AQA · GCSE · MATHEMATICS • EXERCISE SHEET

3.2.1 Scale, similarity and growth (cut of 3.2)

Name: _____ Class: _____ Date: _____ **Total: 29 marks**

KEY WORDS compound interest • area scale factor

Scale, similarity and growth

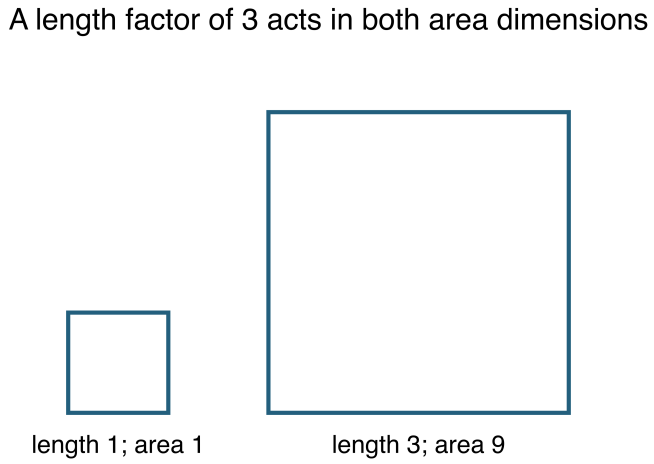
Objective

Use scale factors and maps, the $k : k^2 : k^3$ similarity ladder, compound growth and decay including general iterative processes (rows R2, R12, R16).

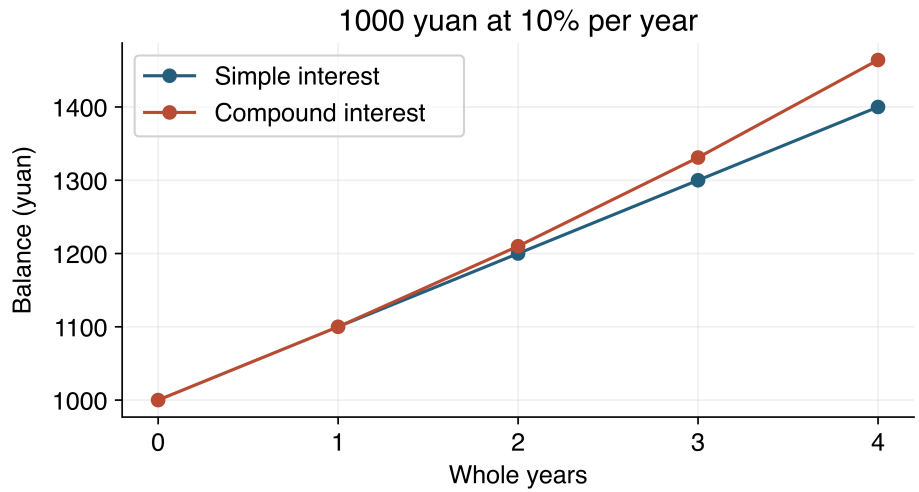
1 Key knowledge and worked examples

Similarity ladder. Lengths k : areas k^2 : volumes k^3. Statues of heights $3 : 5$ have volumes $27 : 125$: a 216 cm^3 smaller statue scales to $216 \times \frac{125}{27} = 1000$ cm^3. Maps and scale drawings convert through the stated ratio.

Growth and decay. $A = P(1 \pm \frac{r}{100})^n$: £2000 at 3% for 4 years gives $2000 \times 1.03^4 =$ £2251.02. Sequential changes multiply: $90000 \times 1.03 \times 1.08 = 100116$ (the 2H June 2024 Q10 anchor). Iterative processes at Higher: $x_{n+1} = 1.05x_n$; the limit solves $x = f(x)$.



Original native-lesson illustration; labels belong to its worked example.



Original native-lesson illustration; labels belong to its worked example.

2 Practice

2.1 Similar jugs have heights 8 cm and 12 cm. The smaller holds 144 cm^3. Find the larger's volume. [3]

2.2 Similar photographs have areas 18 cm^2 and 50 cm^2. Find the ratio of their widths. [3]

2.3 On a 1 : 25 000 map a road measures 6 cm. Find the real length in km. [2]

2.4 £2000 is invested at 3% compound interest. Find the value after 4 years and the interest earned. [3]

2.5 A car worth £12000 depreciates 15% per year. Find its value after 3 years. [2]

2.6 With $x_{n+1} = 1.05x_n$ from $x_1 = 800$, find x_3 and state (with a reason) whether the sequence approaches a finite limit. [3]

3 Exam-style questions

3.1 *(Edexcel-style, 2H June 2024 Q10 adapted.)* A house is worth £90000. Its value rises by 3% one year and by 8% the next. (a) Show its value is now £100116. (b) A second house must exceed £100000 after the same changes. Did it start above or below £89000? Justify. [4]

3.2 *(Original, Higher ladder.)* Two similar bottles have heights in the ratio 2 : 5. The larger holds 500 cm^3. Find the smaller's volume. (b) The smaller's label area is 30 cm^2. Find the larger's label area. [5]

3.3 *(Original, Higher iterative decay.)* Each hour a quantity keeps 80% of its value, with $x_1 = 1000$ and $x_{n+1} = 0.8x_n$. (a) Find x_3. (b) Explain why the values approach zero but never reach it. [4]