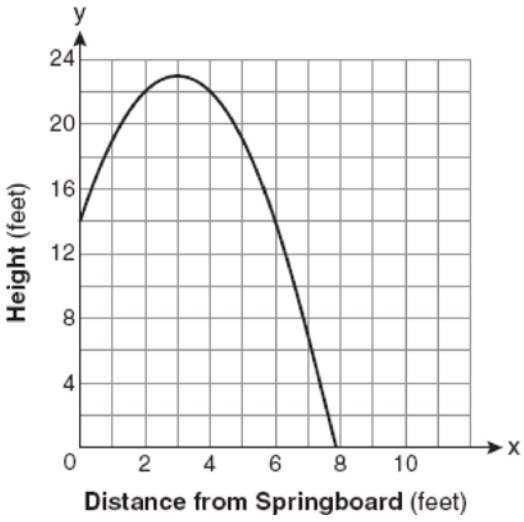
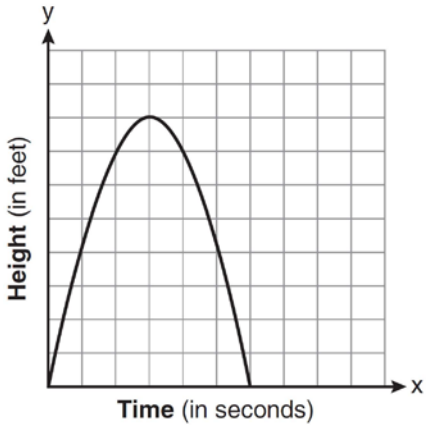
F.IF.B.4: Graphing Quadratic Functions 4

1 A swim team member performs a dive from a 14-foot-high springboard. The parabola below shows the path of her dive.



Which equation represents the axis of symmetry?
1) $x = 3$
2) $y = 3$
3) $x = 23$
4) $y = 23$

2 The graph below represents the parabolic path of a ball kicked by a young child. What are the vertex and the axis of symmetry for the parabola?



1) vertex: (3,8); axis of symmetry: $x = 3$
2) vertex: (3,8); axis of symmetry: $y = 3$
3) vertex: (8,3); axis of symmetry: $x = 3$
4) vertex: (8,3); axis of symmetry: $y = 3$

3 The height, y, of a ball tossed into the air can be represented by the equation $y = -x^2 + 10x + 3$, where x is the elapsed time. What is the equation of the axis of symmetry of this parabola?
1) $y = 5$
2) $y = -5$
3) $x = 5$
4) $x = -5$

4 A model rocket is launched from ground level. Its height, h meters above the ground, is a function of time t seconds after launch and is given by the equation $h = -4.9t^2 + 68.6t$. What would be the maximum height, to the nearest meter, attained by the model?
1) 243
2) 242
3) 241
4) 240

5 The height of a swimmer's dive off a 10-foot platform into a diving pool is modeled by the equation $y = 2x^2 - 12x + 10$, where x represents the number of seconds since the swimmer left the diving board and y represents the number of feet above or below the water's surface. What is the farthest depth below the water's surface that the swimmer will reach?
1) 6 feet
2) 8 feet
3) 10 feet
4) 12 feet

6 An archer shoots an arrow into the air such that its height at any time, t, is given by the function $h(t) = -16t^2 + kt + 3$. If the maximum height of the arrow occurs at time $t = 4$, what is the value of k?
1) 128
2) 64
3) 8
4) 4

7 The height of an object, $h(t)$, is determined by the formula $h(t) = -16t^2 + 256t$, where t is time, in seconds. Will the object reach a maximum or a minimum? Explain or show your reasoning.

8 Vanessa throws a tennis ball in the air. The function $h(t) = -16t^2 + 45t + 7$ represents the distance, in feet, that the ball is from the ground at any time t. At what time, to the *nearest tenth of a second,* is the ball at its maximum height?

