**Lesson Plan**

**Grade 10 Academic Math** **Lesson: 4 - 7**

**Unit: Quadratic Relations** **Topic: Exponent Relations**

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- ***homework check:*** **FM 10 p. 41 # 5 – 8, p. 43 # 4 – 6**

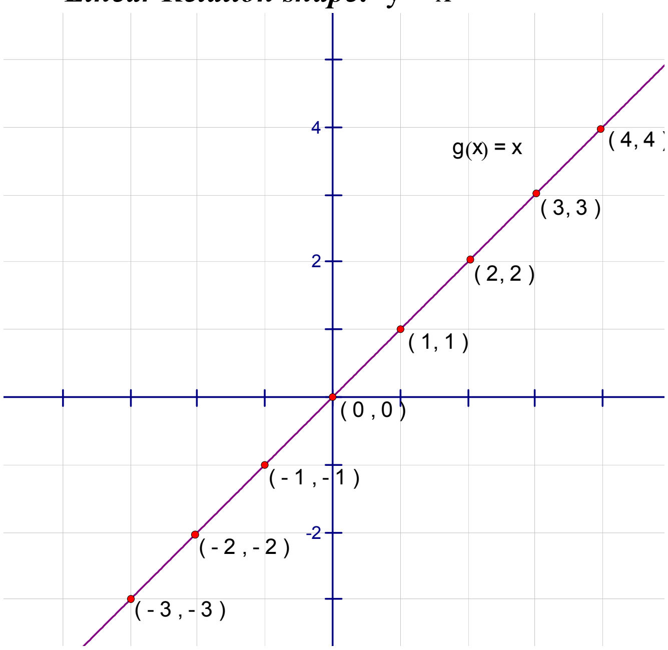
- ***note:*** **Exponential Relations**

The difference between linear, quadratic, and exponential relations lies both in the equations that represent the relation and the shape of the related graph. Recall the following:

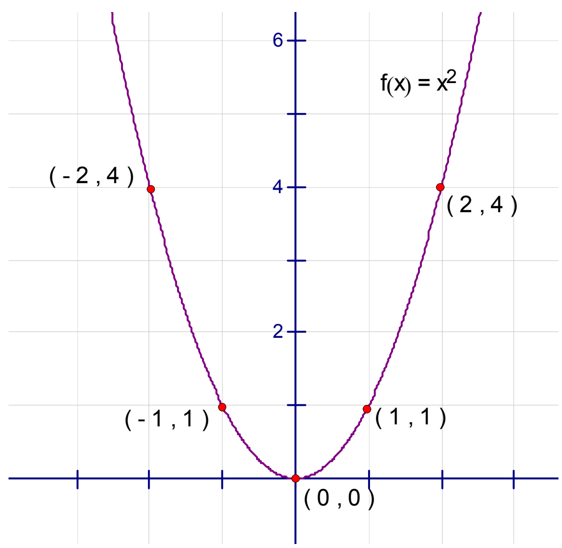
***Linear Equations*** have either the form $y = mx + b$ or $ax + by + c = 0$
***Quadratic Equations*** have the form $ax^2 + bx + c = 0$
***Exponential Equations*** have the form $y = a\,b^x + c$

The shapes of the graphs differ accordingly as follows:

