# Summarize, Review, and Evaluate

# Math 2 Unit 1

# Quadratics & Complex Numbers

Key Standards addressed in this Lesson:
MM2N1a, b, c, d; MM2A3a, b, c, d; MM2A4a, b, c, d
Time allotted for this Lesson: 7 Hours

Have students complete the culminating task as part of the final evaluation of the unit. The remainder of the final evaluation should consist of multiple choice, short answer, fill in the blank, and free response type questions.

# Non-Stop Sports Culminating Task

Peachtree Plains High School fields teams in all Georgia High School Association sports so on any day of the school year many students are practicing, playing, or competing.

1. Monica is on the golf team. When she hits the ball with enough force to give it an initial speed of 112 feet per second, the height of the ball in feet is given by

$$h(t) = -16t^2 + 112t,$$

where *t* is the number of seconds after Monica's club hits the ball.

   a. Convert the formula for the function *h* into vertex form.

   b. Graph the function, state its domain and range, intervals of increase and decrease, intercepts, vertex, and axis of symmetry. Interpret each of these features of the graph in terms of the path of the golf ball.

2. One day at football practice, Darrell, the kicker, punted the ball so that its height in feet above the ground was given by

$$h(t) = -16t^2 + 40t + 4,$$

where *t* is the number of seconds since the ball was punted.

   a. At what time was the football 20 feet or higher above the ground?

   b. At what time was the football less than its height when punted?

3. Based on enrollment projections school officials have decided that, for the next school year, the classroom trailers will be moved to the current practice football field and a new practice field will be located behind the school parking lot. Including end zones, the practice field will be 120 yards by 53 yards in order to closely approximate a standard field. However, the owner of a local nursery has donated enough grass seed to plant 81,000 square feet. Since they have more than enough grass seed for the practice field, school officials would like to plant a uniform border around the field. What are the dimensions of the 81,000 square foot rectangular area that should planted for the practice field and uniform border?

4. Last season the volleyball team played in an invitational tournament held at the Emory University. During the tournament, each invited team played one match against every other participating team. In volleyball, the first team to win three games, or sets, wins a match. At this tournament every match required five sets to determine the winner.

   a. Write a formula for the function that expresses the total number of sets as a function as the total number of teams in the tournament.

   b. If there were a total of 140 sets played during the tournament, how many teams participated?

5. The Peachtree Plains High School softball field is a regulation field so that the home plate and first, second, and third bases are the vertices of a square with side length of 60 feet.

   a. What is the distance from home plate to second base?

   b. First base is 36 feet east and 48 feet north of home plate. Set up a coordinate system with each unit representing 1 foot, east represented by the direction of the positive *x*-axis, and north represented by the positive *y*-axis. Assume that the home plate of the softball field is located at the origin and regard the system as a complex plane. What complex number is identified with first base?

   c. Find the complex number corresponding to third base. Justify your reasoning.

   d. Find the sum of the complex numbers representing first and third bases and show that this number represents the location of second base.

6. Gary is on the baseball team. During a crucial game, the bases were loaded , and Gary was at bat with a full count of 3 balls and 2 strikes when he connected with the next pitch. The ball was 3 feet above the ground when it left Gary's bat, and it reached its greatest height of 28 feet when it was above the head of the center fielder, who was 200 feet from home plate at the time.

   a. The outfield fence is 8 feet high and at center field is 375 feet from home plate. If the ball cleared the fence and went out of the baseball field, Gary had a grand slam home run. Was Gary's hit a home run? Justify your answer algebraically and use a graphing utility to verify it graphically.

   b. The height of the ball is a function of its distance, *x*, from home plate. Denote this function by *H*, sketch the graph based on the given information, and then describe how to the graph *H* using transformations of the graph of the function $f(x) = x^2$.

   c. Write the formula for *H*(*x*) in standard form.

7. Alexa is on the junior varsity basketball team and hopes to be on the varsity team next year. She has decided on a training plan to get her ready for tryouts next year. Part of her plan involves work on free throws, one of her weaknesses. Starting four weeks before tryouts she will shoot 20 free throws on the first day, 25 on the second day, 30 on the third, and so forth. What is the total number of free throws that she will toss during this four weeks of focused free-throw practice?

8. When a player shoots a free throw, its height above the floor is determined by the force of gravity, the initial velocity of the ball, and the height at the moment it leaves the shooter's hand. It is standard to represent the initial velocity, that is the velocity of the ball at the moment it leaves the shooters hand, by $v_0$. Typically, when Alexa shoots a free throw, the ball is 7.5 feet above the floor when it leaves her hand. When this is so, the height of Alexa's free throw, in feet above the floor, is given by the function

$$h(t) = -16t^2 + v_0 t + 7.5,$$

where *t* is the number of seconds from the instant the ball leaves her hand.

The rim of the basketball net is 10 feet above the floor. There are many factors that determine whether a free throw goes through the net, but a basic requirement is that get at least 10 feet high.

a. For what initial velocity will one of Alexa's free throws go exactly 10 feet high? Explain your reasoning.

b. What happens to ball for an initial velocity greater than the one in part a? Explain your reasoning.

c. What happens to the ball for an initial velocity less than the one in part a? Explain your reasoning.