Exponential Functions

1. Determine whether each function represents exponential growth or decay. Select the correct option for each function.

| **Function** | **Growth** | **Decay** |
| --- | --- | --- |
| $$f\left(x\right)=(\frac{1}{2})^{x}$$ |  |  |
| $$f\left(x\right)=(\frac{3}{2})^{x}$$ |  |  |
| $$f\left(x\right)=(\frac{1}{2})^{4x}$$ |  |  |

1. Write an expression equivalent to $\frac{a^{9}}{a^{3}}$ in the form *am*.
2. Write an expression equivalent to *a*–12 in the form (*an*)*m*.
3. Write an expression equivalent to (*a*4*a*–3*b*3)2 in the form *ambn*.
4. This expression defines a function that models the future population of bison in a park after
*t* years.

4200(1.030)*t*

Which expression best defines the function that represents the bison population after
*x* months?

A. 4200(1.426)*x*
B. 4200(1.002)*x*
C. 4200(0.086)*x*
D. 4200(12.36)*x*
5. Maia deposited some money in a bank account. The money earns interest annually, and the interest is deposited bank into her account.

Maia uses an online calculator to determine the amount of money she will have in the account at the end of each year, up to 12 years. The table shows some of the results of the calculator.

| **Years** | **Money in Bank ($)** |
| --- | --- |
| 1 | 551.65 |
| 3 | 554.96 |
| 12 | 570.13 |

Write an equation that models the amount of money, *y*, Maia will have in the account at the end of *t* years.

1. Susan has an ear infection. Her doctor prescribes an antibiotic. The doctor tells Susan to take a 250-milligram dose of the antibiotic every 12 hours for the next 10 days.
* Susan finds out that 4% of the antibiotic is still in her body after 12 hours.
* Assume that each dose is exactly 250 milligrams and that Susan takes one does every 12 hours.

 **Part A**How much of the antibiotic, in milligrams, is in Susan’s body immediately after taking the **2nd** dose?

**Part B**How much of the antibiotic, in milligrams, is in Susan’s body immediately after taking the **10th** dose?

1. This expression defines a function that models the future population of ticks in a park after
*x* months.

320(0.975)*x*

What is the yearly decay rate for the tick population, as a percent? Round to the nearest whole percent.
2. Between 1980 and 1995, there was a single group of Florida panthers that ranged from 30 to 50 individuals in numbers. In 1995, two females from a closely related species were introduced into this population, and the number of Florida panthers increased to 87 by 2003.

The population of Florida panthers can be modeled by either a piece-wise linear function or an exponential function, as shown in the graphs.



Either model is acceptable, but you must choose one.
* State which model you chose to model the population of Florida panthers.
* Based on the model you chose, what would be the approximate population of Florida panthers have been in 2005?

**Teacher Material**

A-SSE.A

Interpret the structure of expressions.

A-SSE.B

Write expressions in equivalent forms to solve problems.

A-CED.A

Create equations that describe numbers or relationships.

F-IF.A

Understand the concept of a function and use function notation.

F-IF.B

Interpret functions that arise in applications in terms of a context.

F-IF.C

Analyze functions using different representations.

F-BF.A

Build a function that models a relationship between two quantities.

| **Question** | **Claim** | **Key/Suggested Rubric** |
| --- | --- | --- |
| 1[[1]](#footnote-1) | 1 |

| **Function** | **Growth** | **Decay** |
| --- | --- | --- |
| $$f\left(x\right)=(\frac{1}{2})^{x}$$ |  | x |
| $$f\left(x\right)=(\frac{3}{2})^{x}$$ | x |  |
| $$f\left(x\right)=(\frac{1}{2})^{4x}$$ |  | x |

**1 point:**  |
| 2[[2]](#footnote-2) | 1 | **1 point:** *a*6. |
| 32 | 1 | **1 point:** Answers will vary. **Example:** (*a*2)–6. NOTE: the product of *n* and *m* must equal –12. |
| 42 | 1 | **1 point:** *a*2*b*6. |
| 52 | 1 | **1 point:** Selects B. |
| 6[[3]](#footnote-3) | 4 | **1 point:** Writes an exponential equation that, in the form *y* = *b*(*a*)*t* , has values of *b* and *a* such that 548 < *b* < 552 and 1.0029 < *a* < 1.0031. |
| 7[[4]](#footnote-4) | 2 | **2 points:** 260 (Part A) AND a number in the interval 355.8 to 355.9, inclusive (Part B).**1 point:** 260 (Part A) OR a number in the interval 355.8 to 355.9, inclusive (Part B). |
| 8[[5]](#footnote-5) | 1 | **1 point:** 26%. |
| 9[[6]](#footnote-6) | 4 | **1 point:** An estimate between 98 and 100 (based on the piece-wise linear model) OR an estimate between 240 and 260 (based on the exponential model) |

1. From Smarterbalanced.org. Grade 11, Claim 1, Target M Item Specifications. Internet. Available from <http://www.smarterbalanced.org/smarter-balanced-assessments/>; accessed 11/2015. [↑](#footnote-ref-1)
2. From Smarterbalanced.org. Grade 11, Claim 1, Target E Item Specifications. Internet. Available from <http://www.smarterbalanced.org/smarter-balanced-assessments/>; accessed 11/2015. [↑](#footnote-ref-2)
3. From Smarterbalanced.org. Grade 11, Claim 4 Item Specifications. Internet. Available from <http://www.smarterbalanced.org/smarter-balanced-assessments/>; accessed 11/2015. [↑](#footnote-ref-3)
4. From Smarterbalanced.org. Grade 11, Claim 2 Item Specifications. Internet. Available from <http://www.smarterbalanced.org/smarter-balanced-assessments/>; accessed 11/2015. [↑](#footnote-ref-4)
5. Adapted from Smarterbalanced.org. Grade 11, Claim 1, Target E Item Specifications. Internet. Available from <http://www.smarterbalanced.org/smarter-balanced-assessments/>; accessed 11/2015. [↑](#footnote-ref-5)
6. From Smarterbalanced.org. Grade 11, Claim 4 Item Specifications. Internet. Available from <http://www.smarterbalanced.org/smarter-balanced-assessments/>; accessed 11/2015. [↑](#footnote-ref-6)