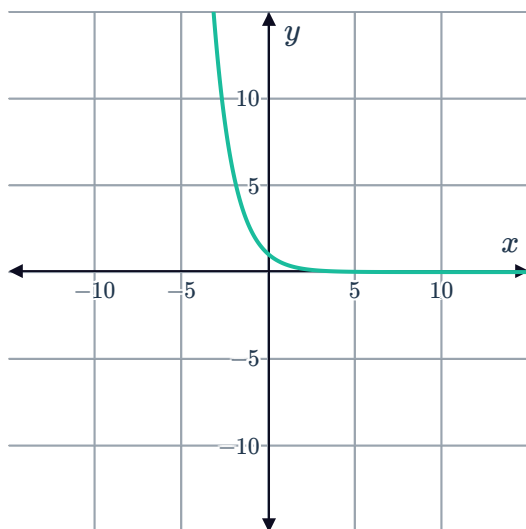


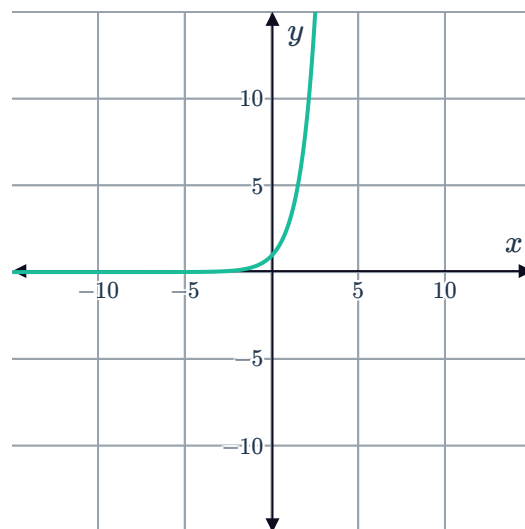
Exponential graphs

1 State whether the following graphs show an exponential function:

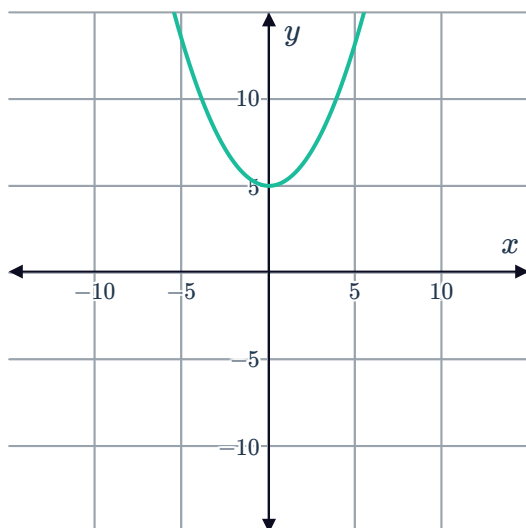
a



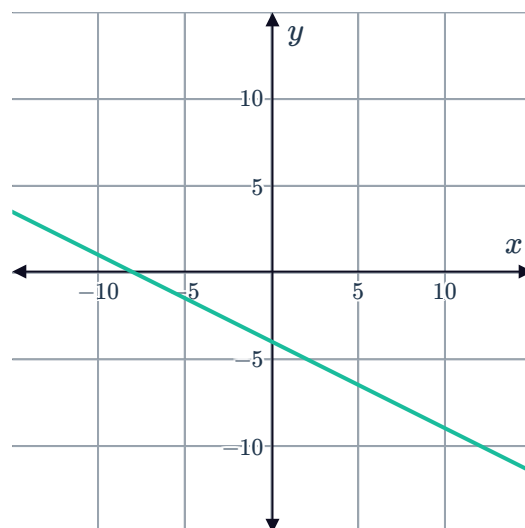
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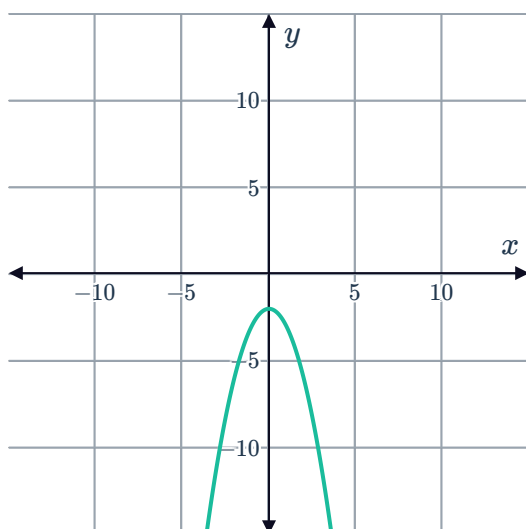
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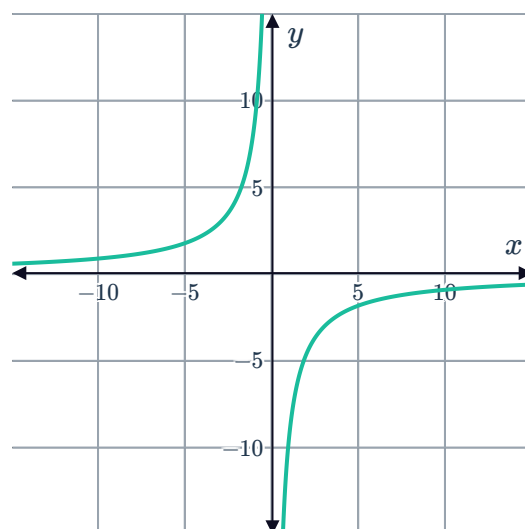
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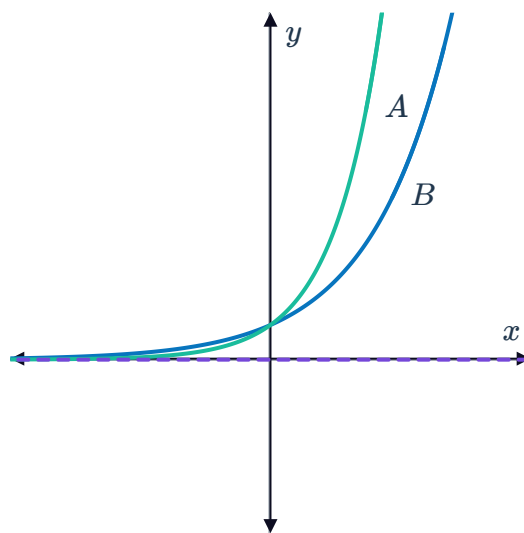
