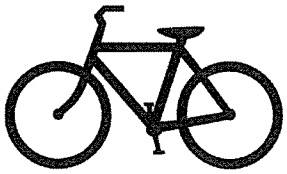
Name: KEY *Date:* _____ *Period:* _____

Advanced Algebra II Honors: Quadratic Regression

Prior to beginning these problems, your calculator must be set up to plot points. In order to do this, you need to turn on your STAT PLOT: push 2ND STATPLOT F1 Y=. Next choose PLOT 1 by pressing ENTRY SOLVE ENTER. Make sure On is highlighted by pressing ENTRY SOLVE ENTER again. Lastly get back to the main screen by pressing 2ND QUIT MODE

SAMPLE PROBLEM – Bicycle Production

Year	# of Bicycles Produced (in millions)
1950	11
1960	20
1970	36
1994	111
2000	137



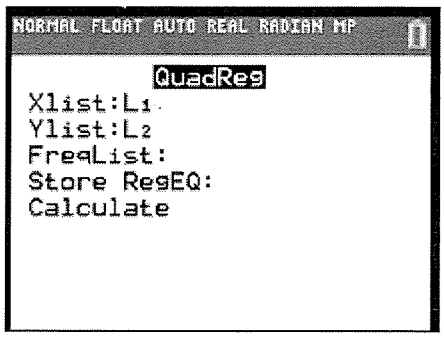
Push LIST STAT. Select 1 to edit. Enter the years in L_1 and the number of bikes produced in L_2. For the years, let x = 0 be 1900. Push STATPLOT F1 Y= Clear out any equations that you have in the Y = menu. **Before you push graph, adjust your window for the data in lists 1 and 2. To do this push TBLSET F2 WINDOW. Once you have adjusted the window push TABLE F5 GRAPH.**

Does the plot of the points appear to be linear or quadratic? quadratic

To calculate the regression equation:

1. Turn your diagnostic on. Push QUIT MODE and scroll down to STAT DIAGNOSTICS: ▶ and highlight On by pressing ENTRY SOLVE ENTER. Get back to the main screen by pressing 2ND QUIT MODE The diagnostic will help us determine if the equation is quadratic or linear. The closer r^2 is to 1 or -1 the better the fit.
2. Next, push LIST STAT ▶ for the CALC menu and choose 5 for QuadReg.

If your screen looks like this: WITH STAT WIZARDS

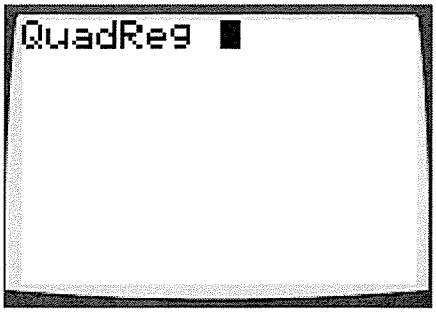


Make sure the Xlist is L_1 and the Ylist is L_2.

For Store RegEQ: Push DISTR VARS ▶ ENTRY SOLVE ENTER ENTRY SOLVE ENTER

Highlight Calculate and push ENTRY SOLVE ENTER Write your equation below.

If your screen looks like this: WITHOUT STAT WIZARDS



Type the following:

On your screen you should see: QuadReg L_1, L_2, Y_1

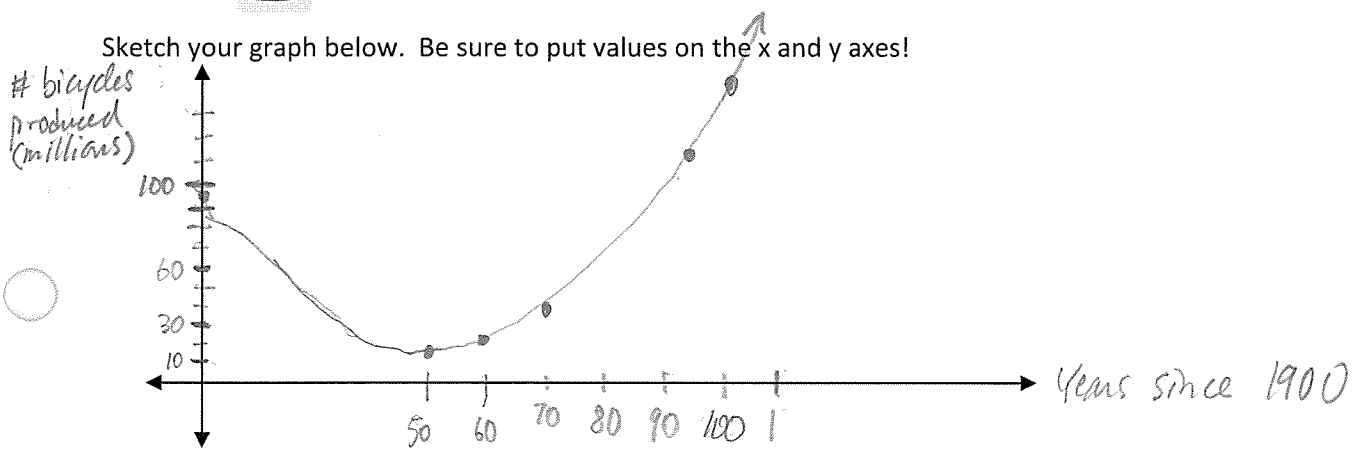
Write your equation below.

