

Mathematical Ecology and Natural Algebra

Basic Algebra · Answer Key · 15 Questions

1. The metabolic rate M of a mammal can be approximated by $M = k \cdot m^{(0.75)}$, where m is body mass. If a species' mass quadruples, by what factor does its metabolic rate increase?

A) 2.83

B) 4.00

C) 5.66

D) 8.00

2. The population growth of a specific bacteria colony follows $P = P_0 \cdot e^{(rt)}$. If $r = 0.2$ and the population triples, approximately how many units of time t have passed? (Use $\ln(3) \approx 1.1$)

A) 2.5

B) 5.5

C) 7.5

D) 10.5

3. In a stable ecosystem, the predator-prey relationship is modeled by $y = ax^2 + bx$. If $a = -0.5$ and $b = 10$, what is the maximum number of predators (y) that can be supported at a prey level x ?

A) 25

B) 50

C) 75

D) 100

4. The concentration of a pollutant in a pond follows $C = k/V$. If the volume V of the pond is reduced by 60% due to drought, what is the new concentration relative to the original?

A) $1.67C$

B) $2.5C$

C) $0.4C$

D) $0.6C$

5. A forest carbon sequestration model uses the formula $S = 200 * \log_{10}(A)$, where A is the area in hectares. To increase sequestration (S) by 200 units, by what factor must the area A be multiplied?

- A) 2
- B) 10
- C) 20
- D) 100**

6. The wingspan (w) of a bird species is related to its weight (m) by the equation $w = 0.5 * m^{(1/3)}$. If a bird's weight increases by a factor of 8, its wingspan increases by a factor of:

- A) 2**
- B) 4
- C) 8
- D) 16

7. The sound intensity (I) of a blue whale call follows the inverse square law $I = k/d^2$. If the distance (d) is tripled, the intensity becomes:

- A) $1/3$ of I
- B) $1/6$ of I
- C) $1/9$ of I**
- D) $1/12$ of I

8. In a pollination experiment, the number of successful seeds (S) is given by $S = 50x - x^2$, where x is the number of visits. What is the optimal number of visits (x) to maximize seeds?

- A) 15
- B) 25**
- C) 35
- D) 50

9. The atmospheric pressure P at altitude h (in km) is $P = 101.3 * e^{(-0.12h)}$. At what altitude is the pressure approximately half of sea level pressure (101.3)? (Use $\ln(2) \approx 0.69$)

- A) 2.75 km
- B) 5.75 km**
- C) 8.75 km
- D) 11.75 km

10. A coral reef's daily growth area follows $A = 2 * (1.1)^t$. At what time t (in days) does the area quadruple from its initial value? ($\log_{1.1}(4) \approx 14.5$)

A) 7.25

B) 14.5

C) 29.0

D) 58.0

11. If the gestation period G of a mammal is related to its lifespan L by $G = 0.1 * L^{(0.5)}$, and a species lives 100 years, what is its gestation period in years?

A) 0.5

B) 1.0

C) 2.0

D) 10.0

12. The rate of leaf litter decomposition R is given by $R = k * T^2$, where T is temperature. If the temperature increases from 10°C to 20°C , the decomposition rate increases by a factor of:

A) 2

B) 4

C) 8

D) 10

13. For a fish school size N , the oxygen consumption is given by $O = N * (100 - 0.5N)$. At what school size N is the total oxygen consumption zero?

A) 50

B) 100

C) 150

D) 200

14. The light intensity I at depth d (meters) in the ocean is $I = 10 * (0.8)^d$. If the intensity is 0.64, what is the depth d ?

A) 1

B) 2

C) 3

D) 4

15. A plant's height h after t weeks is $h = 2t^2 + 5$. If the plant reaches 77 cm, how many weeks have passed?

A) 4

B) 6

C) 8

D) 10