

Lesson 10-2: Quadratic Functions

Part 1: Graphing $y=ax^2+bx+c$

1. 080508a, P.I. A.A.8

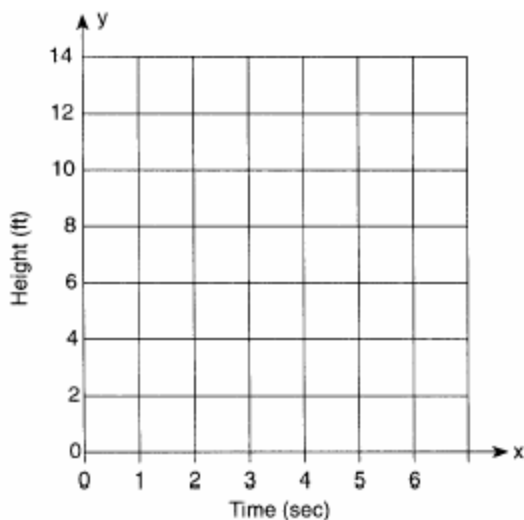
The height of a golf ball hit into the air is modeled by the equation $h = -16t^2 + 48t$, where h represents the height, in feet, and t represents the number of seconds that have passed since the ball was hit. What is the height of the ball after 2 seconds?

[A] 80 ft [B] 16 ft [C] 32 ft [D] 64 ft

2. 010031a, P.I. A.G.4

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.

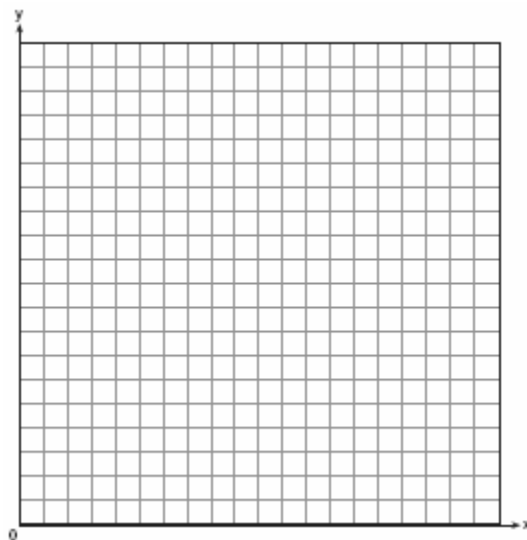
a Graph $y = -x^2 + 6x$ for $0 \leq x \leq 6$ on the grid provided below.



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

3. 060333a, P.I. A.G.4

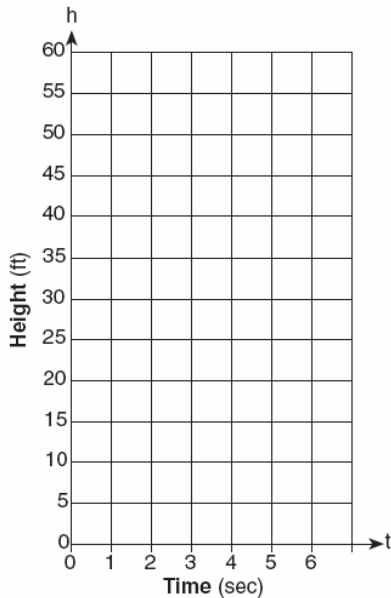
An architect is designing a museum entranceway in the shape of a parabolic arch represented by the equation $y = -x^2 + 20x$, where $0 \leq x \leq 20$ and all dimensions are expressed in feet. On the accompanying set of axes, sketch a graph of the arch and determine its maximum height, in feet.



4. 010439a, P.I. A.G.4

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.

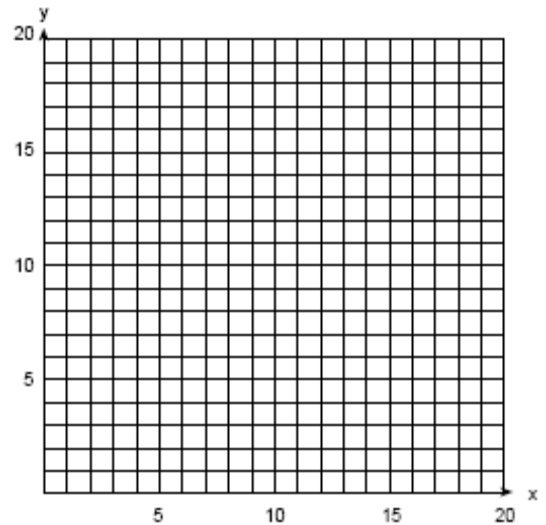


b What is the value of t at which h has its greatest value?