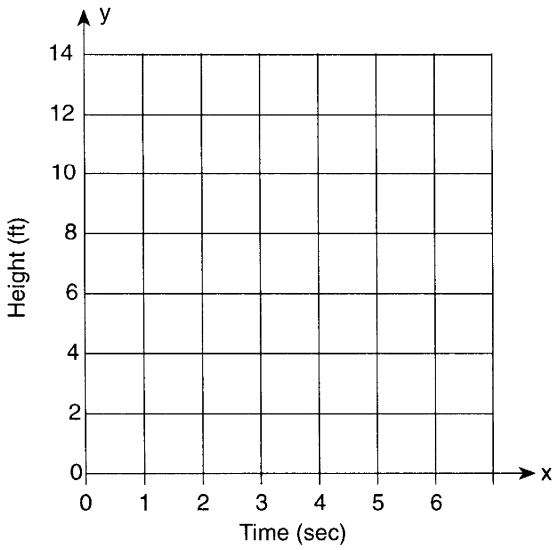
9 The height, h, in feet, a ball will reach when thrown in the air is a function of time, t, in seconds, given by the equation $h(x) = -16t^2 + 30t + 6$. Find, to the *nearest tenth*, the maximum height, in feet, the ball will reach.

10 When a current, I, flows through a given electrical circuit, the power, W, of the circuit can be determined by the formula $W = 120I - 12I^2$. What amount of current, I, supplies the maximum power, W?

11 The equation $W = 120I - 12I^2$ represents the power (W), in watts, of a 120-volt circuit having a resistance of 12 ohms when a current (I) is flowing through the circuit. What is the maximum power, in watts, that can be delivered in this circuit?

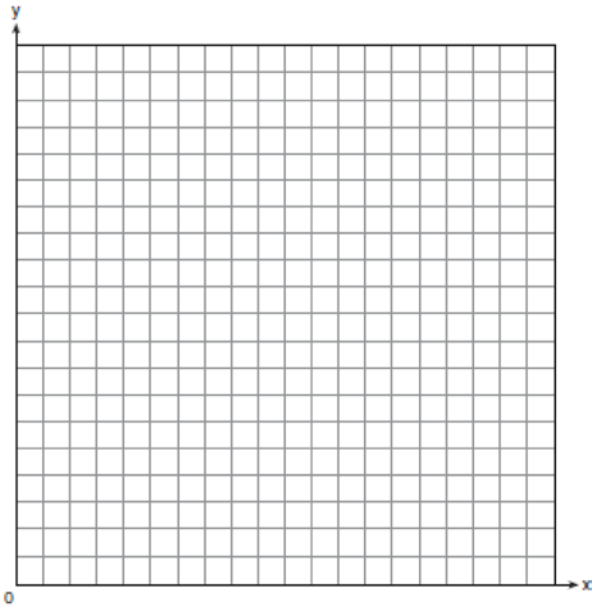
12 Amy tossed a ball in the air in such a way that the path of the ball was modeled by the equation $y = -x^2 + 6x$. In the equation, y represents the height of the ball in feet and x is the time in seconds.

a Graph $y = -x^2 + 6x$ for $0 \le x \le 6$ on the grid provided below.

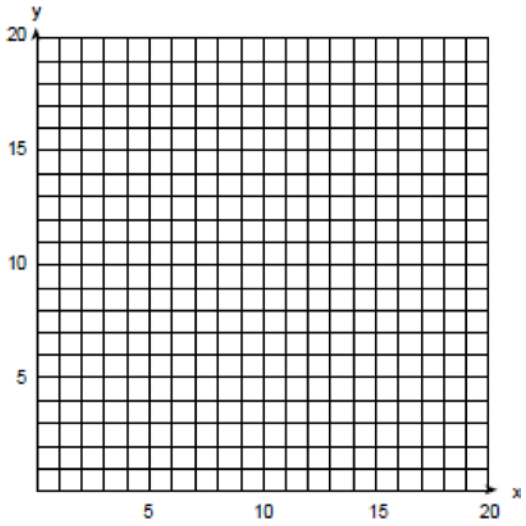


b At what time, x, is the ball at its highest point?

