

Worksheet 4

Exponential Functions - Long Answer Problems

1) POPULATIONS

Several years ago, a company moved its manufacturing plant from Town F to Town G. Since then, the population of Town F has decreased while the population of Town G has increased.

TOWN F

The population of Town F in relation to the time elapsed since the plant was moved is represented by function f described below.

$$f(x) = 20\,000(0.9)^x$$

where x : time elapsed since the plant was moved, in years
 $f(x)$: population of Town F

Today, the population of Town F is 13 122.

Town G

The year the plant was moved, the population of Town G was the same as the population of Town F.

Every year since then, the population of Town G has increased by 15% in relation to the previous year.

To the nearest whole number, by how much did the population of Town G increase from the time the manufacturing plant was moved until today?

2) **CELL PHONES**

Several months ago, Sarah and Zoe each bought a cell phone on the same day. Since then, the value of each woman's cell phone has decreased.

SARAH'S CELL PHONE

Function f described below represents the value of Sarah's cell phone.

$$f(x) = 300(0.97)^x$$

where x : time elapsed, in months, since Sarah bought her cell phone

$f(x)$: value of Sarah's cell phone, in dollars

Today, to the nearest cent, Sarah's cell phone is worth \$257.62.

ZOE'S CELL PHONE

Zoe's cell phone was worth \$240 on the day she bought it.

Each month since then, her cell phone has lost 4% of its value in relation to the previous month.

From the day they were purchased, which of the two cell phones has lost the most value, in dollars?

3) WELL WATER

Jim bought a cottage a few years ago.

Since then Jim has been analyzing the water in the well at his cottage every year on June 1.

Data collected over past years was used to establish that function f described below represents the number of atypical bacteria in the well water in relation to the amount of time elapsed since Jim bought the cottage.

$$f(x) = 16(1.5)^x$$

where x : number of years elapsed since Jim bought the cottage

$f(x)$: number of atypical bacteria per 100 mL of water

In 2012, the analysis revealed that the well water contained 54 atypical bacteria per 100 mL.

In what year will the analysis reveal for the first time that there are more than 200 atypical bacteria per 100 mL of water?

4)

TWO CELL SAMPLES

Marie and Julian work in a medical research laboratory. They are observing the development of viral cells in two samples growing in different conditions.

MARIE'S SAMPLE

Marie's sample started off with 5 cells.

Function f described below is used to determine the number of cells in the sample in relation to the time elapsed since the beginning of the observation period.

$$f(x) = 5(8)^x$$

x : time elapsed, in hours, since the beginning of the observation period

$f(x)$: number of cells in Marie's sample

JULIAN'S SAMPLE

Julian's sample started off with 5 cells.

Julian observes that the number of cells in his sample doubles every 20 minutes.

Does the number of cells grow at the same rate in the two samples? Explain your answer.

5) **THE POPULATION OF A NEW CITY**

A study examined the populations of two neighbouring towns.

TOWN A

Function f described below represents the population of Town A in relation to the time elapsed since 2005.

$$f(x) = 16\,500(1.035)^x$$

x : time elapsed since 2005, in years

$f(x)$: population of Town A

TOWN B

In 2010, Town B has a population of 20 000. It is estimated that each year, the population will increase by 10% relative to the previous year.

The two towns are to be merged in 2014 to form a new city.

What will be the population of the new city in 2014?

6)

DECIBELS

During a concert, a technician measured the sound intensity and the sound pressure to which spectators are subjected.

Data was collected to show that the following function f can be used to determine the sound pressure based on the sound intensity.

$$f(x) = 90(1.02)^x \quad \text{where } x : \text{sound intensity, in decibels (dB)}$$
$$f(x) : \text{sound pressure, in Pascals (Pa)}$$

During this concert, the sound pressure, measured to the nearest tenth of a Pascal, ranged from 91.8 Pa to 126.0 Pa.

During this concert, what was the difference between the maximum sound intensity and the minimum sound intensity?