Lesson #64b
Factoring/Solving Review and Introduction to Linear/Exponential/Quadratic

Success Criteria: I can compare linear, exponential and quadratic situations and answer questions about situations. I can review what I know about factoring and solving polynomials.

Introduction to Linear/Exponential/Quadratic:
Complete Record and Practice Journal pages 231-233.

Factoring/Solving Review:

- **Use the zero-product property to solve the equation:**

1) $2x(x+7)(x-5)=0$

$2x=0$, $x=0$ → $\boxed{x=0}$; $x+7=0$, -7 → $\boxed{x=-7}$; $x-5=0$, $+5$ → $\boxed{x=5}$

2) $(x+8)^2=0$

$(x+8)(x+8)=0$

$x+8=0$, -8 → $\boxed{x=-8}$

3) $2(2x-5)(3x+1)=0$

$2x-5=0$, $+5$ → $2x=5$, $x=\frac{5}{2}$ → $\boxed{x=2.5}$

$3x+1=0$, -1 → $3x=-1$ → $\boxed{x=-\frac{1}{3}}$

- **Factor the polynomial using the GCF:**

4) $-24x^2-12x^3$

$-24x^2 = -1 \cdot 2 \cdot 2 \cdot 2 \cdot 3 \cdot x \cdot x$
$-12x^3 = -1 \cdot 2 \cdot 2 \cdot 3 \cdot x \cdot x \cdot x$

-24: -1, 24; 8, 3; 2, 4; 2, 2
-12: -1, 12; 6, 2; 3, 2

$\boxed{-12x^2(2+x)}$

5) $15t^2-3t+9$

$15t^2-3t+9$

15: 3, 5; -3: -1, 3; 9: 3, 3

$15t^2 = 3 \cdot 5 \cdot t \cdot t$
$-3t = -1 \cdot 3 \cdot t$
$9 = 3 \cdot 3$

$\boxed{3(5t^2-t+3)}$

- **Factor the expressions. Remember to check for a** GCF:

6) $n^2-10n+9$

$a=1$ $b=-10$ $c=9$

$\boxed{(n-9)(n-1)}$

7) $2x^2+6x-20$

$2(x^2+3x-10)$

$a=1$ $b=3$ $c=-10$

$\boxed{2(x-2)(x+5)}$

8) t^2-64

$a=1$ $b=0$ $c=-64$

$\boxed{(t+8)(t-8)}$

- **Solve the equations using the method of your choice. Remember to check for a** GCF:

9) $x^2+7x+15=5$

-5

$x^2+7x+10=0$

$a=1$ $b=7$ $c=10$

$(x+2)(x+5)=0$

$x+2=0$, -2 → $\boxed{x=-2}$

$x+5=0$, -5 → $\boxed{x=-5}$

10) $x^2-100=0$

$a=1$ $b=0$ $c=-100$

$(x+10)(x-10)=0$

$x+10=0$, -10 → $\boxed{x=-10}$

$x-10=0$, $+10$ → $\boxed{x=10}$

11) $x^3+6x^2+8x=0$

$x(x^2+6x+8)=0$

$a=1$ $b=6$ $c=8$

$x(x+4)(x+2)=0$

$\boxed{x=0}$

$x+4=0$, -4 → $\boxed{x=-4}$

$x+2=0$ → $\boxed{x=-2}$

Your friend who loves physics wants to replicate an experiment discussed in her physics class. She takes you to the small balcony off of LRC 4 and gives you an apple, in honor of Sir Isaac Newton who first theorized about gravity when watching an apple fall from a tree. She stands below you on LRC 1 with a motion detector that she has borrowed from the physics department. When she gives the cue that the coast is clear, you toss the apple from the balcony. The motion detector records the following information.

Time (seconds from drop)	0	1	2	3	4
Height (feet from the ground)	176	180	152	92	0

a. According to this data, what is the height of the balcony?

176 feet

b. Is the apple falling at a constant rate? If so, what is the speed of the apple? If not, during which one-second interval is the apple falling the fastest?

Not falling at constant rate

It is falling the fastest between 3+4 sec.

c. Do you think a quadratic model is appropriate for this data? Why or why not?