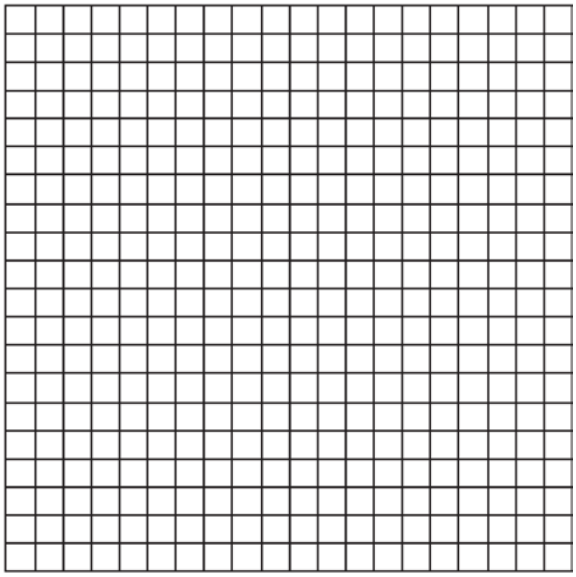
13 An architect is designing a museum entranceway in the shape of a parabolic arch represented by the equation $y = -x^2 + 20x$, where $0 \le x \le 20$ and all dimensions are expressed in feet. On the accompanying set of axes, sketch a graph of the arch and determine its maximum height, in feet.



14 An arch is built so that it is 6 feet wide at the base. Its shape can be represented by a parabola with the equation $y = -2x^2 + 12x$, where y is the height of the arch. Graph the parabola from $x = 0$ to $x = 6$ on the grid below. Determine the maximum height, y, of the arch.



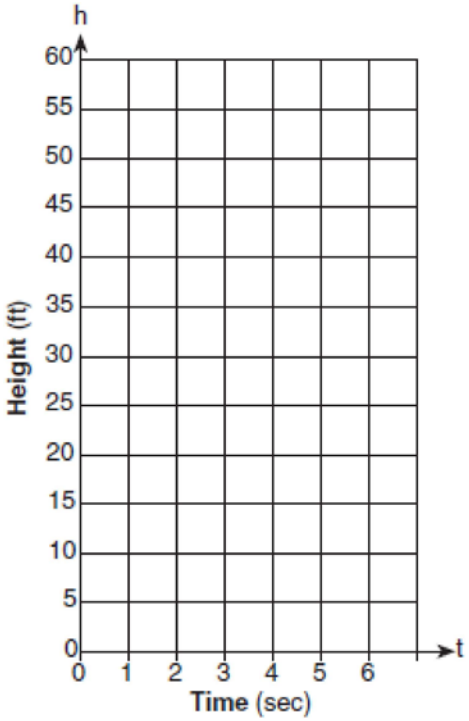
15 A laundry owner's estimate of her weekly profits, p, in dollars, is given by the equation $p = -4w^2 + 160w$, where w represents the number of workers she hires. What is the number of workers she should hire in order to earn the greatest profit? [The use of the accompanying grid is optional.]



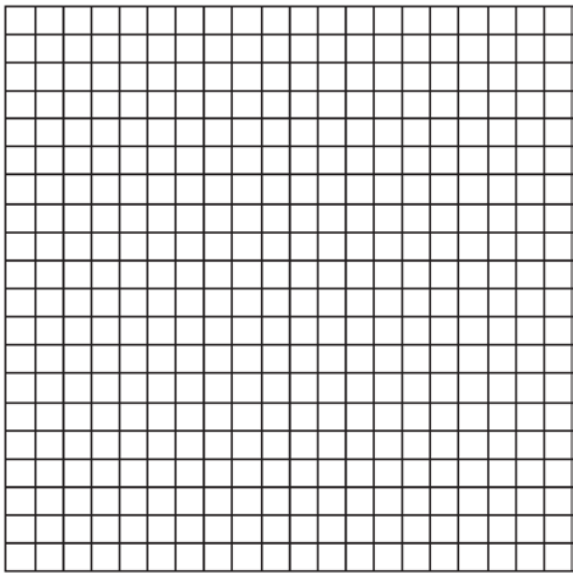
16 Tom throws a ball into the air. The ball travels on a parabolic path represented by the equation $h = -8t^2 + 40t$, where h is the height, in feet, and t is the time, in seconds.

a On the accompanying set of axes, graph the equation from $t = 0$ to $t = 5$ seconds, including all integral values of t from 0 to 5.

