Geometry Lomac 2015-2016 **Date** 1/11 **due** 1/12 **Quadratics: Modeling Day 1** **7.6L**

Name ________________________________ **Per**______

LO: I can model situations with quadratics.

emath 11.7

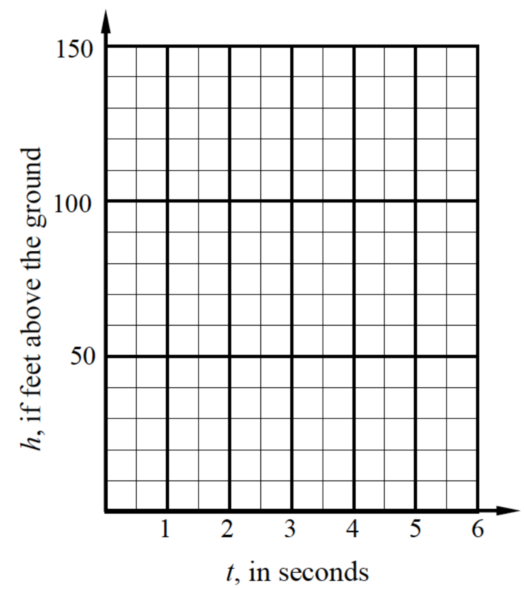
☐ **DO NOW** On the back of this packet

☐ (1) **Quadratics: Modeling**

Physical scenarios that involve **quadratic functions** occur naturally in physics, economics, and a variety of other fields. Typically, the science behind these phenomena are beyond the scope of this course, so our **quadratic modeling** is **less sophisticated** than our **linear** or **exponential.** We will take a final look, with our modeling, of some scenarios that lend themselves well to these functions.

***Exercise* #1:** Projectiles that are fired vertically into the air have heights that are quadratic functions of time. A projectile is fired from the top of a roof. It's height, in feet above the ground, after t-seconds is given by the function:

$$h(t) = -16(t-2)^2 + 144$$



(a) Evaluate $h(0)$. Using proper units, explain the physical significance of this answer.

(b) Determine algebraically the time when the ball hits the ground.

(c) Create a graph of $h(t)$ on the grid provided.

(d) What is the maximum height that the projectile reaches and at what time does it reach this height? Do you see this answer in the **vertex form** of the parabola?

☐ (2) Quadratics: Modeling

***Exercise* #2:** Popcorn has an optimal temperature at which it pops. Food engineers at Perpetual Popping study the percent of popcorn kernels that pop at a certain temperature. Their data is shown in the table below.

Temp, t	385	410	440	490	510	530
Percent, P	38	68	78	65	45	18

(a) Why does a quadratic model seem reasonable given the data in the table?

(b) If the engineers model the percent popped, P, by the equation $P=-\frac{1}{100}(t-450)^2+82$, then at what temperature is the greatest percent of popcorn popped? What is the greatest percent?

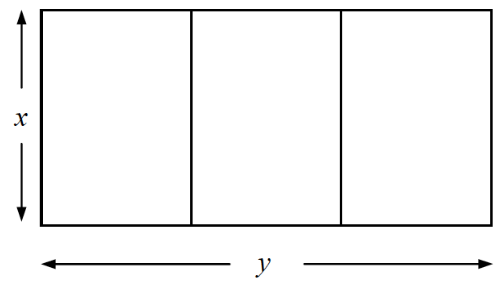
96 A school is building a rectangular soccer field that has an area of 6000 square yards. The soccer field must be 40 yards longer than its width. Determine algebraically the dimensions of the soccer field, in yards.

☐ (3) Quadratics: Modeling area

You can create some quadratic models just on your own from simple geometric ideas like **perimeter** and **area**. Let's do one last modeling problem that involves these two simple concepts.

***Exercise* #3:** Shana is creating a garden that has three equal sized rectangles separated by wire fencing. She has 160 feet of fencing and wants to construct the garden as shown below. Shana decides to designate the overall width of the rectangle as x and the overall length as y, as shown on the diagram.

