Name:____________________

11 U4 - Exponential Functions Assessment

K ____/15 C ____/8 A ___/21

Written Solutions: Provide clear solutions to the following 13 problems. You will receive a ***Communications grade, out of 6*** for how well your math is presented.

1. Evaluate. Express your answer in rational form. **(#1-4 - 2pts each) K ___/8**

   $-9^{-2} + \left(\frac{9^1}{6^2}\right)^{-1}$

2. Simplify the expression. Express your answer with positive exponents.

   $\frac{a^5 b^{-3}}{(a^2 b^{-3})^4}$

3. Simplify the expression. Express your answer with positive exponents.

$$\left(\frac{\left(3x^{-2}\right)^{5}\left(9y^{3}\right)}{(3x)^{3}\left(6y^{-4}\right)^{4}}\right)^{-2}$$

4. Simplify the expression. Express your answer with positive exponents.

$$\frac{\sqrt[3]{729w^{-6}}}{\sqrt{625w^{-4}}}$$

5. State all transformations applied to "construct" the function $y = -3\left(2^{x+6}\right) - 1$. **K ___/2**

6. A cup of delicious tea was left to cool in a room whose temperature was 20°C. The temperature of the tea changes (cools) according to the function $T(t) = 95\left(\frac{1}{2}\right)^{\frac{t}{60}} + 20$, where t is in minutes. Determine the temperature of the liquid after:
 i) 60 minutes, ii) 90 minutes, iii) 3 hours **K ___/3**

   Explain the meaning of the y-intercept and the horizontal asymptote in the context of this problem. **C ___/2**

7. A baker records the internal temperature of an apple pie that has been left to cool on a counter. The room temperature is 21°C. An equation that models this situation is $T(t) = 83(0.5)^{\frac{t}{20}} + 21$ where T is the temperature in degrees Celsius and t is the time in minutes. Determine the temperature, to the nearest degree, of the pie after 25 minutes. How much time did it take for the pie to reach an internal temperature of 40°C? **A ___/3**

   What is the very best “side” you can have with a slice of warm apple pie? (lots of people will say “a scoop of ice cream” - there is something much much better.)

8. A car loses its value each month after it is purchased. Its value as a function of time, in months, is modelled by $V(m) = 28500(0.945)^m$.
   What is the rate of depreciation? **K ___/1**
   What is the value of the car after 10 months? **K ___/1**
   In which month after it is purchased does the car's value fall below $10,000? **A ___/2**

9. The population of a city has grown at an annual rate of approximately 1.6%.
   Write an exponential function which will describe the town's population over time. **A ___/2**
   How long will it take for its population of 125 500 people to double at this growth rate? **A ___/3**

10. In 2021, a sum of $10,000 is invested at a rate of 5.4% per year for 10 years. What is the value of the investment when it matures (at the end of 10 years)? **A ___/3**

11. A 450*g* sample of plutonium-238 has a half-life of 88 years. Determine a function describing this situation. How long will it take for this sample to decay to 100*g*? **A ___/3**

12. The doubling time for a certain type of bacteria is 6 h. Determine a function that describes number of bacterium after *t* hours. **A ___/1**
Determine the number of bacteria after 12 and 36 hours if there were 3000 bacteria initially. **A ___/2**
Without medical intervention a human might die if ther are one million bacteria in their body. How long does the patient have to get the medical attention they need? **A ___/2**