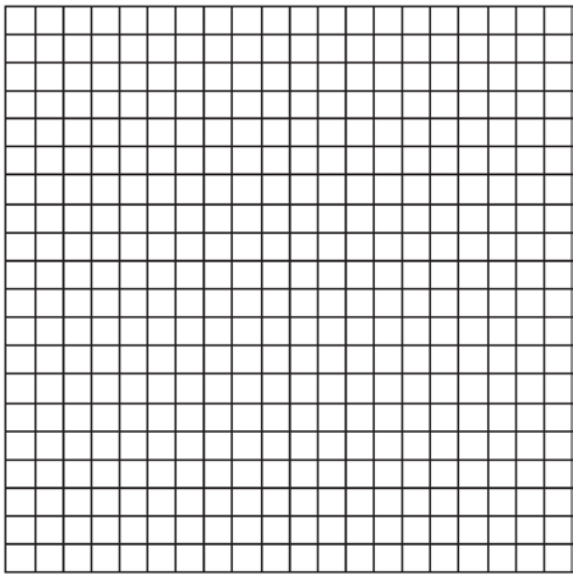
b What is the value of t at which h has its greatest value?



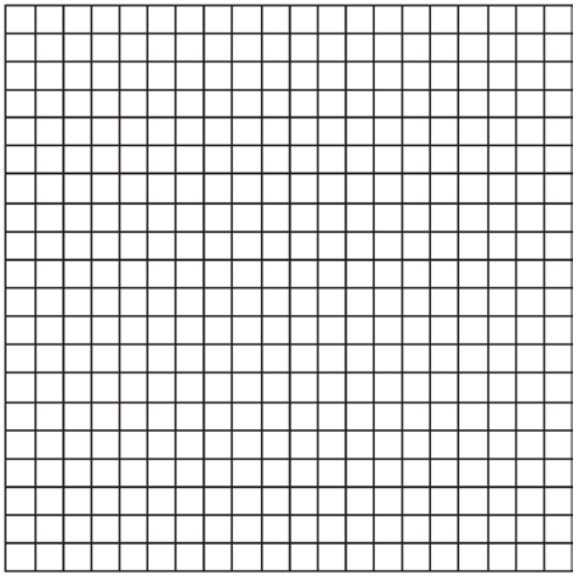
17 Each year, the student council at Briarwood High School sponsors a community talent show to raise money. In previous years, the council has discovered that profit from ticket sales, $P(x)$, is a function of the amount charged per ticket, x, in dollars, as modeled by the equation $P(x) = 120x - 12x^2$. What amount should the council charge for a ticket to make the greatest profit? [The use of the grid is optional.]



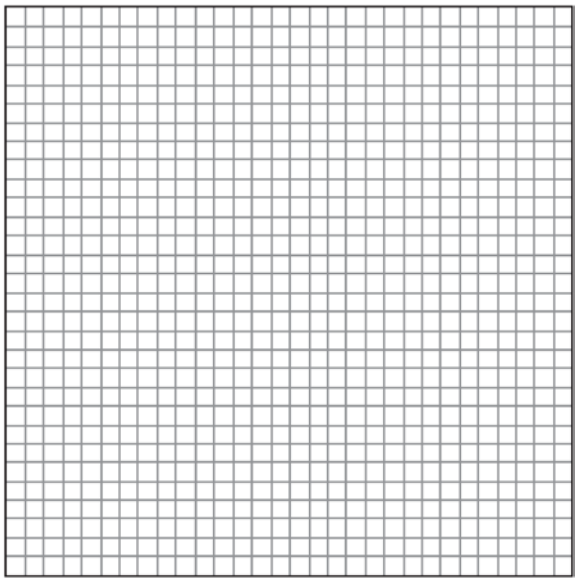
18 The path of a rocket fired during a fireworks display is given by the equation $s(t) = 64t - 16t^2$, where t is the time, in seconds, and s is the height, in feet. What is the maximum height, in feet, the rocket will reach? In how many seconds will the rocket hit the ground? [The use of the grid is optional.].



