

If h = height in feet, & t = time in seconds

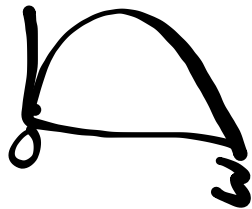
$$h = -16t^2 + 48t = 16t(-t + 3)$$

- ① What is max height & when will it occur? $x = 1.5$

$$h = -16(1.5)^2 + 48(1.5) = 36$$

- ② When will ball hit ground?

In 3 seconds



Algebra 8r class notes week of 4FEB

For Exercises 7–10, do parts (a)–(d) without a calculator.

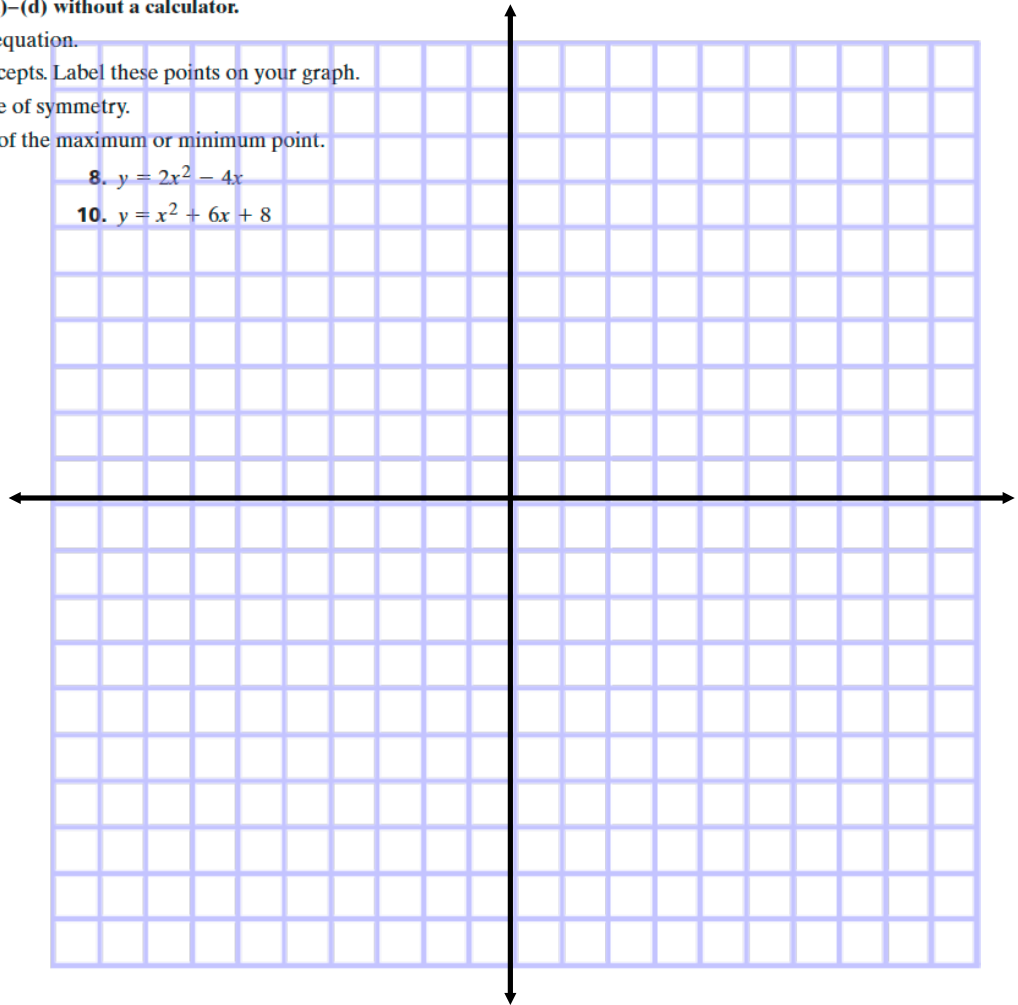
- a. Sketch a graph of the equation.
- b. Find the x - and y -intercepts. Label these points on your graph.
- c. Draw and label the line of symmetry.
- d. Label the coordinates of the maximum or minimum point.

