Determine the number of incongruent solutions for each of the following congruences.

a) \( 72x \equiv 47 \pmod{200} \)

We first find the \( \gcd(72, 200) \) to see if it divides 47. If not then we have no solutions, if it does then we will have the same number of solutions as the \( \gcd \).

We find the \( \gcd \) through maple to be 8.
Since 8 does not divide 47, we will have no solutions.

b) \( 4183x \equiv 5781 \pmod{15887} \)

So, we once again find the \( \gcd(4183, 15887) \), then divide by 5781 to see if we will have solutions or not.

We find the \( \gcd \) through maple to be 47.
We find that \( 47 \div 5781 = 123 \) therefore this congruency will have 123 incongruent solutions.

c) \( 1537x \equiv 2863 \pmod{6731} \)

Same idea as before.
We find the \( \gcd(1537, 6731) \) through maple to be 53.
Since 53 does not divide 2863, we will have no solutions here as well.
Extension: Let’s look at a random example, not given in the book, and see how it works out.

\[ 51x = 22 \pmod{29} \]

So first we of course find the \( \gcd(51,29) \). For a little change, we do it out by hand rather than with the use of Maple.

\[
51 = 29 \cdot 1 + 22 \\
29 = 22 \cdot 1 + 7 \\
22 = 7 \cdot 3 + 1 \\
7 = 1 \cdot 7 + 0
\]

So we find 1 to be our \( \gcd \).

One will of course divide 22, so we will have one incongruent solution.
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> restart;
> gcd(72, 200); 8
> gcd(4183, 15087); 47
> gcd(1537, 6731); 53