Chapter 4 / **Example 14**

Modelling with arithmetic sequences

A piledriver is a machine used in construction to drive support poles into the ground by repeatedly striking them. Acme construction company uses a piledriver that drives support poles 0.12 m deeper into the ground with each strike. The current support pole has already been driven 13.6 m into the ground.

a If the sequence $\{u_n\}$ represents the depth of the support pole after n strikes, find the first three terms of the sequence.

b Write down an expression for the nth term of the sequence.

c The support poles must be driven to a depth of at least 38 m below ground. Determine

i the number of strikes needed to reach this depth

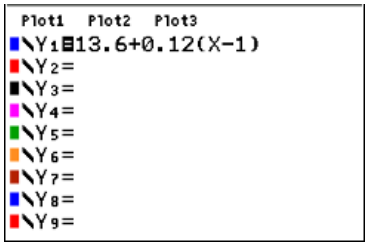
ii the exact depth it will then have reached.

$u_1 = 13.6$, $u_2 = 13.72$, $u_3 = 13.84$

$u_n = 13.6 + 0.12(n-1)$

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

Type $13.6+0.12(x-1)$ and press [ENTER] to enter the equation as Y_1.

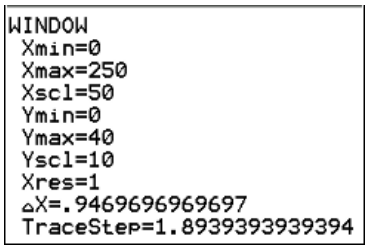


To show the graph in an appropriate window.

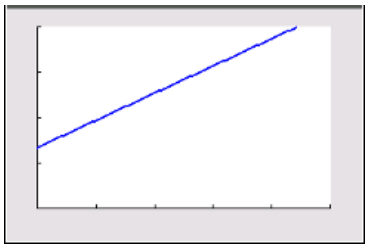
Press [F2] [WINDOW]

Set the axes to show $0 \le x \le 250$ with a scale of 50 and $0 \le y \le 40$ with a scale of 10. Leave the other items the same.

Press [F5] [GRAPH] when you have finished.

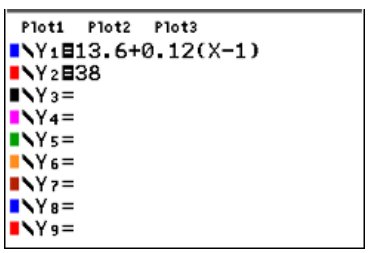


The GDC displays the graph in a suitable window.



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

Type 38 and press [ENTER] to enter the equation as Y_2.



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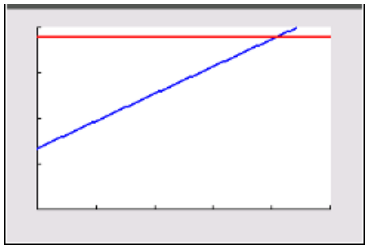
The GDC now displays both straight-line graphs:

$Y_1 = 13.6 + 0.12(x - 1)$

$Y_2 = 38$

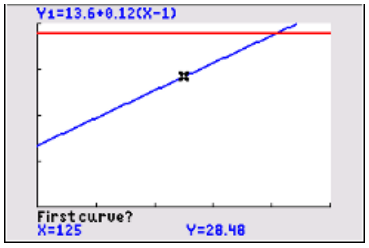


Press 2nd [F4][CALC] 5:intersect

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

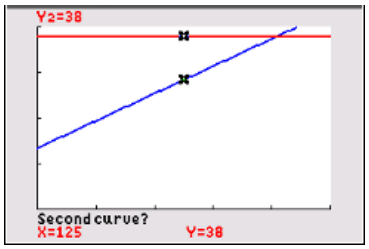
The GDC shows a cross on one of the lines and 'First curve?'.

Press ENTER.



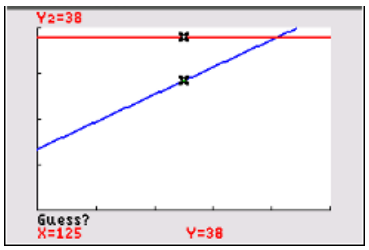
The GDC shows a cross on the other line and 'Second curve?'.

Press ENTER.



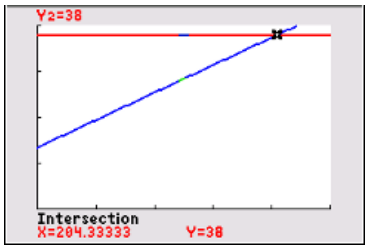
The GDC requires an initial guess for the position of the intersection. Choose the default position.

Press ENTER.



The GDC displays the intersection of the two straight lines at the point $(204.33, 38)$

As n must be a whole number and the depth must be 38 m or more, you choose the next largest whole number, so n = 205.

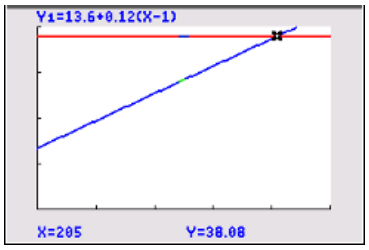


To find the value of the function when n = 205 press 2nd [F4] [CALC] 1:value

Press 205 ENTER to change the x coordinate to 205.

The GDC displays the coordinates of the point $(205, 38.08)$.

$u_{205} = 38.08$



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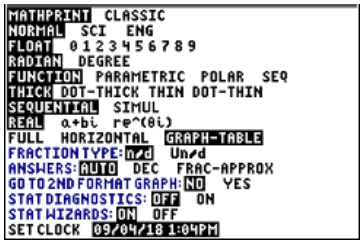
Alternatively, you can use a table of values to find this information.

Press [MODE]. Use the [◄] [▲] [►] [▼] keys to place the cursor on GRAPH-TABLE in the Mode menu, and then press [ENTER] to highlight it.



Press [F5] [GRAPH].

A table of values is displayed alongside the graph.

Press [2nd] [F5] [TABLE] to move the cursor into the table.

You can scroll through the table using [▲] and [▼] on the touchpad.

From the table, you can see that the first term which is greater than 38 is 38.08 when $u = 205$.