

Today's Learning Goal(s):

Date: _____

By the end of the class, I will be able to:

- a) describe the characteristics of the graphs and equations of exponential functions.

Last day's work:

pp. 235-237 # $(1-2)$ ace, 3, $(4-9)$ ace [14]

Review p. 239

p. 236 3. Consider the expression $\frac{x^7(y^2)^3}{x^5y^4}$.

- a) Substitute $x = -2$ and $y = 3$ into the expression, and evaluate it.
 b) Simplify the expression. Then substitute the values for x and y to evaluate it.
 c) Which method seems more efficient?

$$\begin{aligned} \frac{x^7(y^2)^3}{x^5y^4} &= \frac{x^7y^6}{x^5y^4} \\ &= x^{7-5}y^{6-4} \\ &= x^2y^2 \\ &= (-2)^2(3)^2 \\ &= 4(9) \\ &= 36 \end{aligned}$$

p. 237 8. Evaluate. Express answers in rational form with positive exponents.

a) $(\sqrt{10\,000x})^{\frac{3}{2}}$ for $x = 16$

$$\begin{aligned} &= (\sqrt{10\,000} \sqrt{x})^{\frac{3}{2}} \\ &= (100x^{\frac{1}{2}})^{\frac{3}{2}} \\ &= (100^{\frac{3}{2}})(x^{\frac{1}{2}})^{\frac{3}{2}} \\ &= (\sqrt{100})^3(x^{\frac{3}{4}}) \\ &= 10^3x^{\frac{3}{4}} \\ &= 1000x^{\frac{3}{4}} \end{aligned}$$

$$\begin{aligned} &= 1000x^{\frac{3}{4}} \\ &= 1000(16)^{\frac{3}{4}} \\ &= 1000(\sqrt[4]{16})^3 \\ &= 1000(2)^3 \\ &= 1000(8) \\ &= 8000 \end{aligned}$$

p. 237

9. Simplify. Express answers in rational form with positive exponents.

a) $(36m^4n^6)^{0.5}(81m^{12}n^8)^{0.25}$

c) $\left(\frac{\sqrt{64a^{12}}}{(a^{1.5})^{-6}}\right)^{\frac{2}{3}}$

b) $\left(\frac{(6x^3)^2(6y^3)}{(9xy)^6}\right)^{-\frac{1}{3}}$

d) $\left(\frac{(x^{18})^{\frac{-1}{6}}}{\sqrt[5]{243x^{10}}}\right)^{0.5}$

$36^{\frac{1}{2}}(m^4)^{\frac{1}{2}}(n^6)^{\frac{1}{2}} \cdot 81^{\frac{1}{4}}(m^{12})^{\frac{1}{4}}(n^8)^{\frac{1}{4}}$

$= 6m^2n^3 \cdot 3m^3n^2$

$= 18m^{2+3}n^{3+2}$

$= 18m^5n^5$

c) $\left(\frac{(64a^{12})^{\frac{1}{2}}}{(a^{\frac{3}{2}})^{-6}}\right)^{\frac{2}{3}}$

$= \frac{[(64a^{12})^{\frac{1}{2}}]^{\frac{2}{3}}}{[(a^{\frac{3}{2}})^{-6}]^{\frac{2}{3}}}$

$= \frac{(64a^{12})^{\frac{1}{3}}}{(a^{\frac{3}{2}})^{-4}}$

$= \frac{(64)^{\frac{1}{3}}(a^{12})^{\frac{1}{3}}}{a^{-6}}$

$= \frac{\sqrt[3]{64}a^4}{a^{-6}}$

$= 4a^{4-(-6)}$

$= 4a^{10}$

Side
 $\frac{1}{2} \cdot \frac{2}{3} = \frac{1}{3}$
 $-\frac{2}{6} \times \frac{2}{3} = -\frac{4}{9}$
 $\leftarrow -4$

$\frac{3}{2}(-4) = -6$

4.5 Exploring Properties of Exponential Functions

Date: Apr. 9/19

p. 240 Investigate – students complete A – E individually (or in pairs).