e



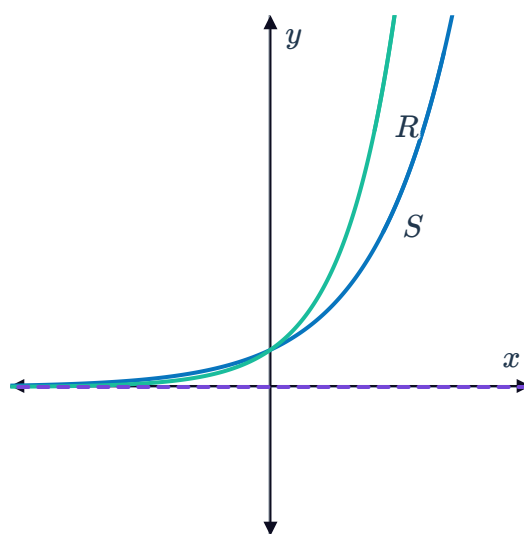
f



- 2** Consider the graphs of the two exponential functions A and B :
One of the graphs is of $y = 3^x$ and the other graph is of $y = 6^x$. Which is the graph of $y = 3^x$?



- 3** Consider the graphs of the two exponential functions R and S :
- a** One of the graphs is of $y = 3^x$ and the other graph is of $y = 5^x$. Which is the graph of $y = 5^x$?
 - b** Which function has its graph below that of the other when $x < 0$? Explain your answer.



