

DUE: August 10, 2020

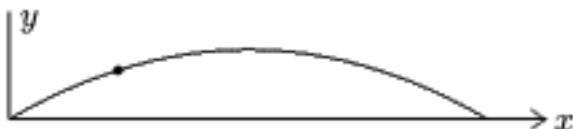
This assignment is for students who have completed Algebra II and are taking Advanced Math in the 2020-2021 school year.

Did you read the instructions? _____

What math are you taking in the 2020-2021 school year? _____

The expectation of the Math Department at Archbishop Hannan High School is that its students become Tenacious Problem Solvers! Thus, as you work on these problems be sure and document your strategies, your mathematical explanations, any drawings, tables or graphs that you use, and the best, complete answer you can find. We hope that you are challenged by these problems and enjoy them. We look forward to the discussion of these problems that we will have in the first weeks of school. Come prepared to defend your solution!

- 1. Claude kicks the soccer ball perfectly from his own goal into the other team's goal. The ball follows the parabolic path shown below:**



The path of the ball is described by the quadratic function $y = -0.002x^2 + 0.4x$. This function relates the height of the ball ("y") to the horizontal distance the ball has traveled ("x").

- a) Write this function in factored form:

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- b) Notice that $y = 0$ when $x = 0$. What is the significance of this data?

- c) How far does the ball travel before it hits the ground again?

- d) How high is the ball at its highest point?

2. Some coffee roasters mix beans with different flavor profiles to customize their product. Different flavored coffees have different prices. Suppose that a roaster mixed some coffee worth \$6.49 a pound with some coffee worth \$10.89 a pound, thus obtaining 100 pounds of a mixture worth \$9.24 a pound. How many pounds of each type of bean was used for this mixture?

3. Solve each of the following equations by completing the square. Leave your answers in exact form.

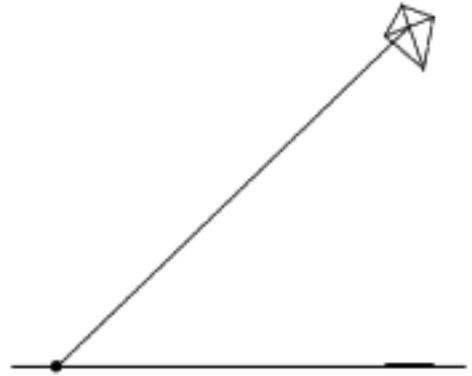
(a) $x^2 + 4x = 12$

(b) $x^2 + 10x = 11$

(c) $x^2 - 6x - 2 = 0$

(d) $x^2 + 10x + 25 = 0$

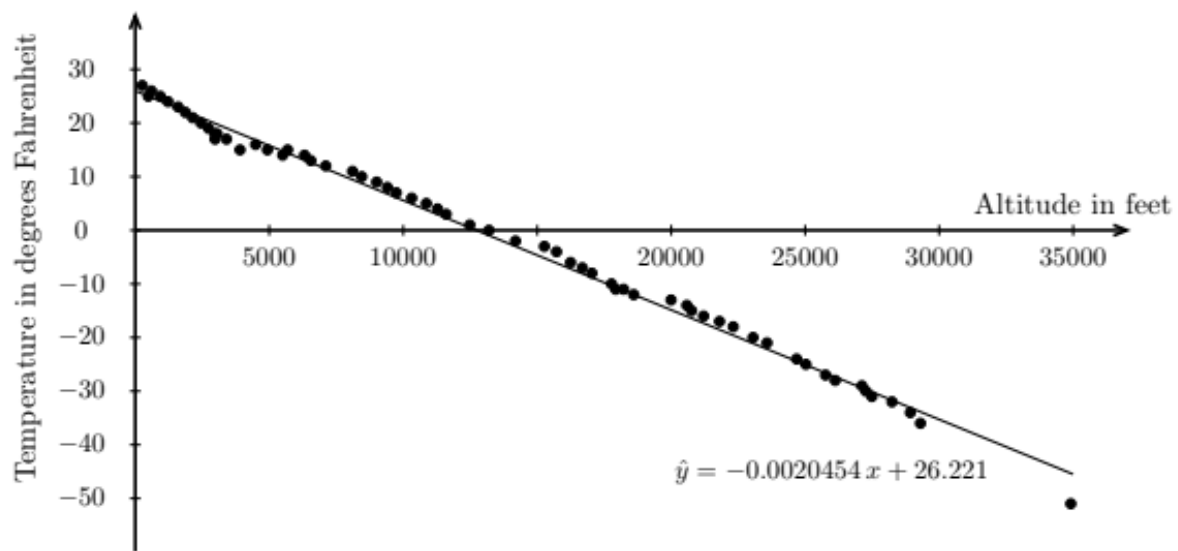
4. While flying a kite at the beach, you notice that you are 100 yards from the kite's shadow, which is directly beneath the kite. You also know that you have let out 150 yards of string. How high is the kite?



5. The perimeter of a rectangular field is 80 meters and its area is 320 square meters. Find the dimensions of the field, correct to the nearest tenth of a meter.
6. In a right triangle, the 58-cm hypotenuse makes a 51-degree angle with one of the legs. To the nearest tenth of a cm, how long is that leg? Once you have the answer, find two ways to calculate the length of the other leg. They should both give the same answer.

7. By using the triangle whose sides have lengths 1, $\sqrt{3}$, and 2, express the sine, cosine, and tangent of a 30-degree angle as ratios of these lengths (in exact form – no decimals). You can use a calculator to check your answers, of course.

8. Recently a math teacher was flying on an airplane and decided to record the outside temperature during the descent. The collected data is shown in the graph along with the equation for the line of best fit.



- (a) This data exhibits a negative correlation between temperature and altitude. What do these words say about the relationship between temperature and altitude?
- (b) Would you say that the correlation is strong or weak? Why?
- (c) State the slope and y-intercept from the regression equation. What is the meaning of each number in the context of this data? Include units in your explanation.

(d) Predict the temperature at an altitude of 30000 feet.

9. Solve each of the following for x:

(a) $10^x = 3$

(b) $e^x = 1$

(c) $\log_x 10 = 2$

(d) $\log_2(x + 1) = 6$

10. Consider the polynomial function $f(x) = 2x^3 + 8x^2 + 6x$.

(a) Factor it.

(b) Where does its graph cross the x axis?

(c) Where is its graph pointed (up or down) on the right side? On the left side? (What is its end behavior?)

11. I have a triangle with sides of 10, 14, and 16. I have another one with sides of 15, 21, and 24. Are they similar? How can you be sure? If they're similar, what is the scale factor from the smaller triangle to the larger one?
12. At a concession stand, chips cost \$3.50 per bag. Popcorn costs \$4 per bag. If the stand made \$142 one night, and the total amount of items sold was 38, then how many bags of chips and how many bags of popcorn were sold?
13. Use any method to find the points where the line $y=3x+1$ intersects the parabola $y = 5x^2 - 2x - 1$.
14. There is a mystery function $ax^2 - 2x + 7$. Its axis of symmetry is the line $x = 10$. What is a ?
15. Simplify: i^{4001}