A. $g(x) = x$ FD (1st Diff)

| x | y |
|----|----|
| -3 | -3 |
| -2 | -2 |
| -1 | -1 |
| 0 | 0 |
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |
| 4 | 4 |
| 5 | 5 |

$-2 - (-3) = 1$
 $-1 - (-2) = 1$
 $0 - (-1) = 1$
 $1 - 0 = 1$
 $2 - 1 = 1$
 $3 - 2 = 1$
 $4 - 3 = 1$
 $5 - 4 = 1$

 $h(x) = x^2$ FD SD (2nd Diff)

| x | y |
|----|----|
| -3 | 9 |
| -2 | 4 |
| -1 | 1 |
| 0 | 0 |
| 1 | 1 |
| 2 | 4 |
| 3 | 9 |
| 4 | 16 |
| 5 | 25 |

$4 - 9 = -5$
 $1 - 4 = -3$
 $0 - 1 = -1$
 $1 - 0 = 1$
 $4 - 1 = 3$
 $9 - 4 = 5$
 $16 - 9 = 7$
 $25 - 16 = 9$

 $k(x) = 2^x$ FD SD

| x | y |
|----|-----|
| -3 | 1/8 |
| -2 | 1/4 |
| -1 | 1/2 |
| 0 | 1 |
| 1 | 2 |
| 2 | 4 |
| 3 | 8 |
| 4 | 16 |
| 5 | 32 |

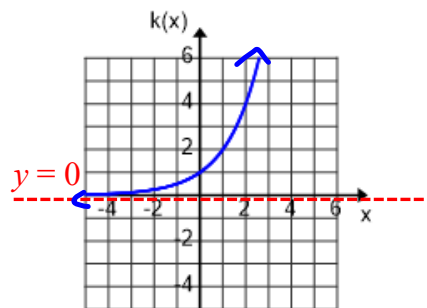
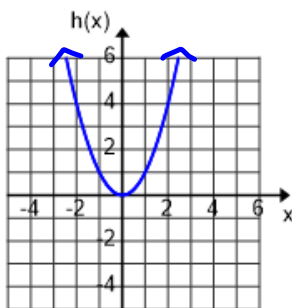
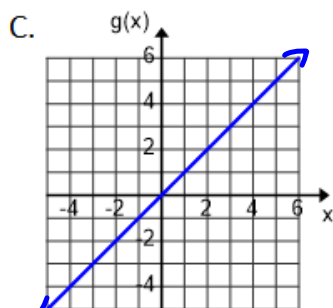
$\frac{1}{4} \div \frac{1}{8} = \frac{1}{2}$
 $\frac{1}{2} \div \frac{1}{4} = \frac{1}{2}$
 $1 \div \frac{1}{2} = 2$
 $2 \div 1 = 2$
 $4 \div 2 = 2$
 $8 \div 4 = 2$
 $16 \div 8 = 2$

\therefore 2nd diff. are constant
 $h(x)$ is quadratic

\therefore y-ratios are constant
 $k(x)$ is exponential

- B. $g(x) \rightarrow$ first differences are equal
 $h(x) \rightarrow$ second differences are equal
 $k(x) \rightarrow$ ratio of successive y-values are equal

use first differences to eliminate translation?



D.

