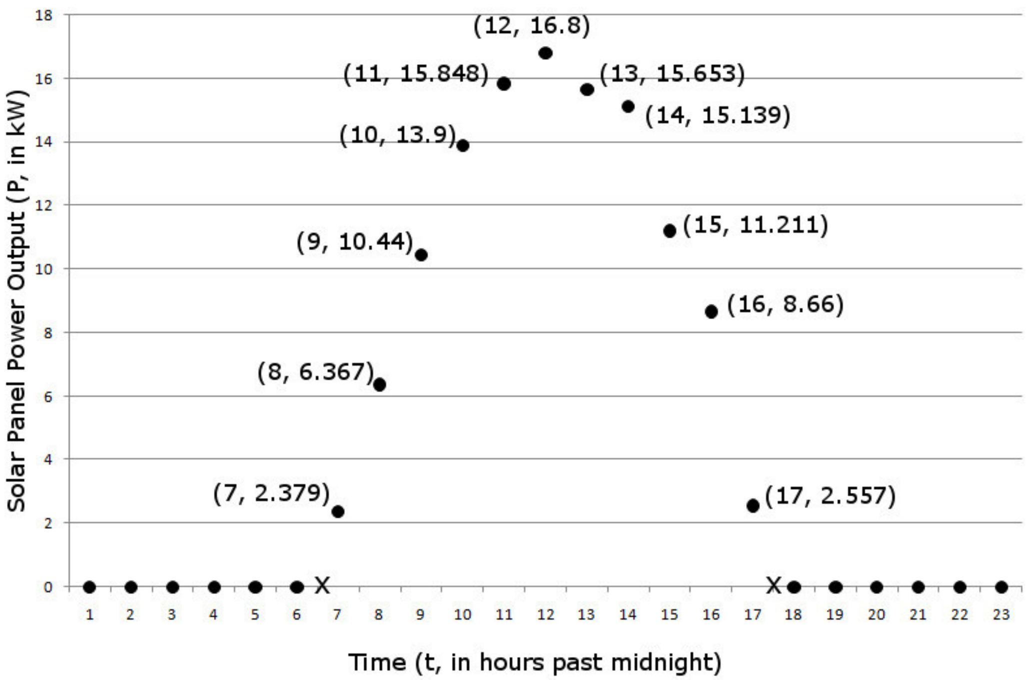
Honors Algebra 3-4/PreCalculus
Equation Model for DV Solar Panels

Desert Vista has solar panels that produce electricity during a portion of the day (when the sun is shining) and the amount of power produced changes throughout the day (due to the changing angle of the sun.) You can find lots of information about DV's solar panels on this great website:

http://kiosk.utilityvision.com/content/projects/tuhsd/Desert%20Vista/Default.aspx

If you click on 'how it works', then click on one of the gauges, you can see data about things like temperature of the solar panels, air temperature, and sunlight on the panel (irradiance) and the power output from the panels (Line kW Inverters). Below is a graph showing the sum of the power output from both solar panels on one particular day in October, 2012:



This graph shows power output from the solar panels vs. time in hours past midnight. Each point that is marked (t, P) gives the y-value (power, P) for a particular x-value (time, t).

<u>Finding a equation model for the curved portion of the graph</u>

1. For this lesson, you will create an equation model for power output as a function of time for DV's solar panels by using your calculator's regression functions, just like we did during the M&M lab. For that lab, we used the calculator's ExpReg function (exponential function regression) feature because we were modeling something that had the shape of an exponential decay function.

   Think about the shapes of the functions we've studied so far. The following types of functions have regression features in our calculators:

   Linear (line) function (LinReg)
   Quadratic (ax^2+bx+c) function (QuadReg)
   Cubic (ax^3+bx^2+cx+d) function (CubicReg)
   Exponential ($a(b)^x$) function (ExpReg)

   Which type of function do you think will best match the solar panel curve shape?

   ____

2. Fill in the table with the data points for the curved part of the solar panel power output function (the first point is filled in as an example):

Time (t) L1	Power (P) L2
7	2.379

Once you've filled in the table, turn on your calculator and do the following:

- Clear out any Y= entries.
- Enter the time and power values from your table into lists L1 and L2 (just as you did in the M&M lab).

