

Chapter 6 / Example 5

Quadratic modelling

There are two methods you can use to do this.

A student wants to model the path of a rock with respect to time.

He is standing at the top of a vertical cliff at a height of 20 m and throws a rock upwards as shown in the diagram.

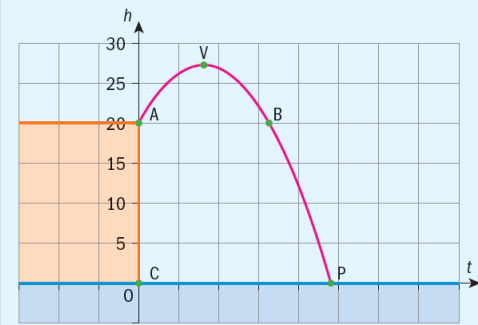
He starts counting time at the instant he throws the rock, at point A.

He measures that the time at which the rock is again at eye level, at point B, is $t = 3.26$ s.

He finally measures that the time at which the rock falls into the sea, at point P, is $t = 4.8$ s.

The function that will model the height of the rock with respect to time is a quadratic function of the form $h(t) = at^2 + bt + c$.

Find the equation of the function that will model the height h of the ball at time t .



Method 1: Using Quadratic regression

You need to identify three clear points on the curve. Known points are A(0, 20), B(3.26, 20) and P(4.8, 0).

Press **MENU** 2 **STAT** to display the List Editor screen.

Enter the x-coordinates in the first column.

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

	List 1	List 2	List 3	List 4
SUB				
1	0			
2	3.26			
3	4.8			
4				

GRAPH CALC TEST INTR DIST

Press **▶** to move to the next column.

Enter the y-coordinates in the second column.

	List 1	List 2	List 3	List 4
SUB				
1	0	20		
2	3.26	20		
3	4.8	0		
4				

GRAPH CALC TEST INTR DIST

Press **F2** CALC, press **F3** REG, press **F3** X^2 .

The parabola is given by the equation

$$h(t) = -2.71t^2 + 8.82t + 20.$$

QuadReg
 $a = -2.7056277$
 $b = 8.82034632$
 $c = 19.99999999$
 $r^2 = 1$
 MSe=
 $y = ax^2 + bx + c$

COPY

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Method 2: Using **Simultaneous equation solver**.

Curve passes through (0, 20), (3.26, 20) and (4.8, 0) as above.

Substituting these points into the general equation of a parabola, $y = ax^2 + bx + c$.

$$a(0)^2 + b(0) + c = 20$$

$$a(3.26)^2 + b(3.26) + c = 20$$

$$a(4.8)^2 + b(4.8) + c = 0$$

Press **MENU** **A** **EQN** and press **F1** SIMUL.

Select **F2** 3 unknowns.

Simultaneous
No Data In Memory

Number Of Unknowns?
2 3 4 5 6

Enter the three equations into the system matrix.

Press **F1** SOLVE.

Enter 3.26^2 and 4.8^2 directly, solver will calculate these for you.

$a_n X + b_n Y + c_n Z = d_n$

	a	b	c	d
1	0	0	1	20
2	10.627	3.26	1	20
3	23.04	4.8	1	0

0

SOLVE DELETE CLEAR EDIT

The parabola is given by the equation

$$h(t) = -2.71t^2 + 8.82t + 20.$$

$a_n X + b_n Y + c_n Z = d_n$

X: -2.705
Y: 8.8203
Z: 20

-2.705627706

REPEAT