

Exponential Models: Growth, Decay, and Interest

Grade 11 – Algebra 2 math · Worksheet · Standards: F-IF.C.8b, F-LE.A.4, F-LE.B.5

Name: _____ Date: _____ Class: _____

These problems model growth and decay with exponential functions: percent rates, compound interest with the number e , half-life, and doubling time. They follow Common Core standards F-IF.C.8b, F-LE.A.4, and F-LE.B.5.

A calculator is useful for the interest problems. Identify the initial amount and the factor first, check them against one known value, and then answer the question with units.

Standards: F-IF.C.8b, F-LE.A.4, F-LE.B.5 · **Level:** Grade 11 Algebra 2

Problem 1 Growth or decay (easy)

For each function, state whether it models growth or decay and give the percent change per period.

- a. $y = 250(1.04)^t$
- b. $y = 90(0.85)^t$
- c. $y = 3 \cdot 2^t$
- d. $y = 1,200(0.97)^t$

Problem 2 A growing town (easy)

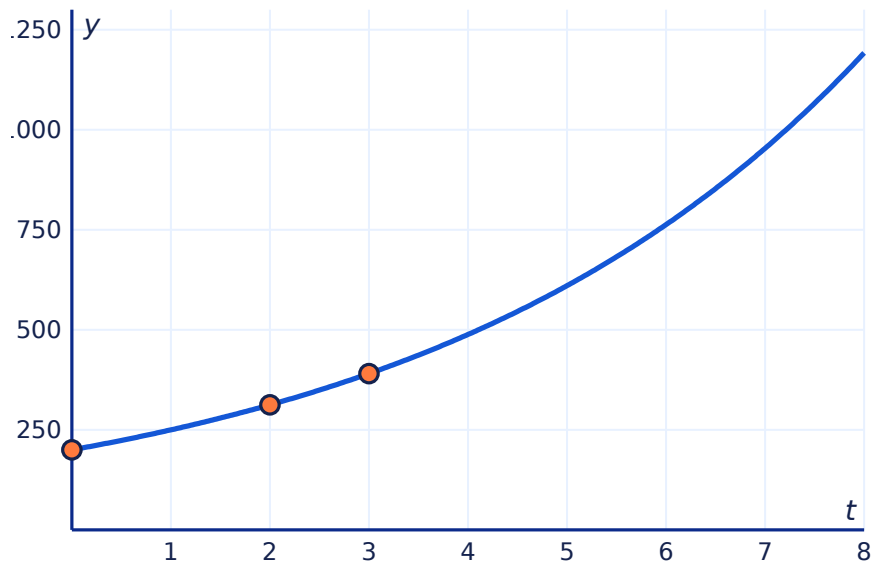
A town of 8,400 people grows 3% per year. Write a model for the population after t years and find the population after 5 years, rounded to the nearest person.

Problem 3 A depreciating car (easy)

A \$31,500 pickup truck loses 11% of its value each year. Write a model for its value after t years and find the value after 3 years.

Problem 4 Reading an exponential graph (easy)

The graph of $y = 200(1.25)^t$ is shown. Identify the initial value and the growth factor, then find y when $t = 2$ and $t = 3$.



Graph of $y = 200(1.25)^t$.

Problem 5 Evaluating powers of e (easy)

Use a calculator to evaluate each expression to three decimal places.

- a. $e^{0.5}$
- b. e^{-1}
- c. $e^{2.3}$

Problem 6 Annual compounding (medium)

A deposit of \$2,500 earns 4.5% interest compounded annually. Find the balance after 6 years.

Problem 7 Monthly compounding (medium)

