

# Algebra 2 - Exponential Growth and Decay - Answer Key

Common Core F-LE.A.2, F-LE.B.5, A-SSE.B.3c, F-IF.C.8b · [maths-pdf.fr/en/](https://maths-pdf.fr/en/)

Every worksheet problem on exponential growth and decay is solved here, one step at a time. Compare your method as well as your final answer, because the steps show where using the rate instead of the growth factor can go wrong. Final answers appear in bold so you can find them quickly when you only need a check.

**Algebra 2** · Common Core State Standards: **F-LE.A.2, F-LE.B.5, A-SSE.B.3c, F-IF.C.8b**

## Exercise 1 - Growth or decay

Growth if  $b > 1$ , decay if  $0 < b < 1$ .

**Growth ( $b = 1.4$ ); decay ( $b = 0.8$ ); decay ( $b = 1/3$ )**

## Exercise 2 - Evaluate

$f(0) = 3$ ,  $f(1) = 6$ ,  $f(2) = 12$ ,  $f(3) = 24$ ,  $f(4) = 48$ .

**3, 6, 12, 24, 48**

## Exercise 3 - Write a function from a table

| x     | 0 | 1  | 2  | 3  |
|-------|---|----|----|----|
| f(x)  | 5 | 10 | 20 | 40 |
| ratio |   | 2  | 2  | 2  |

Constant ratio 2.

The initial value is  $f(0) = 5$ . Consecutive outputs have ratio 2.

$$f(x) = 5 \cdot 2^x$$

### Exercise 4 - Two points

Divide:  $\frac{ab^3}{ab} = \frac{54}{6}$ , so  $b^2 = 9$  and  $b = 3$ .

Then  $a(3) = 6$ , so  $a = 2$ .

$$f(x) = 2 \cdot 3^x$$

### Exercise 5 - Population growth

$$P(t) = 12,000(1.035)^t. P(5) = 12,000(1.035)^5 \approx 14,252.24.$$

**About 14,252 people**

### Exercise 6 - Depreciation

$$V(t) = 24,000(0.85)^t. V(4) = 24,000(0.85)^4 \approx 12,528.15.$$

**About \$12,528.15**

### Exercise 7 - Half-life

$$A(t) = 80\left(\frac{1}{2}\right)^{t/3}. \text{ At } t = 9: \left(\frac{1}{2}\right)^3 = \frac{1}{8}, \text{ so } 80 \cdot \frac{1}{8} = 10.$$

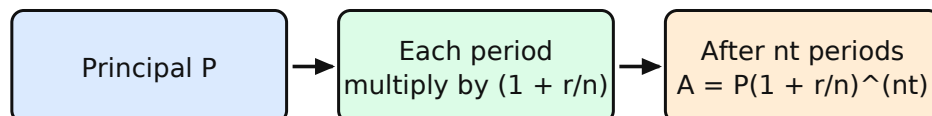
**10 mg**

### Exercise 8 - Doubling time

$$B(t) = 50 \cdot 2^{t/20}. \text{ At 60 minutes, } 2^3 = 8, \text{ so } 50 \cdot 8 = 400.$$

**400 bacteria**

### Exercise 9 - Compound interest



Compound interest repeats a multiplication.

$$A = 2000\left(1 + \frac{0.04}{4}\right)^{4 \cdot 5} = 2000(1.01)^{20} \approx 2,440.38.$$

**About \$2,440.38**

### Exercise 10 - Compounding frequency

Annual:  $5000(1.03)^{10} \approx 6,719.58$ .

Monthly:  $5000\left(1 + \frac{0.03}{12}\right)^{120} \approx 6,746.77$ .

Monthly compounding earns about \$27.19 more.