(a) How much area would the garden contain, in square feet, if the width, x, was 10 feet? Show the calculations that lead to your answer.



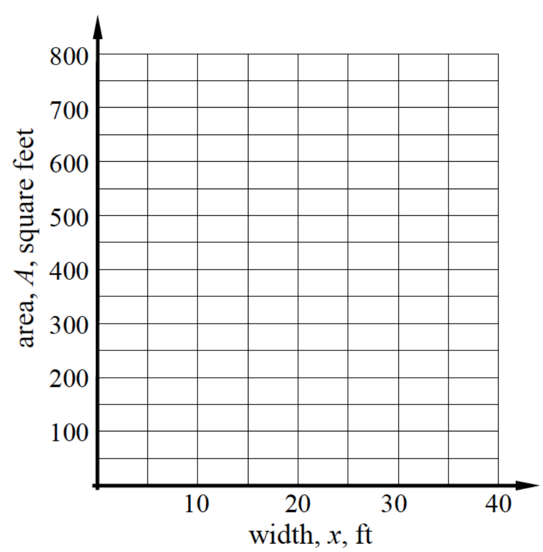
(b) Write a formula for the overall area, A, of the garden in terms of x and y. This should be a very simple formula

(c) Write an equation for the relationship between the width, x, and the length, y, based on the fact that there is 160 feet of fencing. Solve this equation for y.

(d) Find an equation for the area, A, only in terms of the width, x.

(e) Using your calculator, sketch a graph of the area function you found in (d).

(f) What is the maximum area that Shana can enclose with the 160 feet of fencing? What dimensions should she use?



☐ (6) **Exit Ticket**

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☐ (7) **Homework**

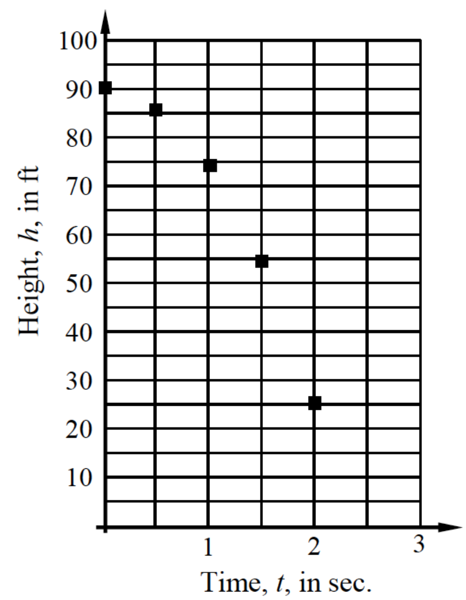
cont.

APPLICATIONS

1. Physics students are modeling the height of an object dropped from the top of a 90 foot tall building. It is let go at $t = 0$ seconds and using photography the students are able to measure, accurate to the nearest tenth ofa foot, the height that the object is above the ground every half-second. The data is shown below.

t (sec)	0	0.5	1.0	1.5	2.0
h (ft)	90	86.1	74.2	54.5	26.8

(a) Given the scatterplot shown to the right, draw a quadratic of best fit by hand through the data. Extend your quadratic until it hits the x-axis.



(b) Students in the class approximate the equation of the quadratic of best fit by:

$h = -16t^2 + 90$

Calculate the residual from this model at $t = 2$ seconds. Show the work that leads to your answer.

(c) Use the students' model above to determine algebraically the time, t, when the ball hits the ground. Show your work and round to the nearest tenth. How does this answer compare with where you drew the zero on the graph?

2. The Fahrenheit temperature of a chemical reaction decreases over time, measured in minutes, and then increases according to the function:

$$F(t) = \frac{1}{2}(t-8)^2 + 72$$

(a) For the function above, $F(0) = 104$. Interpret what this means in terms of the chemical reaction.

