Your Name

Mrs. Theo

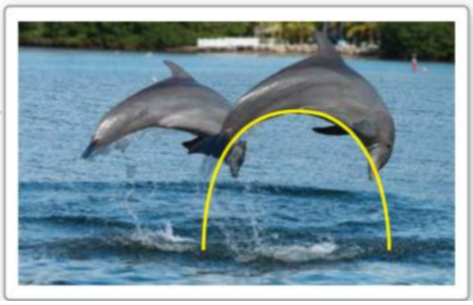
4/20/2021

Solving Applications of Quadratic Functions

Notes

MODELING WITH MATHEMATICS A dolphin jumps out of the water, as shown in the diagram. The function $h = -16t^2 + 26t$ models the height h (in feet) of the dolphin after t seconds. After how many seconds is the dolphin at a height of 5 feet? *(See Example 2.)*

$t = ?$ $h = 5$



$a =$

$b = 26$

$c = -5$

$(5) = -16t^2 + 26t$

$-5 \quad -5$

$0 = -16t^2 + 26t - 5$

-16

$t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$t = \frac{-26 \pm \sqrt{(26)^2 - 4(-16)(-5)}}{2(-16)}$

$t = \frac{-26 \pm \sqrt{676 - 320}}{-32}$

$t = \frac{-26 \pm \sqrt{356}}{-32}$

$t = \frac{-26 + 18.868}{-32}$ and $t = \frac{-26 - 18.868}{-32}$

$t = 0.222$ $t = 1.402$

at 0.222 seconds and 1.402 seconds the dolphin was 5 ft high

24. MODELING WITH MATHEMATICS The amount of trout y (in tons) caught in a lake from 1995 to 2014 can be modeled by the equation $y = -0.08x^2 + 1.6x + 10$, where x is the number of years since 1995.

a. When were about 15 tons of trout caught in the lake?

b. Do you think this model can be used to determine the amounts of trout caught in future years? Explain your reasoning.

$y = -0.08x^2 + 1.6x + 10$

y: # of tons of trout

x: # of years since 1995

$x = ?$ $y = 15$

$15 = -0.08x^2 + 1.6x + 10$

$-15 \quad\quad -15$

get equation = 0

$0 = -0.08x^2 + 1.6x - 5$

$a = -0.08$

$b = 1.6$

$c = -5$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$x = \frac{-(1.6) \pm \sqrt{(1.6)^2 - 4(-0.08)(-5)}}{2(-0.08)}$

$x = \frac{-1.6 \pm \sqrt{0.96}}{-0.16}$

$x = \frac{-1.6 \pm 0.980}{-0.16}$

Split to make two solutions

$x = \frac{-1.6 + 0.980}{-0.16}$ and $x = \frac{-1.6 - 0.980}{-0.16}$

$x = 3.875$ $\quad\quad x = 16.125$

years since 1995

$1995 + 3.875$ $\quad\quad 1995 + 16.125$

In 1998 and 2011 they caught 15 tons of trout

52. Area $= 209 \text{ ft}^2$

$l = (4x - 5)$ ft

$w = (4x + 3)$ ft

$A = l \cdot h$

$209 = (4x - 5)(4x + 3)$

$209 = 16x^2 + 12x - 20x - 15$

$-209 \quad\quad\quad\quad\quad\quad -209$

$0 = 16x^2 - 8x - 224$

$a = 16$

$b = -8$

$c = -224$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$x = \frac{-(-8) \pm \sqrt{(-8)^2 - 4(16)(-224)}}{2(16)}$

$x = \frac{8 \pm \sqrt{64 + 14336}}{32}$

$x = \frac{8 \pm \sqrt{14400}}{32}$

$x = \frac{8 + 120}{32}$ $\quad\quad x = \frac{8 - 120}{32}$

$x = 4$ $\quad\quad x = -3.5$

$x = 4$

$w = 4(4) + 3 = 19$ ft

$l = 4(4) - 5 = 9$ ft

$w = 4(-3.5) + 3 = -11$

$d(t) = 1341t + 8.2t^2$

T is time in seconds after lift off, and d(t) is the distance the Discovery spaceship is from the ground. How long after liftoff did it travel 40,000 ft?

How long did it take to leave the atmosphere and reach outer space?

