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LESSON 6

Creating Quadratic Equations

A-CED.A.1, A-CED.A.2

Finding Quadratic Equations

Quadratic functions are often used in science and business situations. For example, in physics, the function that models objects in motion is $h(t) = \frac{1}{2}gt^2 + v_ot + h_o$. In this function,

- $h(t)$ represents the height of the object,
- t represents the time, in seconds,
- g represents the constant force of Earth's gravity, -32 ft/sec^2 or -9.8 m/sec^2,
- v_o represents the initial velocity, or rate at which the object changes position in ft/sec or m/sec, and
- h_o represents the initial height of the object, when $t = 0$.

Sometimes the information needed to create an equation will be found in descriptive text, such as a word problem.

Try this sample question.

S-1 Hikaru throws a ball into the air with an initial velocity of 44 feet per second. The ball is 5 feet from the ground when he throws it. After a few seconds, the ball lands on the ground. Which function can be used to model the height of the ball Hikaru throws?

A $h(t) = -16t^2 + 5t + 44$

B $h(t) = -16t^2 + 44t + 5$

C $h(t) = -32t^2 + 5t + 44$

D $h(t) = -32t^2 + 44t + 5$

From the given situation, you know that the initial velocity, v_o, is 44 feet per second and that the initial height, h_o, is 5 feet. The force of Earth's gravity, g, is -32 feet per second squared. Substitute these values into the function $h(t) = \frac{1}{2}gt^2 + v_ot + h_o$. This gives $h(t) = -16t^2 + 44t + 5$. Choice B is correct.

The equation of a quadratic function of the form $f(x) = ax^2 + bx + c$ can be found from any three points that lie on the graph of the function. In order to determine the equation, substitute the values of x and y from each given pair of coordinates to create a system of equations involving a, b, and c. Solve the system of equations for these values and substitute them back into the general form of the quadratic function.

Try this sample question.

S-2 A rock is dropped from a cliff into some water directly below. The relationship between the height of the rock and the time since it is dropped is shown in the table below.

Time, *t*, (seconds)	0	1	2	3
Height, *h*, (meters)	256	240	192	112

Write an equation for the function that models this situation.

Substitute three of the four given points into $h(t) = at^2 + bt + c$:

Using (0, 256): $256 = a(0^2) + b(0) + c$, so $c = 256$
Using (1, 240): $240 = a(1^2) + b(1) + 256$ gives $a + b = -16$
Using (2, 192): $192 = a(2^2) + b(2) + 256$ gives $4a + 2b = -64$

Solve the system of equations $\begin{cases} a + b = -16 \\ 4a + 2b = -64 \end{cases}$ for a and b. Using substitution or elimination results in $a = -16$ and $b = 0$. Since $a = -16$, $b = 0$, and $c = 256$, the equation for the function that models this situation is $h(t) = -16t^2 + 256$.

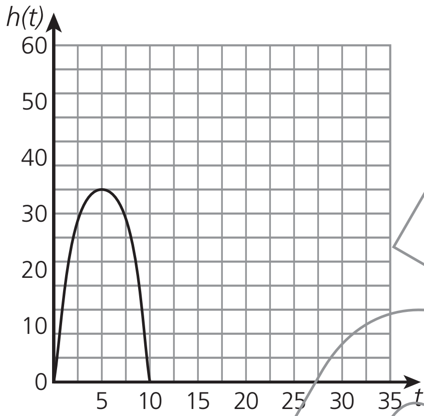
You can check that the function determined in S-2 does pass through those points from the given table by using a graphing calculator or by creating a table of values for given times to determine if the points are the same.

Try this sample question.

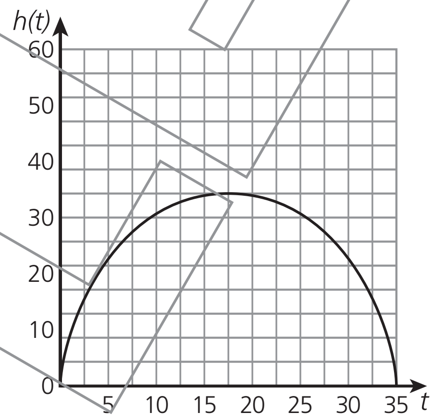
S-3 The height a rocket travels in relation to time can be approximated using the function $h(t) = -5t^2 + 35t$. In the function, $h(t)$ represents the height of the rocket, in meters, at t seconds.

Which graph can be used to model this function?

