

Simple, Compound Interest, Depreciation, Growth & Decay (H)

A collection of 9-1 Maths GCSE Sample and Specimen questions from AQA, OCR, Pearson-Edexcel and WJEC Eduqas.

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Total Marks:	Solutions

1. (a) During an experiment, a scientist notices that the number of bacteria halves every second.

There were 2.3×10^{30} bacteria at the start of the experiment.

Calculate how many bacteria were left after 5 seconds.

Give your answer in standard form correct to two significant figures.

$$\begin{aligned}
 \text{Number} &= 2.3 \times 10^{30} \times 0.5^5 \\
 &= 7.1875 \times 10^{28} \\
 &= 7.2 \times 10^{28}
 \end{aligned}$$

[3]

- (b) In a different experiment the number of bacteria is reduced by a quarter each second. On this occasion the number of bacteria initially was x .

Write a formula to calculate the number of bacteria, r , remaining after t seconds.

$$r = x \times 0.75^t$$

[3]

2. The value of a car £ V is given by

$$V = 20\,000 \times 0.9^t$$

where t is the age of the car in complete years.

- (a) Write down the value of V when $t = 0$.

$$\begin{aligned}
 V &= 20000 \times 0.9^0 \\
 &= 20000
 \end{aligned}$$

(a) £20000..... [1]

(b) What is the value of V when $t = 3$?

$$V = 20000 \times 0.9^3$$

(b) £14580..... [2]

(c) After how many complete years will the car's value drop below £10 000?

$$\begin{aligned} 5 \text{ years} \rightarrow \text{value} &= 20000 \times 0.9^5 = 11809.80 \times \\ 6 \text{ years} \rightarrow &= 10628.82 \times \\ 7 \text{ years} \rightarrow &= 9565.94 \checkmark \end{aligned}$$

(c)7 years..... [2]

3. Katy invests £2000 in a savings account for 3 years.

The account pays compound interest at an annual rate of
2.5% for the first year
 $x\%$ for the second year
 $x\%$ for the third year

There is a total amount of £2124.46 in the savings account at the end of 3 years.

Work out the rate of interest in the second year.

$$2124.46 = 2000 \times 1.025 \times x^2$$

$$\frac{2124.46}{2050} = x^2 \quad x = \sqrt{1.03632...} = 1.0179989...$$

.....1.799% (1.8%)..... [4]

4. Louis and Robert are investigating the growth in the population of a type of bacteria. They have two flasks A and B.

At the start of day 1, there are 1000 bacteria in flask A.

The population of bacteria grows exponentially at the rate of 50% per day.

(a) Show that the population of bacteria in flask A at the start of each day forms a geometric progression.

Day	1	2	3	4
	1000	1500	2225	3337

$$\text{Bacteria} = 1000 \times 1.5^t$$

[2]

The population of bacteria in flask A at the start of the 10th day is k times the population of bacteria in flask A at the start of the 6th day.

(b) Find the value of k .

$$\text{day } 10 = k \times \text{day } 6 \quad k = \frac{1000 \times 1.5^{10}}{1000 \times 1.5^6} \quad k = 5.0625 \quad [2]$$

At the start of day 1 there are 1000 bacteria in flask B. $B = 1000 \times 1.3^t$
 The population of bacteria in flask B grows exponentially at the rate of 30% per day.

(c) Sketch a graph to compare the size of the population of bacteria in flask A and in flask B.

[1]

5. Here are the interest rates for two accounts.

Account A	Account B
Interest: 3% per year compound interest.	Interest: 4% for the first year, 3% for the second year and 2% for the third year.
No withdrawals until the end of three years.	Withdrawals allowed at any time.

Derrick has £10 000 he wants to invest.

a) Calculate which account would give him most money if he invests his money for 3 years.

Give the difference in the interest to the nearest penny.

$$A \rightarrow 10000 \times 1.03^3 = 10927.27$$

$$B \Rightarrow 10000 \times 1.04 \times 1.03 \times 1.02 = 10926.24$$

a) Account **A** by **£1.03** p [5]

(b) Explain why he might not want to use Account A.

he cannot withdraw money at any time.