5. 089933a, P.I. A.G.4

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.

a Graph the parabola from $x = 0$ to $x = 6$ on the grid below.



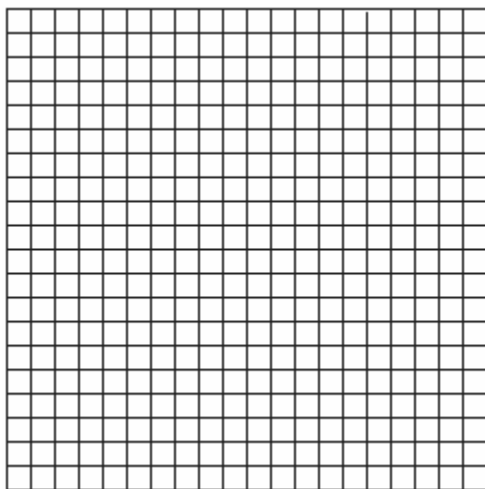
b Determine the maximum height, y , of the arch.

6. 060632b, P.I. A.G.4

A small rocket is launched from a height of 72 feet. The height of the rocket in feet, h , is represented by the equation

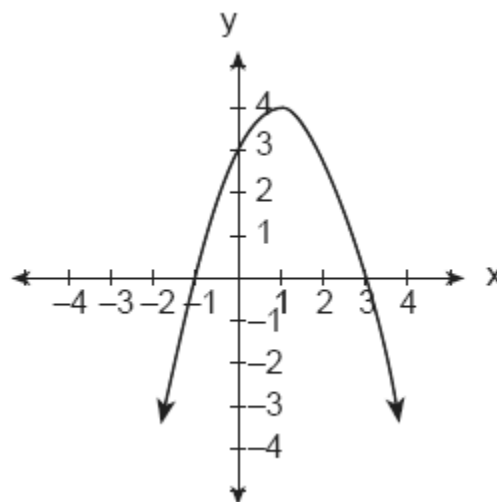
$$h(t) = -16t^2 + 64t + 72, \text{ where } t = \text{time, in}$$

seconds. Graph this equation on the accompanying grid. Use your graph to determine the number of seconds that the rocket will remain at or above 100 feet from the ground. [Only a graphic solution can receive full credit.]



7. 080017a, P.I. A.G.4

Which is an equation of the parabola shown in the accompanying diagram?

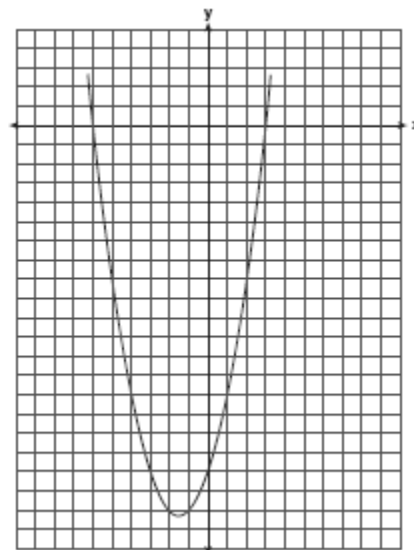


[A] $y = -x^2 + 2x + 3$ [B] $y = -x^2 - 2x + 3$

[C] $y = x^2 - 2x + 3$ [D] $y = x^2 + 2x + 3$

8. 010328a, P.I. A.G.4

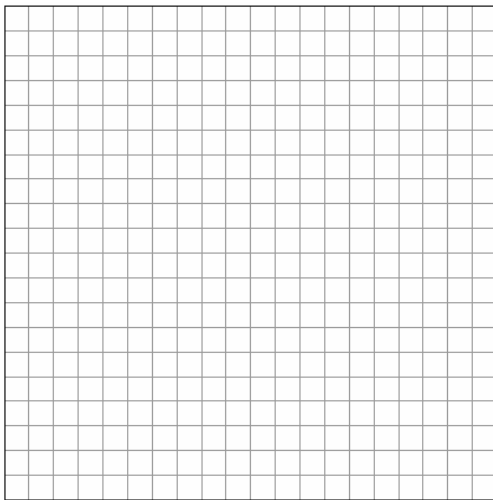
The graph of a quadratic equation is shown in the accompanying diagram. The scale on the axes is a unit scale. Write an equation of this graph in standard form.



