6. The difference quotient of a function \( f \) is \( \frac{f(x+h) - f(x)}{h} \). Find and completely simplify the difference quotient for the function \( f(x) = 2x^2 + 1 \). 8pts

**Answer:**

7. Suppose a population of mice starts at 600 and in 6 months increases to 1200. Using the population model \( A = A_0e^{kt} \), where \( t \) is the time in months, find \( A_0 \) and \( k \). If necessary, you may leave your answer in terms of logarithms. 8pts

**Answer:** \( A_0 = \), \( k = \)
8. Solve algebraically for \( x \) the equation \( \log_2(3x + 5) - \log_2 x = 3 \). 

9. Recently you purchased 45 stamps for $12.40. The stamps were a combination of $0.20 for postcards and $0.37 for first class letters. Set a system of equations to describe this. Be sure to define your variables. **Do not solve this system.**

10. Solve the following system of equations.

\[
\begin{align*}
2x + 3y &= -7 \\
-x + y &= 1
\end{align*}
\]

**Answer:** \( x = \) \( y = \)
Log Rules
\[ y = \log x, x \leftrightarrow b^y = x \]
\[ \log(MN) = \log_M + \log_N \]
\[ \log\left(\frac{M}{N}\right) = \log_M - \log_N \]
\[ \log(M^N) = N \log_M \]
\[ \log_M = \frac{\log_M}{\log_b} \quad \text{for any } a > 0, b \neq 1 \]
\[ \log_{10} x = y \]
\[ \log_{10} e = x \]
\[ 10^{y} = x \]
\[ \ln x = x \]
\[ e^x = x \]
\[ \text{Quadratic Equation} \]
\[ f(x) = ax^2 + bx + c \rightarrow \text{vertex} = \left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right) \]
\[ f(x) = a(x-h)^2 + k \rightarrow \text{vertex} = (h, k) \]
\[ \text{minimum if } a > 0, \text{ maximum if } a < 0 \]
\[ \text{Quadratic Formula} \]
\[ ax^2 + bx + c = 0 \rightarrow x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \]
\[ \text{Discriminant: } b^2 - 4ac \]
\[ \text{Completing the Square} \]
\[ x^2 + bx + c = d \rightarrow x^2 + bx + \left(\frac{b}{2}\right)^2 = \left(\frac{b}{2}\right)^2 + d - c \]
\[ \text{Variation} \]
\[ y = kx \]
\[ \text{Inverse: } y = \frac{1}{x} \]
\[ \text{Join: } y = kx \]
\[ \text{Combined: } y = \frac{kx}{x} \]
\[ \text{Common Formula} \]
\[ \text{Area of a square: } A = s^2 \]
\[ \text{Perimeter of a square: } p = 4s \]
\[ \text{Area of a rectangle: } A = lw \]
\[ \text{Perimeter of a rectangle: } p = 2l + 2w \]
\[ \text{Area of a Circle: } A = \pi r^2 \]
\[ \text{Perimeter of a Circle: } C = 2\pi r = \pi d \]
\[ \text{Area of a Trapezoid: } A = \frac{1}{2} h(a+b) \]
\[ \text{Area of a Triangle: } A = \frac{1}{2} bh \]
\[ \text{Distance Formula} \]
\[ \text{between } (x_1, y_1) \text{ and } (x_2, y_2) \]
\[ D = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2} \]
\[ \text{Midpoint between } (x_1, y_1) \text{ and } (x_2, y_2) \]
\[ \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right) \]
\[ \text{Circle with radius } r \text{ and center } (h, k) \]
\[ (x-h)^2 + (y-k)^2 = r^2 \]
\[ \text{Interest} \]
\[ \text{Compound: } A = P\left(1 + \frac{r}{n}\right)^{nt} \]
\[ \text{Compounded Continuously: } A = Pe^{rt} \]
\[ \text{Absolute Value} \]
\[ |x| = c \leftrightarrow x = \pm c, \ c > 0 \]
\[ |x| < c \leftrightarrow -c < x < c, \ c > 0 \]
\[ |x| > c \leftrightarrow x < -c \text{ or } x > c, \ c > 0 \]
\[ \text{Average Rate of Change} \]
\[ \frac{f(x_2) - f(x_1)}{x_2 - x_1} \]
Exponential Growth and Decay
\[ A = f(t) = Ae^{rt} \]

