BECA / IB Math 5 Exponential functions Name:
4 March 2022

5.8 Classwork: Applications of exponential functions

I can calculate continuous compounding CCSS.HSF.LE.A.2

$FV = PV \times \left(1 + \frac{r}{100k}\right)^{kn}$ where FV is the future value,
PV is the present value, n is the number of years,
k is the number of compounding periods per year,
r% is the nominal annual rate of interest

1. Do Now: A six year investment of $25,000 earns an annual interest rate of 6.125%.

   (a) Find the future value at maturity (after 6 years) with annual compounding.

   (b) Find the value at maturity with monthly compounding.

2. A rabbit population doubles every 4 weeks. There are currently five rabbits in a restricted area. With t representing time, in weeks, then the population of rabbits can be modeled by

$$P(t) = A \times b^{t/4}$$

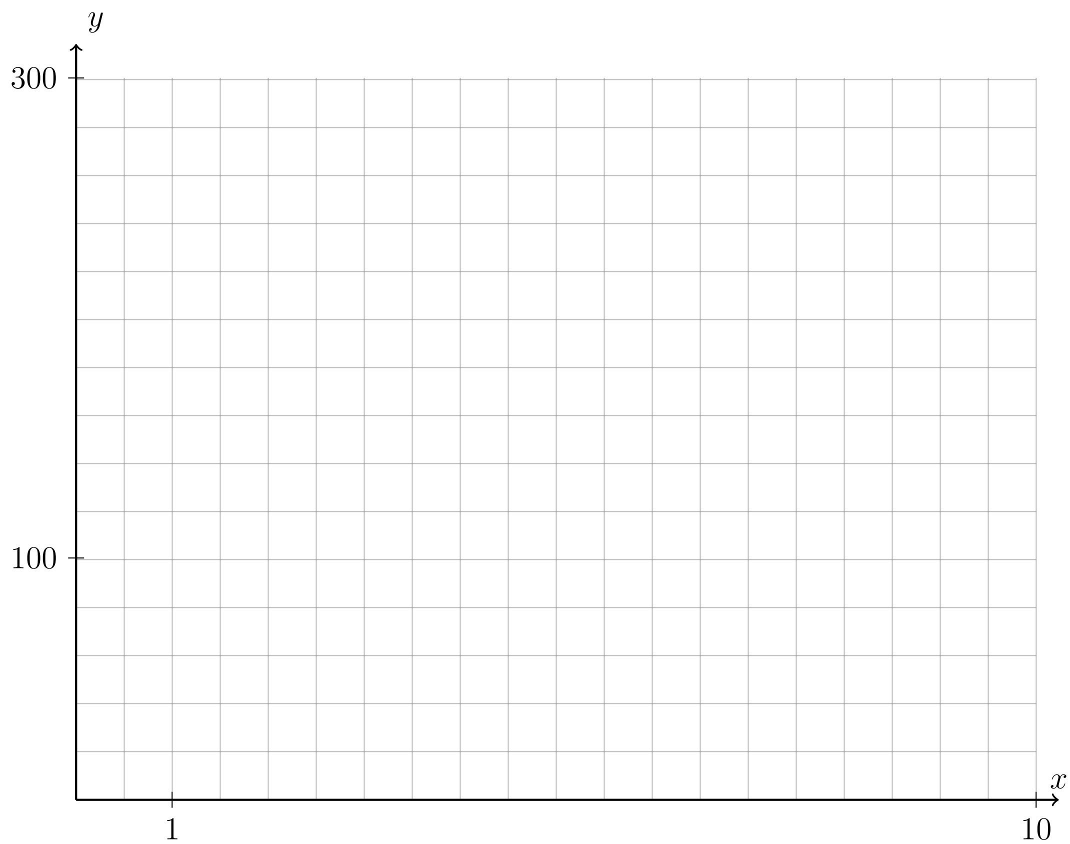
   (a) Write down the value of A

   (b) Write down the value of b

   (c) About how many rabbits will there be in 98 days?

   (d) After how many weeks will there be approximately 160 rabbits?

3. Graph $y = 300(0.89)^{2x} - 10$ on the set of axes below.



4. Researchers in a local area found that the population of rabbits with an initial population of 20 grew continuously at the rate of 5% per month. The fox population had an initial value of 30 and grew continuously at the rate of 3% per month.

   Find, to the *nearest tenth of a month*, how long it takes for these populations to be equal.

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5. In New York State, the minimum wage has grown exponentially. In 1966, the minimum wage was \$1.25 an hour and in 2015, it was \$8.75. Algebraically determine the rate of growth to the *nearest percent*.