7. $y = 9 - x^2$

8. $y = 2x^2 - 4x$

9. $y = 6x - x^2$

10. $y = x^2 + 6x + 8$



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$$y = 2x(x-2)$$

$$0 = 2x(x-2)$$

$$2x = 0 \quad \& \quad x-2 = 0$$

$$x = 0 \quad \& \quad x = 2$$

$$(0,0) \quad \& \quad (2,0)$$

L.O.S

$$x = 1$$

Vertex

$$y = 2(1)^2 - 4(1)$$

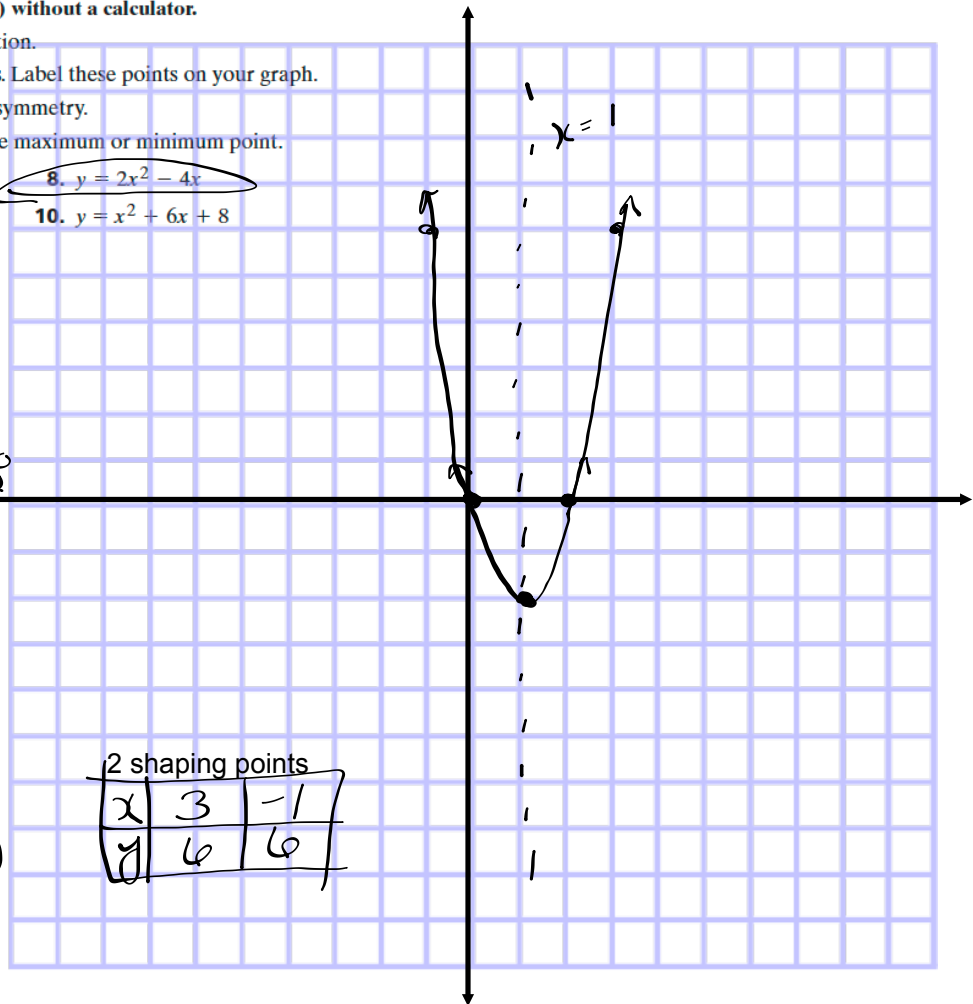
$$2 - 4 = -2$$

$$y = 2(0)^2 - 4(0)$$

$$= 0 \quad (0,0)$$

2 shaping points

x	3	-1
y	6	6



Algebra 8r class notes week of 4FEB

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$$y = x(6-x)$$

x -int
 $0 = x(6-x)$
 $\swarrow \searrow$
 $x=0$ or $6-x=0$
 $(0,0)$ & $(6,0)$

L.O.S. middle of 0 & 6