Yes - it will look like a U

d. When is the apple 100 feet from the ground? Give a reasonable estimate using tenths of a second. Explain your reasoning.

2.9

e. Rob Valentine, who is head of marketing at LMC, has an office with a window, the top of which is roughly 50 feet below the balcony. Estimate to the nearest half second when Rob will be able to see the apple. Explain your reasoning.

126 feet

2.5 seconds

Lesson #65
Comparing Linear, Exponential, and Quadratic Functions

Success Criteria: I can determine if a graph, table, equation or situation is linear, quadratic or exponential.

Problem #1: In the car problem from last class, you generated these 3 tables:

Billy's Car

t	$y=t$	
0	0	
0.2	0.2	
0.4	0.4	
0.6	0.6	
0.8	0.8	
1	1	+1
2	2	+1
3	3	+1
4	4	
5	5	
6	6	
7	7	
8	8	
9	9	

Bob's Car

t	$y=2^t-1$	
0	0	
0.2	0.1	
0.4	0.3	
0.6	0.5	
0.8	0.7	
1	1	+2
2	3	+4
3	7	+8
4	15	+16
5	31	+32
6	63	+64
7	127	+128
8	255	+256
9	511	

Joe's Car

t	$y=t^2$		
0	0		
0.2	0.0		
0.4	0.2		
0.6	0.4		
0.8	0.6		
1	1	+3	+2
2	4	+5	+2
3	9	+7	+2
4	16	+9	+2
5	25	+11	+2
6	36	+13	+2
7	49	+15	+2
8	64	+17	+2
9	81		

(A) If the cars were in a race, who was winning after half a second?

Billy

(B) Who was winning after three seconds?

Joe

(C) Who was winning after six seconds?

Bob

(D) Which car do you want? What does it depend on?

(E) Look at each table from $t = 1$ to 9. Write next to the table the pattern the numbers are increasing by.

(F) What is the linear pattern? (Billy's Car)

Adds the same amount

(G) What is the quadratic pattern? (Joe's Car)

Second difference is same

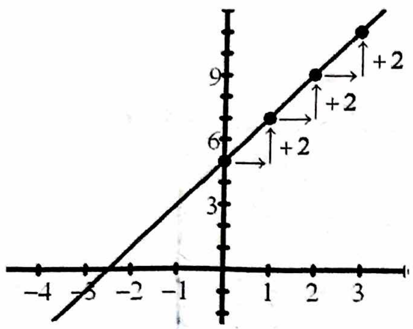
(H) What is the exponential pattern? (Bob's Car)

Multiplies

Linear:	Quadratic:	Exponential:
$y = mx + b$	$y = ax^2 + bx + c$	$y = a \cdot b^x$

Linear:

$y = mx + b$



+1 +1 +1 +1

x	−2	−1	0	1	2
y	1	3	5	7	9

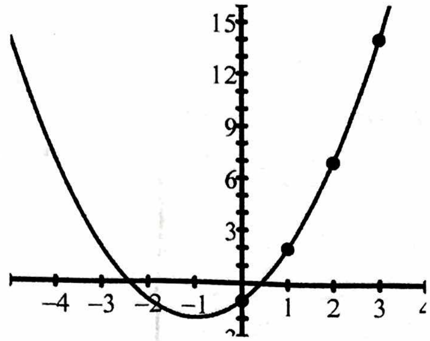
+2 +2 +2 +2

The y-values have a:

COMMON <u>DIFFERENCE</u>

Quadratic:

$y = ax^2 + bx + c$



+1 +1 +1 +1

x	−2	−1	0	1	2
y	−1	−2	−1	2	7

−1 +1 +3 +5

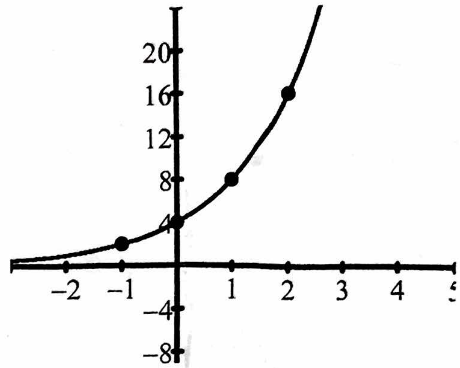
+2 +2 +2

The y-values have a:

COMMON <u>SECOND DIFFERENCE</u>

Exponential:

$y = a \cdot b^x$



+1 +1 +1 +1

x	−2	−1	0	1	2
y	1	2	4	8	16

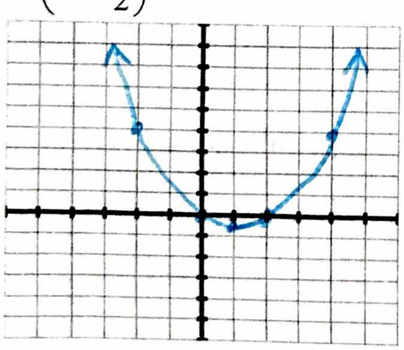
×2 ×2 ×2 ×2

The y-values have a:

COMMON <u>RATIO</u>

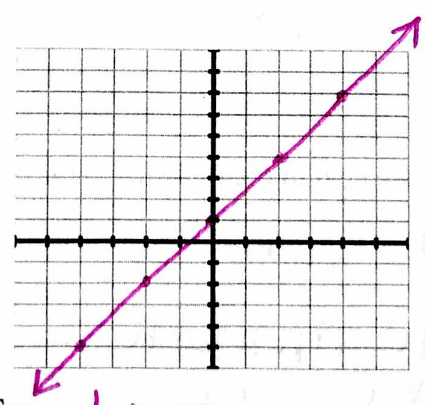
Example #1: Plot the points then tell whether they represent a LINEAR, an EXPONENTIAL, or a QUADRATIC function.

(A) $(4,4)$, $(2,0)$, $(0,0)$, $\left(1, -\frac{1}{2}\right)$, $(-2,4)$



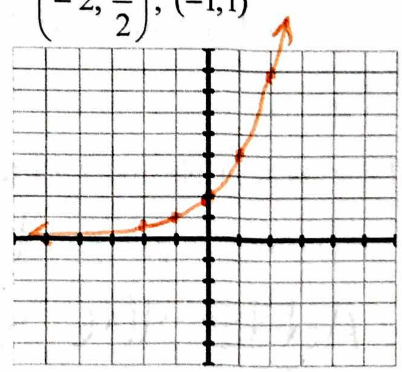
Type: Quadratic

(B) $(0,1)$, $(2,4)$, $(4,7)$, $(-2,-2)$, $(-4,-5)$



Type: Linear

(C) $(0,2)$, $(2,8)$, $(1,4)$, $\left(-2, \frac{1}{2}\right)$, $(-1,1)$



Type: Exponential

Example #2: Tell whether the table of values represents a LINEAR, an EXPONENTIAL, or a QUADRATIC function.

(A)

x	-3	-2	-1	0	1
y	11	8	5	2	-1

$-3 \quad -3 \quad -3 \quad -3$

Type: Linear

(B)

x	-1	0	1	2	3
y	1	3	9	27	81

$+2 \quad +6 \quad +18 \quad +54$

$\times 3 \quad \times 3 \quad \times 3$

Type: Exponential

(C)

x	-1	0	1	2	3
y	0	-1	2	9	20

$-1 \quad +3 \quad +7 \quad +11$

$+4 \quad +4 \quad +4$

Type: Quadratic

(D)

