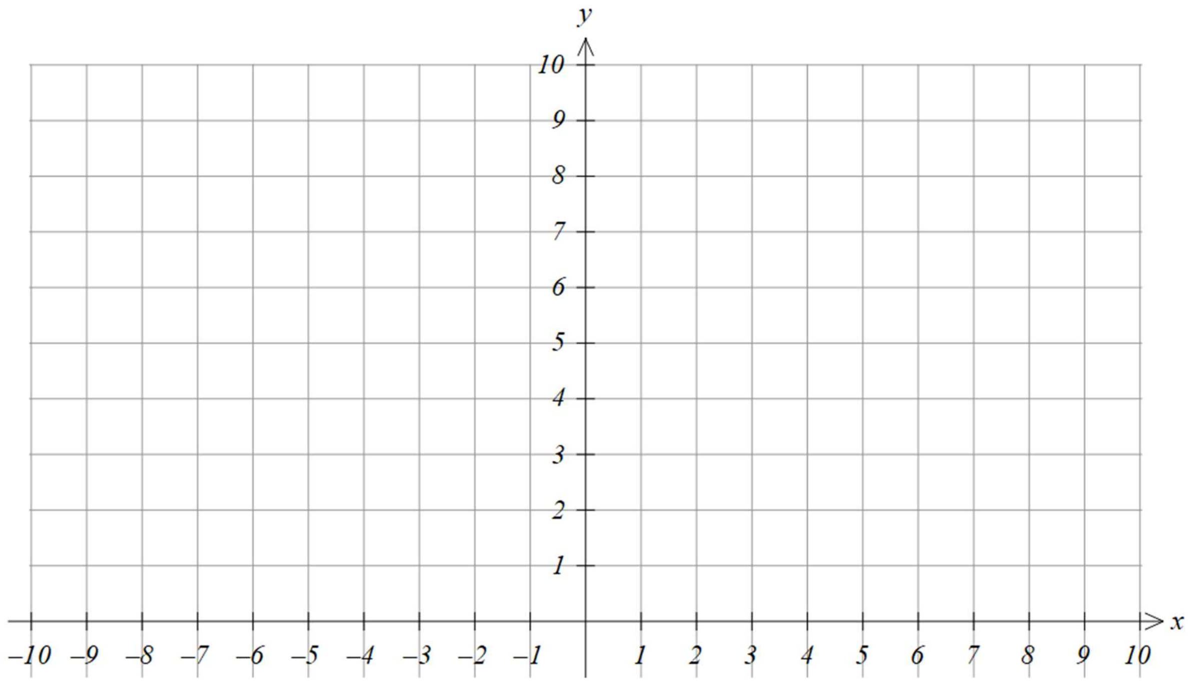
GRAPHS OF EXPONENTIAL AND LOGARITHMIC FUNCTIONS

An exponential function is of the form $f(x) = a^x$ where $a > 0$ and $a \neq 1$

Example 1: $f(x) = 2^x$ We can fill a table of values:

x	*-5*	*-4*	*-3*	*-2*	*-1*	*-0.5*	*0*	*0.5*	*1*	*2*	*3*
y											



Example 2: $f(x) = 3^x$ Fill a table of values, then draw the function above

x	*-5*	*-4*	*-3*	*-2*	*-1*	*-0.5*	*0*	*0.5*	*1*	*2*	*3*
y											

Example 3: $f(x) = \left(\frac{1}{2}\right)^x$ Fill a table of values, then draw the function above