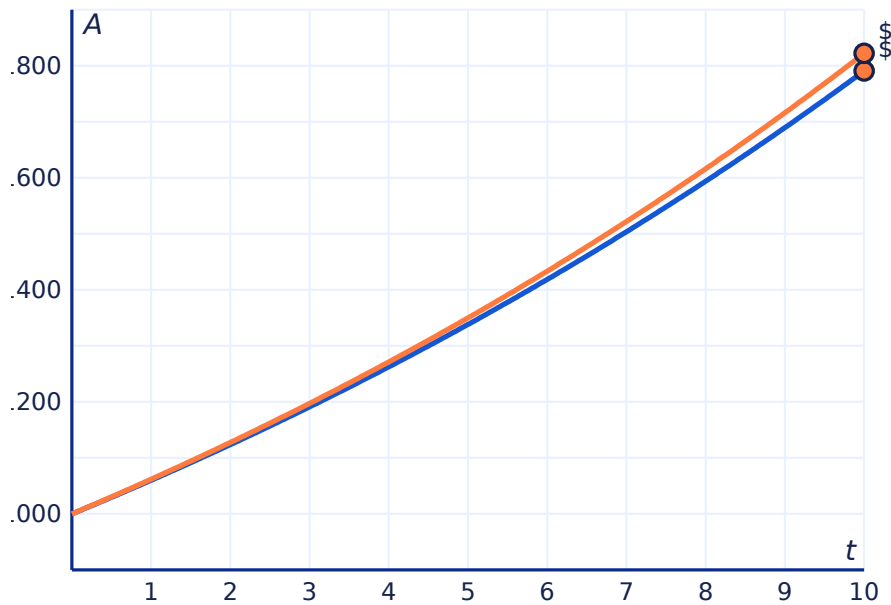
A deposit of \$4,000 earns 3.6% interest compounded monthly. Find the balance after 5 years.

Problem 8 Continuous compounding (medium)

A deposit of \$1,500 earns 5% interest compounded continuously. Find the balance after 8 years.

Problem 9 Comparing compounding frequencies (medium)

Find the value of \$1,000 at 6% after 10 years when it is compounded annually, quarterly, monthly, and continuously. The figure shows two of the graphs.



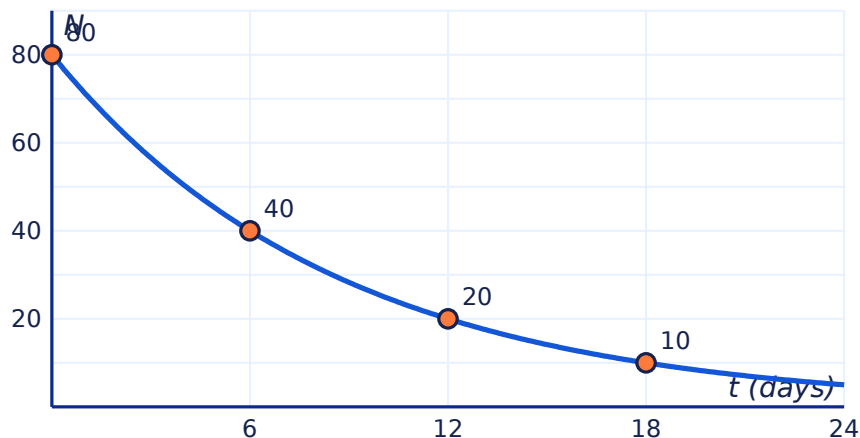
Annual and continuous compounding.

Problem 10 Interpreting parameters (medium)

The value of a delivery van is modeled by $V(t) = 15,000(0.9)^t$, where t is in years. State what 15,000 and 0.9 mean, and find the value after 2 years.

Problem 11 Half-life (medium)

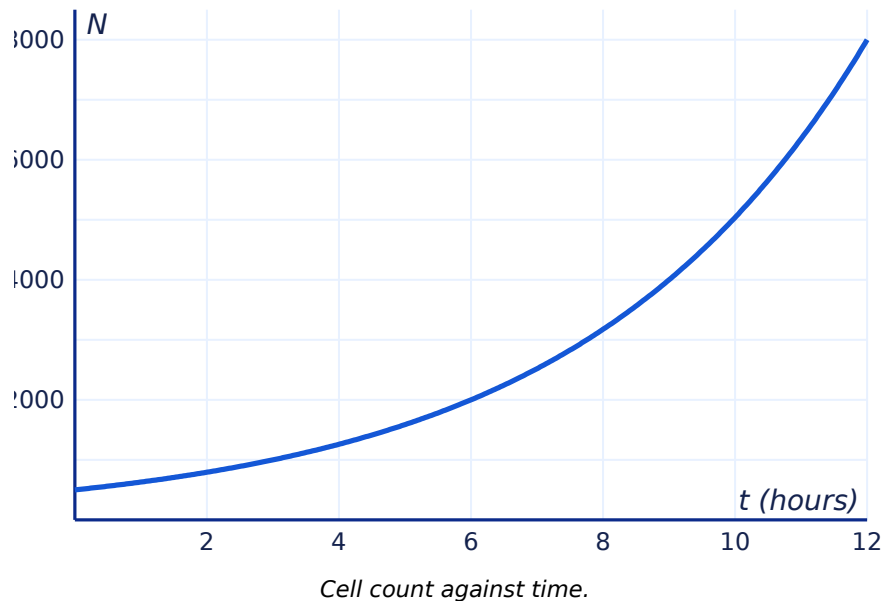
A 80-milligram sample of a medicine has a half-life of 6 days. Write the model $N(t) = 80(1/2)^{t/6}$, then find the amount remaining after 18 days and after 3 days.



