Transformations of Exponential Functions     *Oct 29/2019*

Recall:

Given:  $y = a\,f\left[\,k\left(x - p\right)\right] + q$

$\qquad\qquad\quad\;$ 1 $\qquad$ 2 $\qquad\quad$ 3 $\qquad\quad$ 4

All possible transformation are:

(1) vertical reflection and scaling $\qquad$ $y \rightarrow ay$
$\quad\;\;$ (stretch/compress).

(2) horizontal reflection and scaling $\qquad$ $x \rightarrow \dfrac{x}{k}$
$\quad\;\;$ (stretch/compress).

(3) horizontal shift (left/right). $\qquad$ $x \rightarrow x + p$

(4) vertical shift (up/down). $\qquad$ $y \rightarrow y + q$

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For any single point, the transformations can be summarized as an <u>image point</u>:

$$(x, y) \rightarrow \left( \frac{x}{k} + p,\; ay + q \right)$$

$\qquad\qquad\qquad\;\;$ 2 $\quad\;$ 3 $\quad$ 1 $\qquad$ 4

Special features, such as asymptotes, can also be transformed in this way:

vertical
asymptote $\qquad$ $x = c \rightarrow x = \dfrac{c}{k} + p$

horizontal
asymptote $\qquad$ $y = d \rightarrow y = ad + q$

parent exponential function has HA at y=0

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Function Notation vs x-y Notation   $f(x) = b^x, 0 < b < 1, b > 1$

$$y = af\left[k(x-p)\right] + q \qquad\qquad y = ab^{k(x-p)} + q$$

Examples:

| transformation | function notation | x-y notation |
|---|---|---|
| vertical stretch | $y = 5f(x)$ | $y = 5(2^x)$ |
| vertical reflection | $y = -f(x)$ | $y = -(2^x)$ |
| vertical shift | $y = f(x) + 3$ | $y = 2^x + 3$ |
| horizontal stretch | $y = f(\frac{1}{2}x)$ | $y = 2^{\frac{1}{2}x}$ |
| horizontal reflection | $y = f(-x)$ | $y = 2^{-x}$ |
| horizontal shift | $y = f(x-5)$ | $y = 2^{x-5}$ |

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Assigned Work:

p.251 # 1, 2, 3, 4, 5, 9, 11

d

$2(d) \quad k(x) = 5^{3x-6}$

$= 5^{3(x-2)}$

$5^{3x-5}$

$= 5^{3\left(x - \frac{5}{3}\right)}$

$y = af\left[k(x-p)\right] + q$

$y = a\left(b^{k(x-p)}\right) + q$

$= \left(5^3\right)^{x-2}$

$= 125^{x-2}$

$= \left(125^x\right)\left(125^{-2}\right)$

$= \dfrac{1}{15625}\left(125^x\right)$

$a = \dfrac{1}{15625}$

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