No quiz today-we will go over 1.4 HW after Ms. Hansen takes attendance and she will check your 1.3 HW soon after, so GET READY!!

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5. Fill in Adam's table with all of the arrangements for the fence. (The first one is done for you.)

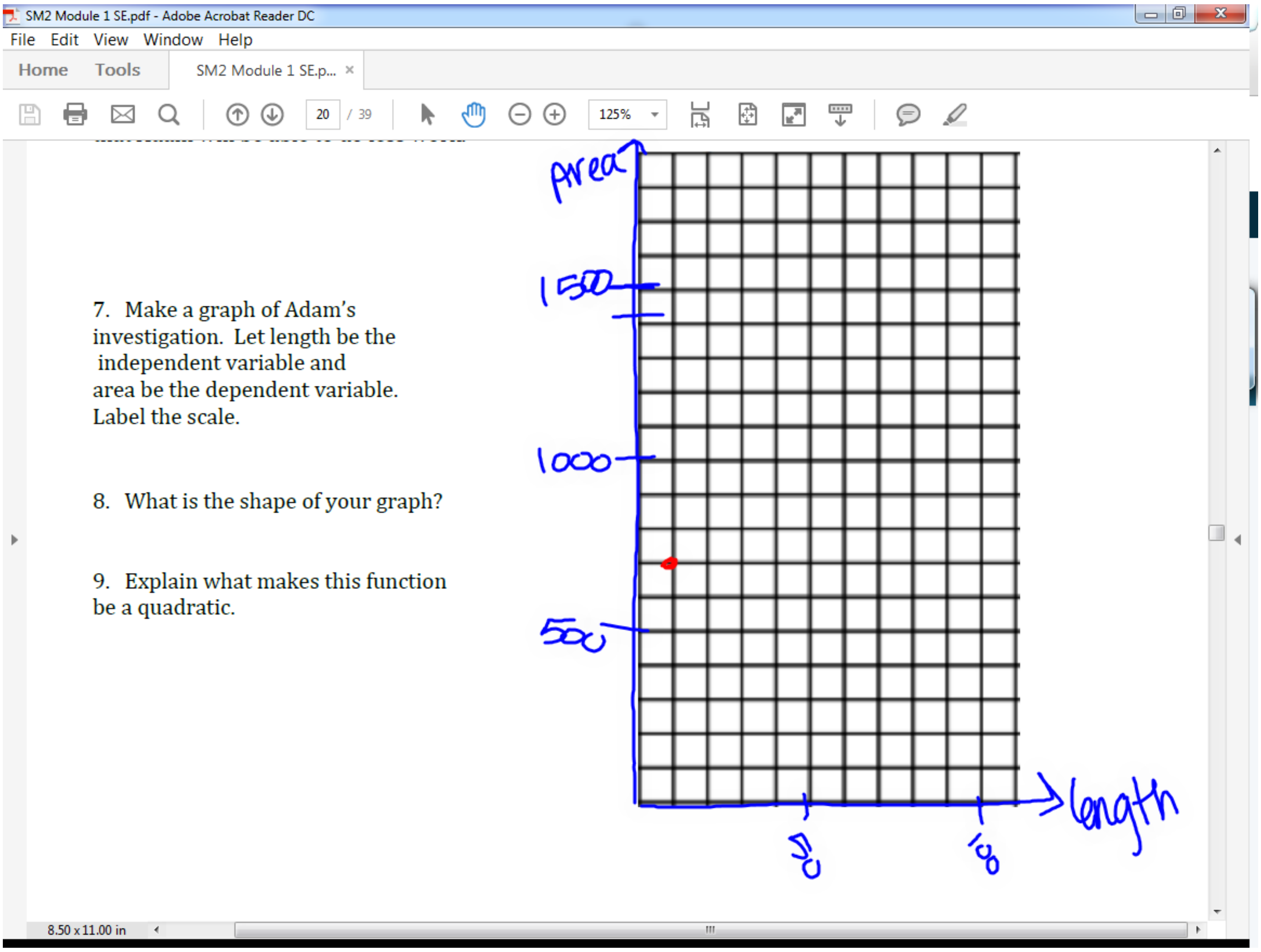
	Length in "fencing" units	Width in "fencing" units	Length in ft.	Width in ft.	Perimeter (ft)	Area $(ft)^2$
	1 unit	7 units	10 ft	70 ft	160 ft	700 ft^2
a.	2 units	6	20	60	160 ft	1200
b.	3 units	5	30	50	160 ft	1500
c.	4 units	4	40	40	160 ft	1600
d.	5 units	3	50	30	160 ft	1500
e.	6 units	2	60	20	160 ft	1200
f.	7 units	1	70	10	160 ft	700

