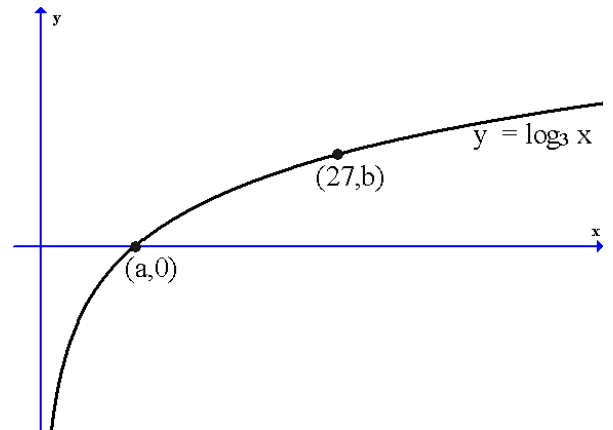


Logarithms – Graphs/Exponential Growth

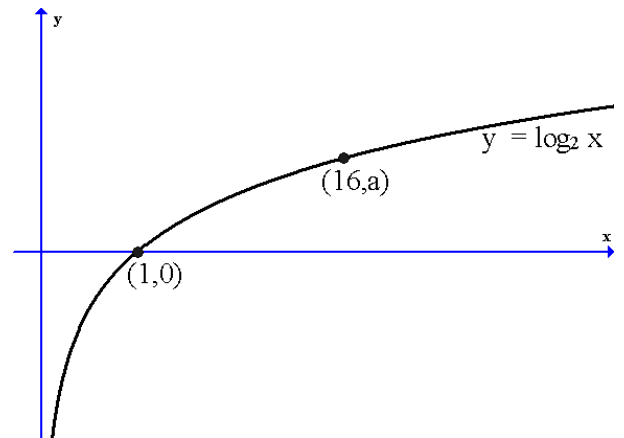
1. The diagram shows part of the graph of $y = \log_3 x$.

- (a) Find the values of a and b .
(b) Sketch the graph of $y = \log_3(x + 1) - 3$.



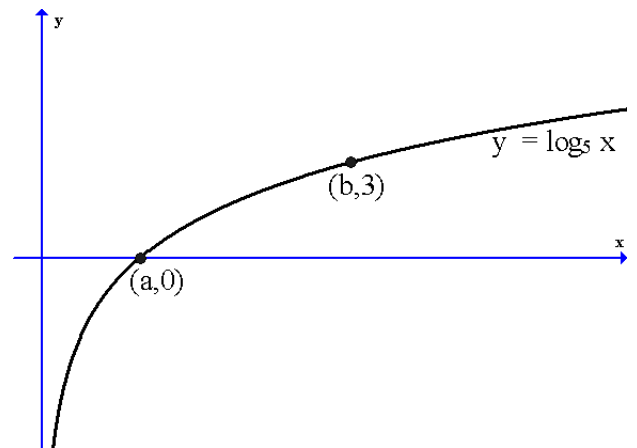
2. The diagram shows part of the graph of $y = \log_2 x$.

- (a) Find the value of a .
(b) Sketch the graph of $y = \log_2 x - 4$.
(c) Sketch the graph of $y = \log_2 8x$.



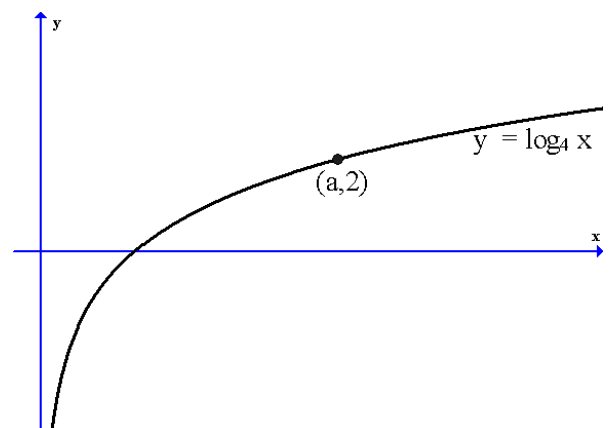
3. The diagram shows part of the graph of $y = \log_5 x$.

- (a) Find a and b .
(b) Sketch the graph of $y = \log_5 5x$.
(c) Sketch the graph of $y = \log_5 x^2$.
(d) Sketch the graph of $y = \log_5 \frac{1}{x}$.



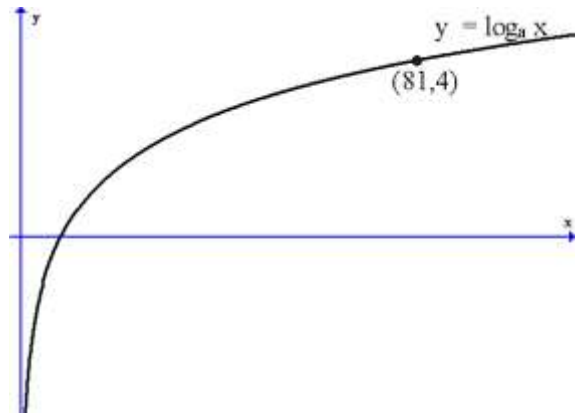
4. The diagram shows part of the graph of $y = \log_4 x$.

