1) Let $f(x) = x^2 - 2x - 63$ with a domain of all real $x \in [-\infty, -2]$. Prove that f is injective. What is the range of f? (You may either use Calculus or complete the square to prove your answers.)

2) Find $f^{-1}(x)$ for the function given in question #1.

3) Let A be a set of 8 elements and B be a set of 12 elements. How many functions can be defined with the domain of A and the co-domain of B?

4) Let $f(x) = \sqrt{20x - x^2}$ and g(x) = 7x - 6. Determine $h_1(x) = f(g(x))$ and $h_2(x) = g(f(x))$. What are the largest possible domains for which functions $h_1(x)$ and $h_2(x)$ can be defined?

5) Original Version:

Let $f(x) = \frac{a}{x+a}$, where a is a non-zero constant. Let $f^n(x)$ to be the function f composed with itself n times. (For example, $f^3(x) = f(f(f(x)))$.) Using trial and error, conjecture a guess for $f^n(x)$ and use mathematical induction to prove that guess. Your guess should be a closed form without any summations in it. The constants/variables that should appear in your guess are a, b, n and x. (Note: this question is pretty hard, so don't worry if you don't get it.)

PLEASE DO NOT DO THIS VERSION, IT'S TOO HARD. YOU MAY JUST SKIP THE QUESTION WITH NO PENALTY. IF YOU WANT A DOABLE QUESTION FOR PRACTICE, REPLACE THE FUNCTION WITH THIS ONE:

$$f(x) = \frac{1}{x+1}$$

6) Sandra normally takes 2 hours to drive from her house to her grandparents' house driving her usual speed. However, on one particular trip, after 40% of the drive, she had to reduce her speed by 30 miles per hour, driving at this slower speed for the rest of the trip. This particular trip took her 228 minutes. What is her usual driving speed, in miles per hour?

7) Give a summary of the life and academic contributions of Emilie du Chatelet. Please aim for a length of roughly 200 - 400 words. **Your summary must be typed.** Please state the sources you used in writing your summary.