Date: 25.12.2013
Teachers: Ceren Özbay
Number of Students: 6
Grade Level: 10
Time Frame: 40 Minutes

FINDING A QUADRATIC FORM FROM ITS GRAPH

1. Goal(s)
- To develop an understanding of graphs of quadratic functions.

2A. Specific Objectives (measurable)
- Students will able to find a quadratic from its graph.
- Students will be able to determine the equation of a parabola using the vertex form of a parabola.

2B. Ministry of National Education (MoNE) Objectives
- 10.6.2. İkinci Dereceden Fonksiyonlar ve Grafikleri,

2C.IGCSE Standards:
- Recognition of quadratic functions from the shape of their graphs. (Functions – Extended curriculum 3.2)

3. Rationale
- Graphing of quadratics will help students to visualize quadratic equations
- Quadratic functions are widely used in science, business, and engineering. The U-shape of a parabola can describe the trajectories of water jets in a fountain and a bouncing ball.
- Students need all information so they can analyze the graphs and how they related to given situations in the problems and they will reach a conclusion about the nature of the roots

4. Materials
- Board.
- At least two different colored board markers.
- Worksheets

- Projector
- Computer
- A notebook in which there is a list of the names of the students and a pencil for assessment

5. Resources
- Haese&Harris Publications. Mathematics for the international student Mathematics HL (Core) book. The authors are Paul Urban, John Owen, David Martin, Robert Haese, Sandra Haese, and Mark Bruce.
- Haese&Harris Publications IGCSE Cambridge International Mathematics (0607) Extended book. The authors are Keith Black, Alison Ryan, Michael Haese, Robert Haese, Sandra Haese, and Mark Humphries.
- 10.sınıf Esen yayınları Matematik konu anlatımlı.

6. Getting Ready for the Lesson (Preparation Information)
- Before teaching, teacher will introduce herself.
- Teacher should make sure that she gets worksheets.
- Teacher will draw real life examples' graph on the board in the engagement part.
- Copy worksheets for each student before the class. There are 6 students in the class.
- Explain students the instruction given in the worksheet.
- Let the students study worksheets individually or with a group
- Monitor the students while they are studying, and help them if they need
- Each student will check her/ his pair's worksheet

7. Prior Background Knowledge (Prerequisite Skills)
- Students will be expected to have algebraic thinking skills
- Students will be expected to know linear equation and the difference between linear equation and quadratic equation
- Students will be expected to be familiar with the factorizing a quadratic equation
- Students should know what quadratics means.
- Student should know how to find the discriminant of a quadratic.
- Students should know to draw a linear equation.
- Students should know relationship between discriminant and roots of the quadratics.

Lesson Procedures

Transition: So far, you have learned how to draw quadratics functions. If I show you a graph of a quadratic function, you think, can you find the equation in the quadratic form? Let's try.

8A. Engage (5 minutes)

- Remind students that the topic of the lesson is the graphing a quadratic function
- Say students "You studied the quadratic functions last week and today we will see them in our daily life."
- Ask students" Do you know skate board? What kind of motion do you observe there and imagine I have a ball which I obtained it from the papers that I did not use anymore in my hand and I want to throw it in the trash bin from at this point to there. What kind of motion do you observe this time?"
- Wait students to think about it and then discuss, let them answer the question.
- Want the students to open their notebook and sketch these graphs on it.

*Transition: **Part 1-** What do we need to find a quadratic function from its graph?*

B. Explore (20min)

- Wait for the answers and write on the board
- Wants students to write on their notebooks

    Needs:

- ✓ x-intercept(s)
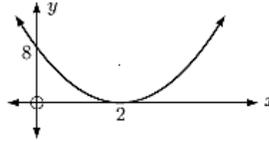- ✓ y- intercept
- ✓ vertex
- ✓ Axis of symmetry

- Ask students: Do we need to all the elements at the same time?
- Wait for answers and want students to note the answer on their notebooks on their own words.
  - project the following g graphs one by one on the board, ask students to draw the graphs on their notebooks simultaneously.

