

Chapter 8 / Example 7

Kinematics

A particle moves in a straight line such that its velocity at any time t can be modelled by $v(t) = t - t^3 \text{ ms}^{-1}$. Find

- the displacement of the particle in the first two seconds, and interpret your answer.
- the total distance travelled by the particle in the first two seconds.

Press **MENU** 1 **Run-Matrix** to display the Run-Matrix screen for arithmetical calculations.

Press **F4** MATH **F6** \triangleright **F1** $\int dx$.
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.
Enter the function $x - x^3$ and the limits 0 and 2.

Use the **▶** **◀** **▲** **▼** keys to navigate the template.
Press **EXE**.

The solution shows that the displacement is -2 , which is 2 m to the left of the starting position.

To understand this, you will look at the graph of the function.

Press **MENU** 5 **GRAPH** to display the equation entry screen.

Type $x - x^3$ and press **EXE** to enter the equation as Y1.

Choose suitable window settings to display the graph.

Press **SHIFT** **F3** V-WIN.

Set the axes to show $-0.5 \leq x \leq 2.5$ with a scale of 0.5 and $-8 \leq y \leq 2$ with a scale of 1.

You can leave the other items as they are.

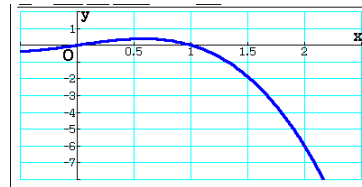
Press **EXIT** when you have finished.

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Kinematics

Press **F6** DRAW to display the graph screen.

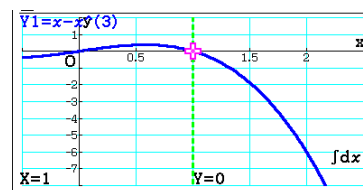
The GDC displays the curve $Y1 = x - x^3$ in a suitable window.



To find the integral press **F5** G-SOLVE **F6** \triangleright **F3** $\int dx$ **F1** $\int dx$.

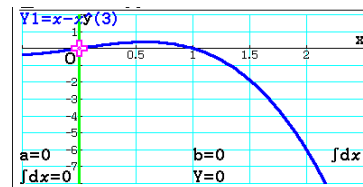
To find the area you need to give the lower and upper limits of the region that includes the intersection.

The GDC asks you to set the lower limit.



Type 0 and press **EXE**.

The GDC asks you to set the upper limit.

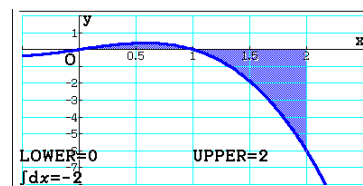


Type 2, the upper limit, and press **EXE**.

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

$$\int_0^2 (x - x^3) dx = -2.$$

As you can see part of the area shaded is above and part below the x-axis.

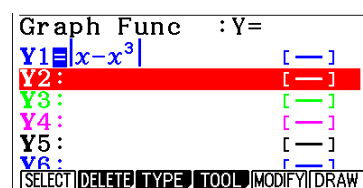


To find the total distance travelled the two portions of the area could be calculated separately. Alternatively, the function $Y_1 = |x - x^3|$ could be used.

Press **EXIT** to return to the equation entry screen.

To enter the modulus function press **OPTN** **F5** NUMERIC **F1** Abs.

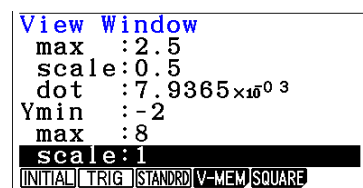
Type $x - x^3$ and press **EXE**.



Press **SHIFT** **F3** V-WIN.

Change the y-axis to $-2 \leq y \leq 8$ and leave the other items as they are.

Press **EXIT** when you have finished.

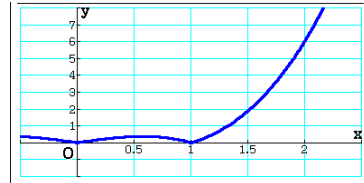


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Press **F6** DRAW to display the graph screen.

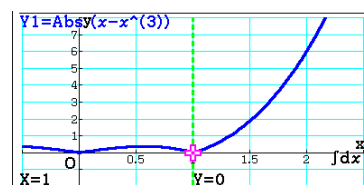
The GDC displays the curve $Y1 = |x - x^3|$ in a suitable window.



To find the integral press **F5** G-SOLVE **F6** \triangleright **F3** $\int dx$ **F1** $\int dx$.

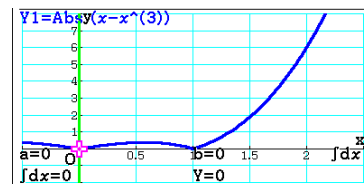
To find the area you need to give the lower and upper limits of the region that includes the intersection.

The GDC asks you to set the lower limit.



Type 0 and press **EXE**.

The GDC asks you to set the upper limit.



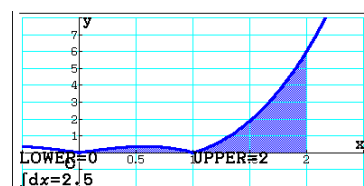
Type 2, the upper limit, and press **EXE**.

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

$$\int_0^2 |x - x^3| dx = 2.5.$$

As you can the whole of the shaded area is above the x-axis.

The total distance travelled is 2.5 m.



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

Press **F4** MATH **F6** \triangleright **F1** $\int dx$ to see an integral template.

Enter the function $|x - x^3|$ and the limits 0 and 2.

To enter the modulus function press **OPTN** **F6** \triangleright **F5** NUMERIC **F1** Abs

Press **EXE**.

The solution shows that the total distance travelled is 2.5 m.