- 4** Determine whether following are increasing or decreasing exponential functions:

- | | | | |
|---|---|-------------------------|--|
| a $y = 2^x$ | b $y = \left(\frac{2}{4}\right)^x$ | c $y = 0.75^x$ | d $y = 4.15^x$ |
| e $y = \left(\frac{7}{5}\right)^x$ | f $y = 0.98^x$ | g $y = 1.5^{-x}$ | h $y = \left(\frac{1}{8}\right)^{-x}$ |

Increasing exponential graphs

5 Consider the expression $y = 4^x$.

i Complete the table of values:

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

ii Sketch the graph.

iii Describe what happens to the y -values as x increases.

iv Describe what happens to the y -values as x decreases.

v Does the curve cross the x -axis?

vi At what value of y does the graph cross the y -axis?

6 For each of the following functions:

i Find the y -value of the y -intercept of the curve.

ii Complete the table of values:

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

iii Find the horizontal asymptote of the curve.

iv Sketch the graph.

a $y = 5^x$

b $y = 10^x$

c $y = 2^x$

7 Consider the expression $y = 10^x$.

i Can the value of y ever be negative?

ii Can the value of y ever be equal to 0?

iii As the values of x get larger and larger, what value does y approach?

iv As the values of x get smaller and smaller, what value does y approach?

v Find the y -value of the y -intercept of the curve.

vi How many x -intercepts does the curve have?

vii Sketch the graph.

8 Consider the exponentials $y = 2^x$ and $y = 3^x$:

a Find the horizontal asymptote of each curve:

i $y = 2^x$

ii $y = 3^x$

b Complete a table of values for each exponential:

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

i $y = 2^x$

ii $y = 3^x$

c Sketch the graphs of $y = 2^x$ and $y = 3^x$ on the same set of axes.

d Find the coordinates of the point at which the two graphs intersect.

9 Consider the function $y = 4^x$.

a Sketch the graph of $y = 4^x$.

b Complete the table of values for $y = \left(\frac{1}{4}\right)^{-x}$:

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

c Sketch the graph of $\left(\frac{1}{4}\right)^{-x}$.

d Compare the graphs of 4^x and $\left(\frac{1}{4}\right)^{-x}$.

Decreasing exponential graphs

10 Consider the function $y = \left(\frac{1}{3}\right)^x$:

a Write two functions that are equivalent to $y = \left(\frac{1}{3}\right)^x$.

b Sketch the graph of $y = 3^x$ on a number plane.

c Sketch the graph of $y = \left(\frac{1}{3}\right)^x$ on the same number plane as $y = 3^x$.

11 Consider the two equations $y = 5^{-x}$ and $y = 6^{-x}$. Which is decreasing more rapidly for $x > 0$?

12 Consider the expression $y = 2^{-x}$.

i Complete the table of values:

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

ii Sketch the graph.

iii Describe what happens to the y -values as x increases.

iv Describe what happens to the y -values as x decreases.

v Does the curve cross the x -axis?

vi At what value of y does the graph cross the y -axis?

13 For each of the following functions:

i Find the y -value of the y -intercept of the curve.

ii Complete the table of values:

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

iii Find the horizontal asymptote of the curve.

iv Sketch the graph.

a $y = 3^{-x}$

b $y = 4^{-x}$

c $y = 6^{-x}$

14 Consider the expression $y = 9^{-x}$.

i Can the value of y ever be negative?

ii Can the value of y ever be equal to 0?

iii As the values of x get larger and larger, what value does y approach?

iv As the values of x get smaller and smaller, what value does y approach?

v Find the y -value of the y -intercept of the curve.

vi How many x -intercepts does the curve have?

vii Sketch the graph.

15 Consider the exponentials $y = 5^{-x}$ and $y = 8^{-x}$:

a Find the horizontal asymptote of each curve:

i $y = 5^{-x}$

ii $y = 8^{-x}$

b Complete a table of values for each exponential:

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

i $y = 5^{-x}$

ii $y = 8^{-x}$

c Sketch the graphs of $y = 5^{-x}$ and $y = 8^{-x}$ on the same set of axes.

d Find the coordinates of the point at which the two graphs intersect.

