Application Problems Summary

When asked to determine the height of an object at a certain time, you need to:

When asked to identify the maximum or minimum height that an object reaches, you are being asked to find the ________________________. So you need to:

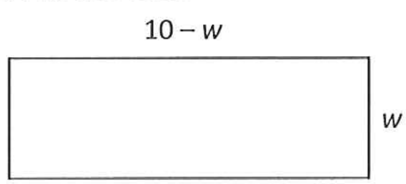
When asked to identify the time at which an object reaches its maximum or minimum height, you are being asked to find the ____. So you need to:

When asked to identify the time at which an object remains in the air or the time that an object will hit the ground, you need to find the ____________________ of the function. Then re-read the question and use the __________________ that you just found to answer the question. To find the ___________________ you need to:

When asked to identify the time at which an object reaches a certain height, you need to:

<u>**Practice Problems**</u> *(You must show your work for each problem!)*

1. The area of a garden is given by the formula: $A = 10w - w^2$, where w is the width in meters and A is the area.



A) What would the area of the garden be if the width was 2 meters?

B) What is the maximum area of the garden?

C) At what width, in meters, will the garden reach its maximum area?

2. Hugh Betcha launched a model rocket with an initial speed of 88 feet per second. The approximate height h (in feet) is modeled by: $h = -16t^2 + vt$, where t is the time in motion (in seconds) and v is the initial upward velocity (in feet per second).

A) After how many seconds the rocket be 40 feet high?

B) How long does it take the rocket to hit the ground?

3. Each of the "golden arches" at a McDonald's restaurant is in the shape of a parabola. Each arch is modeled by: $h(x) = -x^2 + 6x$, where $h(x)$ is the height of the arch (in feet) at a distance x (in feet) from one side.

A) Find the equation of the axis of symmetry.

B) How high is the arch at the axis of symmetry?

4. A major league batter smashes a pitch toward the left field fence, which is 10 feet high and 350 feet from homeplate. The height as a function of time in motion is modeled by the function: $h(t) = -16t^2 + 64t + 4$, where $h(t)$ is the height of the ball (in feet) t seconds after being hit.

A) At what time will the ball hit the ground?

B) At what time(s) will the height of the ball be 52 feet?

Application Problems Summary

When asked to determine the height of an object at a certain time, you need to:

plug the given time in for "t" and find the height

When asked to identify the maximum or minimum height that an object reaches, you are being asked to find the extrema. So you need to:

use $\frac{-b}{2a}$ to find the x-coordinate of the vertex the plug that into the equation to find the y-coord. of the vertex

When asked to identify the time at which an object reaches its maximum or minimum height, you are being asked to find the x-coordinate of the vertex. So you need to:

use $\frac{-b}{2a}$ to find the x-coordinate of the vertex

When asked to identify the time at which an object remains in the air or the time that an object will hit the ground, you need to find the zeros of the function. Then re-read the question and use the zeros that you just found to answer the question. To find the zeros you need to:

let h = 0 (make sure everything is on one side) and use the quadratic formula to find the zeros

When asked to identify the time at which an object reaches a certain height, you need to:

let h = the given height, make sure everything is on the same side, and use the quadratic formula to find the zeros

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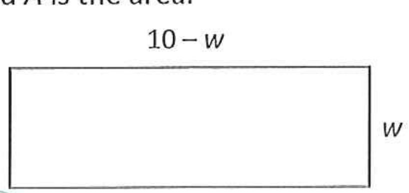
Practice Problems *(You must show your work for each problem!)*

1. The area of a garden is given by the formula: $A = 10w - w^2$, where w is the width in meters and A is the area.



A) What would the area of the garden be if the width was 2 meters?

$A = 10(2) - 2^2$
$= 20 - 4$
$= 16\ m^2$

B) What is the maximum area of the garden?

$\frac{-(10)}{2(-1)} = \frac{-10}{-2} = 5$

$A = 10(5) - 5^2$
$= 50 - 25 = 25\ m^2$

C) At what width, in meters, will the garden reach its maximum area?

5 m

2. Hugh Betcha launched a model rocket with an initial speed of 88 feet per second. The approximate height h (in feet) is modeled by: $h = -16t^2 + vt$, where t is the time in motion (in seconds) and v is the initial upward velocity (in feet per second). $h = -16t^2 + 88t$

A) After how many seconds the rocket be 40 feet high?

$$h = -16t^2 + 88t \rightarrow 40 = -16t^2 + 88t \rightarrow \boxed{0 = -16t^2 + 88t - 40}$$

$$\frac{-88 \pm \sqrt{88^2 - 4(-16)(-40)}}{2(-16)} = \frac{-88 \pm \sqrt{5184}}{-32} = \frac{-88 \pm 72}{-32} = \frac{-88+72}{-32} = \frac{-16}{-32} = 0.5, \quad \frac{-88-72}{-32} = \frac{-160}{-32} = 5$$

after 0.5 sec

B) How long does it take the rocket to hit the ground?

$$0 = -16t^2 + 88t$$

$$\frac{-88 \pm \sqrt{88^2 - 4(-16)(0)}}{2(-16)} = \frac{-88 \pm \sqrt{7744}}{-32} = \frac{-88 \pm 88}{-32} = \frac{-88+88}{-32} = 0, \quad \frac{-88-88}{-32} = \frac{-176}{-32} = 5.5$$

5.5 sec

3. Each of the "golden arches" at a McDonald's restaurant is in the shape of a parabola. Each arch is modeled by: $h(x) = -x^2 + 6x$, where $h(x)$ is the height of the arch (in feet) at a distance x (in feet) from one side.

A) Find the equation of the axis of symmetry.

$$X = \frac{-6}{2(-1)} = \frac{-6}{-2} = +3 \rightarrow X = +3$$

B) How high is the arch at the axis of symmetry?

$$h(X) = -(+3)^2 + 6(+3)$$
$$= -9 + 18$$
$$= 9 \text{ ft}$$

4. A major league batter smashes a pitch toward the left field fence, which is 10 feet high and 350 feet from homeplate. The height as a function of time in motion is modeled by the function: $h(t) = -16t^2 + 64t + 4$, where $h(t)$ is the height of the ball (in feet) t seconds after being hit.

A) At what time will the ball hit the ground?

$$0 = -16t^2 + 64t + 4$$

$$\frac{-64 \pm \sqrt{64^2 - 4(-16)(4)}}{2(-16)} = \frac{-64 \pm \sqrt{4352}}{-32} = \frac{-64 \pm \sqrt{4352}}{-32} = \frac{-64+\sqrt{4352}}{-32} = -0.06, \quad \frac{-64-\sqrt{4352}}{-32} = 4.06$$

4.06 sec

B) At what time(s) will the height of the ball be 52 feet?

$$52 = -16t^2 + 64t + 4$$
$$0 = -16t^2 + 64t - 48$$

$$\frac{-64 \pm \sqrt{64^2 - 4(-16)(-48)}}{2(-16)} = \frac{-64 \pm \sqrt{1024}}{-32} = \frac{-64 \pm 32}{-32} = \frac{-64+32}{-32} = 1, \quad \frac{-64-32}{-32} = 3$$

1 and 3 sec