

Unit 3 test: Take Home Portion

Date Assigned _____ Date due _____

This is the take home portion of the test. You will be given the same questions in class to justify with a written statement. These questions are very involved and you should spend a significant amount of time justifying your results.

Directions:

- For each of the following problems solve completely and show all of your work (Please attach any additional work to this sheet to turn in).
- Provide a written justification in the space provided using complete sentences.

1.) When designing a vehicle for Tesla Motor Company the company and its engineers have to provide cost estimates using what information they have now regarding prices. Suppose that a Tesla engineer determines that she can use the formula $-\frac{1}{2}t^2 + 20 = P_c$ to estimate when the price of carbon fiber will be P dollars per kilogram, t years from the present.

a.) In order for the company to turn a profit on each vehicle they need to determine when the price of Carbon fiber will be less than \$15.50/Kg. determine the interval of years over which they may be able to turn a profit. Justify your result.

b.) Explain why this model for pricing may be useful and why it may not be useful. Consider what happens far into the future, will this model still make sense?

c.) Tesla motor company plans to up production when the price of Carbon fiber is \$7.50/Kg or below. Determine when this may happen in the future. Justify your result.

d.) Suppose the company is also planning to use solar panels in their cars and a similar pricing model is found to predict when the price will reach a specific value. The model for solar panels per square foot is:

$$3t^2 - 10t + 30 = P_s$$

Predict when the combined price of the solar panels per square foot and the price of the carbon fiber will be at their lowest. Justify your result. (Hint: the word "combined" can be interpreted as "sum")

2.) The letter i represents the $\sqrt{-1}$. Based upon this representation please explain and justify the following in your own words (this portion may be typed if you so desire):

a.) Some quadratics equations have real solutions and some may have non real solutions. Explain when this occurs algebraically using the quadratic formula and what this represents when graphing an equation.

b.) When taking a power of i there is a cyclic pattern that occurs. Explain this pattern and how large powers of i can be found quickly and efficiently (Hint: Provide some examples of large powers of i)

c.) A single complex number takes the form $a + bi$ and can be graphed on the "complex plane" as a point with a real portion and a non-real portion. Explain what effect taking the complex conjugate of a complex number will have with these graphed values in the complex plane.

d.) If we say that the variable Z is a complex number of the form $a + bi$ such that $Z = a + bi$ and that \bar{Z} is the complex conjugate of Z . What is $Z + \bar{Z}$, $Z - \bar{Z}$ and $Z \cdot \bar{Z}$?