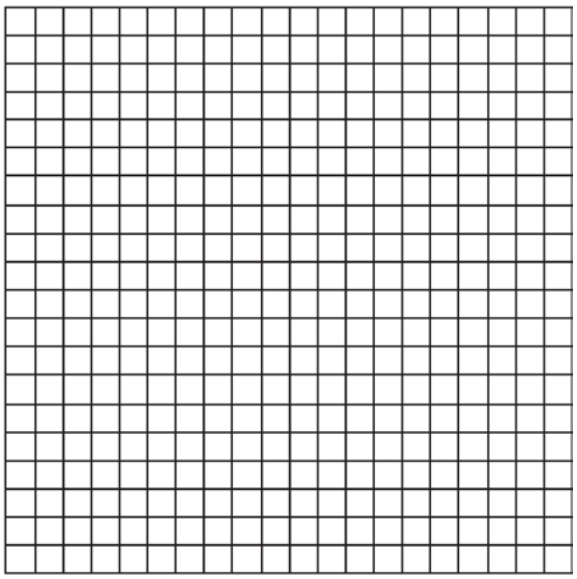
19 A baseball player throws a ball from the outfield toward home plate. The ball's height above the ground is modeled by the equation $y = -16x^2 + 48x + 6$, where y represents height, in feet, and x represents time, in seconds. The ball is initially thrown from a height of 6 feet. How many seconds after the ball is thrown will it again be 6 feet above the ground? What is the maximum height, in feet, that the ball reaches? [The use of the accompanying grid is optional.]



20 The members of the Lincoln High School Prom Committee are trying to raise money for their senior prom. They plan to sell teddy bears. The senior advisor told them that the profit equation for their project is $y = -0.1x^2 + 9x - 50$, where x is the price at which the teddy bears will be sold and y is the profit, in dollars. On the grid below, graph this relationship so that $0 \le x \le 90$ and $-50 \le y \le 160$. How much profit can the committee expect to make if they sell the teddy bears for \$20 each? What price should they charge for the teddy bears to make the maximum profit possible?



21 A rock is thrown vertically from the ground with a velocity of 24 meters per second, and it reaches a height of $2 + 24t - 4.9t^2$ after t seconds. How many seconds after the rock is thrown will it reach maximum height, and what is the maximum height the rock will reach, in meters? How many seconds after the rock is thrown will it hit the ground? Round your answers to the *nearest hundredth*. [Only an algebraic or graphic solution will be accepted.]



F.IF.B.4: Graphing Quadratic Functions 4
Answer Section

1 ANS: 1 REF: 080813ia

2 ANS: 1 REF: 081405ia

3 ANS: 3

$x = \frac{-b}{2a} = \frac{-10}{2(-1)} = 5.$

REF: 081018ia

4 ANS: 4

$x = \frac{-68.6}{2(-4.9)} = \frac{-(8)}{2(2)} = 7$

$y = -4.9(7)^2 + 68.6(7) = 240.1$

REF: fall9915b

5 ANS: 2

$x = \frac{-b}{2a} = \frac{-(-12)}{2(2)} = 3$

$y = 2(3)^2 - 12(3) + 10 = -8$

REF: 010907b

6 ANS: 1

$t = \frac{-b}{2a}$

$4 = \frac{-(k)}{2(-16)}$

$k = 128$

REF: 060101b

7 ANS:

Maximum, because $a < 0$ the parabola representing the relationship between the object's height and time is cupped downward and therefore has a maximum.