6. Discuss Adam's findings. Explain how you would rearrange the sections of the porta-fence so that Adam will be able to do less work.

c-40ft x 40ft

7. Make a graph of Adam's investigation. Let length be the independent variable and area be the dependent variable. Label the scale

8.50 x 11.00 in



7. Make a graph of Adam's investigation. Let length be the independent variable and area be the dependent variable. Label the scale.

8. What is the shape of your graph?

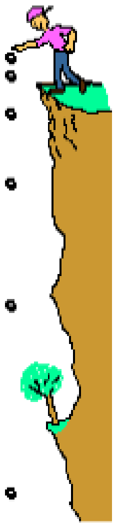
9. Explain what makes this function be a quadratic.

1.5 Look Out Below!

A Solidify Understanding Task

What happens when you drop a ball? It falls to the ground.

That question sounds as silly as "Why did the chicken cross the road?" (To get to the other side.) Seriously, it took scientists until the sixteenth and seventeenth centuries to fully understand the physics and mathematics of falling bodies. We now know that gravity acts on the object that is falling in a way that causes it to accelerate as it falls. That means that if there is no air resistance, it falls faster and faster, covering more distance in each second as it falls. If you could slow the process down so that you could see the position of the object as it falls, it would look something like the picture below.



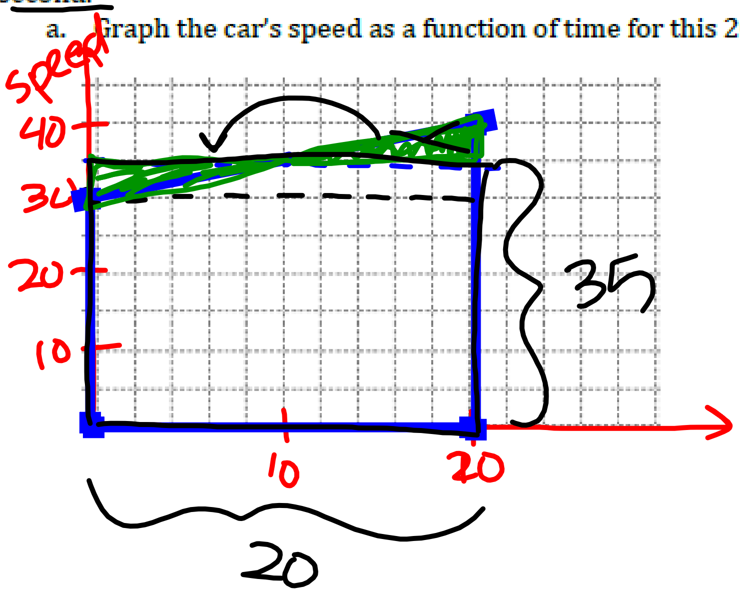
To be more precise, objects fall at a constant rate of acceleration on earth of about 32 feet per second per second. The simplest case occurs when the object starts from rest, that is, when its speed is zero when $t = 0$. In this case, the object's instantaneous speed after 1 second is 32 feet per second; after 2 seconds, its instantaneous speed is $2(32) = 64$ feet per second; and so on. Other planets and moons each have a different rate of acceleration, but the basic principal remains the same. If the acceleration on a particular planet is g, then the object's instantaneous speed after 1 second is g units per second; after 2 seconds, its instantaneous speed is $2g$ units per second; and so on.

