Solving Quadratic Equations by Graphing   Date: ________

For this activity you will need to use a graphing calculator.
First reset it by pressing `2ND` `+` and scrolling down to `Reset`. Choose `All RAM...`, and `Reset.`

To graph a function press `Y=` and type in the function, using the `X,T,Ø` key for the variable *x*.
Then press `GRAPH`

You can adjust what you see by pressing `WINDOW`

<u>Example 1</u>

A model rocket is launched from the roof of a building. The height, $h(t)$, in metres, at any time, *t*, in seconds, is modelled by the function $h(t) = -5t^2 + 15t + 20$.

a) Use the graphing calculator to graph the function, $h(t)$.
Adjust the window so that you can see the entire graph (set `Ymax` to 35 and change `Yscl` to 5).
Sketch the graph.

b) Determine the *y*-intercept of the function and label it on the graph.
Press `2ND` `TRACE` to get to the `Calc` menu. Choose `1: value`. You can now enter any *x* value and the calculator will return the corresponding *y* value. (So to find the *y*-intercept enter $x = 0$)

c) How high is the rocket after 2 seconds?

d) Determine the *x*-intercepts (roots, zeros) of the function and label them on the graph.
Finding the *x*-intercepts means solving the corresponding quadratic equation: $0 = -5t^2 + 15t + 20$
Press `2ND` `TRACE` to get to the `Calc` menu. Choose `2: zero`. You must choose a left bound and a right bound so that the calculator knows where to look for an intercept, and press enter.
Repeat to get the other *x*-intercept.

e) Determine the vertex and label it on the graph.
Press `2ND` `TRACE` to get to the `Calc` menu. Since this parabola opens down, the vertex is a maximum. Choose `4: maximum`. (If the parabola opened up you would have to choose `3: minimum`)
You must choose a left bound and a right bound so that the calculator knows where to look, and press enter.

f) When does the rocket reach a height of 25 m?

Option 1: Sub in 25 for *h* and rearrange the equation.

$$25 = -5t^2 + 15t + 20$$
$$0 = -5t^2 + 15t - 5$$

Graph $h(t) = -5t^2 + 15t - 5$ and find the zeros (*x*-intercepts) as before.

Option 2: Graph $h(t) = 25$ and $h(t) = -5t^2 + 15t + 20$.
Go to the `Calc` menu. Select the parabola, then select the line, press enter and it will tell you the point of intersection. Select the parabola and line closer to the other point of intersection and it will tell you that one.

Example 2

The population of an Ontario city is modelled by the function $P(t) = 0.5t^2 + 10t + 300$, where $P(t)$ is the population in thousands and t is the time in years.
[*Note:* $t = 0$ corresponds to the year 2000.]

a) Graph the function on your graphing calculator.
Set the window to have the following dimensions.

```
WINDOW
Xmin=0
Xmax=40
Xscl=5
Ymin=0
Ymax=1200
Yscl=100
Xres=1
```

b) What was the population in 2000?
(Remember that $t = 0$ corresponds to the year 2000.)

c) What will the population be in 2010?

d) When is the population expected to be 1 050 000?
(Hint: See part f) of example 1, and remember that P is the population in thousands.)