$$x=3$$

Vertex
 $y = 6(3) - (3)^2$
 $= 18 - 9 = 9$
 $(3,9)$

8. $y = 2x^2 - 4x$

10. $y = x^2 + 6x + 8$

$$y = \frac{b^2}{4a}$$

$$y = \frac{6^2}{4(1)}$$

$$y = \frac{36}{4} = 9$$

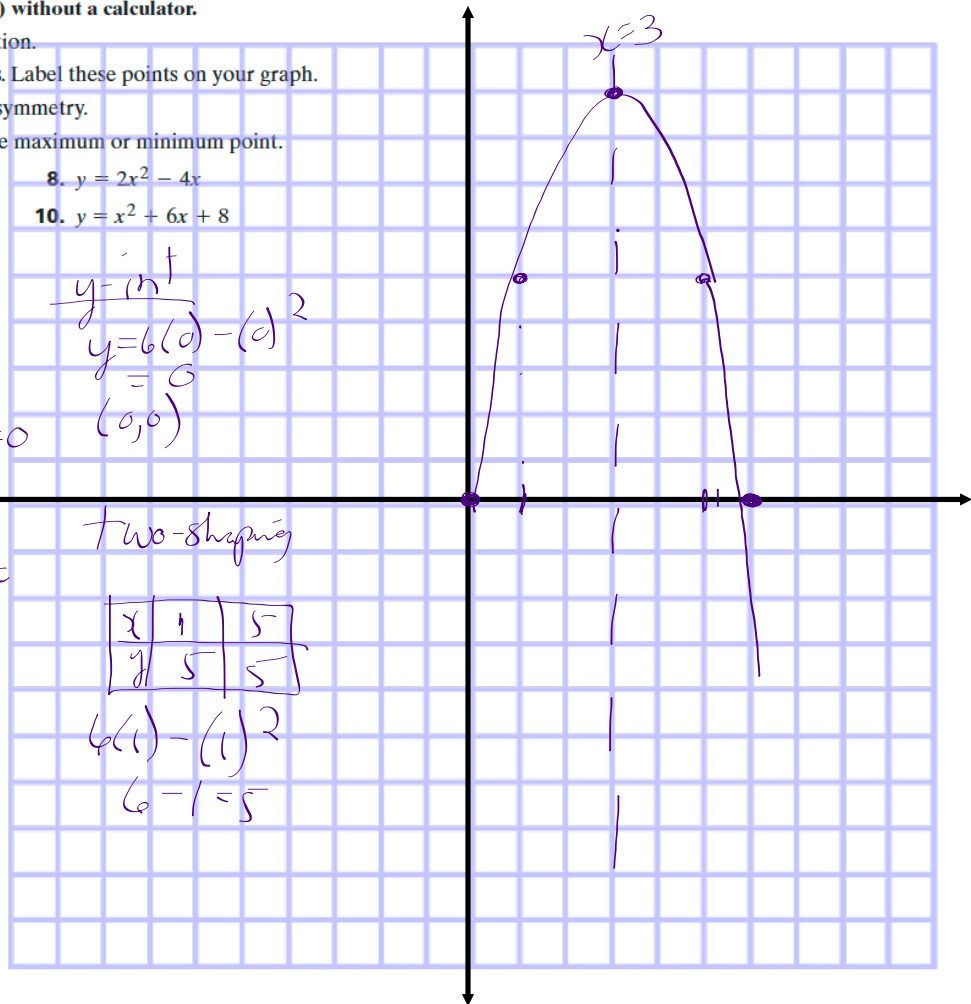
$$(0,0)$$

Two-shaping

x	1	5
y	5	5

$$6(1) - (1)^2$$

$$6 - 1 = 5$$



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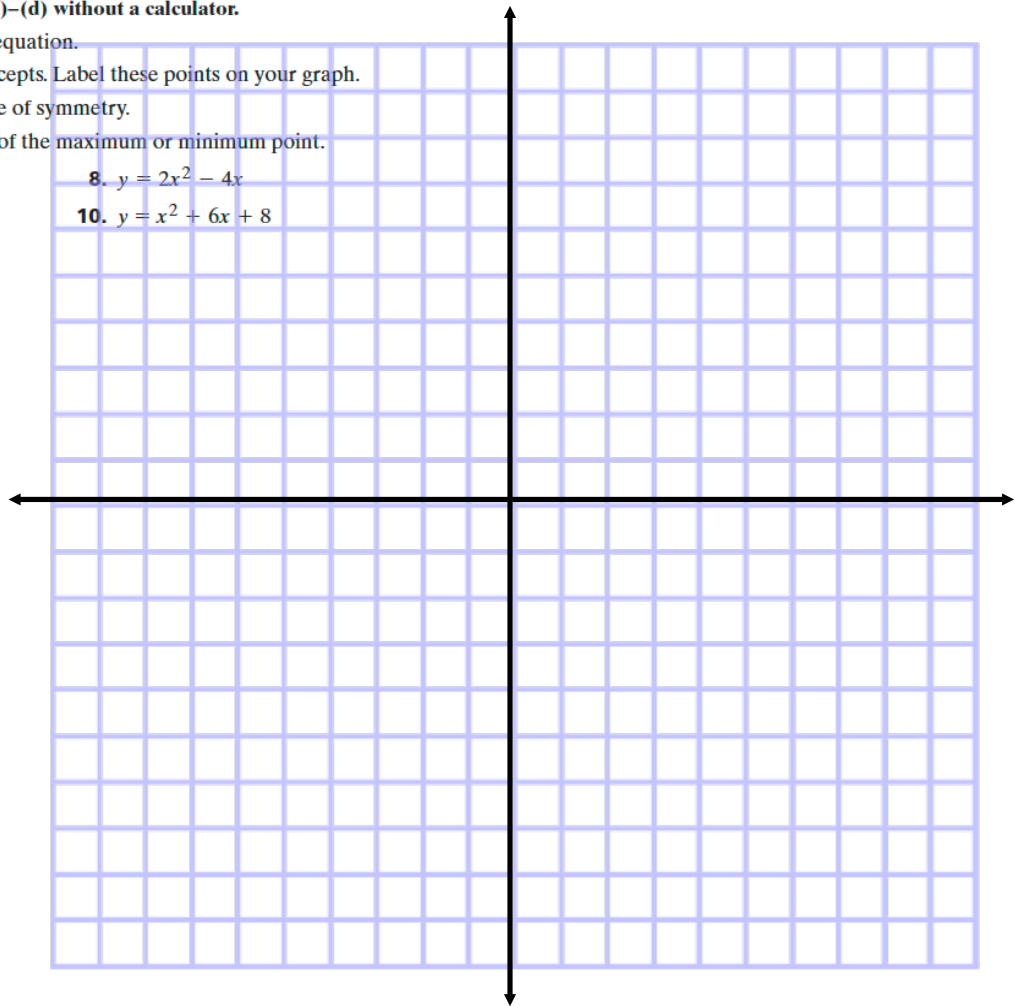
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MATHEMATICS DEPARTMENT

Each student must pass two years of mathematics, not including computer programming courses, in order to fulfill graduation requirements. Wellesley High School strongly encourages enrollment in a mathematics course in each of a student's four years in high school.

Courses are offered ranging from Cognitive Tutor Geometry to Advanced Placement Calculus or Statistics in the senior year, many at three levels of difficulty. Students are recommended for a specific level based upon demonstrated achievement and interest in mathematics. It is strongly urged that students consider these factors when selecting courses of study in mathematics. As a general guideline, students who achieve a grade of B or better in their present course and have their teacher's recommendation will be prepared for the next course at that level.

