



Exponential growth graphs

Year 8 About 70 minutes Calculator allowed 45 marks

Date _____

A Do Now

Quick questions to start.

- A1** Last lesson [1 mark] **A2** Needed today [1 mark]
A bath fills at 8 litres a minute. Work out 3×2^4 .
How long does 52 litres take?

Answer

Answer

- A3** Needed today [1 mark] **A4** From chapter 1 [1 mark]
Write down the multiplier for an increase of 6%. Increase £400 by 10%, then by 10% again.

Answer

Answer

B Example, then your turn

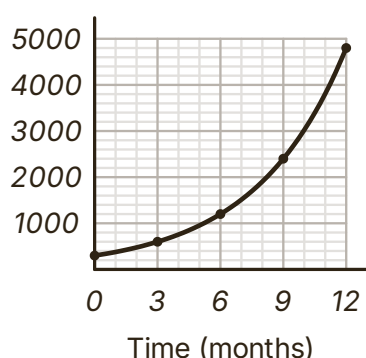
Year 8

Your teacher works through each example with you. Then try the one beside it.

EXAMPLE 1

A colony of 300 bees doubles in size every 3 months. (a) Complete a table of the number of bees after 0, 3, 6, 9 and 12 months. (b) The points are plotted and joined with a smooth curve. Estimate when there are 3000 bees.

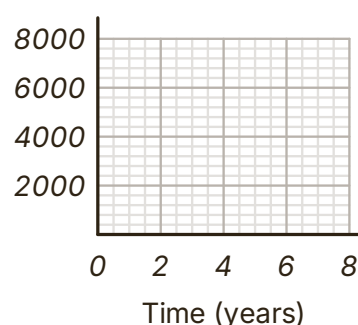
Number of bees



Hint Double each number to get the next one. To read a time, go across from 3000 to the curve, then down.

- B1** A lake has 400 fish. The number doubles every 2 years. (a) Complete a table for 0, 2, 4, 6 and 8 years. (b) Plot the points on the grid and join them with a smooth curve. (c) Estimate when there are 5000 fish. [4 marks]

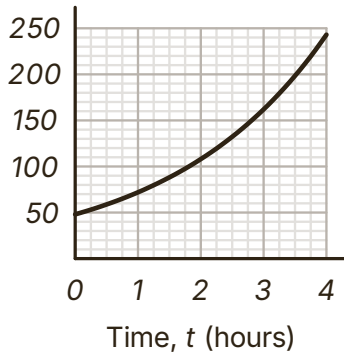
Number of fish



EXAMPLE 2

The number of bacteria, n , in a dish after t hours is $n = 48 \times 1.5^t$. (a) Complete a table of n for $t = 0, 1, 2, 3$ and 4. (b) The graph of $n = 48 \times 1.5^t$ is drawn. Estimate the number of bacteria after $2\frac{1}{2}$ hours. (c) Estimate when there are 200 bacteria.

Number of bacteria, n



Hint Put each value of t into the formula with your calculator: $48 \times 1.5^3 = 162$. Read the graph up from 2.5, and across from 200.

EXAMPLE 3

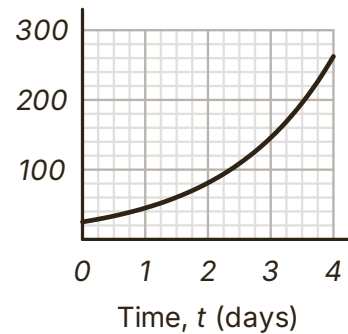
£500 is invested at 6% compound interest a year. The amount after n years is £ A , where $A = 500 \times 1.06^n$. (a) Work out the amount after 5 years. (b) After how many complete years has the amount first doubled?

Hint Doubled means £1000 or more. Try values of n with your calculator, and look for the first year that goes past £1000.

B2 The number of views of a video, n thousand, after t days [3 marks]

is $n = 25 \times 1.8^t$. (a) Complete a table of n for $t = 0, 1, 2, 3$ and 4. Give each value to the nearest whole number. (b) The graph is drawn. Use it to estimate when the video has 200 thousand views.

Views, n (thousands)

**B3** £800 is invested at 9% compound interest a year. The [4 marks]

amount after n years is £ A , where $A = 800 \times 1.09^n$. (a) Work out the amount after 4 years. (b) After how many complete years has the amount first doubled?

C1 Which of these tables show exponential growth? Give a reason. P: 8, 19, 30, 41, 52. Q: 11, 33, 99, 297, 891. R: 8, 40, 200, 1000, 5000. S: 10, 12, 16, 22, 30.