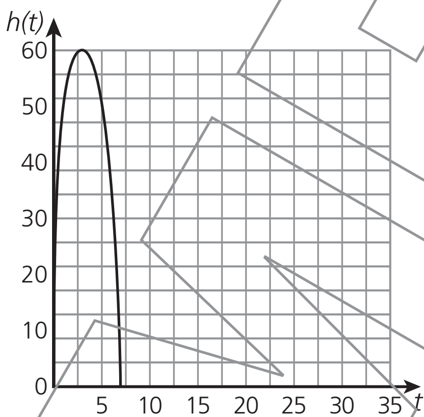
A



C



B



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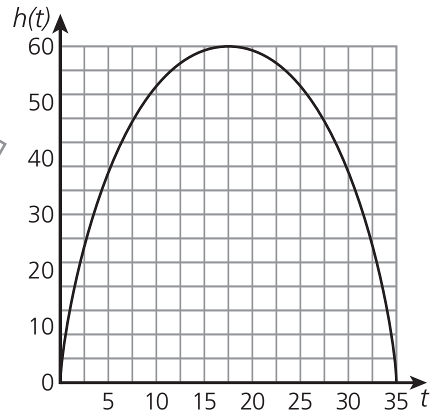


First make a table by choosing some values for t and substituting them into the function $h(t)$.

t	0	1	2	3	4	5
$h(t)$	0	30	50	60	60	50

Then identify the graph that contains these points. The graph in choice B passes through these points. Choice B is correct.

IT'S YOUR TURN

Read each problem. Circle the letter of the best answer.

1 The area of a rectangular field is 1,500 square yards. The length of the field is 20 yards longer than the width of the field. Which equation can be used to determine w, the width of the field?

A $1{,}500 = 20w^2$

B $1{,}500 = w^2 + 20$

C $1{,}500 = w^2 + 20w$

D $1{,}500 = 20w^2 + 20w$

2 The total revenue, R, earned by a company is equal to the price per item sold times the number of items sold. A company can sell 10,000 DVDs at a price of \$12 each. A research company determined that for each \$1 increase in the price of the DVD, 500 fewer DVDs are sold. Which function can be used to model this situation?

A $R(x) = (12 + x)(10{,}000 - 500x)$

B $R(x) = (12 + x)(10{,}000 + 500x)$

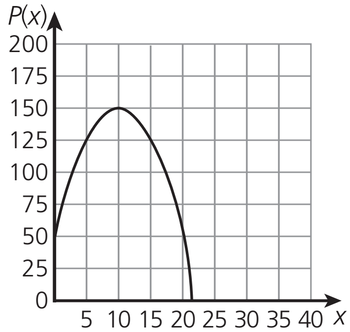
C $R(x) = (12 - x)(10{,}000 - 500x)$

D $R(x) = (12 - x)(10{,}000 + 500x)$

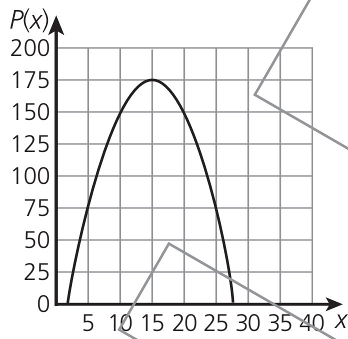
3 Elena starts her own tutoring business. She develops the following profit function that relates her total weekly profit, in dollars, to the number of people she tutors each week: $P(x) = -x^2 + 30x - 50$.

Which graph can be used to model this function?

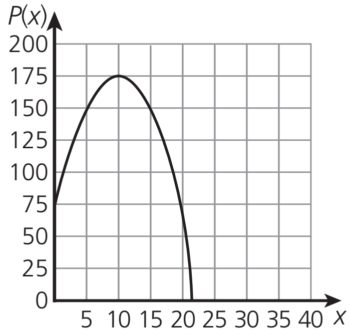
A



C



B



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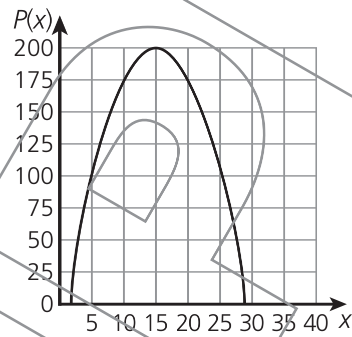

Read each problem. Write your answers.

5 A quadratic function contains the points (0, 4), (1, 16) and (4, 100). Write the equation of this function. Show your work.

5 LaToya hits a ball into the air. The height, $h(t)$, in feet, of the ball t seconds before it lands on the ground is modeled by the function below.

$$h(t) = -2.5t^2 + 12.5t + 5$$

A Complete the table of values to show the height of the ball 0, 1, 2, and 3 seconds after LaToya hits it.

t	0	1	2	3
$h(t)$				

B Graph the function on the coordinate plane below. Be sure to label each axis appropriately.