x	-2	-1	0	1	2
y	3	-3	-5	-3	3

$-6 \quad -2 \quad +2 \quad +6$

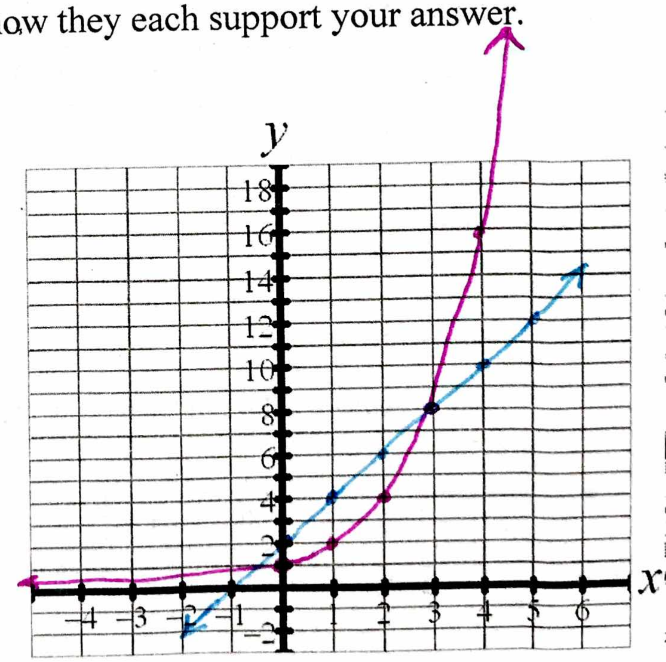
$+4 \quad +4 \quad +4$

Type: Quadratic

Example #3: For what positive values of x is $f(x)$ greater than $g(x)$? Support your answer with a table and with graphs. Explain how they each support your answer.

$f(x) = 2^x$ and $g(x) = 2x + 2$

x	$f(x)$	$g(x)$
0	1	2
1	2	4
2	4	6
3	8	8
4	16	10
5	32	12



f(x) is greater when $x > 3$

Homework: 8.5 Practice A Worksheet

Lesson #65b
Comparing Linear, Exponential, and Quadratic Functions

Success criteria: I can determine what type of data is in a given table. I can create a linear, quadratic or exponential regression in the calculator to model data.

Using a graphing calculator to write an equation from a set of points:

1. Determine the appropriate model – linear, quadratic, or exponential.
2. Press the **STAT** button, then select **1:Edit…**
3. Enter the *x*-values in L_1 and enter the matching *y*-values next to them in L_2.
4. Press the **STAT** button again, move over to the **CALC** heading, then select the appropriate model:
   For linear, select **4:LinReg(ax+b).**
   For quadratic, select **5:QuadReg.**
   For exponential, select **0:ExpReg.**
5. Use the *a*, *b*, and *c* values to write the equation. (You can ignore the r, r^2, and R^2 values.)

Problem #1: Last class we used these tables to determine whether they represent a LINEAR, an EXPONENTIAL, or a QUADRATIC function. Today we will enter the tables into the calculator to create an equation.

(A)

x	-3	-2	-1	0	1
y	11	8	5	2	-1

-3 -3 -3 -3

Type: Linear

Circle the correct form:

$y = mx + b$ or $y = a \cdot b^x$ or $y = ax^2$

$a =$ -3 $b =$ 2 $c =$

Equation: $y = -3x + 2$

(B)

x	-1	0	1	2	3
y	1	3	9	27	81

+2 +6 +18 +54

×3 ×3 ×3

Type: Exponential

Circle the correct form:

$y = mx + b$ or $y = a \cdot b^x$ or $y = ax^2$

$a =$ 3 $b =$ 3 $c =$

Equation: $y = 3 \cdot 3^x$

(C)

x	-1	0	1	2	3
y	0	-1	2	9	20

$-1 \quad +3 \quad +7 \quad +11$

$+4 \quad +4 \quad +4$

Type: Quadratic

Circle the correct form:

$y = mx + b$ or $y = a \cdot b^x$ or $y = ax^2$

$a = 2$ $b = 1$ $c = -1$

Equation:

$y = 2x^2 + 1x - 1$

(D)

x	-2	-1	0	1	2
y	3	-3	-5	-3	3

$-6 \quad -2 \quad +2 \quad +6$

$+4 \quad +4 \quad +4$

Type: Quadratic

Circle the correct form:

$y = mx + b$ or $y = a \cdot b^x$ or $y = ax^2$

$a = 2$ $b = 0$ $c = -5$

Equation: $y = 2x^2 + 0x + -5$

$y = 2x^2 - 5$

Problem #2:

x	y
0	0
2	1
4	4
6	9
8	16

$+1 \quad +3 \quad +5 \quad +7$

$+2 \quad +2 \quad +2$

Type: Quadratic

Circle the correct form:

$y = mx + b$ or $y = a \cdot b^x$ or $y = ax^2$

$a = .25$ $b = 0$ $c = 0$

Equation: $y = .25x^2$

Problem #3:

x	y
-1	-11
0	-3
1	5
2	13
3	21

$+8 \quad +8 \quad +8 \quad +8$

Type: Linear

Circle the correct form:

$y = mx + b$ or $y = a \cdot b^x$ or $y = ax^2$

$a = 8$ $b = -3$ $c =$

Equation: $y = 8x - 3$

Problem #4:

x	y
-1	2
0	6
1	18
2	54
3	162

+4 ×3
+12
+36 ×3
108 ×3

Type: Exponential

Circle the correct form:

$y = mx + b$ or $y = a \cdot b^x$ or $y = ax^2$

$a =$ 6 $b =$ 3 $c =$

Equation: $y = 6 \cdot 3^x$

Lesson #66
Comparing Graphs of Functions

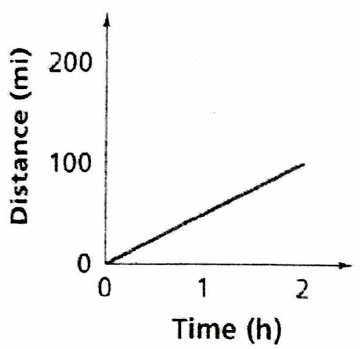
Success Criteria: I can match graphs with situations and tables. I can answer questions about situations given the graphs that model the situation.

The graphs below show the distance traveled vs. time for three different cars.
Note that all three graphs start at the point $(0, 0)$ and end at the point $(2, 100)$.
This means they each drive 100 miles in 2 hours.

So the **average speed** is the same for all three cars: $\dfrac{\textit{Change in Dist.}}{\textit{Change in Time}} = \dfrac{100 \textit{ miles}}{2 \textit{ hours}} = 50 \dfrac{\textit{miles}}{\textit{hour}}$

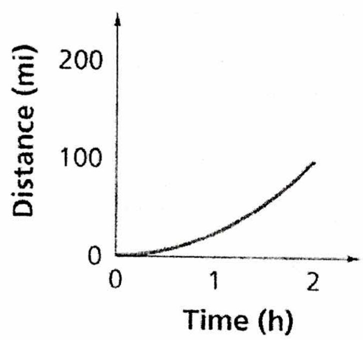
What is **different** is the driving speed of each car **during** the 2 hour period.

Car #1
Moving Steadily



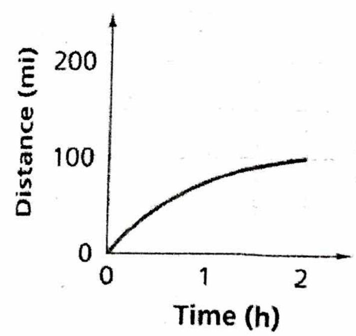
Drives at a constant speed (rate) for the entire 2 hours.

Car #2
Speeding Up Gradually



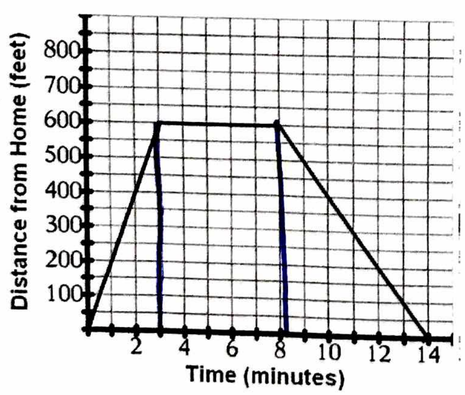
Drives slowly at the start then more quickly toward the end of the 2 hours.

Car #3
Slowing Down Gradually



Drives quickly at the start then more slowly toward the end of the 2 hours.

Example #1: The graph below shows Mary's distance from home during a walk.



What is Mary's average speed the first 3 minutes?

$\frac{600}{3} = 200$ ft/min

What is Mary's average speed the next 5 minutes?

$\frac{0}{5} = 0$ ft/min

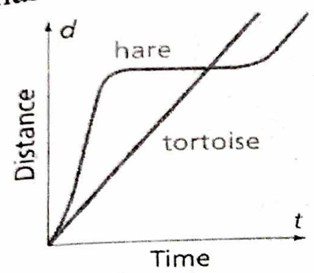
What is Mary's average speed the last 6 minutes?