$$D = \{x \in \mathbb{R}\}$$

$$R = \{y \in \mathbb{R}\}$$

$$D = \{x \in \mathbb{R}\}$$

$$R = \{y \in \mathbb{R} \mid y \geq 0\}$$

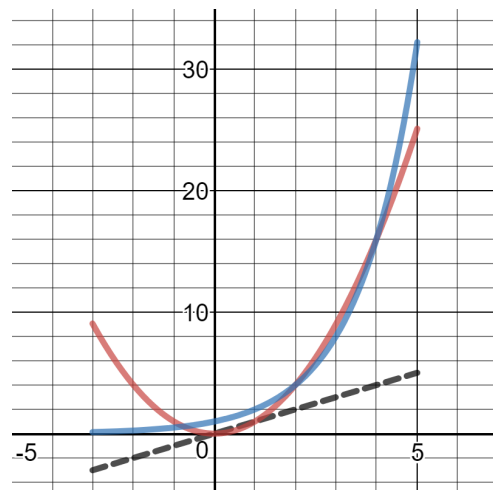
$$D = \{x \in \mathbb{R}\}$$

$$R = \{y \in \mathbb{R} \mid y > 0\}$$

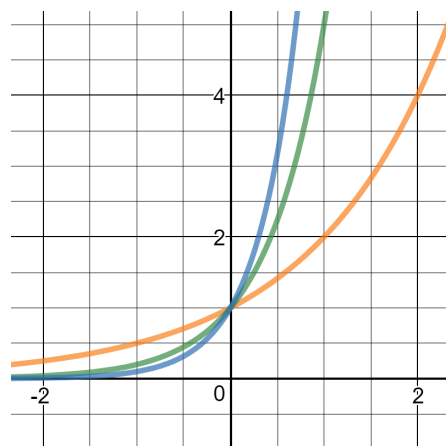
- E. $g(x) \rightarrow$ as independent variable (x) increases,
 the dependent variable (y) also increases at a consistent rate
 $h(x) \rightarrow$ as independent variable (x) increases,
 the dependent variable (y) decreases until $x = 0$ and then increases
 $k(x) \rightarrow$ as independent variable (x) increases,
 the dependent variable (y) also increases, slowly at first and then quickly.

Show with DESMOS?

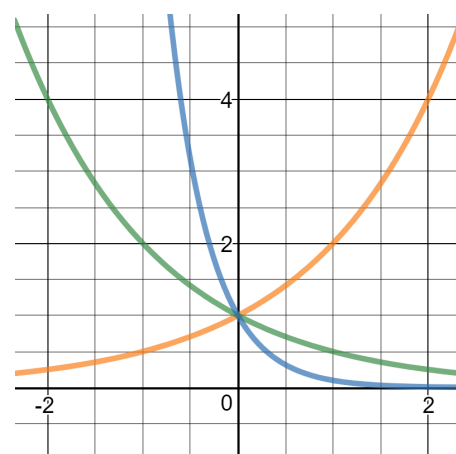
C  <https://www.desmos.com/calculator/dcbvlufgmb>



F  <https://www.desmos.com/calculator/snogpkesaw>



I  <https://www.desmos.com/calculator/yabmbc4wcd>



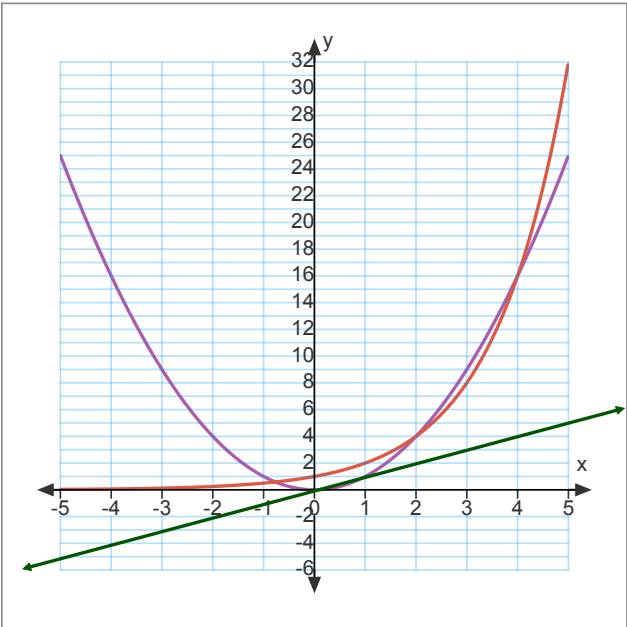
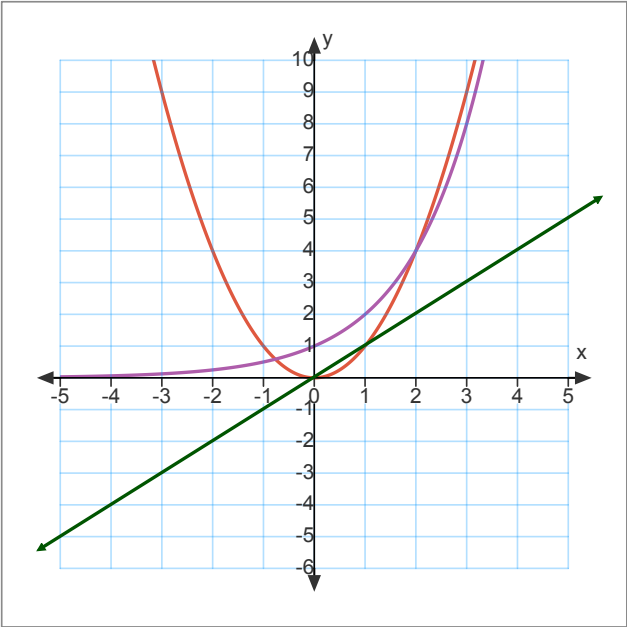
$y = x$