**Annual \$6,719.58; monthly \$6,746.77**

### Exercise 11 - Continuous compounding

$$A = 1500e^{0.03 \cdot 8} = 1500e^{0.24} \approx 1,906.87.$$

**About \$1,906.87**

### Exercise 12 - Rewrite exponents

$$2^{3x} = (2^3)^x = 8^x. \left(\frac{1}{2}\right)^x = (2^{-1})^x = 2^{-x}.$$

$8^x$  and  $2^{-x}$

### Exercise 13 - Effective annual rate

$$1.02^{12i} = (1.02^{12})^i. 1.02^{12} \approx 1.268.$$

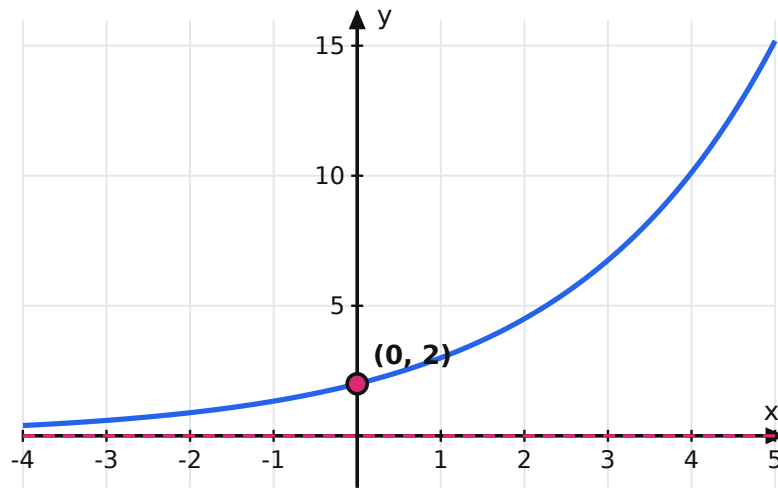
**b about 1.268: an annual rate of about 26.8%**

### Exercise 14 - Monthly equivalent

$$1.07^i = (1.07^{1/12})^{12i}. 1.07^{1/12} \approx 1.00565.$$

About 0.565% per month

### Exercise 15 - Graph features



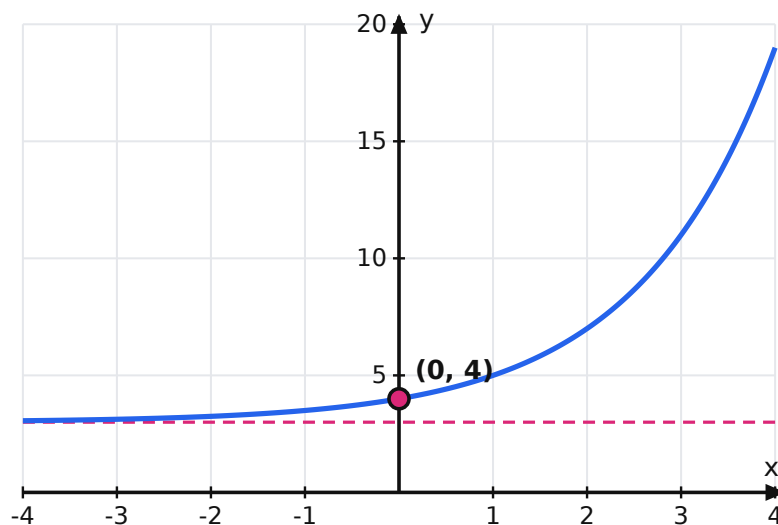
Intercept  $(0, 2)$ ; asymptote  $y = 0$ .

$f(0) = 2$ . As  $x$  decreases,  $f(x)$  approaches 0 but never reaches it.

As  $x$  increases,  $f(x)$  grows without bound.

**y-intercept  $(0, 2)$ ; horizontal asymptote  $y = 0$ ; increasing**

### Exercise 16 - Shifted exponential



Shifted up 3.

$g(0) = 2^0 + 3 = 4$ . The whole graph of  $2^x$  is shifted up 3, so the asymptote moves from  $y = 0$  to

$$y = 3.$$

**y-intercept (0, 4); asymptote  $y = 3$**

### Exercise 17 - Linear or exponential

| Week   | 3   | 4   | 5   |
|--------|-----|-----|-----|
| Plan A | 350 | 400 | 450 |
| Plan B | 160 | 320 | 640 |

Values of both plans.

Plan A:  $200 + 50w$ . Plan B:  $20 \cdot 2^w$ .

Week 4: 400 versus 320. Week 5: 450 versus 640.

**Week 5**

### Exercise 18 - Interpret parameters

250 is the initial concentration. 0.92 means 8% of the drug leaves each hour.

$$f(10) = 250(0.92)^{10} \approx 108.60.$$

**250 mg/L initially; 8% decrease per hour; about 108.60 mg/L**

### Exercise 19 - When does it exceed?

| t (years)      | 7        | 8        | 9        |
|----------------|----------|----------|----------|
| $1000(1.05)^t$ | 1,407.10 | 1,477.46 | 1,551.33 |

Balance by year.

Year 8: about \$1,477.46, below 1,500. Year 9: about \$1,551.33, above 1,500.

**Year 9**

### Exercise 20 - Find the error

A 5% increase means the new amount is  $100\% + 5\% = 105\%$  of the old amount.

$$b = 1.05$$

### Exercise 21 - Tripling

$$V(m) = 4 \cdot 3^m. \quad V(5) = 4 \cdot 243 = 972.$$

**972 views**