9. 060101b, P.I. A.A.8
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 ?
[A] 64 [B] 4 [C] 128 [D] 8
10. 080501b, P.I. A.A.41
What is the turning point, or vertex, of the parabola whose equation is $y = 3x^2 + 6x - 1$?
[A] (1,8) [B] (3,44)
[C] (-1,-4) [D] (-3,8)
11. 080603b, P.I. A.A.41
What is the minimum point of the graph of the equation $y = 2x^2 + 8x + 9$?
[A] (2,33) [B] (-2,-15)
[C] (2,17) [D] (-2,1)
12. 010322b, P.I. A.A.8
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.
13. 060321b, P.I. A.A.41
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?
14. 080321b, P.I. A.A.41
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 $h(t) = -16t^2 + 30t + 6$. Find, to the nearest tenth, the maximum height, in feet, the ball will reach.
15. 010424b, P.I. A.A.41
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 ?
16. 060225b, P.I. A.A.41
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?

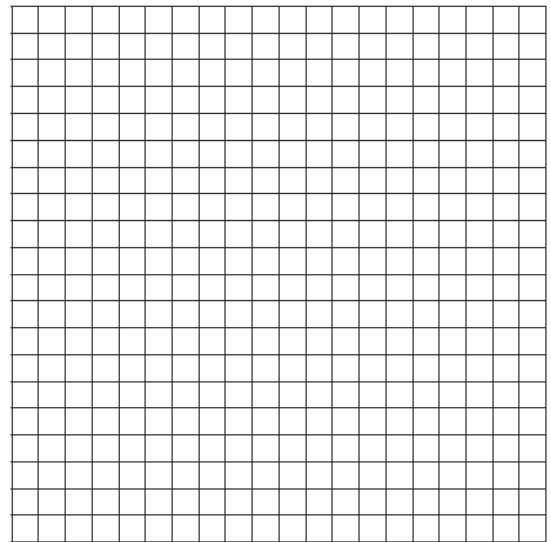
17. 060430b, P.I. A.A.41

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.]



18. 080229b, P.I. A.A.41

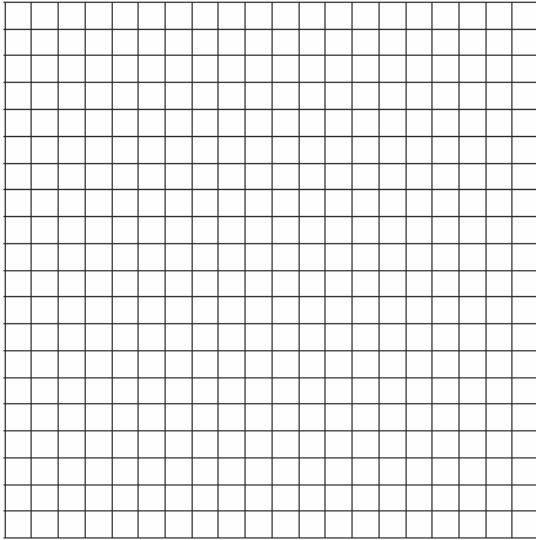
A rock is thrown vertically from the ground with a velocity of 24 meters per second, and it reaches a height of $2 + 24t - 4.9t^2$ after t seconds. How many seconds after the rock is thrown will it reach maximum height, and what is the maximum height the rock will reach, in meters? How many seconds after 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.]



19. 060732b, P.I. A.A.41

The path of a rocket fired during a fireworks display is given by the equation

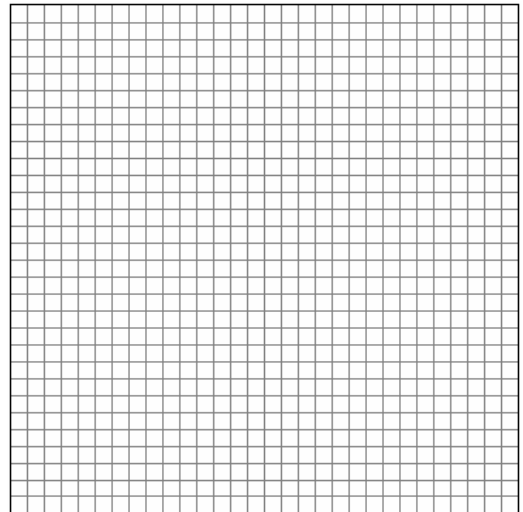
$s(t) = 64t - 16t^2$, where t is the time, in seconds, and s is the height, in feet. What is the maximum height, in feet, the rocket will reach? In how many seconds will the rocket hit the ground? [The grid is optional.]



20. 010834b, P.I. A.A.41

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 $0 \leq x \leq 90$ and $-50 \leq y \leq 160$. 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?