[2 marks]

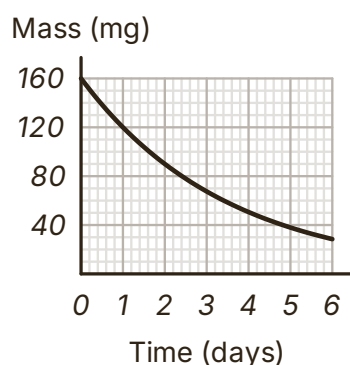
C2 A table for $y = a \times b^x$ is: $x = 0, 1, 2, 3$ and $y = 11, 44, 176, 704$. Find a and b . Work out y when $x = 5$.

Answer $a = \dots$ $b = \dots$ $y = \dots$

C3 The graph shows the mass of a medicine left in a patient's body. The half-life is the time for the mass to fall to half of what it was at the start. Use the graph to estimate (i) the half-life, (ii) the mass left after 5 days.

[2 marks]

C4 A population, P , doubles every 4 years. After t years, $P = 300 \times 2^{\frac{t}{4}}$. Work out P when $t = 12$, and when $t = 10$. Give your second answer to the nearest whole number.



Answer $t = 12 : \dots$ $t = 10 : \dots$

D Exam-style questions

GCSE Foundation

D1 Mia says, "If something grows by 20% every year, it will have doubled after 5 years, because $5 \times 20\% = 100\%$."

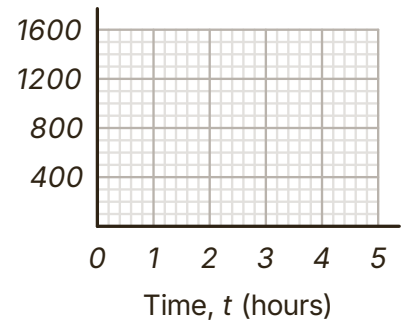
[3 marks]

Is Mia correct? Show working to support your answer.

D2 The number of cells, n , in a sample after t hours is $n = 160 \times 1.5^t$.

- (a) Complete a table of n for $t = 0, 1, 2, 3, 4$ and 5. [2 marks]

Number of cells, n



- (b) Draw the graph of $n = 160 \times 1.5^t$ on the grid. [2 marks]

- (c) Use your graph to estimate when there are 1000 cells. [1 mark]

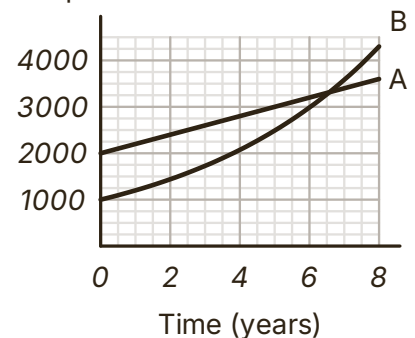
Answer ... hours

Total for D2: 5 marks

D3 The population of Town P goes up by 200 people each year. The population of Town Q goes up by 20% each year. The graph shows both populations.

- (a) Which graph, A or B, shows Town Q? Give a reason. [1 mark]

Population



- (b) Use the graph to estimate when the population of Town Q becomes bigger than the population of Town P. [1 mark]

Answer ... years

- (c) The population of Town Q was 1000 at the start. Work out its population after 8 years. Give your answer to the nearest whole number. [2 marks]

Answer

Total for D3: 4 marks

D4 A patch of weed on a pond covers 3 m^2 . The area it covers doubles every week. The pond has an area of 96 m^2 .

- (a) After how many weeks does the weed cover the whole pond? [2 marks]

Answer ... weeks

- (b) Ravi says, "The pond is half covered after $2\frac{1}{2}$ weeks." Explain why Ravi is wrong. [2 marks]

Total for D4: 4 marks

E Extension

Stretch

No route is given. The hints are at the end of the sheet. Use one at a time.

- E1** The number of cells in a dish is multiplied by the same number every hour. [4 marks]
There are 50 cells at 9:00 am and 450 cells at 11:00 am. Estimate how many cells there were at 10:30 am.

Answer

Extension hints

Cover these with paper. Uncover one at a time.

- E1** **Hint 1** Two hours multiply the number by $450 \div 50 = 9$. What is the multiplier for one hour?
- Hint 2** One hour multiplies by 3, so at 10:00 am there were 150 cells. Half an hour multiplies by a number which, done twice, gives 3.
- Hint 3** Half an hour multiplies by $\sqrt{3} = 1.732 \dots$, so at 10:30 am there were $150 \times \sqrt{3} = 259.8$, about 260 cells.

How did it go?

Colour one circle on each line: not yet, nearly, yes.

I can make a table for an amount that doubles, or is multiplied by the same number, each time. ☐ ☐ ☐

I can draw an exponential graph and read values from it, forwards and backwards. ☐ ☐ ☐

I can use $y = a \times b^x$ for growth, decay and compound interest. ☐ ☐ ☐

I can tell exponential growth from growth by the same amount each time. ☐ ☐ ☐