Pre-AP Algebra 2
Unit 4 – Lesson 7 – Solving Quadratic Functions by Graphing

Objectives: The students will be able to:
- Produce quadratic functions for real world situations
- Use the graph of quadratic functions to answer questions about the real world situation
- Understand the meaning of the solution and the vertex of a quadratic.
- Understand the importance of restricted domains.

Materials: 4-7 Packet

Time	Activity
5 min	**Homework Review** Students may need more time for the Cliff Diving Activity, so no homework review. They may turn it in next class.
30 min	**Quiz on Solving Quadratics**
45 min	**Pairwork:** Students will work on several real life situations modeled with quadratic functions and be able to interpret the real-life meanings of the solutions and the vertex. Graphs should be done on separate graph paper.

Homework # 4-7: Finish packet at home if needed

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4-7 Real World Quadratic Functions and their graphs

1. **Phoebe Small's Rocket Problem –**Phoebe Small is out Sunday driving in her spaceship. As she approaches Mars, she changes her mind, decides that she does not wish to visit that planet, and fires her retro-rocket. The spaceship slows down, and if all goes well, stops for an instant then starts pulling away. While the rocket motor is firing, Phoebe's distance,d, from the surface of Mars depends by a quadratic function on the number of minutes, t, since she started firing the rocket.
   a. Phoebe finds that at times $t = 1$, 2, and 3 minutes, her distances are $d = 425$, 356, and 293 kilometers, respectively. Find the particular equation expressing d in terms of t.

   b. Find the d-intercept and tell what this number represents in the real world.

   c. According to the equation, where will Phoebe be when $t = 15$? When $t = 16$? Does this tell you she is pulling away from Mars when $t = 16$ or still approaching?

   d. Does your model tell you that Phoebe crashed into the surface of Mars, just touches the surface, or pulls away before reaching the surface? Justify your answer.

   e. Sketch a graph of this quadratic function. Find the vertex. What does the vertex represent in the real world?

   f. Based on your answers to the above questions, in what domain do you think this quadratic function will give reasonable values for d? Modify your graph in part e, if necessary, by using a *dotted* line for those parts of the graph that are out of this domain.

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2. **Bathtub Problem** – Assume that the number of liters of water remaining in the bathtub varies quadratically with the number of minutes which elapsed since you pulled the plug.

   a. If the tub has 38.4, 21.6, and 9.6 liters remaining at 1, 2, and 3 minutes respectively, since you pulled the plug, write an equation expressing liters in terms of time.

   b. How much water was in the tub when you pulled the plug?

   c. When will the tub be empty?

   d. What is the lowest number of liters the model predicts? Is this number reasonable? If not, what is the lowest reasonable number of liters?

   e. Draw a graph of the function in the appropriate domain.

   f. Why is a quadratic function more reasonable for this problem than a linear function would be?

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3. **Pizza Problem -** An old Pizza Inn menu from the 1960's lists the following prices for plain cheese pizzas:

   Small (8" diameter)--------$0.85
   Medium (10" diameter)---$1.15
   Large (13" diameter)------$1.75

   a. Assume that the price is a quadratic function of the diameter. Write the function expressing price in terms of diameter.

   b. If Pizza Inn had made 20" pizzas, what do you predict the price would have been?

   c. Suppose that the menu had listed a "Colossal" pizza costing $6.00. What do you predict its diameter would have been?

   d. For what diameter would the price be $0?

   e. Sketch the graph of the function. What is the reasonable domain for this situation?

   f. Find the vertex. Explain its meaning.

4. **Car Insurance Problem -** Suppose that you are an actuary for F. Bender's Insurance Agency. Your company plans to offer a senior citizens' discount policy, and you must predict the likelihood of an accident as a function of the driver's age. From previous accident records, you find the following information:

Age (years)	Accidents per 100 Million Km Driven
20	440
30	280
40	200

You know that the number of accidents per 100 million kilometers driven should reach a minimum then go up again for very old drivers. Therefore, you assume that a quadratic function is a reasonable model.

a. Write the function expressing accidents per 100 million kilometers in terms of age.

b. How many accidents per 100 million kilometers would you expect for an 80 year old driver?

c. Based on your model, who is safer; a 16-year-old driver of a 70-year-old driver?

d. What age driver appears to be the safest?

e. Your company decides to insure drivers up to the age where the accident rate reaches 830 per million kilometers. Graph your function and give the reasonable domain in light of this decision.

5. **Luke and Leia Problem –** Luke and Leia and trapped in a room on a space station. The room is 20 meters long and 15 meters wide. But the length is decreasing linearly with time at a rate of 2 meters per minute, and the width is increasing linearly with time at a rate of 3 meters per minute.

   a. Let t be the number of minutes since the room was 20 by 15. Write particular equations for the length, $L(t)$, and the width, $W(t)$, of the room.

   $L(t) =$______________

   $W(t) =$_____________

   b. Let $A(t)$ be the number of square meters of floor area in the room. Write the particular equation for function $A(t)$.

   $A(t) =$_____________________

   Give $A(t)$ in standard form as well $A(t) =$_____________________

   c. Sketch the graph of area versus time.

   d. Determine a reasonable domain for $A(t)$.

   e. Does the area of the room reach a maximum for a positive value of t? If so, what value of t? If not, how do you tell?

   f. When will the area of the room be zero?