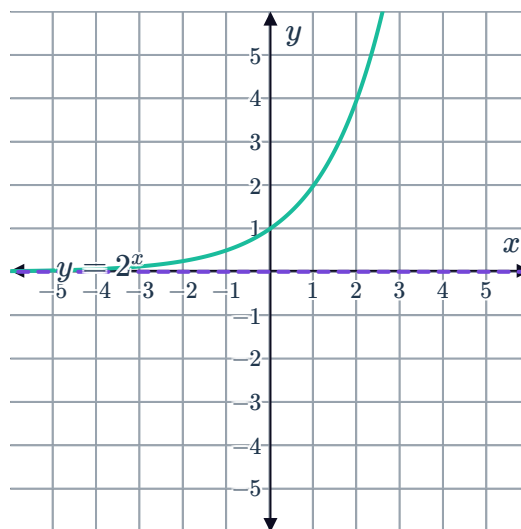
Dilations and reflections

16 How could we use the graph of $y = 7^x$ to draw the graph of $y = 7^{-x}$?

17 Consider the graph of $y = 2^x$:

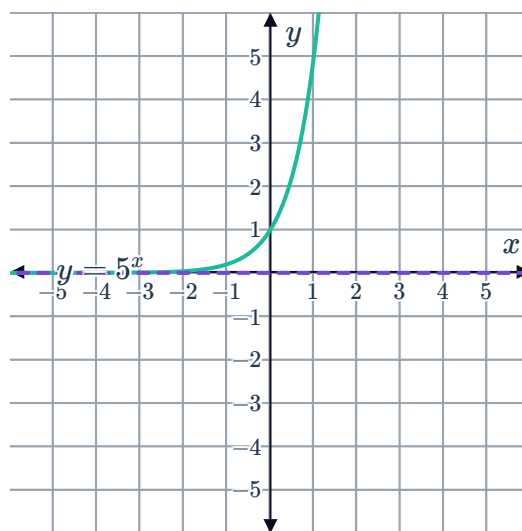
a Describe a transformation of the graph of $y = 2^x$ that would obtain $y = 2^{-x}$.

b Sketch the graph of $y = 2^{-x}$ on the same set of axes as $y = 2^x$.



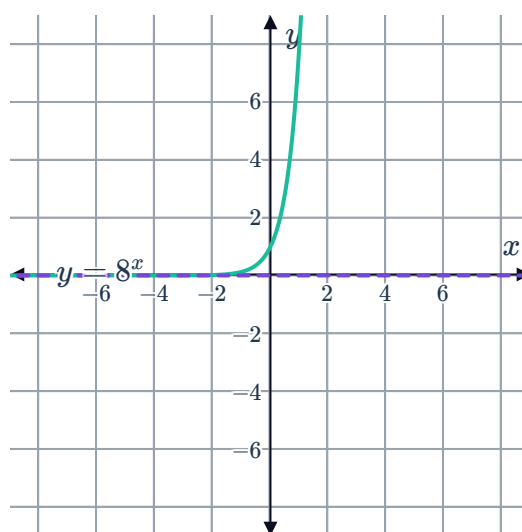
18 Consider the graph of $y = 5^x$:

- a** Describe a transformation of the graph of $y = 5^x$ that would obtain $y = -5^x$.
- b** Sketch the graph of $y = -5^x$ on the same set of axes as $y = 5^x$.



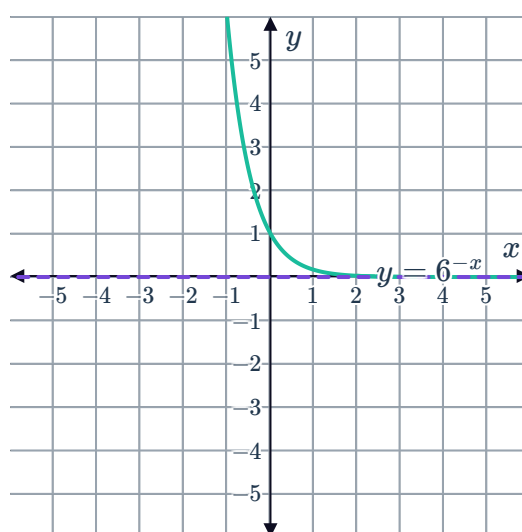
19 Consider the graph of $y = 8^x$:

- a** Describe a transformation of the graph of $y = 8^x$ that would obtain $y = -8^{-x}$.
- b** Sketch the graph of $y = -8^{-x}$ on the same set of axes as $y = 8^x$.



