(Exponential Growth and Decay)

exponential growth (or decay) = initial value $(1 \pm r/100)^t$



1. Newton has a population of 23 000. The population decreases exponentially at a rate of 1.4% per year. Calculate the population of Newton after 5 years.[2]
   0580/22/F/M/18 Q8)

2. There are 30 000 lions in Africa. The number of lions in Africa decreases exponentially by 2% each year. Find the number of lions in Africa after 6 years. Give your answer correct to the nearest hundred.[2]
   0580/22/O/N/18 Q9)

3. The population of Olton is decreasing at a rate of 3% per year.
   In 2013, the population was 50 000.
   Calculate the population after 4 years.
   Give your answer correct to the nearest hundred. [3]
   0580/22/F/M/15 Q12)

4. Robert buys a car for $8000.
   At the end of each year the value of the car has decreased by 10% of its value at the beginning of that year. Calculate the value of the car at the end of 7 years. [3]
   0580/22/O/N/15 Q8)

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5. The population of a village decreases exponentially at a rate of 4% each year.
   The population is now 255. Calculate the population 16 years ago. [3]
   0580/42/O/N/20 Q3)

6. The population of Dubai at the end of 2012 was 2.1 million.
   This was predicted to increase at a rate of 6% each year.
   Calculate the predicted population of Dubai (in millions)at the end of 2015. [3]
   0580/21/O/N/14 Q7)

7. In a city the population is increasing exponentially at a rate of 1.6% per year.
   Find the overall percentage increase at the end of 20 years. [2]
   0580/41/M/J/19 Q8(c)

8. The number of a certain type of bacteria increases exponentially at a rate of r% each day.
   After 22 days, the number of this bacteria has doubled.
   Find the value of r.[3]
   0580/41/O/N/22 Q4 (c)

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9. (i)A new truck costs $15000 and loses 23% of its value each year.
Calculate the value of the truck after three years. [3]
(ii) Calculate the overall percentage loss of the truck's value after three years. [3]
0580/41/O/N/11 Q1)(c)

10. The population of the world grows exponentially at a rate of 1.1% per year.
Find the number of years it takes for the population to grow from 7 billion to 7.31 billion.
Give your answer correct to the nearest whole number. [2]
0580/22/F/M/17 Q4)

11. Xavier's salary increases by 2% each year. In 2010, his salary was $40100.
(i) Calculate his salary in 2015. Give your answer correct to the nearest dollar. [3]
(ii) In which year is Xavier's salary first greater than $47500? [3]
0580/43/M/J/21 Q1(b)

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12. It is estimated that the world's population is growing at a rate of 1.14% per year.
    On January 1st 2014 the population was 7.23 billion.
    (a) Find the expected population (in billions) on January 1st 2020. [2]
    (b) Find the year when the population is expected to reach 10 billion. [2]
    0580/22/M/J/16 Q19)

13. At the start of an experiment there are 20 000 bacteria. The number of bacteria increases at a rate of 30% per hour.
    (a) Work out the number of bacteria after 4 hours. [2]
    (b) After how many **whole** hours, from the start of the experiment, will the number of bacteria be greater than one million? [2]
    0580/23/M/J/16 Q19)

14. The population of a village is 6400. The population is decreasing exponentially at a rate of r% per year. After 22 years, the population will be 2607. Find the value of r. [3]
    0580/41/M/J/19 Q8)(d)

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15. The number of newspapers sold decreases exponentially by x% each year.
Over a period of 21 years the number of newspapers sold decreases from 1 763 000 to 58 000. Calculate the value of x. [3]
0580/42/M/J/19 Q1)(d)

16. Over a period of 3 years, the company's sales of biscuits increased from 15.6 million packets to 20.8 million packets. The sales increased exponentially by the same percentage each year.
Calculate the percentage increase each year. [3]
0580/42/M/J/18 Q1(c)

17. A bacteria population increases exponentially at a rate of r% each day.
After 32 days, the population has increased by 309%.
Find the value of r. [3]
0580/43/O/N/18 Q2)(c)

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18. The population of a city increases exponentially at a rate of $x\%$ **every 5 years**.
In 1960 the population was 60 100.
In 2015 the population was 120 150.
Calculate the value of x [3]
0580/41/O/N/16 Q1(d)

19. A radioactive substance decays at an exponential rate of 2% per day. The initial mass is 80g.
(i) Find the mass at the end of 5 days. [2]
(ii) Find how many **more** whole days, after day 5 , it takes for the mass to reduce to less than 67g. [3]
0580/41/M/J/22 Q2(d)

20. At the start of June, a hive has a population of 2000 bees.
Three months after the start of June the hive has a population of 2662 bees.
The population of this hive can be calculated using the formula $P = ab^x$,
where P is the population of the hive x months after the start of June.
By finding the value of a and the value of b, calculate the population of the hive 7 months after the start of June.
Give your answer correct to the nearest integer. [5]
0580/43/M/J/22 Q3)(b)

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Answers

1) 21400	11) (i)44274 (b)(ii)2019
2) 26 600	12) (a)7.74 (b)2042
3) 44300	13) (a) 57122 (b)15
4) 3826.38	14) 4
5) 490	15) 15
6) 2.5[0]	16) 10.1
7) 37.4	17) 4.5
8) 3.20	18) 6.5[0]
9) (i) 6848 (ii) 54.3	19) (i) 72.3 (ii)4
10) 4	20) a=2000, b =1.1 , p=3897

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