

Environmental Mathematics

Algebra · Practice Test · 8 Questions

1. In the logistic growth equation $dN/dt = rN(1 - N/K)$, what does the variable 'K' represent in an ecosystem with limited resources?

- A) The intrinsic rate of increase
- B) The carrying capacity of the environment
- C) The mortality rate of the species
- D) The initial population density

2. Using the allometric scaling law $M = aL^b$, where M is metabolic rate and L is body mass, what is the theoretical value of the exponent 'b' for many terrestrial mammals?

- A) 0.5
- B) 0.75
- C) 1.0
- D) 1.25

3. If a population of invasive species follows an exponential growth model $P(t) = P_0 * e^{rt}$, and the population triples in 5 years, what is the value of 'r' (the growth rate)?

- A) $\ln(3)/5$
- B) $5/\ln(3)$
- C) $\ln(5)/3$
- D) $3/\ln(5)$

4. In the Fibonacci sequence often observed in phyllotaxis (leaf arrangement), if $F(n)$ is the number of spirals, what is the limit of $F(n+1)/F(n)$ as n approaches infinity?

- A) 1.414
- B) 1.618
- C) 2.718
- D) 3.141

5. The Shannon diversity index is calculated as $H = -\sum(\pi * \ln(\pi))$. If an ecosystem has 4 species with equal proportions ($\pi = 0.25$), what is the value of H?

- A) $\ln(2)$
- B) $\ln(4)$
- C) 0.5
- D) 1

6. When calculating the population density decay as a function of distance from a point source (like seed dispersal), the formula is often $f(r) = A * e^{(-kr)}$. Solving for 'k' in terms of distance 'r', which expression is correct?

- A) $k = -\ln(f(r)/A) / r$
- B) $k = -r * \ln(f(r)/A)$
- C) $k = \ln(f(r)/A) / r$
- D) $k = A * \ln(r) / f(r)$

7. In bioenergetics, the Q10 temperature coefficient is calculated as $Q_{10} = (R_2/R_1)^{(10/(T_2-T_1))}$. If a reaction rate doubles with a 10-degree increase, what is the value of Q10?

- A) 0.5
- B) 1.0
- C) 2.0
- D) 10.0

8. For a predator-prey system described by the Lotka-Volterra equations, the variable 'x' representing prey population size oscillates. What describes the mathematical nature of these oscillations?

- A) Linear regression
- B) Periodic equilibrium cycles
- C) Exponential decay only
- D) Logarithmic growth