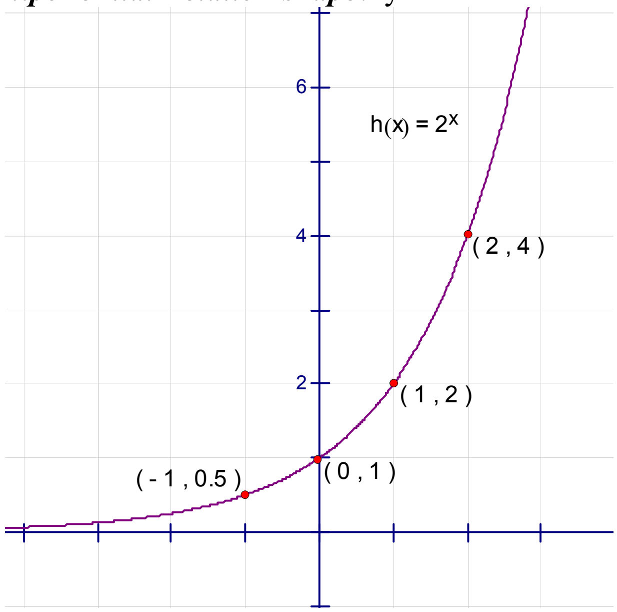
***Linear Relation shape:*** $y = x$




***Quadratic Relation shape***: $y = x^2$



***Exponential Relation shape***: $y = 2^x$




Each shape can be transformed and moved around on the grid according to the changes in the equation. An exponential relation can represent either growth as in the one above or decay depending on the base “b”. Notice that the exponential relation does not have an x intercept but rather becomes almost horizontal as the values decrease and almost vertical as the values increase.

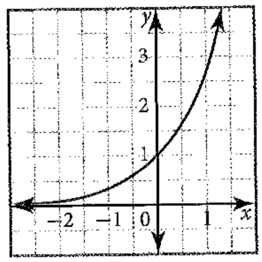
- ***homework assignment:*** **<u>Foundations for College Mathematics 11</u> p. 390 # 1, 2, 4 – 9**

## Practise A

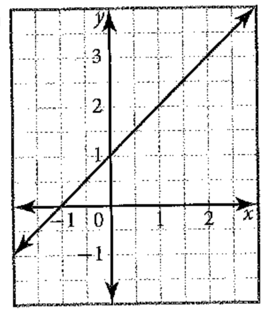
**For help with question 1, refer to Example 3.**

1. Identify the type of growth (linear, quadratic, exponential) illustrated by each graph. Justify your answers.

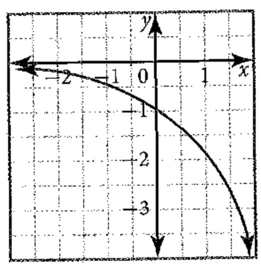
**a)**



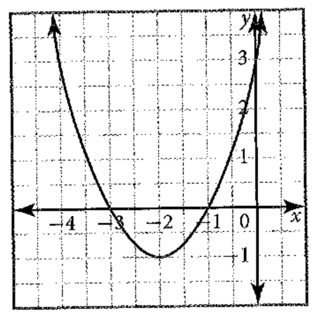

**b)**



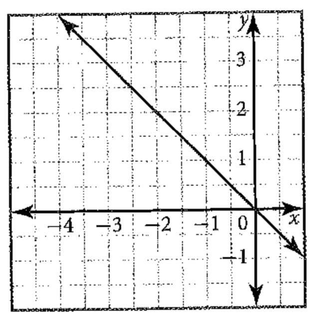

**c)**




**d)**




**e)**




**For help with questions 2 to 5, refer to Example 1.**

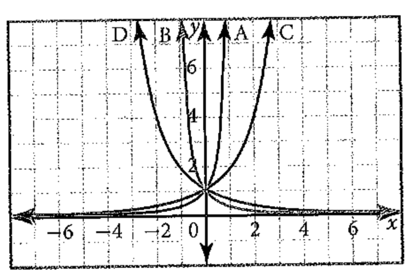
2. Identify which graph represents each relation. Justify your response.

   **a)** $y = 2^x$

   **b)** $y = 10^x$

   **c)** $y = \left(\frac{1}{2}\right)^x$

   **d)** $y = (0.1)^x$



**3.** **a)** Sketch each graph. Use a graphing calculator to check.

**i)** $y = 2^x$ **ii)** $y = 2(2^x)$

**iii)** $y = 3(2^x)$ **iv)** $y = 4(2^x)$

**b)** Describe the role of $a$ in $y = a(b^x)$.

**4.** Make a table of values for each relation. Sketch each pair of relations on the same set of axes. Use a graphing calculator to check.