3. Use your calculator's regression features to find an equation that fits the data:

   - Press 'Stat', then right arrow to 'CALC' menu, then down arrow to the regression function for the function type you think will match this data curve shape.
   - Use L1 for x values, L2 for y values and put the resulting graph in Y1.
   - Run the regression function and record the function your calculator produced below:

   Equation model for curved part of graph: ______________________________

4. Check to see if your equation accurately model your graph by using the 'StatPlot' feature:

   - Press '2nd' 'Y=' (StatPlot), then 'enter' twice to turn on Plot1.
   - Press 'Zoom' 'StatPlot (9) to see your data points and your curve.

<u>Finding x-intercepts to complete the equation model</u>

The equation your found models the curved portion of the graph, between the two x-intercepts (marked with x's on the above graph.) But the power output is zero for times before the first x-intercept and after the 2nd x-intercept, so we should really model this graph with a piece-wise defined function:

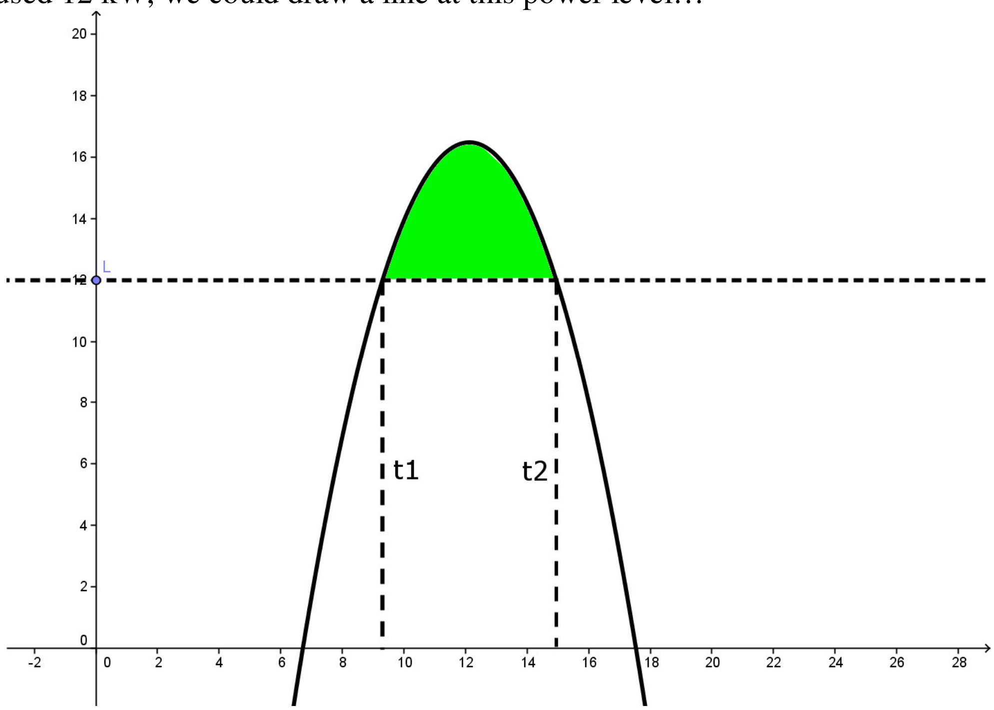
$$P(t) = \begin{cases} 0, & t \le \square \\ \boxed{(your\ \ function\ here)}, & \square < t < \square \\ 0, & t \le \square \end{cases}$$

To finish the model, we need to figure out the t values at the 'x-intercepts'. There are two ways to do this:
1) Use the trace feature on your calculator and find the values where you model curve crosses the x-axis
2) Set your model curve function equal to zero and solve for the x-intercept values using the quadratic equation.
Use one of these methods to find the time (t) values when the power output drops to zero, and write your full equation model here:

Using your model to predict something useful about the solar panels

Suppose that Desert Vista only uses 12 kW of power. If our solar panels produce more than 12 kW, then all of our energy would be coming from clean solar power, and we would need to buy no energy from the power company. In fact, we can sell energy back to the power company any time our solar panels produce more than our needed power.

If we only used 12 kW, we could draw a line at this power level…



…and beginning at time t1 and ending at time t2, we would be selling energy back to the power company. Using your equation model for the power output vs. time function, determine the times t1 and t2. (Remember: at these times, the power is equal to 12).

t1=____________

t2=____________

In your own words, describe why it might be important for the power company to know when these times t1 and t2 occur:

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Bonus question: This data was taken on one day in October. Would this equation model be valid for a day in June? How would you modify your model to account for variations over the year?