6,214 miles = 32,809,920 feet

$32{,}809{,}920 = 1341t + 8.2t^2$

$0 = 8.2t^2 + 1341t - 32{,}809{,}920$

a b c

$t = \frac{-1341 \pm \sqrt{1795600 + 1312000}}{16.4}$

$t = \frac{-1341 \pm \sqrt{3107600}}{16.4}$

$t = \frac{-1341 \pm 1762.839}{16.4}$

$t = \frac{-1341 + 1762.839}{16.4}$ $t = \frac{-1341 - 1762.839}{16.4}$

$t = 25.722$ $t = -187.258$

The spaceship reached 40000 ft in the air after 25.722 seconds.

Can't have negative time

Homework: pg. 521 and 522 #31-34 all and #45-51 all

Let's graph these in our calculator to find out!

In Exercises 31–36, find the number of *x*-intercepts of the graph of the function. *(See Example 4.)*

31. $y = x^2 + 5x - 1$
32. $y = 4x^2 + 4x + 1$
33. $y = -6x^2 + 3x - 4$
34. $y = -x^2 + 5x + 13$
35. $f(x) = 4x^2 + 3x - 6$
36. $f(x) = 2x^2 + 8x + 8$

Answer/solve the questions below.

45. ERROR ANALYSIS Describe and correct the error in solving the equation $3x^2 - 7x - 6 = 0$ using the Quadratic Formula.

$x = \frac{-7 \pm \sqrt{(-7)^2 - 4(3)(-6)}}{2(3)}$

$= \frac{-7 \pm \sqrt{121}}{6}$

$x = \frac{2}{3}$ and $x = -3$

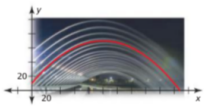
46. ERROR ANALYSIS Describe and correct the error in solving the equation $-2x^2 + 9x = 4$ using the Quadratic Formula.

$x = \frac{-9 \pm \sqrt{9^2 - 4(-2)(4)}}{2(-2)}$

$= \frac{-9 \pm \sqrt{113}}{-4}$

$x \approx -0.41$ and $x \approx 4.91$

47. MODELING WITH MATHEMATICS A fountain shoots a water arc that can be modeled by the graph of the equation $y = -0.006x^2 + 1.2x + 10$, where x is the horizontal distance (in feet) from the river's north shore and y is the height (in feet) above the river. Does the water arc reach a height of 50 feet? If so, about how far from the north shore is the water arc 50 feet above the water?



48. MODELING WITH MATHEMATICS Between the months of April and September, the number y of hours of daylight per day in Seattle, Washington, can be modeled by $y = -0.00046x^2 + 0.076x + 13$, where x is the number of days since April 1.

a. Do any of the days between April and September in Seattle have 17 hours of daylight? If so, how many?

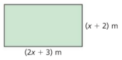
b. Do any of the days between April and September in Seattle have 14 hours of daylight? If so, how many?

49. MAKING AN ARGUMENT Your friend uses the discriminant of the equation $2x^2 - 5x - 2 = -11$ and determines that the equation has two real solutions. Is your friend correct? Explain your reasoning.

50. MODELING WITH MATHEMATICS The frame of the tent shown is defined by a rectangular base and two parabolic arches that connect the opposite corners of the base. The graph of $y = -0.18x^2 + 1.6x$ models the height y (in feet) of one of the arches x feet along the diagonal of the base. Can a child who is 4 feet tall walk under one of the arches without having to bend over? Explain.

MATHEMATICAL CONNECTIONS **In Exercises 51 and 52, use the given area A of the rectangle to find the value of x. Then give the dimensions of the rectangle.**

51. $A = 91$ m²



Homework Key

31. two x-intercepts

32. one x-intercept

33. no x-intercepts

34. two x-intercepts

35. two x-intercepts

36. one x-intercept

45. $-b$ should be $-(-7)$, not -7;
$x = \frac{-(-7) \pm \sqrt{(-7)^2 - 4(3)(-6)}}{2(3)}$; $x = 3$ and $x = -\frac{2}{3}$

46. The equation needs to be in the form $ax^2 + bx + c = 0$, so $c = -4$ not 4; $x = \frac{-9 \pm \sqrt{9^2 - 4(-2)(-4)}}{2(-2)}$; $x = \frac{1}{2}$ and $x = 4$

47. yes; about 42 ft, about 158 ft

48. **a.** no
b. yes; 2 days

49. no; The discriminant is -47, so the equation has no real solutions.

50. no; Substituting 4 for y in the model results in no real solutions.

51. 5; length: 13 m, width: 7 m