**a)** $y = 3^x$ $y = 2(3^x)$

**b)** $y = \left(\frac{1}{2}\right)^x$ $y = 2\left(\frac{1}{2}\right)^x$

**c)** $y = (0.4)^x$ $y = 0.3(0.4)^x$

**5.** Make a table of values for each relation. Graph each pair of relations on the same set of axes. Use a graphing calculator to check.

**a)** $y = 2^x$ $y = 2^{3x}$

**b)** $y = 10^x$ $y = 10^{\frac{x}{2}}$

**c)** $y = \left(\frac{1}{2}\right)^x$ $y = \left(\frac{1}{2}\right)^{\frac{x}{4}}$

**d)** $y = 2^x$ $y = (3)2^{\frac{x}{5}}$

**For help with question 6, refer to Example 2.**

**6.** York Region's population, $P$, is projected to grow until 2031 based on the relation $P = 610\ 000(1.029)^n$, where $n$ is the number of years after 1996.

**a)** Sketch a graph of this relation.

**b)** What is the $P$-intercept? What does it represent?

**c)** What is the projected population of York Region in

**i)** 2015?

**ii)** 2031?

**7.** A pressure reader is used to measure the sound intensity of a bell. The relation $P = 200(0.5)^t$ estimates the sound pressure, $P$, in pascals, after $t$ seconds.

**a)** Sketch a graph of this relation.

**b)** What is the $P$-intercept? What does it represent?

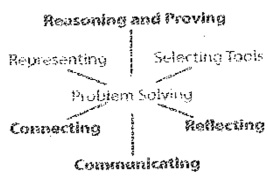
**c)** What was the sound pressure after

**i)** 1 s?

**ii)** 2 s?

## Apply B

8. Between 1996 and 2006, the population of Toronto grew from 2 459 700 to 2 607 600. The population of Peel Region grew from 878 800 to 1 215 300. The populations, $P$, can be estimated using the relations:
$P_{Toronto} = 2\ 459\ 700(1.0058)^n$ $\qquad$ $P_{Peel} = 878\ 800(1.033)^n$
where $n$ is the number of years after 1996.
   **a)** Make a table of values of each population for 10 years after 1996 and sketch a graph for each relation.
   **b)** Compare the growth rates. How do the growth rates affect the graphs?




9. Which model (linear, quadratic, or exponential) would best describe each situation? Why?
   **a)** a car slowing down by $\frac{1}{4}$ of its speed for every second that elapses
   **b)** the height of a stone falling from the top of a cliff
   **c)** a motorcyclist speeding up by 4 km/h each second
   **d)** the number of bacteria doubling every 3 h
   **e)** the path of a basketball when tossed into the air
   **f)** the maximum height of each bounce of a bouncing ball

**Chapter Problem**

10. The sound pressure, in micropascals, is the air pressure exerted by sound waves on objects such as your ear drums. To convert decibels (dB) to sound pressure ($P$), you can use the relation $P = 20 \times 10^{\frac{dB}{20}}$.
   **a)** Plot a graph of this relation. Use $dB$-values from 0 to 160, in steps of 20.
   **b)** Normal conversation measures 60 dB. Sound at a rock concert can reach 120 dB. Compare the sound pressures for these two situations.
   **c)** If the sound level reaches 160 dB, it can perforate your eardrums. What sound pressure will cause this?

11. The sound wave for each note on a piano has a different frequency. A full octave on a piano from note C4 to C5 is shown.

| Note | C4 | C# | D | D# | E | F | F# |
|---|---|---|---|---|---|---|---|
| Frequency (Hz) | 261.6 | 277.2 | 293.7 | 311.1 | 329.6 | 349.2 | 370.0 |

| Note | G | G | A | A | B | C5 |
|---|---|---|---|---|---|---|
| Frequency (Hz) | 392.0 | 415.3 | 440.0 | 466.2 | 493.9 | 523.2 |