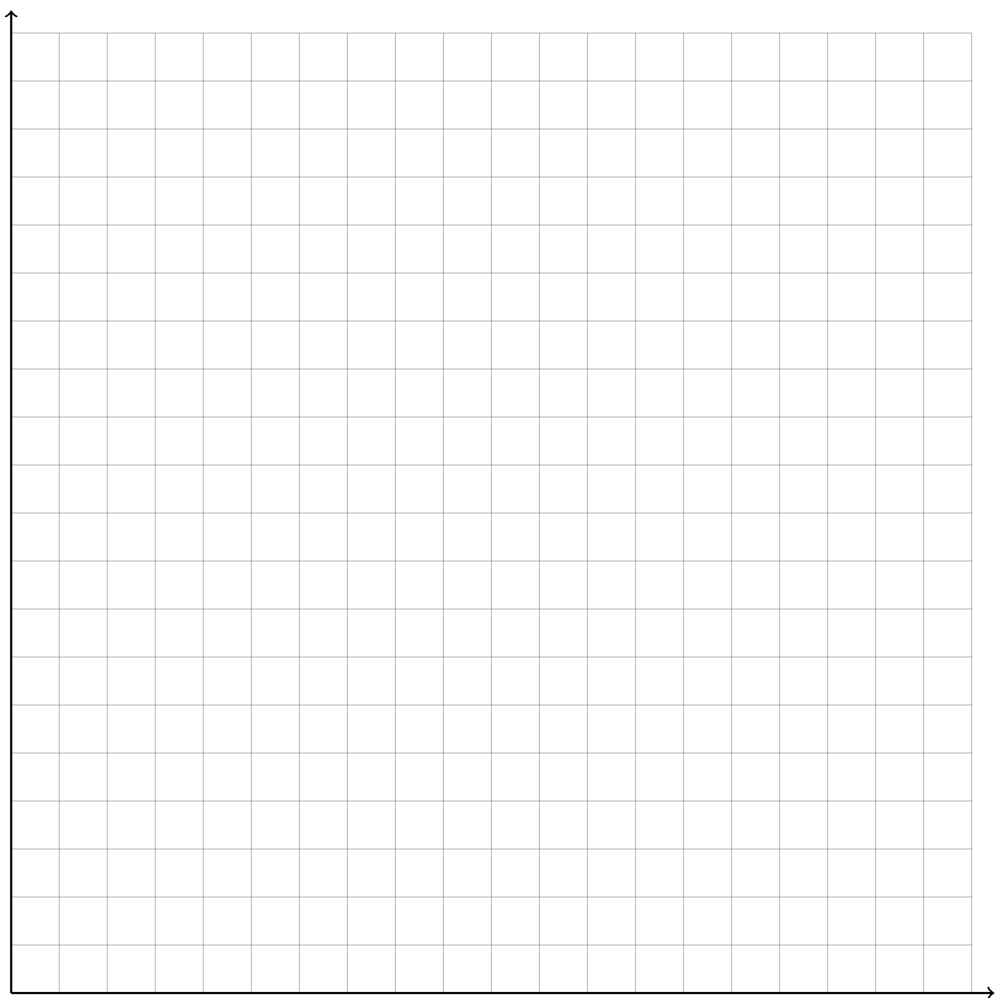
6. Jim is looking to buy a vacation home for \$172,600 near his favorite southern beach. The formula to compute a mortgage payment, M, is $M = P \cdot \dfrac{r(1+r)^N}{(1+r)^N - 1}$ where P is the principal amount of the loan, r is the monthly interest rate, and N is the number of monthly payments. Jim's bank offers a monthly interest rate of 0.305% for a 15-year mortgage.

   With no down payment, determine Jim's mortgage payment, rounded to the nearest dollar.

   Algebraically determine and state the down payment, rounded to the *nearest dollar*, that Jim needs to make in order for his mortgage payment to be \$1100.

7. The value of a certain small passenger car based on its use in years is modeled by $V(t) = 28482.698(0.684)^t$, where $V(t)$ is the value in dollars and t is the time in years. Zach had to take out a loan to purchase the small passenger car. The function $Z(t) = 22151.327(0.778)^t$, where $Z(t)$ is measured in dollars, and t is the time in years, models the unpaid amount of Zach's loan over time.

   Graph $V(t)$ and $Z(t)$ over the interval $0 \leq t \leq 5$, on the set of axes below.



   State when $V(t) = Z(t)$, to the *nearest hundredth*, and interpret its meaning in the context of the problem.

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8. The expression $\left(\dfrac{m^2}{m^{\frac{1}{3}}}\right)^{-\frac{1}{2}}$ is equivalent to

   (a) $-\sqrt[6]{m^5}$

   (b) $\dfrac{1}{\sqrt[6]{m^5}}$

   (c) $-m\sqrt[5]{m}$

   (d) $\dfrac{1}{m\sqrt[5]{m}}$

9. An equation to represent the value of a car after t months of ownership is $v = 32,000(0.81)^{\frac{t}{12}}$. Which statement is *not* correct?

   (a) The car lost approximately 19% of its value each month.

   (b) The car maintained approximately 98% of its value each month.

   (c) The value of the car when it was purchased was $32,000.

   (d) The value of the car 1 year after it was purchased was $25,920.

10. The function below models the average price of gas in a small town since January 1st.

$$G(t) = -0.0049t^4 + 0.0923t^3 - 0.56t^2 + 1.166t + 3.23, \text{ where } 0 \le t \le 10.$$

If $G(t)$ is the average price of gas in dollars and t represents the number of months since January 1st, the absolute maximum $G(t)$ reaches over the given domain is about what value, to the nearest cent?