

Exponential growth and decay

- 1 In a laboratory, the number of bacteria in a petri dish is recorded, and the bacteria are found to double each hour.

a Complete the table of values:

Number of hours passed (x)	0	1	2	3	4
Number of bacteria (y)	1				

- b Find the equation linking the number of bacteria, y , and the number of hours passed, x .
- c At this rate, how many bacteria will be present in the petri dish after 15 hours?
- d Sketch the graph of the number of bacteria over time.
- e Interpret the meaning of the y -intercept in this context.

- 2 One person in a city is infected with a virus. During the first day, before they start to show symptoms and decide to stay home sick, they infect five more people with the virus.

a Given each new person infects an average of five new people on their first day of being sick, complete the table below showing the number of newly infected people for that day:

Day	0	1	2	3	4
Number of people infected	1				

- b If this trend continues, write an expression for the number of people newly infected on day n .
- c There are 345 800 people in the city in total. Given the trend continues, after how many days will the entire city have been infected?

- 3 A particular radioactive isotope decays at a rate such that each month there is $\frac{1}{5}$ as much of the isotope as the previous month.

a Given there is 1 kg of the isotope to start with, complete the table below showing how much of the isotope is left after each month:

Month (x)	0	1	2	3
Amount remaining in kilograms (y)	1			

- b Write the equation for the amount, y , of the isotope that is remaining after x months.
- c How much will be remaining after 7 months?
- d Sketch the graph of the amount of isotope over time.
- e Interpret the meaning of the y -intercept in context.

- 4 1 gram of sugar is poured into a cup of water and immediately begins to dissolve. Each second the amount of sugar remaining is $\frac{1}{4}$ of the amount present in the previous second.

a Complete the table of values:

Seconds passed (t)	0	1	2	3	4	5
Undissolved sugar in grams (y)						

b Write an equation linking undissolved sugar, y , and time, t , in the form:

i $y = a^t$

ii $y = a^{-t}$

- c Find the difference in undissolved sugar between the first and second seconds.
d Find the difference in undissolved sugar between the second and third seconds.
e Describe the change in the amount of undissolved sugar over time.
f According to this model, will all the sugar eventually dissolve? Explain your answer.

- 5 An initial chemical reaction results in a chain of chemical reactions that follow. The total number of reactions after t seconds is given by the equation $y = 4^t$.

- a How many chemical reactions have occurred after the 3rd second?
b How many chemical reactions occur in the 7th second only?
c How many chemical reactions occur in the 8th second only?
d How would you describe the rate of increase of the number of reactions?

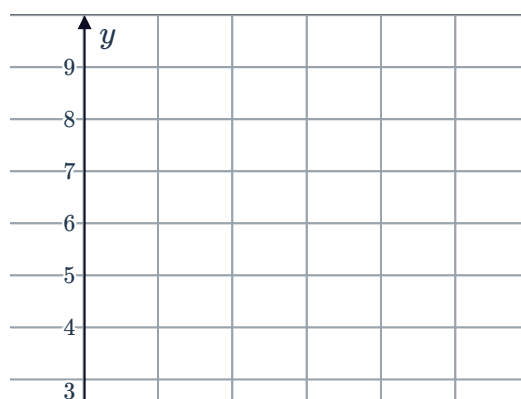
- 6 A sample contains 1 g of Ruthenium-106 which has a half-life of one year.

- a Write an equation to represent the amount of the sample, A , remaining after n years.
b Between which two years does Ruthenium-106 lose the most mass? Select the correct answer.

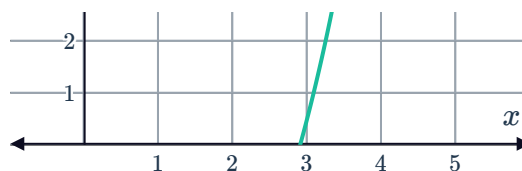
A Years 3 and 4 **B** Years 5 and 6 **C** Years 6 and 7 **D** Years 10 and 11

- 7 The number of layers, y , resulting from a rectangular piece of paper being folded in half x times, is shown in the graph:

- a Write the equation linking y and x in the form $y = a^x$.
b Interpret the meaning of the y -intercept in this context.



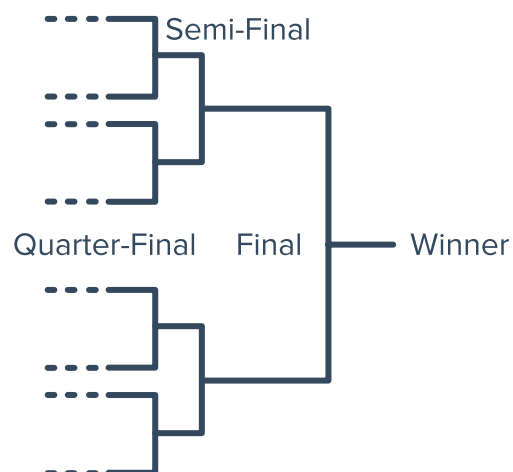
- c If a rectangular piece of paper is folded 10 times, find the resulting number of layers.
- d If a rectangular piece of paper of thickness 0.02 mm is folded 11 times, find the total resulting thickness.



- 8 In a knockout squash tournament, the winner of each round progresses to the next round until there are only two players left. The diagram shows the draw for the final, semi-final and quarter final rounds:

- a Complete the table of values for the total number of players, p , that the competition can accommodate given a number of rounds, r :

Number of rounds (r)	3	4	5	6
Number of players (p)	8			



- b Organisers of a squash tournament want to make sure that each round of the tournament has every spot filled. For what values of p can a tournament be formed?
 - c Write the equation relating r and p .
 - d The organisers of a tournament can fit in 10 rounds of play. How many players can they accept into the tournament?
- 9 When a coin is flipped once there are two possible outcomes: heads (H) or tails (T). And if it is flipped twice there are four possible outcomes: HH, HT, TH or TT.
- a How many possible outcomes are there if the coin is flipped three times?
 - b Write an expression that represents the number of outcomes when a coin is flipped n times.
 - c How many possible outcomes are there if the coin is flipped 8 times?