REF: 010322b

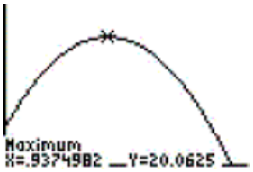
8 ANS:

1.4. $t = \frac{-b}{2a} = \frac{-(45)}{2(-16)} = \frac{45}{32} \approx 1.4$

REF: 060321b

9 ANS:

20.1. $t = \dfrac{-b}{2a} = \dfrac{-(30)}{2(-16)} = \dfrac{15}{16}$



$h = -16\left(\dfrac{15}{16}\right)^2 + 30\left(\dfrac{15}{16}\right) + 6 = \dfrac{321}{16} \approx 20.1$

REF: 080321b

10 ANS:

5. $I = \dfrac{-b}{2a} = \dfrac{-(120)}{2(-12)} = 5$

REF: 010424b

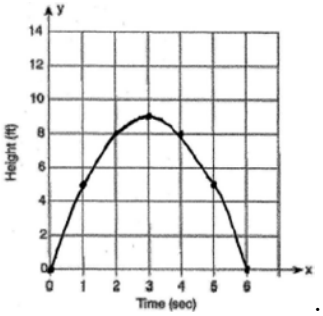
11 ANS:

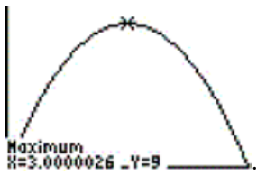
300. $I = \dfrac{-b}{2a} = \dfrac{-(120)}{2(-12)} = 5$

$W = 120(5) - 12(5)^2 = 300$

REF: 060225b

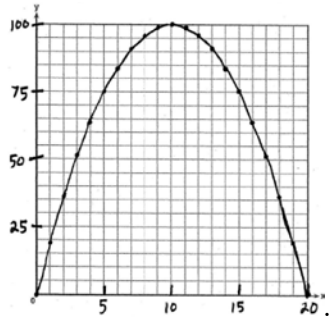
12 ANS:



. 3. $x = \dfrac{-b}{2a} = \dfrac{-(6)}{2(-1)} = 3$. 

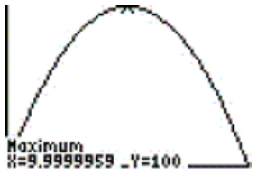
REF: 010031a

13 ANS:



. 100. $x = \dfrac{-b}{2a} = \dfrac{-(20)}{2(-1)} = 10$

$y = -10^2 + 20(10) = 100$



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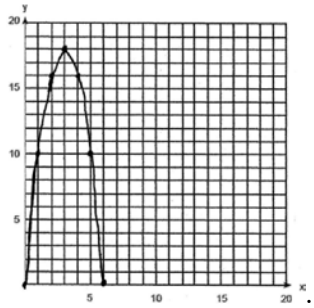
REF: 060333a

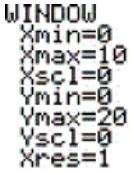
14 ANS:



. 18. $x = \dfrac{-b}{2a} = \dfrac{-(12)}{2(-2)} = 3$

$y = -2(3)^2 + 12(3) = 18$

.



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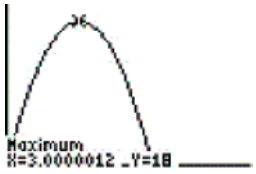
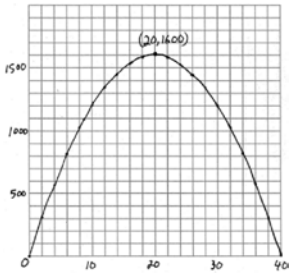


REF: 089933a

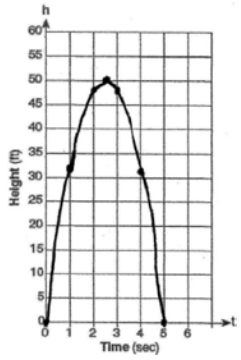
15 ANS:

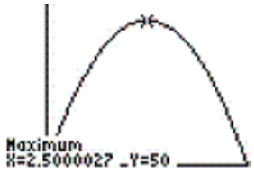
20. $w = \dfrac{-160}{2(-4)} = 20$.



REF: 060822b

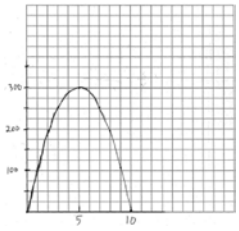
16 ANS:



2.5. $t = \dfrac{-b}{2a} = \dfrac{-(40)}{2(-8)} = 2.5$. 