Decay of the sample.

Problem 12 Doubling time (medium)

A bacteria culture starts with 500 cells and doubles every 3 hours. Write a model, then find the number of cells after 12 hours and after 5 hours.



Problem 13 Changing the time unit (medium)

A quantity is modeled by $y = 200(1.5)^{t/2}$, where t is in years. Write the model in the form $y = a \cdot b^t$ and find the percent growth per year to the nearest tenth of a percent.

Problem 14 Model from a table (medium)

The table shows an investment's value. Show that the growth is exponential, state the percent growth per year, and write the model.

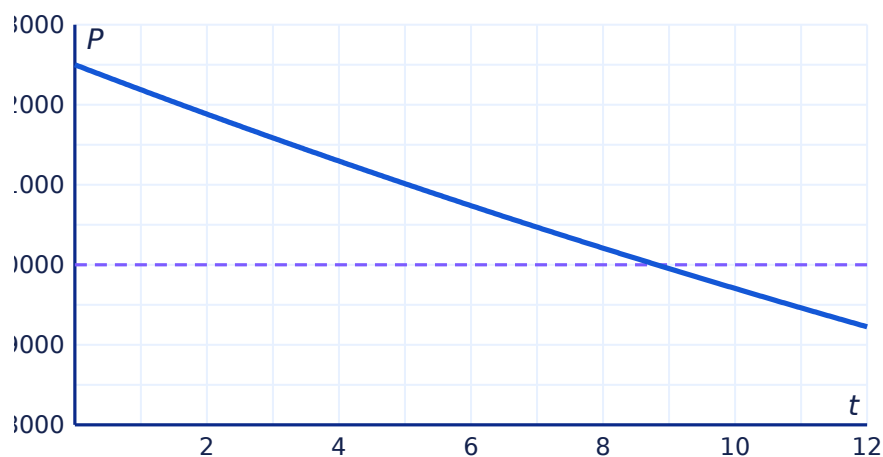
t (years)	0	1	2	3
Value (dollars)	400	460	529	608.35

Problem 15 Doubling an investment (hard)

An account starts with \$5,000 and earns 6% compounded annually. Make a table of the balance for 10, 11, and 12 years to find the first whole year when the balance is at least \$10,000.

Problem 16 A shrinking town (hard)

A town of 12,500 people loses 2.5% of its population each year. Write the model, make a table for 7, 8, and 9 years, and find the first whole year when the population is below 10,000. The figure shows the trend.



Population against time with the 10,000 level.

Problem 17 Carbon dating (hard)

Carbon-14 has a half-life of 5,730 years. What fraction of the original amount remains after 11,460 years, and what percent remains after 2,865 years?

Problem 18 Effective annual yield (hard)

A savings account pays 6% compounded monthly. Find the effective annual yield, which is the percent increase in one year. Compare it with the yield when the 6% is compounded continuously.

Problem 19 Choosing between two offers (hard)

Offer A: deposit \$3,000 at 5% compounded quarterly for 7 years. Offer B: deposit \$2,950 at 5.2% compounded continuously for 7 years. Find the value of each offer and decide which is greater.

Problem 20 Model from two data points (hard)

An exponential model $y = a \cdot b^t$ gives $y = 330$ when $t = 1$ and $y = 399.3$ when $t = 3$. Find a and b , and predict y when $t = 5$.