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.

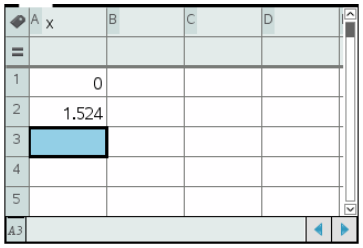
c If $(k, 0.5)$ is a point on the graph of $P(a)$, find the value of k and interpret its meaning in context.

Open a new document and add a Lists & Spreadsheet page.

Type 'x' in the first cell.

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

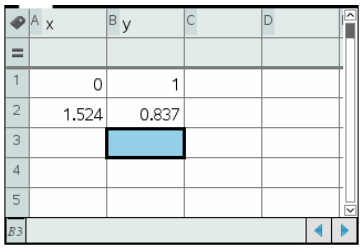
Press enter or ▼ after each number to move to the next cell.



Type 'y' in the cell to the right of 'x'.

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

Use the ▲ ▼ ▶ ◀ keys on the touchpad to navigate the spreadsheet.

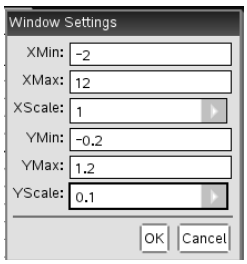


Press ctrl doc ([+page]) and add a Graphs page.

Press menu 4:Window/Zoom | 1:Window Settings…

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

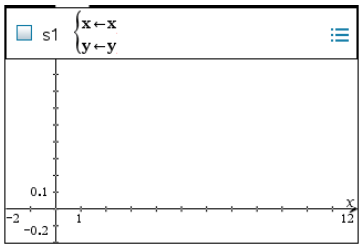
Press enter when you have finished.



Press menu 3:Graph Entry/Edit | 6:Scatter Plot.

The entry line is displayed at the top of the work area.

Type the names of the lists, x and y and press enter.



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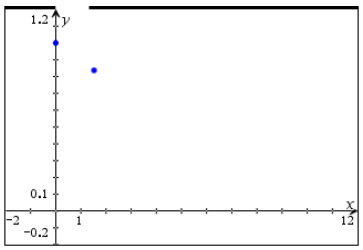
The GDC displays the two points.



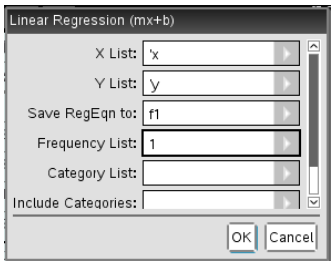
To find the equation of the line through the points, calculate the equation of the regression line.

Return to the Lists & Spreadsheet page by pressing ctrl ◀ del

Press menu 4:Statistics | 1:Stat Calculations | 3:Linear Regression (mx+b)…

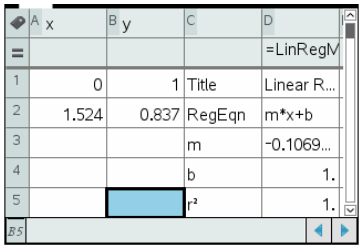
Open the drop down lists with ▶ and select using ▼ and enter del

Choose 'x' for X List, 'y' for Y List, f1 for Save RegEqn to and leave the remaining fields unchanged.



Click the touchpad on OK or press enter del

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



	A x	B y	C	D =LinRegM
1	0	1	Title	Linear R...
2	1.524	0.837	RegEqn	m*x+b
3			m	-0.1069...
4			b	1.
5			r^2	1.

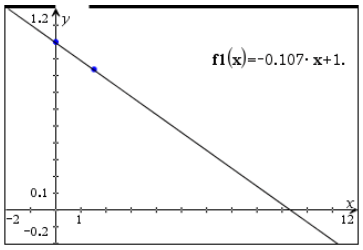
Return to the Graphs page by pressing ctrl ▶ del

Press menu 3:Graph Entry/Edit | 1:Function.

Press ▲ to scroll up to f1 and press enter del

The regression equation is already pasted as f1, but this will select it to display.

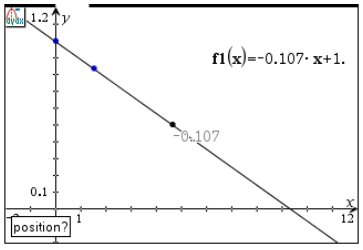
The GDC displays the points and a straight line passing through them.



To find the gradient of the line press

menu 6:Analyse Graph | 5:dy/dx and press enter del

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



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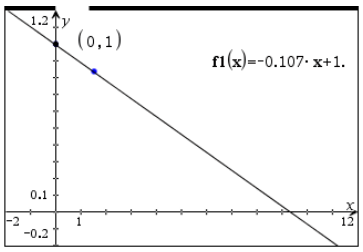
To find the value of *P* when *a* is 0 press menu 5:Trace | 1:Graph Trace.

Press ▲ to select f1.

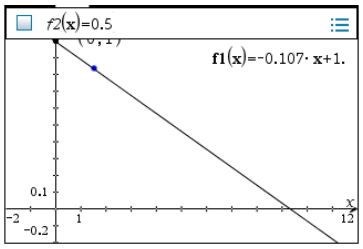
Type 0 and press enter. Press enter again and press esc.

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

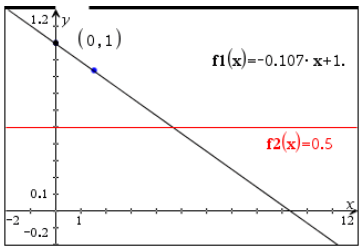


Press tab to display the entry line again. This time '*f2*(*x*)=' is displayed.

Type 0.5 and press enter.



The GDC displays $f1(x) = -0.107x + 1$ and $f2(x) = 0.5$.

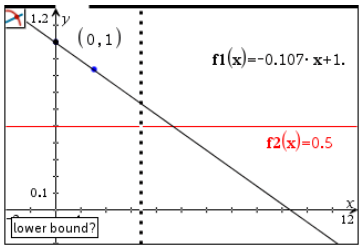


Press menu 6:Analyse Graph | 4:Intersection.

To find the intersection you need to give the lower and upper bounds of the region that includes the intersection.

The GDC shows a line and asks you to set the lower bound. Move the line using the touchpad and choose a position to the left of the intersection.

Click the touchpad.

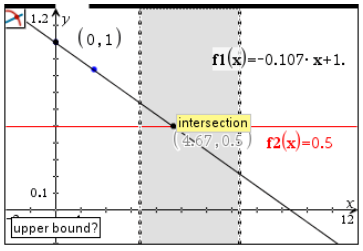


The GDC shows another line and asks you to set the upper bound.

Use the touchpad to move the line so that the region between the lower and upper bounds contains the intersection.

When the region contains the intersection, the calculator will display the word 'intersection' in a box.

Click the touchpad.



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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.