20 Consider the graph of $y = 6^{-x}$:

- a** Describe a transformation of the graph of $y = 6^{-x}$ that would obtain $y = -6^{-x}$.
- b** Sketch the graph of $y = -6^{-x}$ on the same set of axes as $y = 6^{-x}$.
- c** Describe the graph of $y = -6^{-x}$ as x increases.



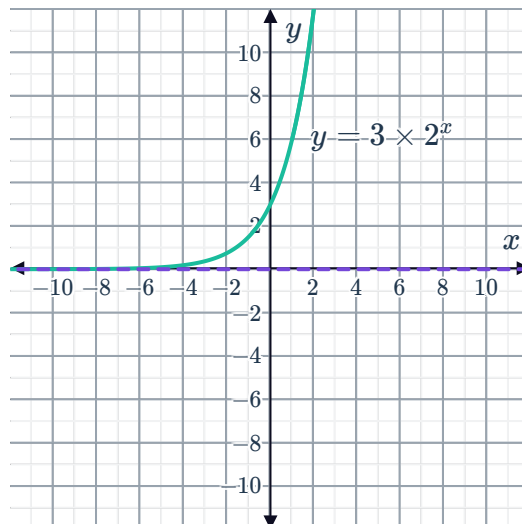
21 Of the two functions $y = 4^x$ and $y = \frac{4^x}{4}$, which is increasing more rapidly for $x > 0$?

22 Consider the function $y = 3(4^x)$.

- a Find the y -value of the y -intercept of the curve.
- b Can the value of y ever be negative?
- c As x approaches infinity, what value does y approach?
- d Sketch the graph of $y = 3(4^x)$.

23 Consider the function $y = 3 \times 2^x$.

- a Find the value of y when $x = 0$.
- b Describe a transformation of the graph of $y = 3 \times 2^x$ that would obtain $y = -3 \times 2^x$.
- c Sketch the graph of $y = -3 \times 2^x$ on the same set of axes as $y = 3 \times 2^x$.
- d The number of bacteria over time is to be modelled by an exponential function, with x representing time and y representing the number of bacteria. If the bacteria are increasing, which function should be used?



24 Consider the original graph $y = 2^x$. The function values of the graph are multiplied by 3 to form a new graph.

- a Complete the following table by finding the points on the new graph:

Point on original graph	$\left(-1, \frac{1}{2}\right)$	$(0, 1)$	$(1, 2)$	$(2, 4)$
Point on new graph	$(-1, \text{?})$	$(0, \text{?})$	$(1, \text{?})$	$(2, \text{?})$

- b Find the equation of the new graph.
- c Sketch the graphs of the original and new function on the same set of axes.
- d For positive x -values, is the graph of the new function above or below the graph of 2^x ?
- e For negative x -values, is the graph of the new function above or below the graph of 2^x ?

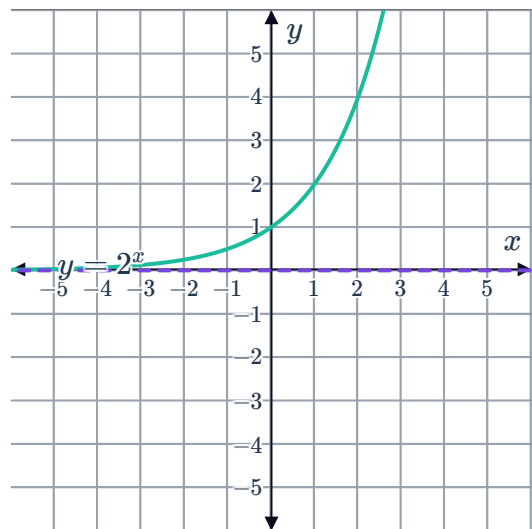
Translations

25 Consider the graph of $y = 6^x$:

- a** Find the y -value of the y -intercept of $y = 6^x$.
- b** Hence, find the y -value of the y -intercept of $y = 6^x + 3$.
- c** Find the horizontal asymptote of $y = 6^x$.
- d** Hence, find the horizontal asymptote of $y = 6^x + 3$.

