

## Rocket Simulation Student Ins.Screens

1.1 1.2 1.3 1.4 ▶RAD AUTO REAL

**"You Don't Have To Be A Rocket Scientist.....Just Use An Nspire!"**

Prelaunch quadratic modeling  
*in the classroom*

1.1 1.2 1.3 1.4 ▶RAD AUTO REAL

This activity is designed for use prior to going outdoors and launching air-powered projectile rockets. The next page provides a set of time (in seconds) and height (in feet) of a launched rocket. After viewing the data, insert a graph and geometry page and make a scatter plot.

1.1 1.2 1.3 1.4 ▶RAD AUTO REAL

	A time	B height	C	D	E	F
1	0	6				
2	.1	15.4				
3	.2	24.6				
4	.3	33.4				
5	.4	41.8				
A7	0					

1.1 1.2 1.3 1.4 ▶RAD AUTO REAL

Trace and determine the vertex of the parabolic shaped scatter plot. Copy page 1.4 and insert a new page and paste the scatter plot. Use the vertex form,  $f(x)=a(x-h)^2+k$ , where h is x-coord and k is y-coord of the vertex. Select an appropriate value for a to begin, you will change this value until it fits the data.

1.2 1.3 1.4 1.5 ▶RAD AUTO REAL

**Question**

What is the model function? What does the value of "a" represent?

**Answer** ▼

1.3 1.4 1.5 1.6 ▶RAD AUTO REAL

Verify how well the vertex model fits the data; go to page 1.3, column C formula entry line. Enter the appropriate model preceded by an "=" sign. Remember in this problem, x-coord values are in the "time" list.

1.4 1.5 1.6 1.7 ▶RAD AUTO REAL

Copy page 1.3, insert a new page and paste the scatter plot. Select 3 points and create 3 equations in the standard form  $y=ax^2+bx+c$ . Use matrix operations to find a, b, and c. Show matrix operations on a calculator page. Enter the function and check the fit. Verify in Column D on page 1.3 in the same manner as vertex model.

1.5 1.6 1.7 1.8 ▶RAD AUTO REAL

Indicate the coordinates of the three points selected:

The three equations in the form :

$$a*x^2 + b*x + c = y$$

are as follows:

1.6 1.7 1.8 1.9 ▶RAD AUTO REAL

Go to page 1.3, highlight the time and height lists and complete a quadratic regression. Graph and check the fit.

Press Menu

1.7 1.8 1.9 1.10 ▶RAD AUTO REAL

**Question**

How many seconds is the rocket in the air?

**Answer** ▼

1.8 1.9 1.10 2.1 ▶RAD AUTO REAL

**Parametric Modeling**

1.9 1.10 2.1 2.2 ▶RAD AUTO REAL

Insert a G and G page,select parametric for graph type. Simulate the vertical launch of the air-powered rocket parametrically.

The  $Y_{1t} = 16t^2 + 96t + 6$ , representing vertical motion per unit of time, t. Set  $X_{1t} = 3$ . Set the window appropriately.

1.10 2.1 2.2 2.3 ▸ RAD AUTO REAL

**Question**

Trace the graph on page 2.3, what is the maximum height reached? How many seconds did it take to reach maximum height?

**Answer** ▾

2.1 2.2 2.3 3.1 ▸ RAD AUTO REAL

Insert a graph and geometry page and simulate the projectile launched horizontally in the air. Use the equations  $X_{1t} = t$  and  $Y_{1t} = -16t^2 + 96t + 6$ , representing the horizontal motion per unit of time.

2.2 2.3 3.1 3.2 ▸ RAD AUTO REAL

Trace the graph on page 3.2 noting the height of the rocket at various times. Use  $y_1(t)$  to find height in  $t$  time, try several different times.

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2.3 3.1 3.2 3.3 ▸ RAD AUTO REAL

**Question**

Realizing when the rocket reaches maximum height, give two times at which the heights would be equal and under 120 feet.

**Answer** ▾

3.1 3.2 3.3 4.1 ▸ RAD AUTO REAL

Each flight has a different loft due to **initial velocity** created by the washer used and the **angle** at which the angle is launched.  $V_0$  represents initial velocity,  $T$  represents time and  $\theta$  represents the launch angle. Insert a G and G page, page layout 8. Use the formulas:  $X_{1t} = V_0 T \cos(\theta)$

$Y_{1t} = V_0 T \sin(\theta) - 16T^2$

3.2 3.3 4.1 4.2 ▸ RAD AUTO REAL

Graph the parametric equations for the 30°, 45°, 60° launch angles on the same set of axes. Use attributes to distinguish

Press Menu

3.3 4.1 4.2 4.3 ▸ RAD AUTO REAL

**Question**

Which launch angle results in the greatest horizontal distance traveled?

**Answer** ▾

4.1 4.2 4.3 4.4 ▸ RAD AUTO REAL

**Question**

Explain why it appears that two of the launches travel the same horizontal distance.

**Answer** ▾