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GCSE MATHEMATICS • RATIO & PROPORTION

Growth & Decay

Worked Solutions

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • Calculator allowed except where shown

Full worked solutions for the free Growth and Decay worksheet, GCSE and iGCSE Maths



Tap a section to jump straight to it

Full worked solutions for every question on the Growth & Decay worksheet, in the same order and with the same question numbers.

How to mark your work. Tick each step you got right, not just the final answer. In the exam, method marks are given for correct working even when the final answer is wrong. If you lost marks, find the *first* line where your working is different from ours. That is the thing to fix.

In Section E: **M** = method mark, **P** = process mark, **A** = accuracy mark, **B** = independent mark, **C** = communication mark.

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A**Your turn answers**

Compare each line of your working with the solution.

FOUNDATION

A1 $2500 \times 1.03^3 = 2731.8175$ **£2731.82**

A2 Multiplier 0.85: $800 \times 0.85^2 =$ **£578**

A3 3 years: $9000 \times 0.9^3 = 6561$ 4 years: $9000 \times 0.9^4 = 5904.9$ **4 years**

HIGHER

A4 $2187 \div 0.9^3 = 2187 \div 0.729 =$ **£3000**

A5 $4096 \div 8000 = 0.512$ $\sqrt[3]{0.512} = 0.8$ **20** % decrease each year

A6 $u_1 = 0.9 \times 500 + 30 = 480$ $u_2 = 0.9 \times 480 + 30 = 462$ $u_3 = 0.9 \times 462 + 30 =$ **445.8**

A7 $\frac{ab^4}{ab^2} = \frac{12}{48}$, so $b^2 = \frac{1}{4}$ and $b = \frac{1}{2}$ $48 = a \times \frac{1}{4}$ **$a = 192$** **$b = \frac{1}{2}$**

B**Fluency solutions**One mark for each correct part. The notes in *italics* explain why each sequence was chosen.**FOUNDATION**

B1 (a) **£1050** (b) **£1102.50** (c) $1000 \times 1.05^3 = 1157.625$ **£1157.63**

(d) $1000 \times 1.05^{10} = 1628.894\dots$ **£1628.89**

Each year adds more interest than the last, because the interest earns interest.

B2 (a) $2000 + 3 \times 80 =$ **£2240** (b) $2000 \times 1.04^3 = 2249.728$ **£2249.73** (c) $2000 + 10 \times 80 =$ **£2800**

(d) $2000 \times 1.04^{10} = 2960.488\dots$ **£2960.49**

After 3 years the difference is under £10. After 10 years it is over £160.



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B3 (a) $800 \times 1.1^3 = 1064.8$ (b) $800 \times 0.9^3 = 583.2$ (c) $800 \times 0.5^3 = 100$ (d) $800 \times 2^3 = 6400$

Up 10% and down 10% are not the same size of change: 1064.8 is 264.8 above 800, but 583.2 is 216.8 below.

B4 (a) $1.1^4 = 1.4641$, $1.1^5 = 1.61...$ **5** (b) $0.9^6 = 0.531...$, $0.9^7 = 0.478...$ **7**

(c) $1.07^{10} = 1.96...$, $1.07^{11} = 2.10...$ **11** (d) $0.93^9 = 0.520...$, $0.93^{10} = 0.484...$ **10**

In (c) and (d) no amount is given: the start value does not affect the number of years.

B5 (a) **£2500** (b) **4%** (c) $2500 \times 1.04^3 = 2812.16$

B6 (a) **320 g** (b) 3 halvings: **80 g** (c) 6 halvings: **10 g** (d) $640 \div 5 = 128 = 2^7$, 7 halvings: **35 years**

HIGHER

B7 (a) $605 \div 1.21 = 500$ (b) $486 \div 0.81 = 600$ (c) $1728 \div 1.728 = 1000$ (d) $50 \div 0.0625 = 800$

B8 (a) $\sqrt{1.21} = 1.1$ **10% increase** (b) $\sqrt{0.81} = 0.9$ **10% decrease**

(c) $\sqrt[3]{1.728} = 1.2$ **20% increase** (d) $\sqrt[3]{0.421875} = 0.75$ **25% decrease**

B9 (a) 60, 72, **86.4** (b) 50, 50, **50** (c) 62, 64.4, **67.28** (d) 28, 22, **19**

In (b) the value never changes: $1.2 \times 50 - 10 = 50$. Start above 50 and it grows away. In (d) the values get closer and closer to 16.

B10 (a) $a = 5, b = 3$ (b) $b^2 = \frac{1}{4}$ $a = 80, b = \frac{1}{2}$ (c) $b = \frac{18}{12}$ $a = 8, b = 1.5$ (d) $b^2 = 25$ $a = 2, b = 5$

When a point has $x = 0$, a is the y -value. Otherwise divide one equation by the other to find b first.

C

Reasoning solutions

Your wording can be different. Check that your reason makes the same point.

FOUNDATION

C1 $1.03^4 = 1.1255...$, which is an increase of about **12.55%** **No.** Each year's interest is added to the amount, so the total is more than 12%

C2 (a) Tom multiplied by 3 instead of using the power 3. He should multiply by 1.04 three times.

(b) $500 \times 1.04^3 = 562.432$ **£562.43**



C3 (a) Each year the car loses 20% of a **smaller** value, so it never reaches £0

(b) $0.8^5 = 0.32768$ **32.8%** (to 1 d.p.)

