1: You invest $1000 in an account yielding 4% compounded continuously. When will the account reach $1500?

\[ A = Pe^{rt} \]
\[ 1500 = 1000e^{0.04t} \]
\[ \ln(1.5) = 0.04t \]
\[ t = \frac{\ln(1.5)}{0.04} = 10.14 \text{ years} \]

2: Show that the geometric sum \( S = a + ar + ar^2 + \cdots + ar^{n-1} \) satisfies \( S = \frac{a - ar^n}{1 - r} \).

\[ S = a + ar + ar^2 + \cdots + ar^{n-1} \]
\[ -rS = ar + ar^2 + \cdots + ar^{n-1} + ar^n \]
\[ (1 - r)S = a - ar^n \]
\[ S = \frac{a - ar^n}{1 - r} \]

3: You want to start saving for a house. You decide that you will wait until you can save $30,000 for a down payment. You put $800 per month into an account yielding 3% compounded monthly. How long will it take to have enough for a down payment?

\[ d = 800 \]
\[ i = \frac{0.03}{12} = 0.0025 \]
\[ A = 30,000 \]
\[ N = ? \]

\[ \frac{30,000}{800} (1.0025^n - 1) \]
\[ 1.09375 = (1.0025)^n \]
\[ \ln(1.09375) = n \ln(1.0025) \]
\[ n = \frac{\ln(1.09375)}{\ln(1.0025)} = 35.89 \]

It will take 36 months to save enough for a down payment.