

Exponents, Logarithms and Growth Models Explained

Grade 12 – Precalculus math · Test · Standards: F-LE.A.4, F-BF.B.5, F-IF.C.8b

Name: _____ Date: _____ Class: _____

This 45-minute test has 9 questions worth 20 points. It covers evaluating logarithms, log laws, solving equations, graphs and models. A calculator is allowed. Show each step so partial credit can be awarded.

Standards: F-LE.A.4, F-BF.B.5, F-IF.C.8b · **Level:** Grade 12 Precalculus

Time: 45 minutes · 9 questions · Total: 20 points · Calculator: as allowed by your teacher

Question 1 Evaluate Logarithms (2 points)

Evaluate without a calculator.

- a. $\log_3(1/81)$ (1 point)
- b. $\log_8 2$ (1 point)

Question 2 Expand and Condense (2 points)

(a) Expand $\log_5 25x^2/\sqrt{y}$. (1 point) (b) Write $2 \ln 3 + 4 \ln 2 - \ln 6$ as one logarithm. (1 point)

Question 3 Solve an Exponential Equation (2 points)

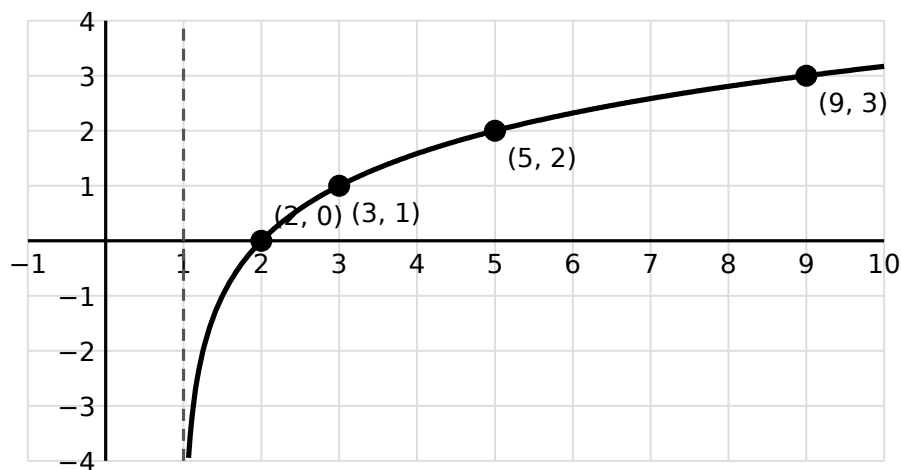
Solve $3^{2x-1} = 14$. Give the exact form and a decimal to three places.

Question 4 Logarithmic Equation (3 points)

Solve $\log_6 x + \log_6(x - 5) = 1$ and verify each candidate.

Question 5 Graph of a Shifted Logarithm (2 points)

The graph shows $f(x) = \log_2(x - 1)$ with a dashed vertical asymptote.



Graph of f .

- Give the equation of the asymptote and the domain. (1 point)
- Solve $f(x) = 3$. (1 point)

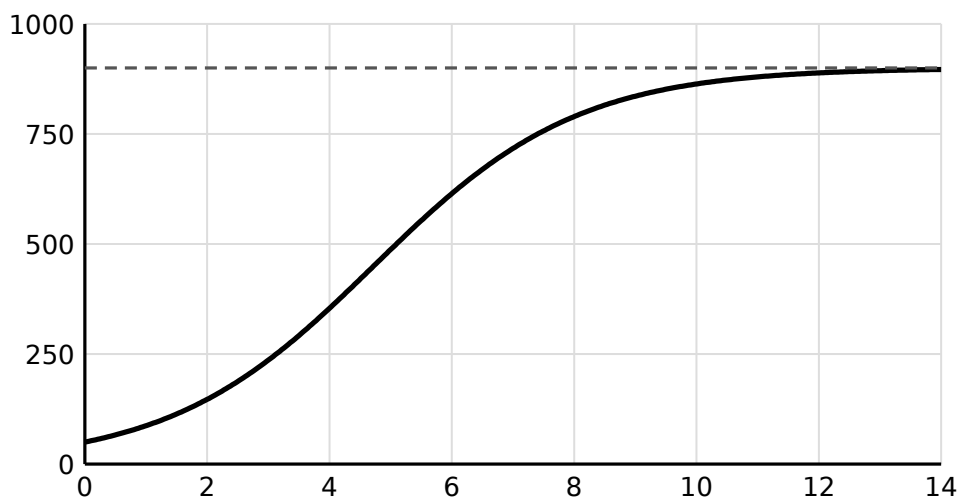
Question 6 Continuous Growth of a Town (3 points)

A town of 18,500 people grows continuously at 2.4% per year, so $P(t) = 18500e^{0.024t}$.

- Find the population after 10 years (nearest person). (1 point)
- Find the doubling time to the nearest tenth of a year. (1 point)
- When will the population reach 30,000? Round to the nearest tenth of a year. (1 point)

Question 7 Logistic Model of a Herd (2 points)

A herd on an island follows $N(t) = \frac{900}{(1 + 17e^{-0.6t})}$ (t in years), graphed below.



Graph of $N(t)$.

- State the carrying capacity and the initial population. (1 point)
- When does the herd reach 450 animals? Round to two decimals. (1 point)

Question 8 Logarithmic Scales (3 points)

- (a) An earthquake of magnitude 7.1 and another of magnitude 5.4 are compared. How many times greater is the amplitude of the larger one? (1 point)
- (b) A quake has amplitude 2,000 times the reference amplitude. Find its magnitude with $M = \log(A/A_0)$. (1 point)
- (c) The pH of a solution is $-\log[H^+]$. Find the hydrogen-ion concentration when $\text{pH} = 3.4$. (1 point)

Question 9 Find an Inverse (1 point)

Find the inverse of $f(x) = \ln(x - 3) + 1$.