[1]

6. The population, P , of an island t years after January 1st 2016 is given by this formula.

$$P = 4200 \times 1.04^t$$

a) What was the population of the island on January 1st 2016?

(a) **4200** [1]

b) Explain how you know that the population is increasing.

the multiplier is 1.04, which shows a 4% increase

[1]

c) What is the annual percentage increase in the population?

c) 4 % [1]

d) Work out the population of the island on January 1st 2021.

$$4200 \times 1.04^5 = 5109.942..$$

d) 5109 / 5110 [2]

7. Toby invested £7500 for 2 years in a savings account.

He was paid 4% per annum compound interest.

How much money did Toby have in his savings account at the end of 2 years?

$$7500 \times 1.04^2$$

£ 8112 [2]

8. Ibrar bought a house for £145 000

The value of the house depreciated by 4% in the first year.

The value of the house depreciated by 2.5% in the second year.

$$145000 \times 0.96 \times 0.975 = 135720$$

Ibrar says,

"4 + 2.5 = 6.5 so in two years the value of my house depreciated by 6.5%"

a) Is Ibrar right? No.

You must give a reason for your answer.

$$\frac{9280}{145000} \times 100 = 6.4\% \quad \text{He has calculated it incorrectly ... it is } 6.4\%$$

The value of Ibrar's house increases by x% in the third year.

At the end of the third year the value of Ibrar's house is £140 000

b) Work out the value of x.

Give your answer correct to 3 significant figures.

$$145000 \times 0.96 \times 0.975 \times y = 140000$$

$$y = \frac{140000}{135720} = 1.0315355..$$

$$x = 3.15\%$$

9. Ian invested an amount of money at 3% per annum compound interest.

At the end of 2 years the value of the investment was £2652.25

a) Work out the amount of money Ian invested.

$$2652.25 = x \times 1.03^2 \quad \text{£} \dots\dots\dots 2500 \quad [3]$$

$$x = \frac{2652.25}{1.03^2}$$

Noah has an amount of money to invest for five years.

<p>A</p> <p>Saver Account</p> <p>4% per annum compound interest.</p>	<p><i>annuing</i></p> <p>£100</p>	<p>B</p> <p>Investment Account</p> <p>21% interest paid at the end of 5 years.</p>
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Noah wants to get the most interest possible.

b) Which account is best?

You must show how you got your answer.

<p>A</p> <p>100×1.04^5</p> <p>$= 121.67$</p> <p>$\uparrow 21.67$</p>	<p>B</p> <p>$21\% = 21$</p> <p>$\uparrow 21$</p>
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Saver account is better $21.67 > 21$

[2]

10. A virus on a computer is causing errors.

An antivirus program is run to remove these errors.

An estimate for the number of errors at the end of t hours is $10^6 \times 2^{-t}$

this is an estimate.

a) Work out an estimate for the number of errors on the computer at the end of 8 hours.

$$10^6 \times 2^{-8} = 3906.25$$

$\dots\dots\dots 3906 \dots\dots\dots [2]$

b) Explain whether the number of errors on this computer ever reaches zero.

there is no value of 't' where $10^6 \times \frac{1}{2^t} = 0$

[1]

11. The population of a city increased by 5.2% for the year 2014

At the beginning of 2015 the population of the city was 1560000

Lin assumes that the population will continue to increase at a constant rate of 5.2% each year.

a) Use Lin's assumption to estimate the population of the city at the beginning of 2017
Give your answer correct to 3 significant figures.

$$1560,000 \times 1.052^2$$

$$1726458.24$$

$\dots\dots\dots 1,730,000 \dots\dots\dots [3]$

$$1560000 \times 1.052^5 = 2000000$$

$n = 5$

- b) (i) Use Lin's assumption to work out the year in which the population of the city will reach 2000000

2015 → 2020

2020

- ii) If Lin's assumption about the rate of increase of the population is too low, how might this affect your answer to (b)(i)?

if the rate of increase is too low, 2,000,000 may be reached sooner than 2020.