$y = x^2$

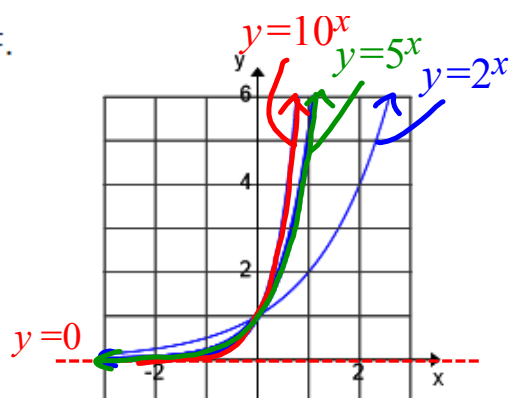
$y = x^2$

$y = 2^x$

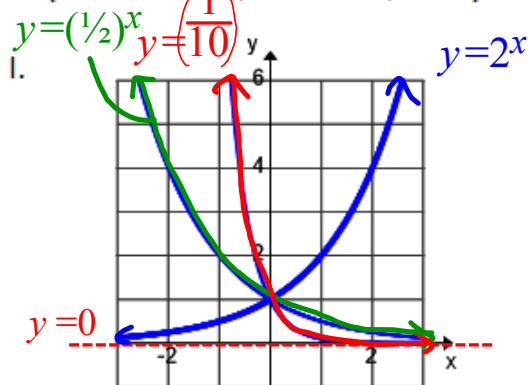
$y = 2^x$



F.



Reminder:

Asymptotes **MUST** always be drawn and labelled.G. For all 3 functions, $D = \{x \in \mathbb{R}\}$ and $R = \{y \in \mathbb{R} \mid y > 0\}$.The y -intercept = 1, there are no x -intercepts,and there is a Horizontal Asymptote [H.A.] at $y = 0$ (x -axis).H. $y = 10^x$ increases fastest, and $y = 2^x$ has the slowest rate of increase.

J. All properties remain the same as G.

K. As the values of x increase the graphs with fractional bases decrease (decay).

Summary: Properties of $y = b^x$

- $b > 0$, $b \neq 1$
- $y\text{-int} = 1$
- H.A.: $y = 0$ (x -axis) [Horizontal Asymptote]
- $D = \{x \in \mathbb{R}\}$
- $R = \{y \in \mathbb{R} \mid y > 0\}$
- Increasing when $b > 1$ (growth)
- The greater the value of b , the faster the growth
- Decreasing when $0 < b < 1$ (decay)
- Equal ratios of successive y -values

For tomorrow, think about the general form of $y = a(b^x) + c$ and how the values of a and c relate to the graphs we drew today.

Are there any Homework Questions you would like to see on the board?

Last day's work:

pp. 235-237 $\#(1 - 2)_{ace}$, 3, $(4 - 9)_{ace}$ [14]

Review p. 239

Today's Homework Practice includes:

pp. 240-241 A - P

READ p. 242

p. 243 #1, 2