Chapter 13 / **Example 14**

Displacement and distance

A particle moves along a straight line such that its displacement s in metres from an origin O is given by $s(t) = t^2 - 4t + 3$, for $0 \le t \le 5$, where t is time in seconds.

a Find the velocity of the particle at time t.

b Find when the particle is moving to the right and when it is moving to the left.

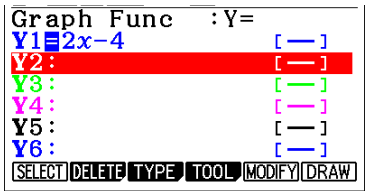
c Draw a motion diagram for the particle.

d Write definite integrals for the particle's displacement on the interval $0 \le t \le 5$ and for the distance travelled on the interval $0 \le t \le 5$. Use a GDC to find the value of the integrals. Use the motion diagram to verify the results.

$v(t) = 2t - 4$.

Press MENU 5 GRAPH to display the equation entry screen.

Type $2x - 4$ and press EXE to enter the equation as Y1.

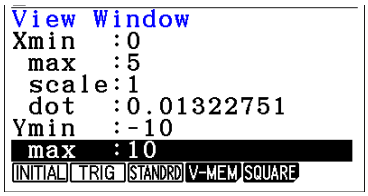


Press SHIFT F3 V-WIN.

Set the axes to show $0 \le x \le 5$ and $-10 \le y \le 10$

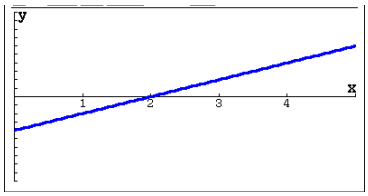
You can leave the other items as they are.

Press EXIT when you have finished.



Press F6 DRAW to display the graph screen.

The GDC displays the velocity time graph for $0 \le x \le 5$.

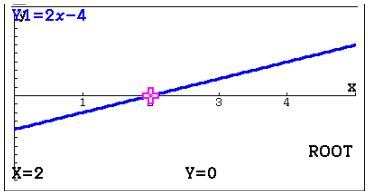


To find the zero press F5 G-SOLVE and then press F1 ROOT.

The GDC shows the first zero.

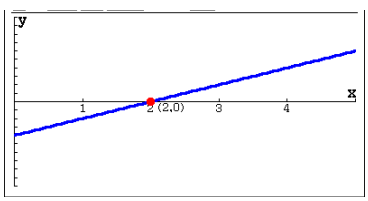
Press EXE to display its coordinates.

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



The GDC displays a zero at $(2, 0)$.

The particle is moving left for $0 < t < 2$ since $v(t) < 0$ on $[0, 2]$ and moving right for $2 < t < 5$ since $v(t) > 0$ on $[2, 5]$.



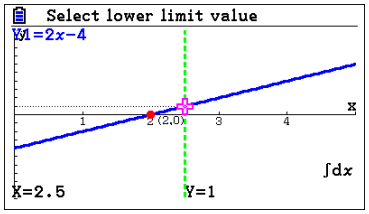
Chapter 13 / **Example 14**

Displacement and distance

To find the displacement between $t = 0$ and $t = 5$ press SHIFT F5 G-SOLVE F6 ▷ F3 ∫dx F1 ∫dx

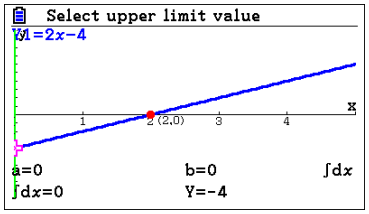
To find the area you need to give the lower and upper limits of the region that includes the intersection.

The GDC asks you to set the lower limit.



Type 0 and press EXE.

The GDC asks you to set the upper limit.

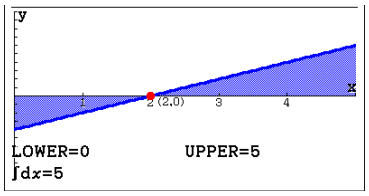


Type 5, the upper limit, and press EXE.

The GDC shows the area defined by the integral and its value.

$$\int_0^5 2x - 4\,\mathrm{d}x = 5$$

The displacement is 5 m.

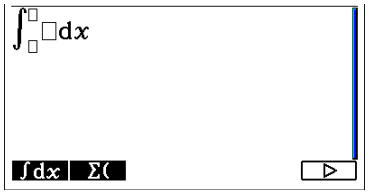


The distance travelled can be calculated using the integral function.

Press MENU 1 RUN·MAT to display the Run-Matrix screen for arithmetical calculations.

Press F4 MATH F6 ▷ F1 ∫dx

You will see an integral template. There are three fields to complete in the template: one for each of the limits and one for the function you are integrating.



Using the modulus function enter the function $|2x - 4|$.

To enter the modulus function press F4 MATH F3 Abs

Enter the lower limit 0 and using the upper limit 5.

Press EXE.

$$\int_0^5 |2x - 4|\,\mathrm{d}x = 13$$

The distance travelled is 13 m.