

Lesson 5: Transformations of Exponential Functions

Part A – Introduction

Recall:

- Any function $y = f(x)$ can be transformed according to $y = af[k(x - d)] + c$. Therefore all the transformations can be applied to the exponential function as follows: $y = ab^{k(x-d)} + c$.
- Always factor first, if needed;
 - a determines vertical stretch or compression
 - k determines the horizontal stretch /compression
 - d determines the horizontal translation left or right
 - c determines the vertical translation up or down
- Apply the transformations in this order (i) horizontal/vertical stretches
(ii) reflections
(iii) translations
- Mapping technique: $(x, y) \rightarrow \left(\frac{x}{k} + d, ay + c\right)$

Part B – Anatomy of the Transformed Exponential Function

Let $f(x) = 2^x$, applying all the transformations we get,

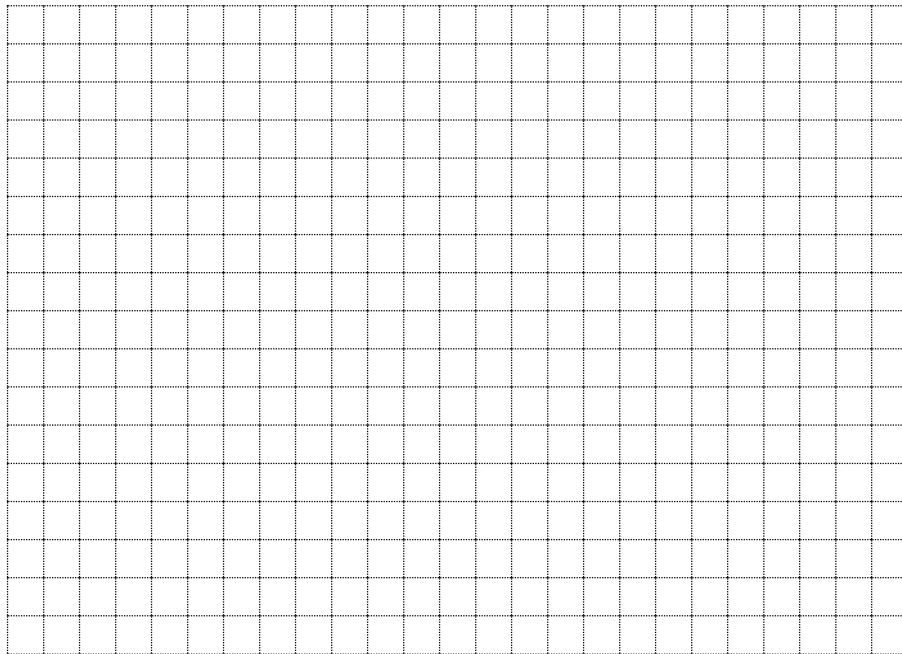
$$g(x) = -4f(-3x - 9) + 6$$

$$= -4(2)^{-3(x+3)} + 6$$

Part C – Examples

Graph each of the following functions. State the y-intercept, the equation of the asymptote, domain and range.