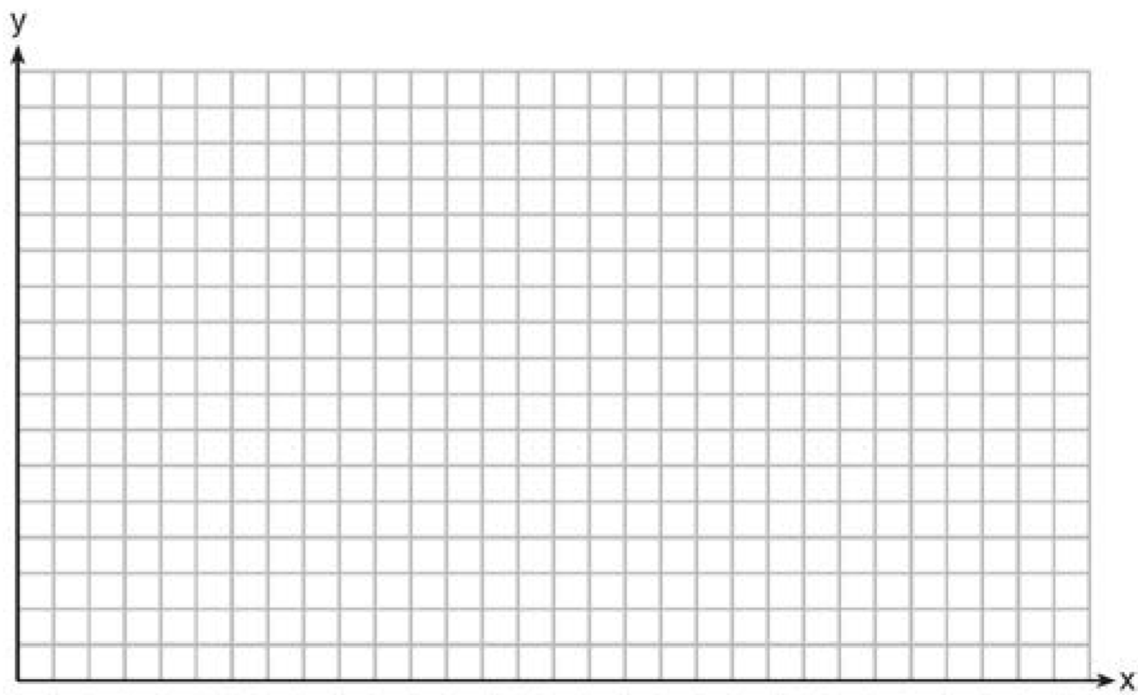
(b) What is the minimum temperature reached during the reaction and at what time does it reach it?

Exit Ticket **Name**________________________________ **Date** ______ _____ **Per**_ _____ **7.6L**

The LO (Learning Outcomes) are written below your name on the front of this packet. Demonstrate your achievement of these outcomes by doing the following:

Solve the problem below.

102 A football player attempts to kick a football over a goal post. The path of the football can be modeled by the function $h(x) = -\frac{1}{225}x^2 + \frac{2}{3}x$, where x is the horizontal distance from the kick, and $h(x)$ is the height of the football above the ground, when both are measured in feet. On the set of axes below, graph the function $y = h(x)$ over the interval $0 \le x \le 150$.



Determine the vertex of $y = h(x)$. Interpret the meaning of this vertex in the context of the problem. The goal post is 10 feet high and 45 yards away from the kick. Will the ball be high enough to pass over the goal post? Justify your answer.

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(1) Translation to algebra progress. Write one or more algebraic statement(s) to represent this situation. Be sure to write at least one "Let" statement to define any variables.

Show work that justifies your response or write a mathematical explanation.

100 Which point is *not* on the graph represented by $y = x^2 + 3x - 6$?

1 $(-6, 12)$
2 $(-4, -2)$
3 $(2, 4)$
4 $(3, -6)$