In this task, we will explore the mathematics of falling objects, but before we start thinking about falling objects we need to begin with a little work on the relationship between speed, time, and distance.

Part 1: Average speed and distance travelled

Consider a car that is traveling at a steady rate of 30 feet per second. At time $t = 0$, the driver of the car starts to increase his speed (accelerate) in order to pass a slow moving vehicle. The speed increases at a constant rate so that 20 seconds later, the car is traveling at a rate of 40 feet per second.

a. Graph the car's speed as a function of time for this 20-second time interval.



$A = 20(35)$
$A = 700\text{ft}^2$

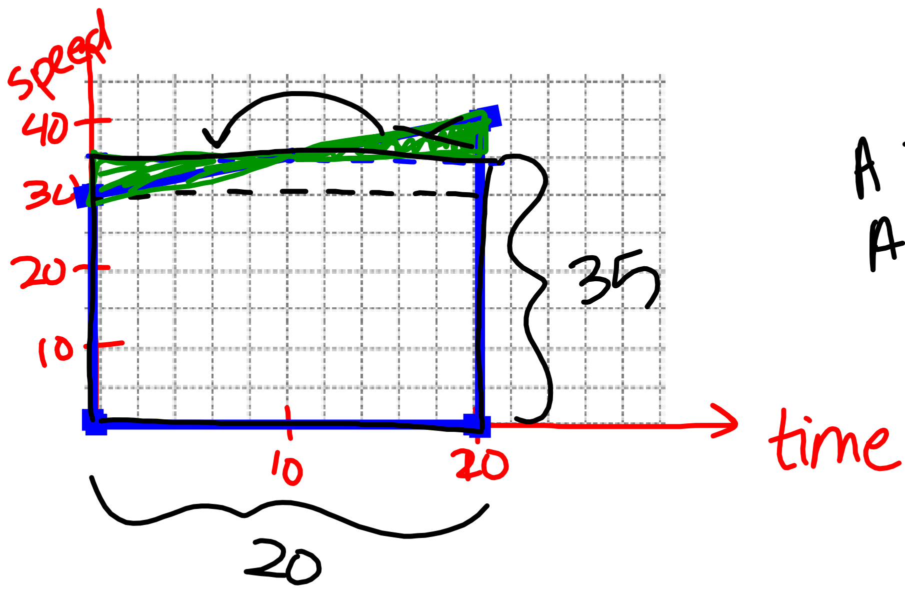
b. Calculate the average speed of the car for this 20-second time interval.

$$\frac{30+40}{2} = \frac{70}{2} = 35\,ft/sec$$

c. Find the total distance the car travels during this 20-second time interval.

$$\frac{35\,ft}{1\,\cancel{sec}} \cdot 20\,\cancel{sec} = 700\,ft$$

d. Explain how to use area to find the total distance the car travels during this 20-second interval.



$$A = 20(35)$$
$$A = 700ft^2$$

This problem illustrates an important principle: ***If an object is traveling with constant acceleration, then its average speed over any time interval is the average of its beginning speed and its final speed during that time interval.***

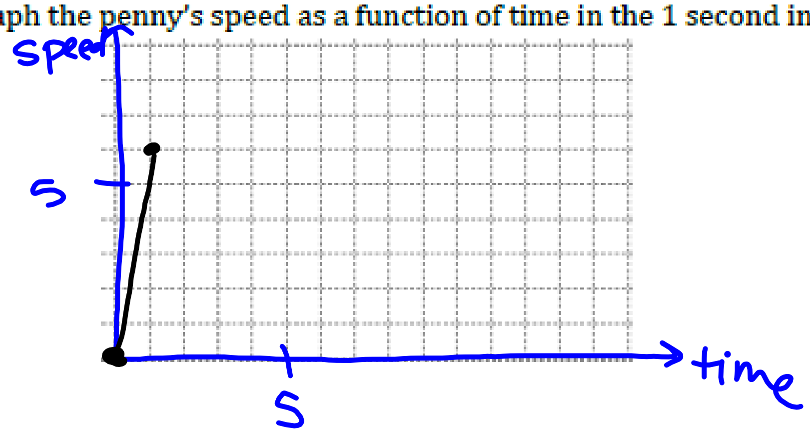
Let's apply this idea to a penny that is dropped (initial speed is 0 when $t = 0$) from the top of the Empire State Building.

