1. Show all of your work as you use the Extended Euclidean Algorithm to find an \( x \) in \( 0 \leq x < 221 \) for which \( 73x \equiv 1 \pmod{221} \). (Hint: The answer is \( x = 109 \). This question is really asking whether you have learned the Extended Euclidean Algorithm.)

2. Show all of your work as you solve the congruence

\[
17x \equiv 14 \pmod{21}.
\]

Find (a) all solutions \( x \) modulo 21 and (b) all integer solutions \( x \). (Hint: ONE answer to ONE part is \( x = -14 \). This question is really asking whether you have learned how to solve linear congruences. ANSWER PARTS (a) and (b) SEPARATELY.)

3. In 1962, Rosser and Schoenfeld proved explicit inequalities for \( \pi(x) \) and other functions related to prime numbers. Corollary 3 of Theorem 2 of their paper says that

\[
0.6x / \ln x < \pi(2x) - \pi(x) < 1.4x / \ln x
\]

for all \( x \geq 20.5 \). Use this formula to estimate the number of 512-bit primes and the number of 1024-bit primes. Give an upper and lower bound for each number. Give the four answers to at least two significant figures.