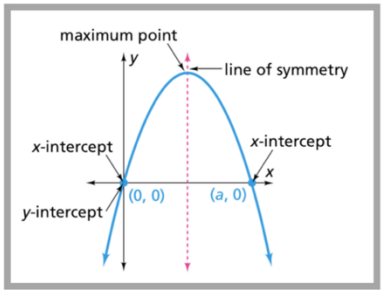
Name Key Block _____ Date _____

Using Key Features to Answer Questions

Quadratic relationships model many real-life situations. We can use the **Key Features** of the parabola to answer all sorts of questions about the situation.

Key Features:

- y-intercept
- first x-intercept
- second x-intercept
- line of symmetry
- vertex (max/min)



Problem 1

Steph is practicing golf at the driving range. The equation that models the height of the ball is: $y = -0.5x^2 + 12x$ where y represents the height of the ball measured in feet, and x represents the time in seconds.

Graph the equation above in Desmos, and answer the following questions, indicating which Key Feature gave you the answer.

Question	Key Feature	Answer
1. How long will it take for the golf ball to hit the ground?	2nd x-intercept	24 sec.
2. What is the highest point the golf ball reached?	vertex	72 feet
3. How long did it take the golf ball to reach its highest point?	LOS	12 sec.

Other questions you can answer using the graph (move the cursor along the parabola to find point coordinates):

4. If the ball is 31.5 feet in the air, how many seconds have gone by? Is there only one answer?

   3 seconds and 21 seconds

5. How high will the ball be after 1 second?

   11.5 feet

6. How long was the golf ball above 40 feet?

   from 4 to 24 seconds for a total of 20 seconds.

Problem 2

Eric is sitting at the top of a cliff above the ocean's surface. He is waiting for his friends to climb up and meet him. As he waits, he decides to start casually tossing pebbles off the side of the cliff. The equation that represents the height of his pebble $y = -x^2 + 5x + 500$ where *y* represents the height of the pebble measured in feet, and *x* represents the time in seconds.

Graph the equation above in Desmos, and answer the following questions, indicating which Key Feature gave you the answer.

Question	Key Feature	Answer
1. How high above the ocean's surface does Eric toss the pebble from?	y-intercept	500 ft
2. How long before the pebble hits the surface of the ocean?	2nd x-intercept	25 sec.
3. How long after the pebble is tossed does it reach its highest point?	LOS	2.5 sec.
4. What is the highest point that the pebble reaches?	vertex	506.25

Other questions you can answer using the graph (move the cursor along the parabola to find point coordinates):

5. How high is the pebble after 1 second?

   504 feet

6. How long is the pebble higher that Eric?

   5 seconds

7. How long after the pebble is tossed is it 200 feet above the surface of the ocean?

   20 seconds

Without using Desmos, calculate the key features you will need to find answers to the following problems

Problem 3

A toy rocket is launched vertically upward. It's height in feet (h) after t seconds is given by the equation $h = -16t^2 + 128t$. Show all work below.

a. How long will it take for the rocket to return to the ground? 8 seconds
b. How high off the ground is the launch pad? 0 feet
c. How long will it take the rocket to hit its maximum height? 4 seconds
d. What is the maximum height the rocket will reach? 256 feet
e. How high was the rocket after 2 seconds? 192 feet

a. $h = -16t(t-8)$

$-16t = 0$, $\frac{-16t}{-16} = \frac{0}{-16}$, $t = 0$

$t - 8 = 0$, $+8 \quad +8$, $t = 8$

x-ints: (0,0) (8,0)

e. $h = -16t(t-8)$
$= -16(2)(2-8)$
$= (-32)(-6)$
$= 192$ feet

b. y-int: (0,0)
Launched from the ground.

c. LOS: $x = \frac{0+8}{2} = 4$
4 seconds

d. $h = -16t(t-8)$
$= -16(4)(4-8)$
$= 256$ feet

Problem 4

Peter jumped off of a cliff into the ocean in Acapulco while vacationing with some friends. His height as a function of time could be modeled by the function $h = -16t^2 + 16t + 480$ where t is the time in seconds and h is the height in feet. Show all work below.

a. How high above the water is Peter before he jumps? 480 feet

b. How long did it take for Peter to reach his maximum height? 0.5 seconds

c. What was the highest point that Peter reached? 484 feet

d. Peter hit the water after how many seconds? 6 seconds

e. How far above the water was Peter after 3 seconds? 384 feet

a. y-int

$h = -16(0)^2 + 16(0) + 480$

$h = 480$

b. $h = -16(t^2 - t + 30)$

$0 = -16(t-6)(t+5)$

$t - 6 = 0$ $\quad t + 5 = 0$

$+6 \quad +6 \quad -5 \quad -5$

$t = 6 \quad t = -5$

LOS: $x = \frac{6-5}{2} = 0.5$

c. $h = -16(0.5-6)(0.5+5)$

$= -16(-5.5)(5.5)$

$= 484$

d. 2nd x-int calculated in part b.

e. $h = -16(3-6)(3+5)$

$= -16(-3)(8)$

$= 384$