C4 $1.05^{14} = 1.979\dots$, less than 2 $1.05^{15} = 2.078\dots$, more than 2 It first doubles after **15** years, as required

HIGHER

C5 (a) $y = 2 \times 3^x$: **A** $y = 5 \times 0.5^x$: **B** $y = 5 \times 1.5^x$: **C**

A and C both grow. A crosses the y-axis lower, at 2; C crosses at 5. B decreases, so $b < 1$.

(b) D is a straight line. The graph of $y = ab^x$ is a curve, and it never crosses the x-axis.

C6 (a) $0.8 \times 150 + 30 = 120 + 30 = 150$ **as required**

(b) $u_1 = 0.8 \times 50 + 30 = \mathbf{70}$ $u_2 = 0.8 \times 70 + 30 = \mathbf{86}$

The values increase, getting closer and closer to **150**, but never reach it.

C7 Account A: $\times 1.06$ in a year. Account B: $\times 1.03^2 = \times 1.0609$ in a year.

$1.0609 > 1.06$, so **Account B** gives more, as required

C8 (a) Annual multiplier m with $m^{12} = 2$, so $m = 2^{\frac{1}{12}} = 1.0594\dots$ about **5.9%** as required

(b) 30 years is 2.5 doubling periods: $2^{2.5} = 5.656\dots$ increase of **465.7%** (to 1 d.p.)

D

Problem solving solutions

There is often more than one correct method. Any complete, correct method scores full marks.

FOUNDATION

D1 A: $4000 \times 1.02^3 = 4244.832$, plus £100 gives £4344.83 B: $4000 \times 1.03^3 = 4370.908$, which is £4370.91

Account B, by $4370.91 - 4344.83 = \mathbf{£26.08}$

D2 $42\,000 \times 0.97^6 = 34\,984.8\dots$ This is less than 35 000, so **Yes**, the council is correct (just).

After 5 years it is still 36 067, so it is year 6 that takes it below 35 000.



- D3** (a) About **6700** (accept 6500 to 6900) (b) About **4.4 hours** (accept 4.3 to 4.5)
 (c) $3000 \div 2000 = 1.5$ and $4500 \div 3000 = 1.5$ **50** % each hour

- D4** 8 am to 2 am is 18 hours, which is $18 \div 6 = 3$ halvings. $400 \rightarrow 200 \rightarrow 100 \rightarrow$ **50 mg**

HIGHER

D5

Year	Town A: $60\,000 \times 0.98^n$	Town B: $45\,000 \times 1.03^n$
5	54 235	52 167
6	53 151	53 732

Town B is first bigger after **6** years

- D6** There is no need to find the price. From year 2 to year 5 is 3 more years:
 $13\,005 \times 0.85^3 = 7986.695\dots$ **£7986.70**
 Check: the price was $13\,005 \div 0.85^2 = £18\,000$, and $18\,000 \times 0.85^5$ gives the same answer.

- D7** $F_{n+1} = 1.1F_n - 60$, $F_0 = 800$: 820, 842, 866.2, 892.8, 922.1, 954.3, 989.7, 1028.7
 First more than 1000 after **8** months

- D8** $P \times 1.05^{10} = (P + 1000) \times 1.03^{10}$
 $1.628894\dots P = 1.343916\dots P + 1343.916\dots$ $0.284978\dots P = 1343.916\dots$
 $P = 4715.85\dots$ **£4716**

E

Exam practice solutions

Marks are shown on the right of each line.

FOUNDATION

Foundation and Higher crossover

- E1** 4000×1.025^3 M2
 $= 4307.5625$ **£4307.56** A1
 M1 for 4000×1.025 or for a correct first year of £4100
- E2** Amir: $5000 \times 0.03 \times 4 = £600$ M1
 Bea: $5000 \times 1.028^4 = 5583.960\dots$ M1
 Bea's interest = £583.96 M1
Amir, by **£16.04** A1



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E3 500×0.8^n : 400, 320, 256, 204.8, 163.84 M1
 Year 4 is 204.8, still more than 200 M1
 5 years A1

E4 (a) 1.035^6 B1
 (b) 0.96 B1

E5 $18\,000 \times 0.85^4$ M2
 $= 9396.1125$ $\pounds 9396.11$ A1

E6 Plan 1: $1000 + 120 = \pounds 1120$ M1
 Plan 2: $1000 \times 1.01^{12} = 1126.825\dots$, so $\pounds 1126.83$ M1
 Plan 2 gives more ($\pounds 1126.83$ against $\pounds 1120$) C1

HIGHER

E7 $5624.32 \div 1.04^3$ M2
 $= 5624.32 \div 1.124864$ $\pounds 5000$ A1

E8 $15972 \div 12\,000 = 1.331$ M1
 $\sqrt[3]{1.331} = 1.1$ M1
 10% A1

E9 $A_1 = 1.05 \times 3000 - 200 = 2950$ M1
 $A_2 = 2897.5$ $A_3 = 1.05 \times 2897.5 - 200 = 2842.375$ M1
 $\pounds 2842.38$ A1

E10 (a) $ab^2 = 720$ and $ab^5 = 2430$ M1
 $b^3 = \frac{2430}{720} = 3.375$, so $b = 1.5$ M1
 $a = 720 \div 1.5^2 = 320$ A1
 (b) $320 \times 1.5^8 = 8201.9\dots$ $320 \times 1.5^9 = 12\,302.9\dots$ M1
 9 hours A1