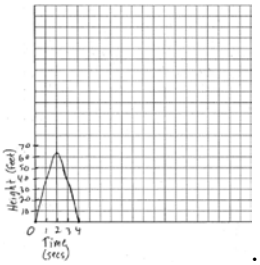
REF: 010439a

17 ANS:

5. $x = \dfrac{-b}{2a} = \dfrac{-120}{2(-12)} = 5$. 

REF: 080825b

18 ANS:

64, 4. 

. $t = \dfrac{-b}{2a} = \dfrac{-(64)}{2(-16)} = \dfrac{-64}{-32} = 2$

$s = 64(2) - 16(2)^2 = 64$

. $64t - 16t^2 = 0$

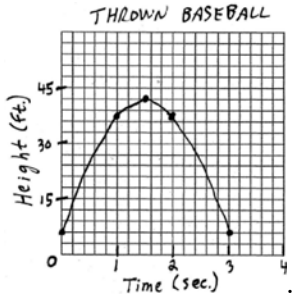
$16t(4 - t) = 0$

$16t = 0 \quad 4 - t = 0$

$t = 0 \qquad t = 4$.

REF: 060732b

19 ANS:



3, 42. $6 = -16x^2 + 48x + 6$

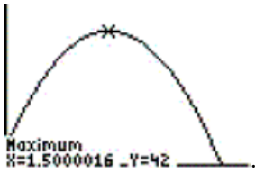
$0 = -16x^2 + 48x$ divide each term by -16

$0 = x^2 - 3x$

$0 = x(x-3)$

$x = 0 \quad x = 3$. The ball will again be 6 feet above the ground 3 seconds after the ball is thrown. $x = \dfrac{-b}{2a} = \dfrac{-(48)}{2(-16)} = 1.5$. The maximum height the ball reaches is

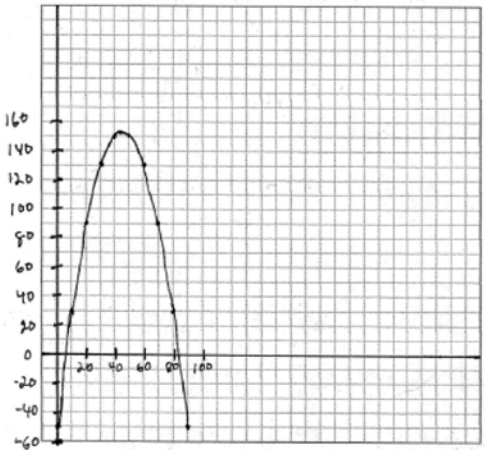
$y = -16(1.5)^2 + 48(1.5) + 6 = 42$



42 feet.

REF: 060430b

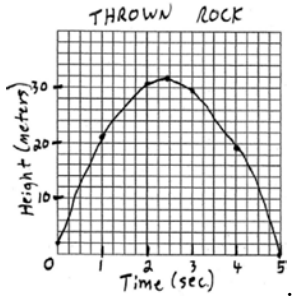
20 ANS:



90, 45. $y = -0.1(20)^2 + 9(20) - 50 = 90$. $x = \dfrac{-b}{2a} = \dfrac{-(9)}{2(-.1)} = 45$

REF: 010834b

21 ANS:



. t=2.45, h=31.39.

$$t = \frac{-b}{2a} = \frac{-(24)}{2(-4.9)} = \frac{120}{49} \approx 2.45$$

$$h = 2 + 24(\frac{120}{49}) - 4.9(\frac{120}{49})^2 \approx 31.39$$

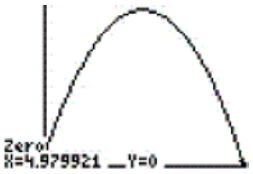
. When the rock hits the ground, the height is zero.

$$-4.9t^2 + 24t + 2 = 0$$

$$\frac{-24 \pm \sqrt{24^2 - 4(-4.9)(2)}}{2(-4.9)}$$

$$\frac{-24 - \sqrt{615.2}}{-9.8} \approx 4.98$$

$\frac{-24 + \sqrt{615.2}}{-9.8}$ is negative.



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REF: 080229b