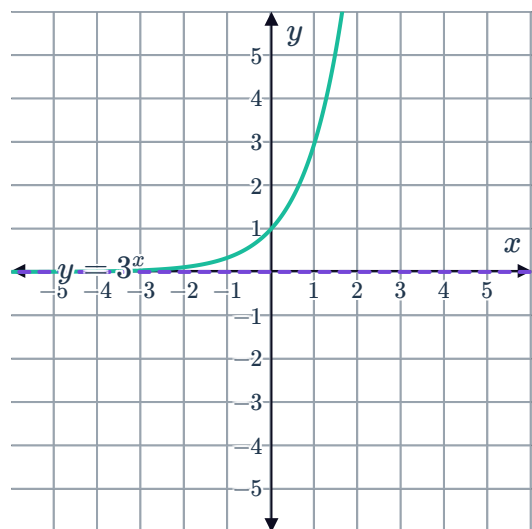
26 Consider the graph of $y = 2^x$:

- a** Describe the translation required to shift the graph of $y = 2^x$ to obtain the graph of $y = 2^x - 5$.
- b** Sketch the graph of $y = 2^x - 5$ on the same set of axes as $y = 2^x$.



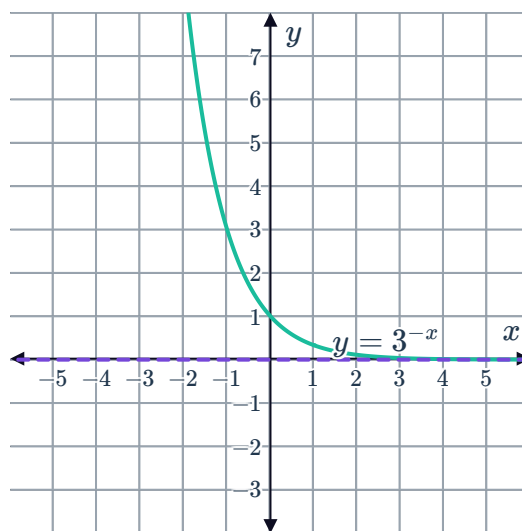
27 Consider the graph of $y = 3^x$:

- a** Describe the translation required to shift the graph of $y = 3^x$ to obtain the graph of $y = 3^x + 1$.
- b** Sketch the graph of $y = 3^x + 1$ on the same set of axes as $y = 3^x$.



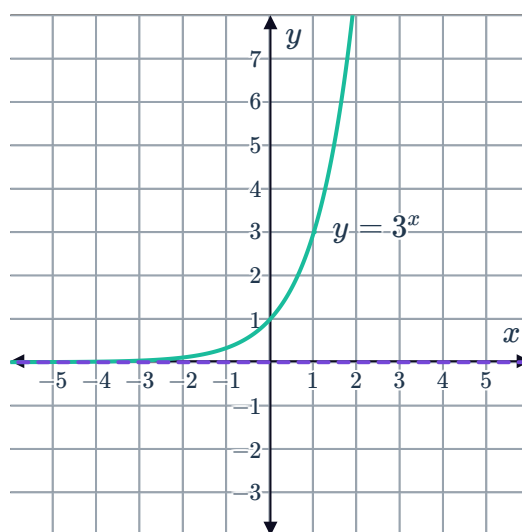
28 Consider the graph of $y = 3^{-x}$:

- a** Describe the translation required to shift the graph of $y = 3^{-x}$ to obtain the graph of $y = 3^{-x} + 5$.
- b** Sketch the graph of $y = 3^{-x} + 5$ on the same set of axes as $y = 3^{-x}$.