Logarithmic Model/Logistic Growth
\[ A = f(t) = \frac{C}{1 + Ae^{-rt}} \]

Line Equations
Slope: \[ m = \frac{y_2 - y_1}{x_2 - x_1} \]
General Form: \[ Ax + By + C = 0 \]
Point-Slope Form: \[ y - y_1 = m(x - x_1) \]
Slope-Intercept Form: \[ y = mx + b \]

Factoring of 2 Cubes
\[ a^3 + b^3 = (a + b)(a^2 - ab + b^2) \]
\[ a^3 - b^3 = (a - b)(a^2 + ab + b^2) \]

Functions
Even: \[ f(-x) = f(x) \] for all \( x \) in the domain of \( f \)
Odd: \[ f(-x) = -f(x) \] for all \( x \) in the domain of \( f \)
Composition: \[ (f \circ g)(x) = f(g(x)) \]

Inverse of a Function
If \( f(x) = y \), then \( f^{-1}(y) = x \) for \( y \) in the domain of \( f \)

To find: Replace \( x \) with \( y \) and solve for \( y \).

Polynomials
End behavior: If the degree of the function is even and the leading coefficient is positive, the graph will rise both to the left and to the right. If even and the coefficient is negative, the graph will fall both to the left and the right. If odd and the leading coefficient is positive, the graph will rise to the right and fall to the left. If odd and the leading coefficient is negative, the graph will fall to the right and rise to the left.

Rational Functions
Vertical Asymptotes: Simplify the function, then \( x = a \) is a vertical asymptote if \( a \) is a zero of the denominator.
Horizontal Asymptote: Let \( f(x) = \frac{a_n x^n + \cdots + a_0}{b_m x^m + \cdots + b_0} \)
If \( n > m \), there is no horizontal asymptote.
If \( m > n \), the horizontal asymptote is \( y = \frac{a_n}{b_m} \).
If \( m = n \), the horizontal asymptote is \( y = \frac{a_n}{b_m} \).

Rules of Exponents
\[ b^{-r} = \frac{1}{b^r} \]
\[ b^{-r} \cdot b^r = b^{r-r} = b^0 \]
\[ \left( b^r \right)^r = b^{r \cdot r} = b^{r^2} \]
\[ (ab)^r = a^r b^r \]

Order of Transformations
1. Horizontal Shift
\[ y = f(x - c) \] shifts right \( c \) units
\[ y = f(x + c) \] shifts left \( c \) units
2. Vertical Stretch/Shrink
\[ y = cf(x), c > 0 \] shrinks by a factor of \( c \)
\[ c < 1 \] shrinks by a factor of \( c \)
3. Reflections
\[ -f(x) \] reflects over \( x \)-axis
\[ f(-x) \] reflects over \( y \)-axis
4. Vertical Shift
\[ f(x) + c \] shifts up \( c \) units
\[ f(x) - c \] shifts down \( c \) units

Multiplicity: If \( r \) is a zero of odd multiplicity, then the graph crosses the \( x \)-axis at \( r \). If \( r \) is a zero with even multiplicity, then the graph only touches the \( x \)-axis.

Remainder Theorem: If the polynomial \( f(x) \) is divided by \( x - c \), then the remainder is \( f(c) \).

Factor Theorem: Let \( f(x) \) be a polynomial.
Then \( f(c) = 0 \) if and only if \( x - c \) is a factor of \( f(x) \).