$\frac{600}{6} = 100$ ft/min

Describe Mary's walk in detail. Include her walking rates in your description.

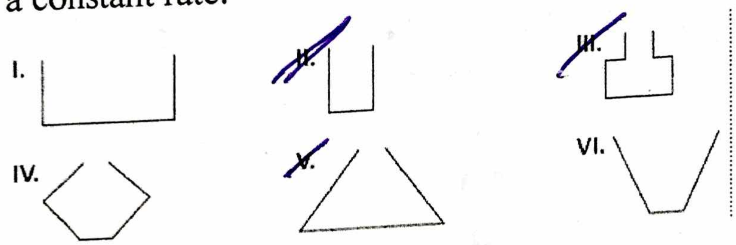
Mary walked 200 ft/min for 3 min & was 600 ft from home. then Mary walked 0 ft/min for 5 min so she stopped. then last 6 min, she walked 100 ft/min until she got home.

Example #2: The graph below shows the distance vs. time in a race between a tortoise and a hare.

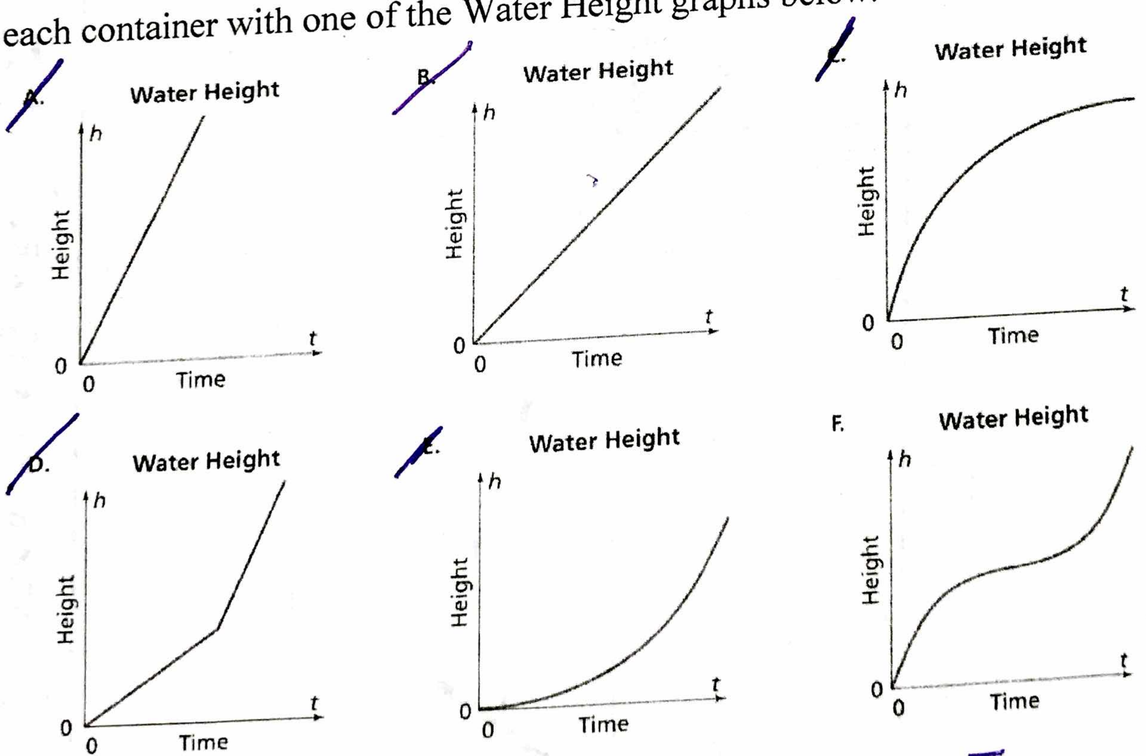


Describe the race and tell who won.

Example #3: The diagrams below show the side view of several containers that are being filled with water at a constant rate.



Match each container with one of the Water Height graphs below.



Answers: I: B II: A III: D IV: F V: E VI: C

Video: Filling up Containers of different shapes with water

Homework: "Journey to the Bus Stop" – write legibly. Include the speed.