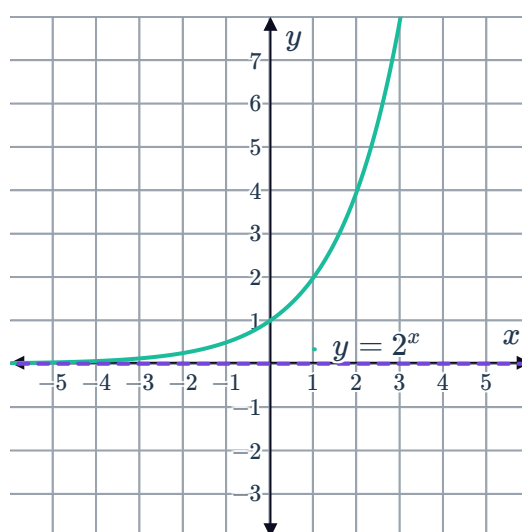
29 Consider the graph of $y = 3^x$:

- a** Describe the translation required to shift the graph of $y = 3^x$ to obtain the graph of $y = 3^{x-2}$.
- b** Sketch the graph of $y = 3^{x-2}$ on the same set of axes as $y = 3^x$.



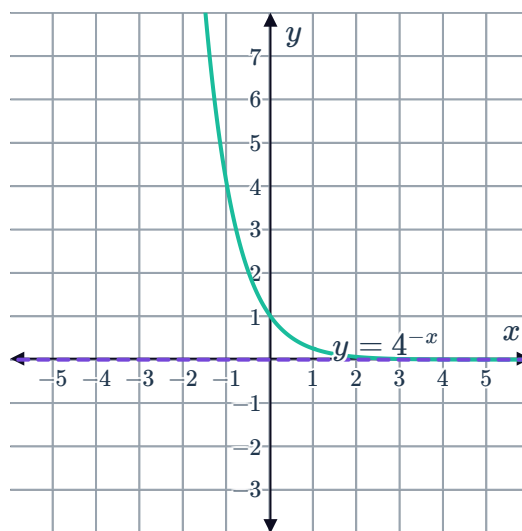
30 Consider the graph of $y = 2^x$:

- a** Describe the translation required to shift the graph of $y = 2^x$ to obtain the graph of $y = 2^{x+3}$.
- b** Sketch the graph of $y = 2^{x+3}$ on the same set of axes as $y = 2^x$.



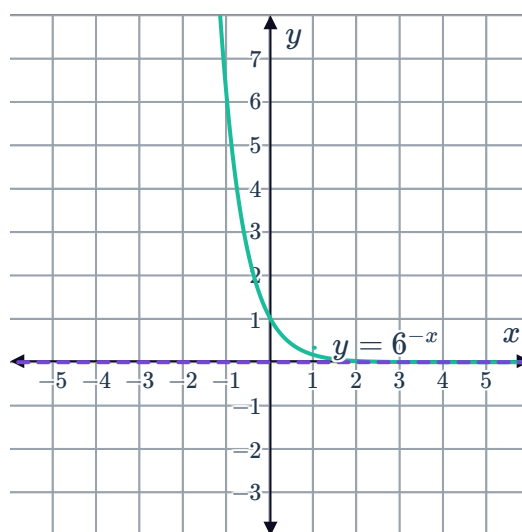
31 Consider the graph of $y = 4^{-x}$:

- a** Describe the translation required to shift the graph of $y = 4^{-x}$ to obtain the graph of $y = 4^{-x+1}$.
- b** Sketch the graph of $y = 4^{-x+1}$ on the same set of axes as $y = 4^{-x}$.



32 Consider the graph of $y = 6^{-x}$:

- a** Describe the translation required to shift the graph of $y = 6^{-x}$ to obtain the graph of $y = 6^{-x-4}$.
- b** Sketch the graph of $y = 6^{-x-4}$ on the same set of axes as $y = 6^{-x}$.



33 State the new equation when the graph of $y = 2^x$ is moved down by 9 units.

34 State the new equation when the graph of $y = 12^x$ is moved left by 6 units.

35 State the new equation when the graph of $y = 3^{-x}$ is moved right by 2 units and down by 7 units.