[3]

- 12 The number of slugs in a garden t days from now is p_t where

$$p_0 = 100$$

$$p_{t+1} = 1.06p_t$$

Work out the number of slugs in the garden 3 days from now.

$$p_0 = 100$$

$$p_1 = 1.06 \times 100$$

$$p_2 = 1.06 \times 1.06 \times 100$$

$$p_3 = 1.06^3 \times 100 = 119.10... \quad 119 \text{ slugs} \quad [3]$$

13. The number of bees in a beehive at the start of year n is P_n .

The number of bees in the beehive at the start of the following year is given by

$$P_{n+1} = 1.05(P_n - 250)$$

At the start of 2015 there were 9500 bees in the beehive.

How many bees will there be in the beehive at the start of 2018?

$$P_{2015} = 9500$$

$$P_{2016} = 1.05(9500 - 250) = 9712.5$$

$$P_{2017} = 1.05(9712.5 - 250) = 9935.625$$

$$P_{2018} = 1.05(9935.625 - 250) = 10169.90625$$

10,170

[3]

14. An amount of money was invested for 8 years.

It earned compound interest at 2.5% per year.

After 8 years the total value of the investment was £11 696.67

a) Tom is trying to work out the total interest earned.

Tom

$$\begin{aligned} \text{Interest for 8 years} &= £11696.67 \times 0.025 \times 8 \\ &= \text{original} \times 0.025^8 \end{aligned}$$

State what is wrong with Tom's method.

he should have used the original amount and
it should be a power of 8 not $\times 8$

[1]

b) Work out the total interest earned.

$$\begin{aligned} \text{original} &= \frac{11696.67}{1.025^8} \\ &= 9600.0017... \end{aligned}$$

$$\begin{aligned} \text{Interest} &= 11696.67 \\ &\quad - 9600 \\ &= £2096.67 \end{aligned} \quad [3]$$

15. On 1st January 2012 Beth invested some money in a bank account.

The account pays 2.5% compound interest per year.

On 1st January 2013 Beth withdrew £1000 from the account.

On 1st January 2014 she had £17 466 in the account.

Work out how much money Beth originally invested in the account.

$$\begin{aligned} 2012 &\rightarrow ? \\ &\quad \times 1.025 \end{aligned}$$

$$2013 \leftarrow -1000$$

$$\begin{aligned} &\quad \times 1.025 \uparrow \\ 2014 &= 17466 \end{aligned}$$

$$\begin{aligned} &[(17466 \div 1.025) + 1000] \div 1.025 \\ &= £17600 \end{aligned}$$

[4]

CREDITS AND NOTES

Q	Awarding Body	Q	Awarding Body	Q	Awarding Body
1	WJEC Eduqas	8	Pearson Edexcel	15	AQA
2	OCR	9	Pearson Edexcel		
3	Pearson Edexcel	10	Pearson Edexcel		
4	Pearson Edexcel	11	Pearson Edexcel		
5	OCR	12	Pearson Edexcel		
6	OCR	13	Pearson Edexcel		
7	Pearson Edexcel	14	AQA		

Notes:

These questions have been retyped from the original sample/specimen assessment materials and whilst every effort has been made to ensure there are no errors, any that do appear are mine and not the exam board s (similarly any errors I have corrected from the originals are also my corrections and not theirs!).

Please also note that the layout in terms of fonts, answer lines and space given to each question does not reflect the actual papers to save space.

These questions have been collated by me as the basis for a GCSE working party set up by the GLOW maths hub - if you want to get involved please get in touch. The objective is to provide support to fellow teachers and to give you a flavour of how different topics "could" be examined. They should not be used to form a decision as to which board to use. There is no guarantee that a topic will or won't appear in the "live" papers from a specific exam board or that examination of a topic will be as shown in these questions.



Links:

AQA <http://www.aqa.org.uk/subjects/mathematics/gcse/mathematics-8300>

OCR <http://ocr.org.uk/gcsemaths>

Pearson Edexcel <http://qualifications.pearson.com/en/qualifications/edexcel-gcses/mathematics-2015.html>

WJEC Eduqas <http://www.eduqas.co.uk/qualifications/mathematics/gcse/>

Contents:

This version contains questions from:

AQA – Sample Assessment Material, Practice set 1 and Practice set 2

OCR – Sample Assessment Material and Practice set 1

Pearson Edexcel – Sample Assessment Material, Specimen set 1 and Specimen set 2

WJEC Eduqas – Sample Assessment Material