- (a) Find a .
(b) Sketch the graph of $y = \log_4 4x$.
(c) Sketch the graph of $y = \log_4 x^3$.



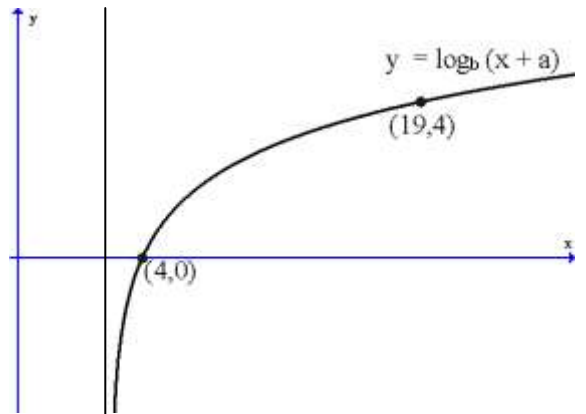
5. The diagram shows part of the graph of $y = \log_a x$.

- (a) Determine the value of a .
- (b) Sketch the graph of $y = \log_a 9x^2$
- (c) Sketch the graph of $y = \log_a \frac{1}{x}$.



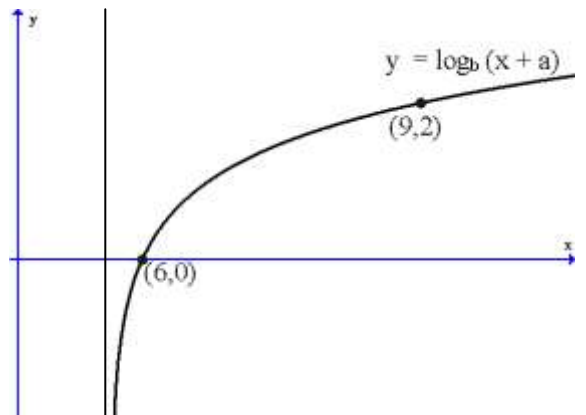
6. The diagram shows the graph of $y = \log_b (x + a)$.

Find the values of a and b .



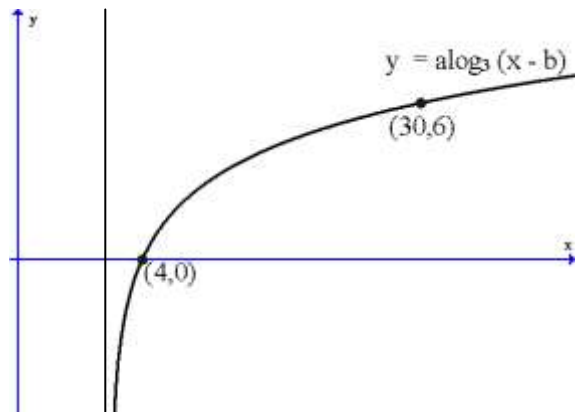
7. The diagram shows the graph of $y = \log_b (x + a)$.

Find a and b .



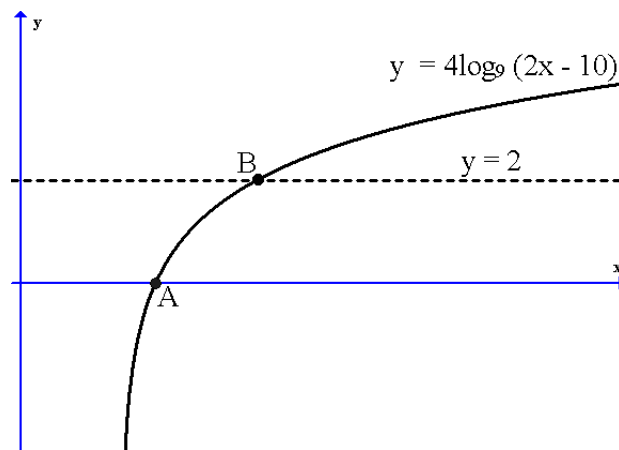
8. The diagram shows the graph of $y = a \log_3 (x - b)$.

Find a and b .



9. The diagram shows the graph of $y = 4\log_9(2x - 10)$.

Find the coordinates of A and B.



10. The number of bacteria of a particular strain is given by $B(t) = 45e^{1.5t}$, where t is the time in hours.
- How many bacteria are there at time zero?
 - How long will it take for the number of bacteria to treble?
11. A radioactive material has mass m , at time t years, given by $m = m_0e^{-0.02t}$, where m_0 is the original mass.
- If the original mass is 500g, find the mass after 25 years.
 - Find the percentage of the material left after 10 years.
12. For a radioactive substance $A = A_0e^{-kt}$, where A_0 is the original mass and t is the time in minutes. In 5 minutes, 20g of this substance is reduced to 16g.
- Find k to 2 significant figures.
 - Find the half life of this substance (the time taken for the amount of the substance to fall by half).
13. For a radioactive substance the mass at time t years is given by $m = m_0e^{-0.02t}$ where m_0 is the original mass.
- If the original mass is 600g find the mass after 10 years.
 - Find the half life of this substance.
14. A radioactive substance is defined by $M = M_0e^{-kt}$, where M_0 is the original mass and M is the mass after t years. Experiments have shown that $M = 0.8M_0$ after 3 years.
- Find the value of k .
 - Find the percentage reduction in mass after 20 years.