[1] C

a [3] A parabola is correctly graphed through (0,0), (1,5), (2,8), (3,9), (4,8), (5,5), and (6,0).

[2] The correct table of values is shown but is not graphed through the entire domain.

or [2] The correct points are graphed but as a broken line graph not a curve.

or [2] At least three values are correctly calculated and graphed.

[1] At least two of the values are correctly calculated, and the student tried to graph all points.

b [1] 3

or [1] The correct time, x , for an incorrect graph in part a is found.

a and b [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an

[2] obviously incorrect procedure.

[4] 100 and a correct parabolic arch is drawn, and appropriate work is shown, such as a table of values for the parabola or correctly labeled points.

[3] 100 and a correct parabolic arch is drawn, but no table of values or labeled points are shown.

or [3] 100 and a correct parabolic arch is drawn, and appropriate work is shown, but no scale or an incorrect scale is shown.

or [3] A correct parabolic arch is drawn, but the maximum height is missing or is incorrect.

[2] An incorrect parabolic arch is drawn, but an appropriate maximum height is found.

or [2] A correct height is determined algebraically, but a parabolic arch is not drawn.

or [2] 100 and an appropriate parabolic arch is drawn, but it is not drawn between $0 \leq x \leq 20$.

[1] A correct parabolic arch is drawn, but no work is shown, such as a table of values or correctly labeled points, and the maximum height is missing or is incorrect.

or [1] 100, but no work is shown and no parabolic arch is drawn.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[3] incorrect procedure.

- a [3] A parabola with points graphed at (0,0), (1,32), (2,48), (3,48), (4,32), and (5,0) is shown. [Points do not have to be labeled on the graph for full credit.]
[2] Appropriate work is shown, such as a table of values, but one graphing error is made.
or [2] The correct points are graphed, but the parabola is drawn incorrectly, such as connecting (2,48) and (3,48) as a line segment or not connecting the points at all.
or [2] At least four correct values are found, and the parabola is graphed appropriately.
or [2] A correct table of values is shown for all values from 0 to 5, but no graph is drawn.
[1] Two or three correct values are found, and the parabola is graphed appropriately.
or [1] A correct table of values is shown for an incorrectly transcribed equation, such as $h = 8t^2 + 40t$, but no graph is drawn.
b [1] 2.5 is found algebraically or identified from a table or from the graph of the parabola.
or [1] An appropriate value of t is found, based on an incorrect graph.
or [1] $2 < t < 3$ is given as the range of values based on the line segment drawn in part a.
a and b [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
-
- [4] _____
- a [3] A parabola is correctly graphed through (0,0), (1,10), (2,16), (3,18), (4,16), (5,10), and (6,0).
[2] A correct table of values is shown, but not all the points are graphed correctly.
or [2] The correct points are graphed but as a broken-line graph, not a curve.
or [2] At least four values are calculated correctly and graphed.
[1] The student has at least two of the values calculated correctly and has tried to graph all the points.
[0] Fewer than two values are calculated correctly.
b [1] A maximum height of 18 is found.
or [1] Correct y is found for an incorrect graph in part a.
a and b [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
-
- [5] _____
- [4] A correct graph is drawn, and 3.
[3] 3, and appropriate work is shown, but one graphing error is made.
or [3] A correct graph is drawn and the points 0.5 and 3.5 are identified, but the difference is not calculated.
[2] Appropriate work is shown, but two or more graphing errors are made.
or [2] Appropriate work is shown, but one conceptual error is made.
or [2] 3, but a method other than a graphic solution is used.
[1] Appropriate work is shown, but one conceptual error and one graphing error are made.
or [1] A correct graph is sketched with $t = 0$ to $t = 4$, but no further correct work is shown.
or [1] 3, but no work is shown and no graph is drawn.
[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
-
- [6] _____
- [7] A _____

[3] $y = x^2 + 3x - 18$, and appropriate work leading from the roots to the equation is shown.

[2] Appropriate work is shown, but one computational error is made.

or [2] $x^2 + 3x - 18 = 0$, but appropriate work is shown.

or [2] Only the correct factors $(x + 6)$ and $(x - 3)$ are shown.

[1] Appropriate work is shown, but more than one computational error is made.

or [1] Only the roots -6 and 3 are shown, such as $x = -6$, $x = 3$.

or [1] $y = x^2 + 3x - 18$, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[8] incorrect procedure.

[9] C

[10] C

[11] D

[2] Maximum, and an appropriate reason is given, such as the value of a is negative (less than 0) or the graph opens downward.

