

E1.17 Exponential growth and decay

Name: _____ Class: _____ Date: _____ Total: 14 marks

KEY WORDS compound interest 复利 • depreciation 折旧 • multiplier 乘数
• exponential decay 指数衰减 • initial value 初始值

Objective

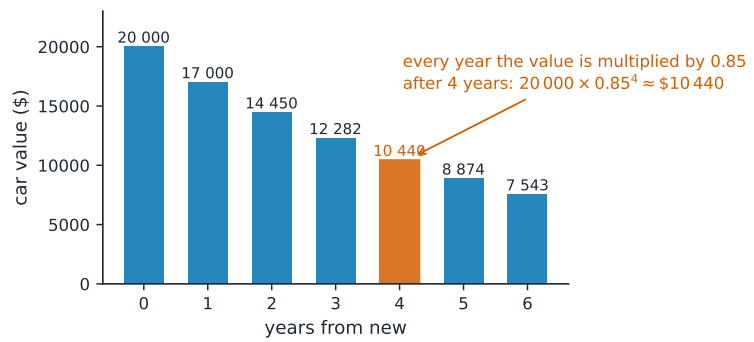
Build the skills to answer Extended exam questions on **exponential growth and decay** 指数增长与衰减 — **compound interest** 复利, **depreciation** 折旧 and **population change** 人口变化, all through a repeated **multiplier** 乘数.

You must be able to:

- write down the multiplier for a given percentage increase or decrease
- use the formula $\text{final} = \text{initial} \times (\text{multiplier})^n$
- work backwards to find the initial amount, or find how many years a change takes

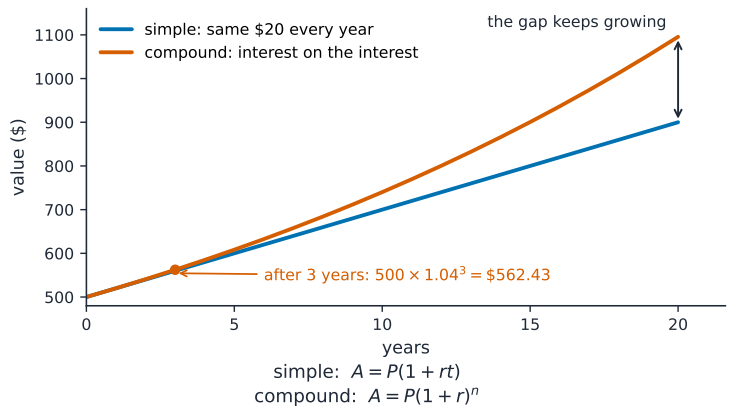
1 Worked examples

■ One multiplier, raised to the number of years



$V = V_0 r^t$ with $0 < r < 1$ for decay · here $r = 0.85$ each year

Each year takes the same fraction, so the fall gets smaller in size but never stops



Compound interest pulls away from simple interest because it earns on interest

- **The multiplier:** an increase of 4% is $\times 1.04$; a decrease of 15% is $\times 0.85$. An increase of 7.5% is $\times 1.075$.
- **Formula:** $\text{final} = \text{initial} \times (\text{multiplier})^n$, where n is the number of years.
- **Worked:** \$2000 at 4% compound interest for 3 years = $2000 \times 1.04^3 = \$2249.73$.
- **Backwards:** divide instead of multiplying — $\text{initial} = \text{final} \div (\text{multiplier})^n$.

Answer shapes (marked by **method marks** — M1 for a correct method, A1 for the correct answer): writing the multiplier raised to the correct power is the method mark, so show it even if the calculator does the rest.

2 Practice

2.1 Write down the multiplier for an increase of 7.5%. [1]

2.2 \$5000 is invested at 3% per year compound interest. Find the value after 2 years. [2]

2.3 A population of 8000 falls by 6% each year. Find the population after 3 years, correct to the nearest whole number. [2]

3 Exam-style questions

3.1 A car costs \$24,000 when new and loses 18% of its value each year.

(a) Find its value after 3 years, correct to the nearest dollar. [3]

(b) Find the number of complete years before its value first falls below \$10,000. [3]

3.2 A sum of \$ P is invested at 5% per year compound interest. After 2 years it is worth \$3307.50. Find P . [3]