Honors Level: honor courses are designed for gifted and highly motivated students who have demonstrated high achievement and the ability to handle an accelerated pace. Student work requires thoughtful analysis and attention to detail leading to synthesis of new ideas and prior learning. Diversified strategies and skills to solve complex, challenging problems, and the ability and desire to think, reason, work independently and in teams, and communicate mathematically on an abstract and symbolic level will be expected of all students. Nightly homework may include previewing new material, applying and extending concepts discussed in class, researching various aspects of mathematics, and completing team projects. This sequence leads to the study of Calculus or Statistics at the Advanced Placement level in the senior year. Students should have a teacher recommendation based on superior achievement in a previous mathematics course.

ACP Level: courses are a demanding part of the advanced college preparatory program. The pace is rigorous and a great deal of outside preparation is expected. Students must demonstrate effective mathematical skills or be sufficiently motivated and determined to acquire these skills. The ability to think, reason, and communicate mathematically is required. Consolidation and application of math concepts are developed both independently and with the guidance of the teacher. Written and oral work must exhibit proficiency in a multi-faceted approach to solving problems. Nightly homework may involve applying and extending concepts discussed in class; previewing new material; and, at times, carrying out independent projects. This sequence leads to an introduction to college mathematics in the senior year. Students should have a teacher recommendation based on solid success in a previous mathematics course.

CP Level: is a college preparatory program for students who need substantial structure and a focus on skill development. Material is presented at a deliberate pace in both abstract and experiential formats. The goal of these courses is to enable students to be confident learners who are solidly based in the fundamentals of mathematics. Those fundamentals must include the ability to think, reason and communicate effectively about mathematics. There is a continual emphasis on applying problem solving skills to real life situations. There is considerable variety in approaches to the course work. Nightly homework may involve applying and extending concepts discussed in class; previewing new material; and, at

[illegible]

factor
completely

$$x^3 + 11x^2 + 10x$$

$$= x (\underline{x^2 + 11x + 10}) \quad \text{1st look for GCF}$$

$$= x (x + 1)(x + 10)$$

Then see if it
can be factored
again

factor
completely

$$4x^2 - 100 =$$

$$(2x+10)(2x-10) =$$
$$2(x+5)2(x-5) =$$
$$4(x+5)(x-5)$$

$$4(x^2 - 25) =$$

1st look for a
GCF

$$4(x-5)(x+5)$$

Then see if it
can be factored
again

factor
completely $3x^2 - 15x + 18 =$

$$3(x^2 - 5x + 6) =$$

1st look to see if
there is a GCF

$$3(x-3)(x-2)$$

Then look to see
if you can factor
again

Solve the following quadratic equations by first factoring and then using the zero-product property. Then check each by substituting back into the original expanded form of the equation.

$$4y^2 - 18y = 0 \quad x^2 - 12 = -3$$

$$2y(2y - 9) = 0$$

$$\begin{array}{l} \downarrow \text{ or } \downarrow \\ \frac{2y=0}{2 \quad 2} \qquad \frac{2y-9=0}{+9 \quad +9} \\ \hline y=0 \qquad \frac{2y}{2} = \frac{9}{2} \\ \qquad \qquad y = \frac{9}{2} \end{array}$$

$$\boxed{y=0 \text{ or } \frac{9}{2}}$$

$$\begin{array}{r} +3 \quad +3 \\ \hline \end{array}$$

$$x^2 - 9 = 0$$

$$(x+3)(x-3) = 0$$

$$\begin{array}{l} \downarrow \text{ or } \downarrow \\ x+3=0 \qquad x-3=0 \\ x=-3 \qquad x=3 \end{array}$$

$$x = -3 \text{ or } 3$$

$$\boxed{x = \pm 3}$$

Solve by factoring:

① $3x^2 + 5x = 12$

$$\begin{aligned} & \underline{-12 \quad -12} \\ & 3x^2 + 5x - 12 = 0 \\ & (3x - 4)(x + 3) = 0 \\ & \downarrow \qquad \qquad \searrow \\ & 3x - 4 = 0 \qquad x + 3 = 0 \\ & \Rightarrow 3x = 4 \qquad \Rightarrow x = -3 \\ & \Rightarrow x = \frac{4}{3} \end{aligned}$$

$x = \frac{4}{3} \text{ or } -3$

② $x^2 - 6x + 11 = 2$

$$\begin{aligned} & \Rightarrow x^2 - 6x + 9 = 0 \\ & (x - 3)(x - 3) = 0 \\ & \quad \quad \quad \vee \\ & x - 3 = 0 \\ & \quad \quad \quad \boxed{x = 3} \end{aligned}$$

Did You Know?