[1] Minimum, but an appropriate reason is given, based on an incorrect equation, such as an error in finding the axis of symmetry.

[0] Maximum or minimum, but no reason or an inappropriate reason is given.

or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an

[12] obviously incorrect procedure.

[2] 1.4, and appropriate work is shown, such as finding the axis of symmetry.

[1] Appropriate work is shown, but one computational or rounding error is made.

or [1] 1.4, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[13] incorrect procedure.

[2] 20.1, and appropriate work is shown.

[1] Appropriate work is shown, but one computational or rounding error is made.

or [1] Appropriate work is shown, but one conceptual error is made.

or [1] The time when the ball reaches its maximum height is found correctly, but no further correct work is shown.

or [1] 20.1, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[14] incorrect procedure.

[2] 5, and appropriate work is shown.

[1] Appropriate work is shown, but one computational error is made.

or [1] Appropriate work is shown, but one conceptual error is made.

or [1] 5, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[15] incorrect procedure.

[2] 300, and appropriate work is shown.

[1] Appropriate work is shown, but one computational error is made.

or [1] 300, but no work is shown.

[0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously

[16] incorrect procedure.

- [4] 3 and 42, and appropriate work is shown, such as a graph, substitution, or a table of values.
- [3] Appropriate work is shown, but one computational or graphing error is made.
- [2] Appropriate work is shown, but two or more computational or graphing errors are made.
- or [2] Appropriate work is shown, but one conceptual error is made.
- or [2] The number of seconds is found correctly, and appropriate work is shown, but the height is not found or is found incorrectly.
- or [2] The height is found correctly, and appropriate work is shown, but the number of seconds is not found or is found incorrectly.
- [1] 3 and 42, but no work is shown.
- [0] 3 or 42, but no work is shown.
- or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- [17] _____

- [4] Time of maximum height = 2.45, maximum height = 31.39, time when it hit the ground = 4.98, and appropriate algebraic or graphic work is shown. [Answers for time, in seconds, may vary based on method of solution.]
- [3] Appropriate algebraic or graphic work is shown, but one computational or graphing error is made.
- or [3] The times are found correctly, but the maximum height is incorrect.
- [2] The rock's maximum height and the time it takes to reach that height are found correctly, but the time it takes to hit the ground is incorrect.
- or [2] The time it takes the rock to hit the ground is found correctly, but the maximum height and the time it takes to reach that height are incorrect.
- [1] Time of maximum height = 2.45, maximum height = 31.39, time when it hit the ground = 4.98, but no work is shown.
- [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an obviously incorrect procedure.
- [18] _____

[4] Maximum height = 64 and time = 4, and appropriate work is shown.

[3] Appropriate work is shown, but one computational or graphing error is made.

or [3] The correct time is found, and appropriate work is shown, but the maximum height is not found.

[2] Appropriate work is shown, but two or more computational or graphing errors are made.

or [2] Appropriate work is shown, but one conceptual error is made.

or [2] The maximum height is found correctly, and appropriate work is shown, but an incorrect value is found for t .

or [2] Appropriate work is shown, but only the time that the maximum height occurs is found, and the quadratic equation

$64t - 16t^2 = 0$ is factored, but no further correct work is shown.

[1] Appropriate work is shown, but one conceptual error and one computational or graphing error are made.

or [1] Appropriate work is shown, but only the time that the maximum height occurs is found, or the quadratic equation

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

or [1] Maximum height = 64 and time = 4, but no work is shown.

[0] Maximum height = 64 or time = 4, but no work is shown.

or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an

[19] obviously incorrect procedure.

[6] A correct graph is drawn, 90 and 45, and appropriate work is shown.

[5] Appropriate work is shown to answer all three parts of the question, but one computational or graphing error is made.

[4] Appropriate work is shown, but two or more computational or graphing errors are made.

or [4] A correct graph is drawn, and 90 or 45, and appropriate work is shown.

[3] Appropriate work is shown, but one conceptual error is made.

or [3] 90 and 45, and appropriate work is shown, but no graph is drawn.

or [3] A correct graph is drawn, but no further correct work is shown.

[2] Appropriate work is shown, but one conceptual error and one computational or graphing error are made.

[1] 90 or 45, and appropriate work is shown.

or [1] 90 and 45, but no work is shown and no graph is drawn.

[0] 90 or 45, but no work is shown.

or [0] A zero response is completely incorrect, irrelevant, or incoherent or is a correct response that was obtained by an

[20] obviously incorrect procedure.