It's a Radical, Rational Universe

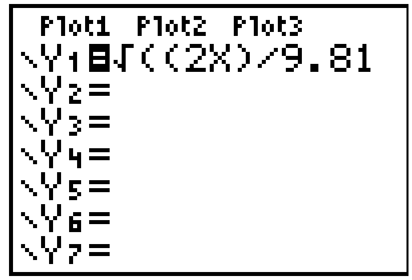
Name ______________________

Class ______________________

Problem 1 – Acceleration Due to Gravity

The function $t = \sqrt{\frac{2d}{g}}$ models the time, *t*, in seconds it takes for any object at rest to fall a distance, *d*, in meters neglecting air resistance and friction.

Enter this equation next to **Y1** in the [Y=] window (with $g = 9.81 \text{m/s}^2$). Press [ZOOM] and select **ZStandard** to view the graph.



Note: *y* will replace *t* and *x* will replace *d*.

1. What restrictions should be placed on the function $y = \sqrt{\frac{2x}{9.81}}$ given its real context?

2. Using the graph, press [TRACE] to determine how much time will elapse for the fall of an object being dropped from a height of 200 m above the ground?

3. Is there a maximum value for this function? Explain your reasoning.

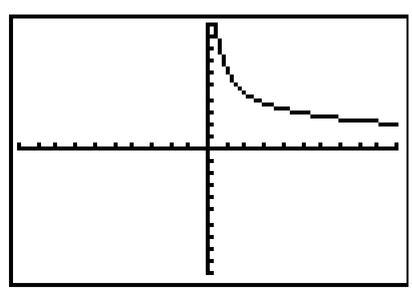
A comparison of acceleration due to gravity for various bodies is provided to the right.

Acceleration due to gravity is provided in m/s^2.

Body	Gravity
Sun	274.13
Mercury	3.59
Venus	8.87
Earth	9.81
Moon	1.62
Mars	3.77
Jupiter	25.95
Saturn	11.08
Uranus	10.67
Neptune	14.07
Pluto	0.42

Go back to the [Y=] screen and again graph $t = \sqrt{\frac{2d}{g}}$.

This time let *d* = 20 meters, and let *x* replace *g*. Observe the times required for an object to fall from a height of 20 meters.



Use [TRACE] to answer the following questions.

4. On which of the given bodies will the 20 meter fall require the **most** time?

5. On which of the given bodies will the 20 meter fall require the **least** time?

6. How much time will the fall of the object from a 20 meter height require on Earth?

Problem 2 – Solution Dilution

Chemists often have to dilute existing solutions to create new solutions using up solutions they have on hand.

5 liters of a 10 molar solution of hydrochloric acid is diluted with *x* liters of a 2 molar hydrochloric acid solution. This concentration adjustment may be modeled with the equation

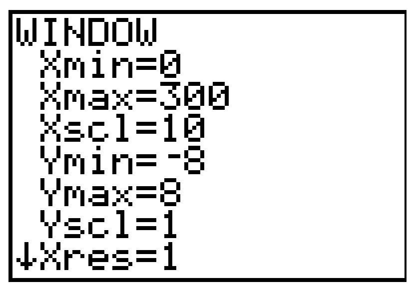
$$M(x) = \frac{5 \cdot 10 + x \cdot 2}{5 + x}$$

M(*x*) is the concentration in molarity for a solution prepared using 5 L of the 10 molar solution and *x* Liters of the 2 molar solution.

Enter this equation next to **Y1** on [Y=] screen.

Press [WINDOW] and set the **Xmin** to 0 and the **Xmax** to 300.

Press [GRAPH] and then press [TRACE] to help answer the questions below.



7. Given $M(x) = \frac{5 \cdot 10 + x \cdot 2}{5 + x}$, what is the highest possible concentration for this situation?

8. What is the lowest possible concentration approached in this situation?

9. Does any part of the graph *not* make sense in the real context of this problem? If so, explain.