EQUATION: $Y = 0.0419X^2 - 3.7744X + 95.0051$ r^2 = 0.999724109

Push STATPLOT F1 Y= . YOUR QUADRATIC EQUATION SHOULD APPEAR IN Y_1.

Now push TABLE F5 GRAPH. You should see both your plotted points and the best-fit graph. YAY!!!

Sketch your graph below. Be sure to put values on the x and y axes!



Questions:

1. Use your calculator to determine how many bikes were produced in 1965? Press 2ND CALC F4 TRACE for the CALCULATE menu then press 1:value. Put in the X-value you want (x=65 in this case) and hit enter.

26.9051 million

2. How many bikes to you predict will be produced in 2035? X=135

349.9868 million

3. Use your calculator to determine when were 55.82 million bikes produced? Press STATPLOT F1 Y= . Put the Y-value you want (y=55.82 in this case) into Y_2. Press 2ND CALC F4 TRACE for the CALCULATE menu then press 5:intersect. It will say First curve? Press ENTRY SOLVE ENTER Then Second curve? Press ENTRY SOLVE ENTER. Then Guess? Press ENTRY SOLVE ENTER.

Intersection of 2 graphs

X = 77.999 → 1977 end of

X = 97.999 → end of 1997

4. When were 127.995 million bikes produced?

5. **Review**: Calculate the linear regression for the data.

EQUATION: $y = 2.6021x - 131.6376$ $r^2 =$ 0.9645843101

Which equation is the better fit? (circle) LINEAR or (QUADRATIC)

YOUR TURN:

1. The table below give the minimum stopping distance (in feet) required to stop a car traveling at the given speed on dry pavement.

Speed (mi/hr)	10	20	30	40	50	60	70
Stopping Distance	19	42	73	116	173	248	343

a. Set your WINDOW. Change the WINDOW so that X-MAX = 100 and Y-MAX = 500. Plot the data points.

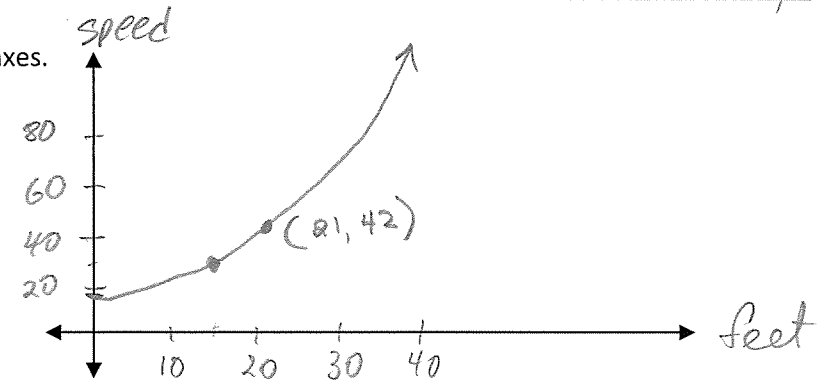
b. Find the equation that is the best fit for these points: $y = 0.0724x^2 - 0.4905x + 19.7143$

To turn off your STAT PLOT: push 2ND STATPLOT F1 Y= . Next choose PLOT 1 and highlight Off then enter.

c. Determine the stopping distance if you are traveling

65 mi/hr. 293.6429 80 mi/hr. 443.7143 15 mi/hr. 28.6429

d. Sketch your graph. Label your axes.



2. The data in the table represents the amount of water in a draining bathtub and the amount of time since the plug was pulled.

Amount of Water (L)	38.4	30.0	19.6	7.2
Time (Min)	1	1.5	2	2.5

a. Write an equation expressing liters (L) in terms of time (t). $y = -4x^2 - 6.8x + 49.2$

b. How much water was in the tub when you pulled the plug? (y-int) 49.2 liters

c. How long did it take the tub to empty? (x-intercept or zero) 2.7586 minutes

3. The local discount store charges $6.60 for a flashlight. On the average, 200 0f them are sold each day. A survey indicates that the sales will decrease by an average of 10 flashlights per day for each 50-cent increase in price. Find the maximum price that will obtain the maximum income.

a. Solve the problem algebraically. Find the maximum price that will obtain the maximum income.