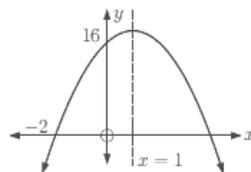Find the equation of the quadratic function with graph:

a
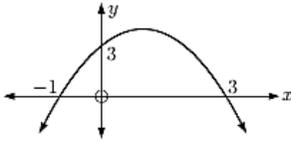
b

a   Since the x-intercepts are -1 and 3,
$y = a(x+1)(x-3)$.
The graph is concave down, so $a < 0$.
When $x = 0$, $y = 3$
$\therefore\ 3 = a(1)(-3)$
$\therefore\ a = -1$
The quadratic function is
$y = -(x+1)(x-3)$.

b   The graph touches the x-axis at $x = 2$,
so $y = a(x-2)^2$.
The graph is concave up, so $a > 0$.
When $x = 0$, $y = 8$
$\therefore\ 8 = a(-2)^2$
$\therefore\ a = 2$
The quadratic function is
$y = 2(x-2)^2$.

- Then, let them to try to find the quadratics functions.
- Give them 3minutes for each graph.
- Then collect the answers from the students and wrote the answers on the board.
- Make them realize their mistakes by asking "what do you think about your friends' answer? Why do you think it is correct or wrong?"
- Then draw other two graphs the following :

Find the equation of the quadratic function with graph:

Find the equation of each quadratic function given its graph:

a

V(3, −2)

b

V(−4, 2)

The axis of symmetry $x = 1$ lies midway between the x-intercepts.

∴ the other x-intercept is 4.

∴ the quadratic has the form
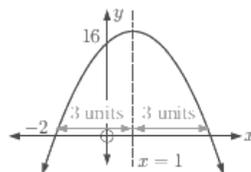$y = a(x + 2)(x − 4)$ where $a < 0$

But when $x = 0$, $y = 16$

∴ $16 = a(2)(−4)$

∴ $a = −2$

The quadratic is $y = −2(x + 2)(x − 4)$.
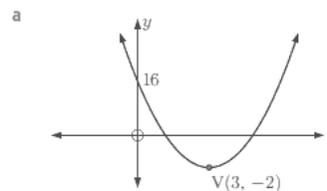
a Since the vertex is $(3, −2)$, the quadratic has the form
$y = a(x − 3)^2 − 2$ where $a > 0$.
When $x = 0$, $y = 16$

∴ $16 = a(−3)^2 − 2$

∴ $16 = 9a − 2$

∴ $18 = 9a$

∴ $a = 2$

The quadratic is $y = 2(x − 3)^2 − 2$.
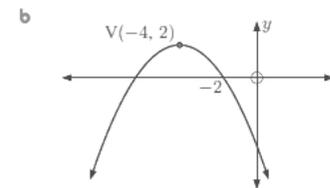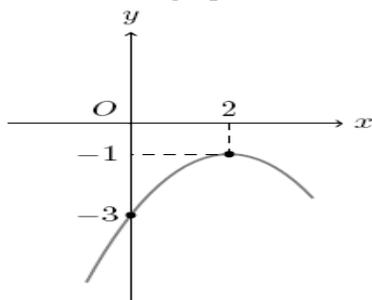
b Since the vertex is $(−4, 2)$, the quadratic has the form
$y = a(x + 4)^2 + 2$ where $a < 0$.
When $x = −2$, $y = 0$

∴ $0 = a(2)^2 + 2$

∴ $4a = −2$

∴ $a = −\frac{1}{2}$

The quadratic is
$y = −\frac{1}{2}(x + 4)^2 + 2$.

- Ask students " and now how can we find the quadratic forms of the graphs ?" and say " please try to find them"
- Again, give the 4 minutes and collect the answers and check them with students.
- Give them last graph the following:

$$y = \frac{−x^2}{2} + 2x − 3$$

- Watch the same procedures as previous page for this graph.
- Finally, project he following question.

Find the equation of the quadratic whose graph cuts the x-axis at 4 and -3, and which passes through the point $(2, -20)$. Give your answer in the form $y = ax^2 + bx + c$.

Since the x-intercepts are 4 and -3, the quadratic has the form $y = a(x-4)(x+3)$ where $a \neq 0$.

When $x = 2$, $y = -20$

$\therefore \quad -20 = a(2-4)(2+3)$

$\therefore \quad -20 = a(-2)(5)$

$\therefore \quad a = 2$

The quadratic is $y = 2(x-4)(x+3)$
$$= 2(x^2 - x - 12)$$
$$= 2x^2 - 2x - 24$$

- Give them two minutes and students will try to find the answer.

Transition: So far, you all did a good job. Now make a brief summary.

C. Explain (5 min)

- Make a brief summary by using slideshow.
- If students have a problem in the explore part. Teacher will explain and solve the problem. One of the problems can be during the stating axis of symmetry.
- Before solving problems, teacher will ask all the class whether they have an idea about the questions or not.