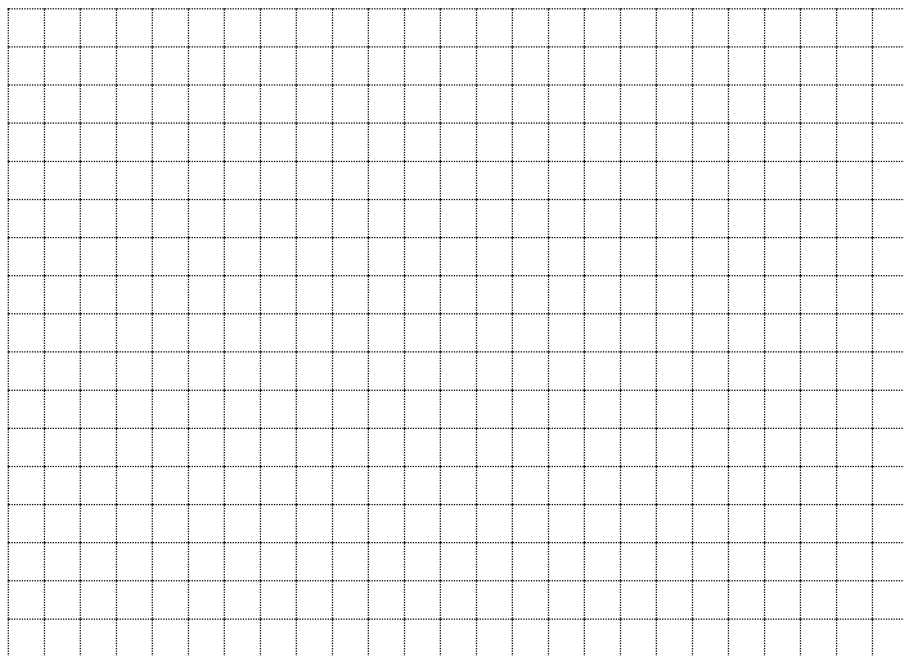
a) $y = -2^x + 4$ (Hint: Graph the new asymptote first; it's given by $y = c$)



y-intercept: _____ equation of asymptote: _____

domain: _____ range: _____

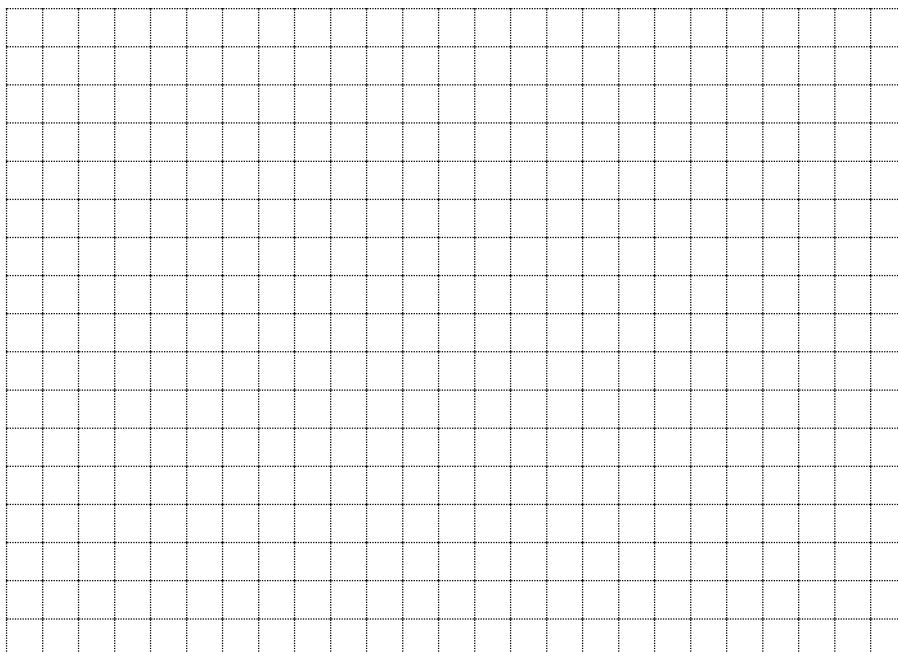
b) $y = 3^{-(x-4)}$



y-intercept: _____ equation of asymptote: _____

domain: _____ range: _____

c) $y = \left(\frac{1}{2}\right)^{3x} - 2$



y-intercept: _____ equation of asymptote: _____

domain: _____ range: _____

Worksheet:

Graphing Transformations of $y = b^x$.

Graph each of the following exponential functions, and determine:

- (i) the equation of the horizontal asymptote
- (ii) the y-intercept
- (iii) the domain and range

a) $y = 2(3^x - 1)$

b) $y = \frac{1}{3}(2^{(x+4)})$

c) $y = -(3^x) + 2$

d) $y = 2\left(\frac{2}{3}\right)^{-x} - 3$

