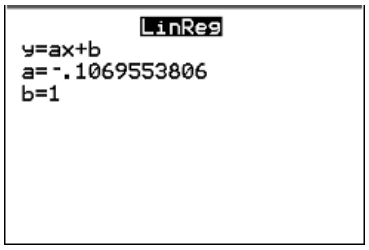
Leave the X List as L_1 and the Y List as L_2.

Enter Y_1 as the place to store the regression equation. To enter Y_1 press ALPHA [F4] 1:Y_1

Navigate down to Calculate and press ENTER.

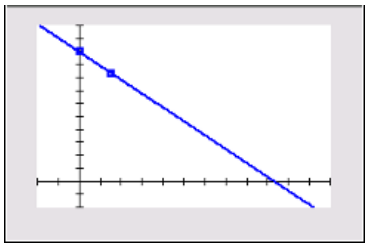


The equation of the line is $P(a) = 1 - 0.107a$



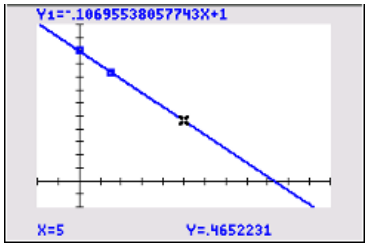
Press [F5] GRAPH.

The GDC displays the points and a straight line passing through them.



To find the gradient of the line press 2nd [CALC] 6:dy/dx and press ENTER.

The GDC displays a point on $P(a) = 1 - 0.107a$ and the gradient at that point, which is –0.107.



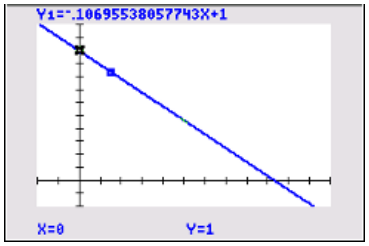
Chapter 4 / **Example 4**

Modeling with linear functions

To find the value of P when a is 0 press [2nd] [CALC] 1:value.

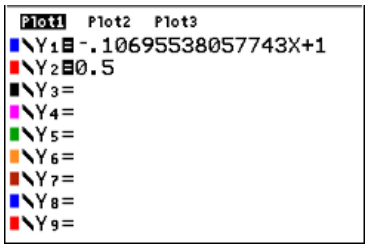
Type 0 and press [ENTER].

The GDC displays the coordinates of the point $(0,1)$.



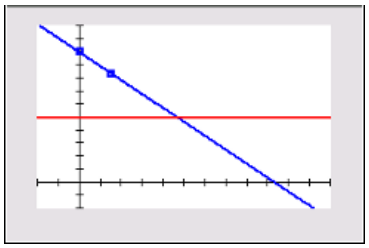
Press [F1] [Y=] to display the equation entry screen.

Type 0.5 and press [ENTER] to enter the equation as Y_2.



Press [F5] [GRAPH].

The GDC displays $Y_1 = -0.107x + 1$ and $Y_2 = 0.5$

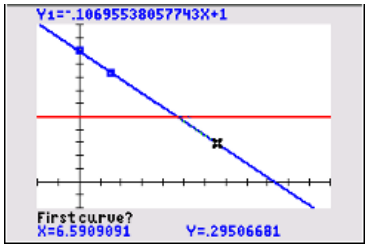


Press [2nd] [F4][CALC] 5:intersect

To find the intersection you need to choose the two lines that intersect.

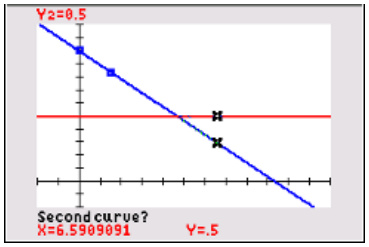
The GDC shows a cross on one of the lines and 'First curve?'.

Press [ENTER].



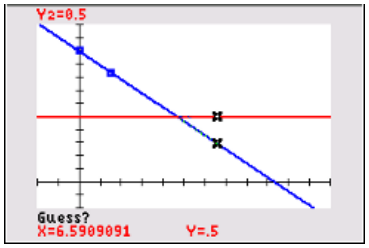
The GDC shows a cross on the other line and 'Second curve?'.

Press [ENTER].



The GDC requires an initial guess for the position of the intersection. Choose the default position.

Press [ENTER].



Chapter 4 / **Example 4**

Modeling with linear functions

The GDC displays the intersection of the two straight lines at the point $(4.67, 0.5)$

The air pressure will be 50% of the pressure at sea level at an altitude of 4.67 km.