**Lesson 5.3 Exponential Models**

***Goal: Apply exponential models to analyze and predict behaviour of real-world situations***

***Exponential Models***

Represent quantities that change at a constant \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ rate (quantities are \_\_\_\_\_\_\_\_\_\_\_\_ by a fixed amount at regular intervals.

* In a table of values, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ / \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ factors are equal
* The graph resembles an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ curve
* The equation is written in the form \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ where \_\_\_\_\_\_ is the initial value and
\_\_\_\_\_\_ is the growth/decay factor. Notice that the exponent is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Growth/Decay Factors***

In an exponential equation, , the growth/decay factor is given by the value of ***b***

|  |  |
| --- | --- |
| * If ***b*** > 1, the relation is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Growth factor = 1 + growth rate
* Growth rate = growth factor – 1
 | * If 0 < ***b*** < 1, the relation is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Decay factor = 1 – decay rate
* Decay rate = 1 – decay factor
 |

***EXAMPLE 1*** Determine the growth or decay rate in each of the following:

1.  **b)** 

***EXAMPLE 2*** Which models represent exponential relations?

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |

|  |  |
| --- | --- |
| ***t*** | ***A*** |
| 0 | 35 |
| 1 | 25 |
| 2 | 15 |
| 3 | 5 |

 |  |

|  |  |
| --- | --- |
| ***d*** | ***P*** |
| 0 | 51.2 |
| 1 | 64 |
| 2 | 80 |
| 3 | 100 |

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|  |  |  |  |
|  |  |  |  |

***Comparing Pairs of Exponential Relations***

Compare the initial value and compare the growth/decay factor

***EXAMPLE 3*** The equations of two colonies of bacteria are shown below.

 ***Colony A***:  ***Colony B***: 

1. Use a ***graphing calculator*** to graph both equations. You will need to change window settings as shown (press WINDOW). Describe how the two graphs compare.
2. How would the graph for Colony A change if there were 200 bacteria initially?

***Fitting an Exponential Model to Data***

We can use \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to model data that appear lie along an exponential curve and produce a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of best fit

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | 1921 | 1931 | 1941 | 1951 | 1961 | 1971 | 1981 | 1991 | 2001 |
| **B.C. Population****(millions)** | 0.52 | 0.69 | 0.82 | 1.17 | 1.63 | 2.18 | 2.82 | 3.37 | 4.08 |

***EXAMPLE 4***

1. Use a ***graphing calculator*** to determine the exponential relation  that best fits the data above, where ***x*** is the number of years **since 1921** and ***y*** is the population of British Columbia in millions.
2. What do the values of ***a*** and ***b*** represent in this situation?
3. Estimate the population of British Columbia in 1985.

**Practice**: Page 315 #2 – 7, \*8, \*11, \*12 **\****technology needed for questions marked with an asterisk*