Transition: If you have no questions, let's solve more problems.

D. Extend (10min):

- Students will try to solve questions about graphing of quadratic equations on the worksheet.
- Walk around and ask "how did you get this answers?"
- Check the students whether they solve the problems or not.
- If they finish part 1, ask students to switch their worksheets with their pairs.
- Each student will check his/her pair's answer.

- Then, answers will be checked on the board by writing the questions on the board.

Transition: Every mission has completed successfully.

E. Evaluate (During the whole lesson):
- Assesses students' knowledge and skills through oral questions.
- Observe the students during the lesson.
- Take notes students' name if they have a problem when they solve questions.

9. Closure & Relevance for Future Learning
- Ask students to explain what they learn today.
- Then, Want students to write 3 informations that they have learned this lesson on their notebooks.
- Assign students to do the rest of the questions on the worksheet.
- Ask students if there are any points not understood.
- Then say that "Ok, thank you so much for this enjoyable lesson"
- Give the students their homework
- State the next topic of the lesson

10. Specific Key Questions:
- How can you define the quadratic equations?(knowledge)
- How can you factorize a quadratic equation?(knowledge)
- What did you notice in this problem?(analysis)
- How can we generalize the way that we observed?(synthesis)
- Can you estimate what the pattern is?(evaluation)
- What if we chance the coefficients of the quadratic then What would the discriminant be?(application)
- Can you explain why the mathematicians use this symbol or why they called the formula discriminant?(comprehension)
-

11. Modifications
- If students cannot remember previous lesson, give them some clues.
- If students do not give answer to your questions, wait 20 seconds more.
- Choose simple questions firstly to solve on the board.

- If the students cannot remember the factorization remind how to factorize
- If the students cannot give answer your questions wait 20second more or give them clues
- If students confuse about the answer clarify it by another way
- If they cannot solve the problems or did not understand, want another student to explain their friends how she or he did or which method they used
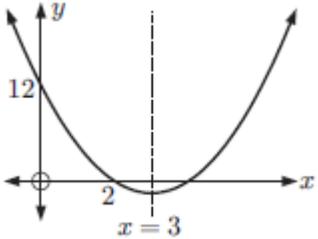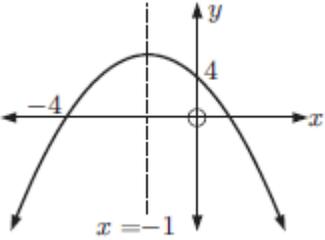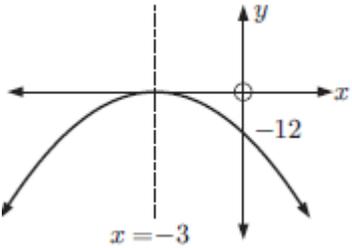
WORKSHEET

1. Find the equation of the quadratic with graph :

a-	b-	c-
Ans:	Ans:	Ans:

2. If V is the vertex, find the equations of the quadratic function with graph:
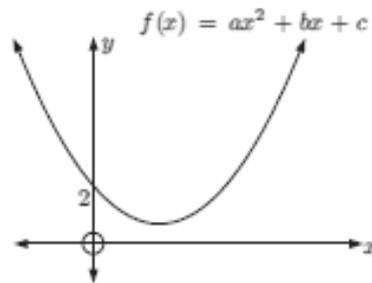
a-	b-	c-
Ans:	Ans:	Ans:

3. Find the equation of the quadratic with graph :

a-	b-	c-
Ans:	Ans:	Ans:

4.

Consider the quadratic function $f(x) = ax^2 + bx + c$ alongside.

a State the value of c.

b The graph passes through $(1, 1)$ and $(2, 6)$. Use this information to write two equations in terms of a and b.

c Solve these equations simultaneously, and hence state the equation of the quadratic.

$f(x) = ax^2 + bx + c$

Ans:

a-

b-

c-

5.

The quadratic function $f(x) = ax^2 + bx + c$ has y-intercept -2 and axis of symmetry $x = 3$.
The graph also passes through $(5, 3)$.

a State the value of c.

b Use the remaining information to write two equations in terms of a and b.

c Solve these equations simultaneously, and hence state the equation of the quadratic.

d Graph the quadratic using technology.

Ans:
a-

b-

c-

d-

SLIDESHOW