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.

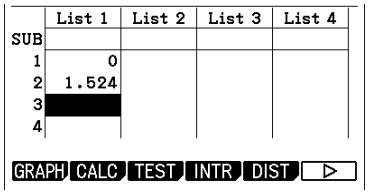
c If $(k, 0.5)$ is a point on the graph of $P(a)$, find the value of k and interpret its meaning in context.

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

Press MENU 2 STAT to display the List Editor screen.

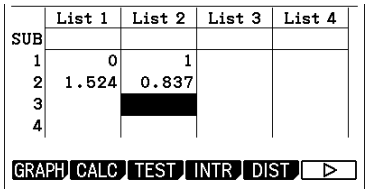
Enter the x-coordinates of the two points in the first column.

Press EXE after each number to move to the next cell.



Press ▶ to move to the next column.

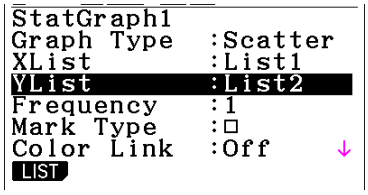
Enter the y-coordinates of the two points in the second column.



Press F1 GRAPH.

Press F6 SET.

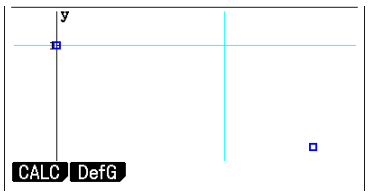
Choose Graph Type: F1 Scatter, XList: List1 and YList: List2.



Press EXIT.

Press F1 GRAPH1.

The GDC displays the two points.



© Oxford University Press 2019

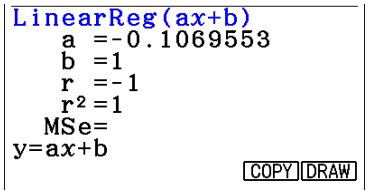
Chapter 4 / **Example 4**

Modeling with linear functions

To find the equation of the line through A and B, calculate the equation of the regression line. Press [F1] CALC, [F2] X, [F1] ax+b.

The form of the regression equation is '$y = ax + b$'.

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

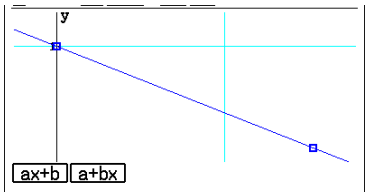


Press [F5] COPY.

The GDC displays the equation entry screen.

Press [SHIFT] [9] PASTE and press [EXE].

Press [F6] DRAW.



Choose suitable window settings to display the graph.

Press [MENU] 5 [GRAPH] ⏸

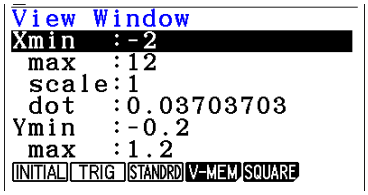
Press [F1] SELECT.

Press [SHIFT] [F3] V-WIN.

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

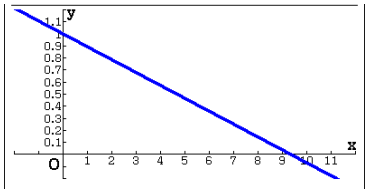
You can leave the other items as they are.

Press [EXIT] when you have finished.



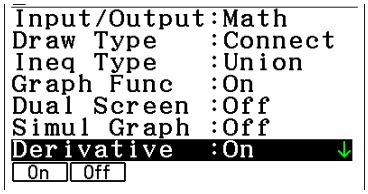
Press [F6] DRAW to display the graph screen.

The GDC displays the straight line passing through the two points.



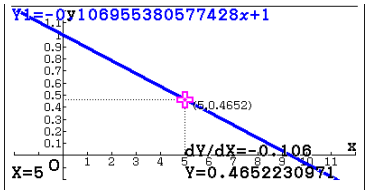
Press [EXIT] then press [SHIFT] [MENU] SET UP.

Scroll down to Derivative with ▼ and use [F1] to set this to 'On'. Press [EXIT] to return to the equation entry screen and [F6] DRAW to return to the graph.



To find the gradient of the line press [F1] Trace.

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



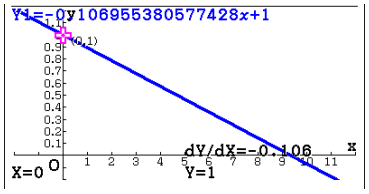
© Oxford University Press 2019

Chapter 4 / **Example 4**

Modeling with linear functions

To find the value of P when a is 0 type 0 and press [EXE].

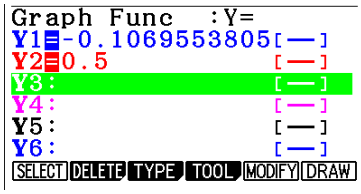
The GDC displays the coordinates of the point $(0,1)$.



You now need to Plot the line $y = 0.5$ on the same axes and find the intersection point.

Press [EXIT] to return to the equation entry screen.

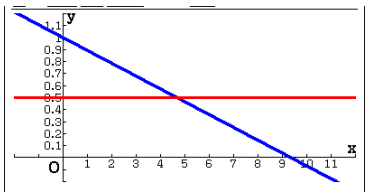
Type 0.5 press [EXE] to enter the equation as Y2.



Press [F6] DRAW. The GDC now displays both graphs:

$Y1 = -0.107x + 1$

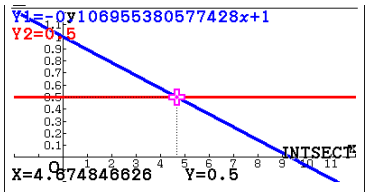
$Y2 = 0.5$



To find the intersection press [F5] G-Solv [F5] Intersect.

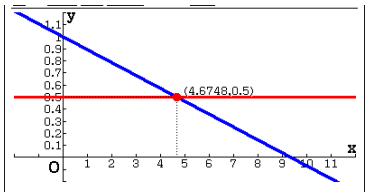
Press [EXE] to display the coordinates.

Press [EXIT] to leave G-Solv mode and [F6] DRAW to display the graph screen again.



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.



© Oxford University Press 2019