x	*-5*	*-4*	*-3*	*-2*	*-1*	*-0.5*	*0*	*0.5*	*1*	*2*	*3*
y											

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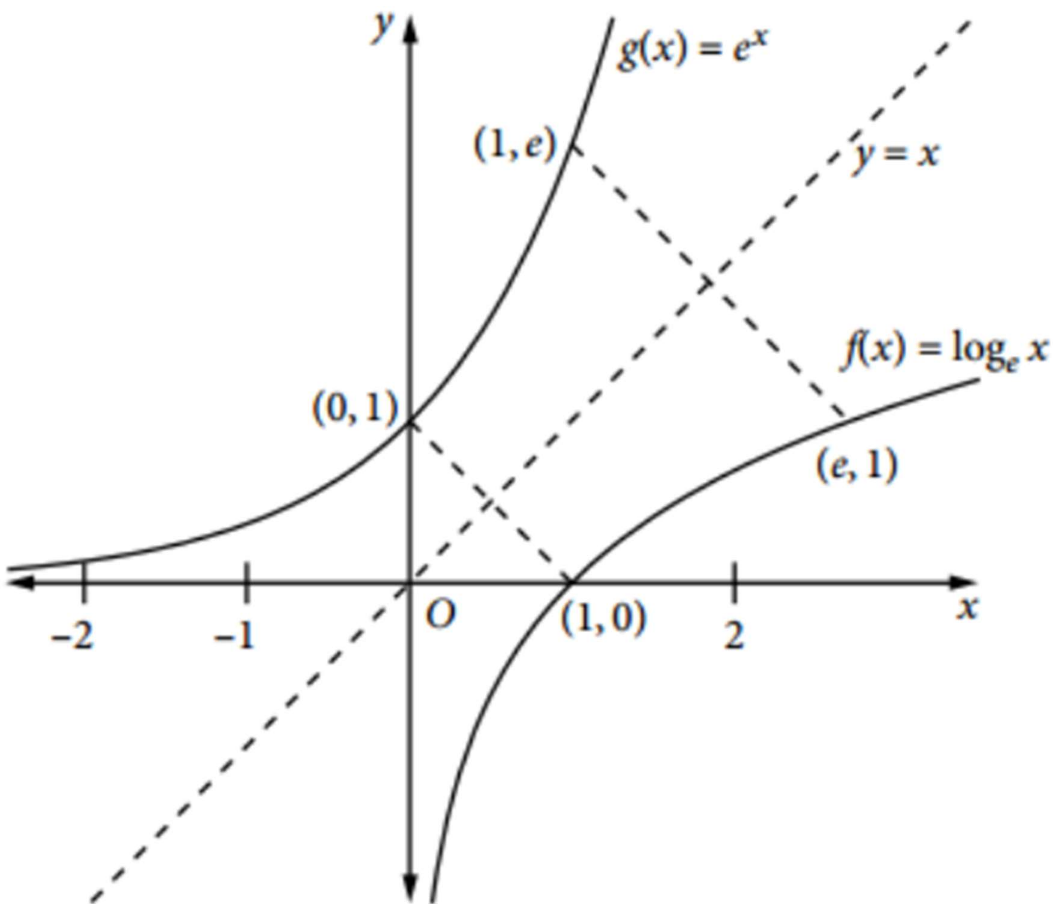
Observations:

- All exponential functions:
  - pass through the point $(0,1)$
  - have $y = 0$ as an asymptote.
- For all exponential functions, the **domain** is $\mathbb{R}$ (all real numbers) and the **range** is $\mathbb{R}^+$.
- The larger the value of "a", the steeper the curve.
- The value of "a" for which the gradient of the curve at Point $(0,1)$ is exactly 1 is 2.718281828…. This number is named e (from the mathematician Leonhard Euler who studied it extensively). This very special number continues indefinitely and never repeats, so it is an "*irrational*" number. Like the number π, it is also said to be "*transcendental*" as it cannot be a solution to a polynomial equation with rational coefficients.

The inverse function of $f(x) = e^x$ is $f^{-1}(x) = ln\,(x)$ so $e^{ln\,(x)} = ln(e^x) = x$

Because these the functions $f(x) = ln\,(x)$ and $g(x) = e^x$ are inverse of each other, their graphs are symmetrical about the line $y = x$, as shown on the graph below:



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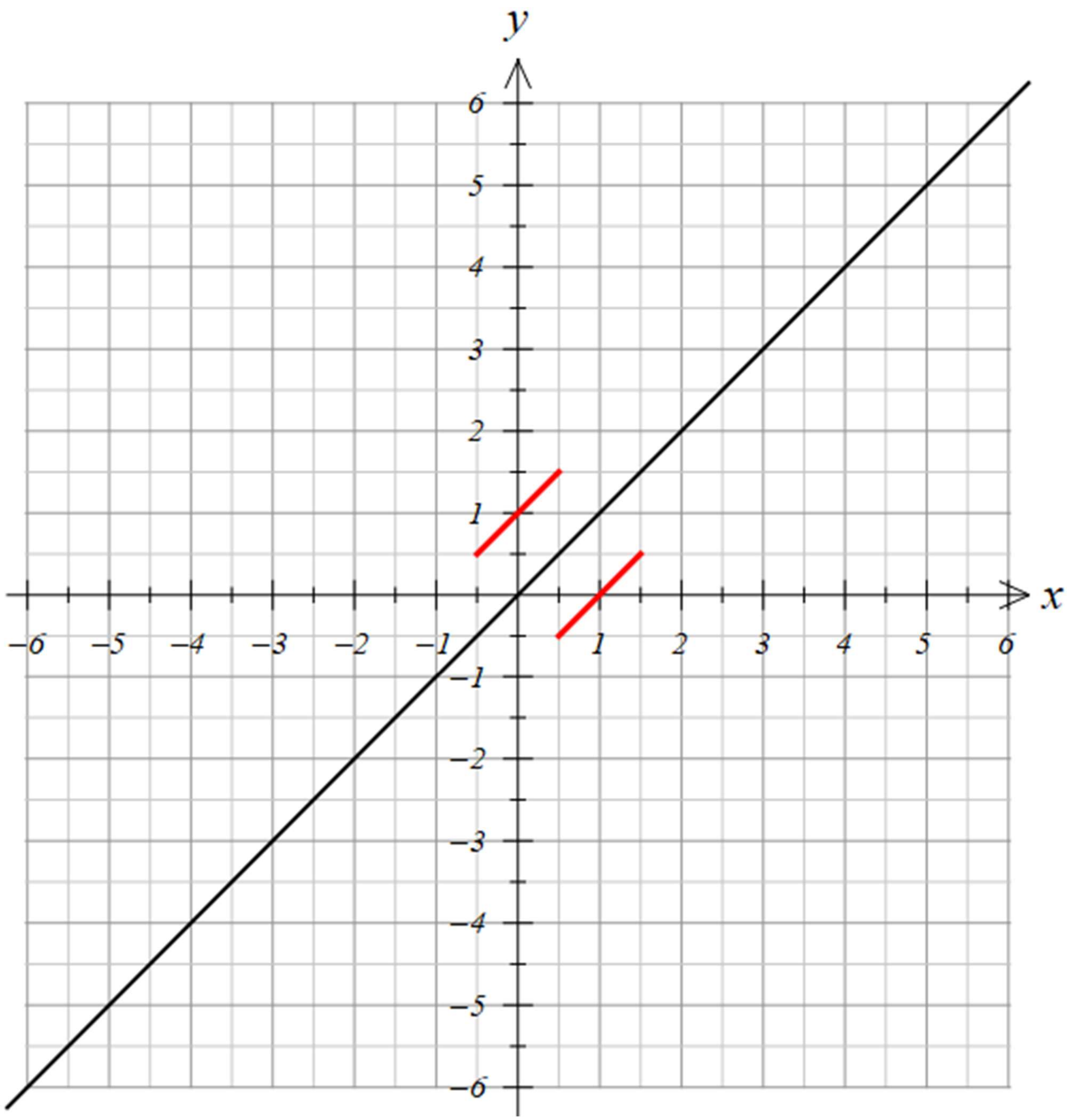
On the graph below, graph the functions $f(x) = e^x$ and $g(x) = ln\,(x)$.

Note that because the gradient of the graph of $f(x) = e^x$ at the point (0,1) is 1 (by definition of the number e), the gradient of the graph of $f(x) = ln\,(x)$ at the point (1,0), i.e. symmetrical of the point (0,1) with regard to the line $y = x$, is also 1. These gradients have been marked in red on the blank graph below.



On the graph below, graph the function $f(x) = e^{-x}$

The tangent at point (0,1) has been marked in red to assist graphing.