Let x = # of increments of change

Income = (#flashlights)(price)

$I(x) = (200 - 10x)(6.60 + 0.5x)$

$= 1320 - 66x + 100x - 5x^2$

$= -5x^2 + 34x + 1320$

$I(x) - 1320 = -5\left(x^2 - \frac{34}{5}x\right)$

$-\frac{34}{5} \cdot \frac{1}{2} \rightarrow -\frac{34}{10} \rightarrow \left(\frac{34}{10}\right)^2 = \frac{1156}{100} \rightarrow -5(11.56) = -57.8$

$I(x) - 1320 - 57.8 = -5\left(x^2 - \frac{34}{5}x + \frac{1156}{100}\right)$

$I(x) - 1377.8 = -5(x - 3.4)^2$

$I(x) = -5(x - 3.4)^2 + 1377.8$

6.8 increments of change

New price = $6.6 + 0.5(3.4) = \$8.30$

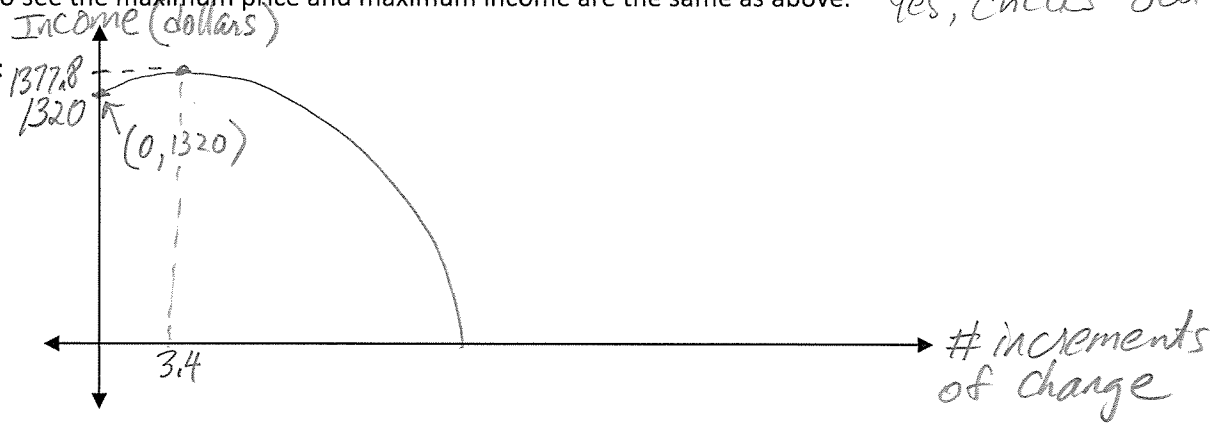
max price = $8.30, max income $1377.80

b. Enter your ORGINAL equation {that is, the equation you have BEFORE you complete the square} in your calculator: $y_1 = (200 - 10x)(6.60 + 0.5x)$

Graph your equation. Sketch the graph BELOW.

Check to see the maximum price and maximum income are the same as above. Yes, checks out!

GRAPH:



4. A study compared the speed x (in miles per hour) and the average fuel economy y (in miles per gallon) for cars. The results are shown in the table. Find a quadratic model.

Speed, x	15	20	25	30	35	40	45	50	55	60	65
Fuel Economy, y	22.3	25.5	27.5	29.0	28.8	30.0	29.9	30.2	30.4	28.8	27.4

a. Quadratic Equation: $y = -0.0079x + 0.7269x + 13.7562$

b. What is the fuel economy at 85 mi/hr? $x = 85$ $y = 18.25$ miles per gallon

c. When is the fuel economy 26.8 miles/gallon? at 24.48 mph and 67.18 mph

What is the vertex?

What is the significance of the vertex?

5. The table below shows the time it takes to boil a potato whose smallest diameter (that is, whose shortest distance through the center) is d.

Diameter (mm), d	20	25	30	35	40	45	50
Boiling time (min),t	27	42	61	83	109	138	170

Find the best fit quadratic model for time as a function of diameter.

a. Equation: $t = 0.0680d^2 + 0.0119d - 0.6428$

b. How long will it take to boil a potato with a diameter of 37 mm? 93.02 minutes

c. You boil a potato for 192 minutes. What is the diameter of the potato? 53.1012 mm

6. The table shows the distance (in meters) traveled by a baseball hit at various angles. In each case, the initial speed of the ball off the bat is assumed to be 40 m/sec. Find a quadratic equation that gives the distance d as a function of the angle A.

Angle (in degrees)	10	15	30	36	42	45	48	54	60
Distance (d)	58.3	79.7	126.9	136.6	140.6	140.9	139.3	132.5	120.5

Equation: $d = -0.0738A^2 + 6.430A + 0.6927$

What is the distance the ball will travel when hit at an angle of 57 degrees? 127.3038 m

What is the distance the ball will travel when hit at an angle of 75 degrees? 67.5955 m