- The average flea weighs 0.000001 pound and is 2 to 3 millimeters long. It can pull 160,000 times its own weight and can jump 150 times its own length. This is equivalent to a human being pulling 24 million pounds and jumping nearly 1,000 feet!
- There are 3,000 known species and subspecies of fleas. Fleas are found on all land masses, including Antarctica.
- Most fleas make their homes on bats, rats, squirrels, and mice.
- The bubonic plague, which killed a quarter of Europe's population in the fourteenth century, was spread by rat fleas.
- Flea circuses originated about 300 years ago and were popular in the United States a century ago.



4.3

Putting It All Together

You have used equations to model a variety of quadratic functions. You may have noticed some common characteristics of these equations. You have also observed patterns in the graphs and tables of quadratic functions.

To understand a relationship, it helps to look at how the value of one variable changes each time the value of the other variable increases by a fixed amount. For a linear relationship, the y -value increases by a constant amount each time the x -value increases by 1.

Look at this table for the linear relationship $y = 3x + 1$. The “first differences” are the differences between consecutive y -values.

Because the y -value increases by 3 each time the x -value increases by 1, the first differences for $y = 3x + 1$ are all 3.

Now, you’ll look at differences for quadratic relationships.

~~Example~~

x	y	
0	1	
1	4	$4 - 1 = 3$
2	7	$7 - 4 = 3$
3	10	$10 - 7 = 3$
4	13	$13 - 10 = 3$
5	16	$16 - 13 = 3$

Getting Ready for Problem 4.3

The simplest quadratic relationship is $y = x^2$, and it is the rule for generating square numbers. In fact, the word *quadratic* comes from the Latin word for “square.”

The table below shows that the first differences for $y = x^2$ are not constant.

x	y	
0	0	
1	1	$1 - 0 = 1$
2	4	$4 - 1 = 3$
3	9	$9 - 4 = 5$
4	16	$16 - 9 = 7$
5	25	$25 - 16 = 9$

- What happens when you look at the “second differences” for $y = x^2$?

x	y	First differences	Second differences
0	0		
1	1	$1 - 0 = 1$	$3 - 1 = 2$
2	4	$4 - 1 = 3$	$5 - 3 = 2$
3	9	$9 - 4 = 5$	$7 - 5 = 2$
4	16	$16 - 9 = 7$	$9 - 7 = 2$
5	25	$25 - 16 = 9$	

- Study the pattern of first and second differences for $y = x^2$. Do you think the tables for other quadratic functions will show a similar pattern?

Problem 4.3 Functions and Patterns of Change

- A. 1.** Make a table of values for each quadratic equation below. Include integer values of x from -5 to 5. Show the first and second differences as is done for the table above.
- a.** $y = 2x(x + 3)$ **b.** $y = 3x - x^2$
c. $y = (x - 2)^2$ **d.** $y = x^2 + 5x + 6$
- 2.** Consider the patterns of change in the values of y and in the first and second differences. In what ways are the patterns similar for the four tables? In what ways are they different?
- 3.** What patterns of change seem to occur for quadratic relationships?
- B. 1.** Make a table of (x, y) values for each equation below. Show the first and second differences.
- a.** $y = x + 2$ **b.** $y = 2x$ **c.** $y = 2^x$ **d.** $y = x^2$
- 2.** Consider the patterns of change in the values of y and in the first and second differences. How are the patterns similar in all four tables? How are they different?
- 3.** How can you use the patterns of change in tables to identify the type of relationship?

ACE Homework starts on page 64.

a. $y = 2x(x + 3)$

x	y
0	0
1	8
2	20
3	36
4	56
5	80

1st difference

2nd

it is QUADRATIC

b. $y = 3x - x^2$

x	y
0	0
1	2
2	2
3	0
4	-4
5	-10