acceleration: 6 ft/sec every second

1. What will its speed be after 1 second?

6 ft/sec

2. Graph the penny's speed as a function of time in the 1 second interval.



3. What is the average speed of the penny in the 1-second interval?

$$\frac{0+6}{2} = 3 \text{ ft/sec}$$

4. What is the total distance that the penny fell in the 1-second interval?

distance = rate × time

d = avg. speed × time (sec)

$$d = \frac{3\text{ ft}}{1\,\cancel{\text{sec}}} \cdot 1\,\cancel{\text{sec}} = 3\text{ ft.}$$

Part 2: Falling, Falling, Falling

When the astronauts went to the moon, they performed Galileo's experiment to test the idea that any two objects, no matter their mass, will fall at the same rate if there is no air resistance (like on the moon). Because the moon doesn't have air resistance, we are going to pretend like we're the astronauts dropping moon rocks and thinking about what happens. On the surface of the moon the constant acceleration increases the speed of a falling object by 6 feet per second each second. That is, if an object is dropped near the surface of the moon (e.g., its initial speed is zero when $t = 0$), then the object's instantaneous speed after 1 second is 6 feet per second, after 2 seconds, its instantaneous speed is 12 feet per second, and so on.

1. Using this information, create a table for the speed of an object that is dropped from a height of 200 feet above the surface of the moon as a function of the elapsed time (in seconds) since it was dropped.

d = speed x time

6t

time	speed	avg. speed	total distance travelled*	height above moon
0	0	0	0	200
1	6	$\frac{0+6}{2} = 3$	$3(1) = 3$	197
2	12	$\frac{0+12}{2} = 6$	$3 \cdot 2(2) = 12$	188
3	18	$\frac{0+18}{2} = 9$	$3 \cdot 3(3) = 27$	173
4	24	$24/2 = 12$	$3 \cdot 4(4) = 48$	152
5	30	$30/2 = 15$	$3 \cdot 5(5) = 75$	125
6	36	$36/2 = 18$	$3 \cdot 6(6) = 108$	92
7	42	$42/2 = 21$	$21(7) = 147$	53
8	48	$48/2 = 24$	$24(8) = 192$	8
9	54	$\frac{54}{2} = 27$	$27(9) = 243$	-43
t	$6t$		$3t^2$	$200 - 3t^2$

>3 >9 >15 >21 >27

>6 >6 >6 >6

Quad

2. Add another column to your table to keep track of the distance the object has fallen as a function of elapsed time. Explain how you are finding these distances.

distance = avg. speed x time

3. Approximately how long will it take for the object to hit the surface of the moon?

$\approx$ 8 sec.

4. Write an equation for the distance the object has fallen as a function of elapsed time t.

$d = 3t^2$

-OR-

$d(t) = 3t^2$

5. Write an equation for the height of the object above the surface of the moon as a function of elapsed time *t*.

$h = 200 - 3t^2$

-OR- $h(t) = 200 - 3t^2$

6. Suppose the object was not dropped, but was thrown downward from a height of 250 feet above the surface of the moon with an initial speed of 10 feet per second. Rewrite your equation for the height of the object above the surface of the moon as a function of elapsed time *t* to take into account this initial speed.

7. How is your work on these *falling objects problems* related to your work with the *rabbit runs?*

8. Why are the "distance fallen" and "height above the ground" functions quadratic?

Homework/Classwork

Finish 1.5