5. (a) 5286 = 278 \cdot 19 + 4 \text{ so } q = 278 \text{ and } r = 4.
(b) -5286 = -279 \cdot 19 + 15 \text{ so } q = -279 \text{ and } r = 15.
(c) 5286 = 278(-19) + 4 \text{ so } q = -278 \text{ and } r = 4.
(d) -5286 = 279(-19) + 15 \text{ so } q = 279 \text{ and } r = 15.

8. (a) The domain of \( f \) is \( \mathbb{Z} \), the integers. The range of \( f \) is all of the possible remainders, \( \{0, 1, 2, \ldots, n - 1\} \).
(b) \( f \) is not one-to-one because \( f(0) = 0 \) since \( 0 = 0 \cdot n + 0 \) and \( f(n) = 0 \) since \( n = 1 \cdot n + 0 \). Thus \( f(0) = f(n) \) but \( 0 \neq n \).
(c) \( f \) is not onto because the range \( \{\{1, 2, \ldots, n - 1\} \} \) is not equal to the target \( \mathbb{N} \cup \{0\} \).

10. (b) Begin in the following way.

\[
\begin{align*}
57483 & = 28741 \cdot 2 + 1 \\
28741 & = 14370 \cdot 2 + 1 \\
14370 & = 7185 \cdot 2 + 0 \\
7185 & = 3592 \cdot 2 + 1 \\
3592 & = 1796 \cdot 2 + 0 \\
1796 & = 898 \cdot 2 + 0 \\
898 & = 449 \cdot 2 + 0 \\
449 & = 224 \cdot 2 + 1 \\
224 & = 112 \cdot 2 + 0 \\
112 & = 56 \cdot 2 + 0 \\
56 & = 28 \cdot 2 + 0 \\
28 & = 14 \cdot 2 + 0 \\
14 & = 7 \cdot 2 + 0 \\
7 & = 3 \cdot 2 + 1 \\
3 & = 1 \cdot 2 + 1 \\
1 & = 0 \cdot 2 + 1 \\
\end{align*}
\]

Then the binary representation is the remainders written in the reverse order:

\[
(57483)_{10} = (11100000100010111)_{2}
\]

We can find the octal representation in a similar way or we can use the binary representation. Notice that the binary representation tells us that

\[
57483 = 2^{15} + 2^{14} + 2^{13} + 2^{7} + 2^{3} + 2^{1} + 2^{0}.
\]

Remember that \( 8 = 2^3 \), so rewrite in terms of \( 2^3 \).

\[
\begin{align*}
57483 & = (2^3)^5 + 2^2 \cdot (2^3)^4 + 2 \cdot (2^3)^4 + 2 \cdot (2^3)^2 + (2^3) + (2 + 1) \\
& = 8^5 + (4 + 2) \cdot 8^4 + 2 \cdot 8^2 + 8^1 + 3 \cdot 8^0 \\
& = (160213)_{8}
\end{align*}
\]
To get the hexadecimal representation, use the fact that $16 = 2^4$. Recall that in hexadecimal, 10 is represented by $A$, 11 by $B$, 12 by $C$, 13 by $D$, 14 by $E$, and 15 by $F$.

\[
57483 = 2^{15} + 2^{14} + 2^{13} + 2^7 + 2^3 + 2^1 + 2^0
\]

\[
= 2^3 \cdot (2^4)^3 + 2^2 \cdot (2^4)^3 + 2 \cdot (2^4)^3 + 2^3 \cdot (2^4)^1 + (2^3 + 2^1 + 2^0)
\]

\[
= (8 + 4 + 2)16^3 + 8 \cdot 16^1 + (8 + 2 + 1)16^0
\]

\[
= (F08B)_{16}
\]

(c) $185,178 = (10110100110101010)_{2} = (551532)_{8} = (2B35A)_{16}$.

From 4.1:

9. (b) This statement is false. Let $a = 6$, $b = 24$, and $c = 8$. Then $a|b$ and $c|b$ but $ac = 48 \neq b$.

(c) This statement is true. If $a|b$, then $b = ak$ for some integer $k$. So $bc = (ak)c = a(kc)$ and $kc$ is an integer so $a|bc$.

11. (j) In this case, $b$ is larger than $a$, so we start with $b$. The Euclidean algorithm gives:

\[
54,321 = 4 \cdot 12,345 + 4941
\]

\[
12,345 = 2 \cdot 4941 + 2463
\]

\[
4941 = 2 \cdot 2463 + 15
\]

\[
2463 = 164 \cdot 15 + 3
\]

\[
15 = 5 \cdot 3 + 0
\]

The last nonzero remainder is 3 so $gcd(12345, 54321) = 3$. To write 3 as a linear combination of $a$ and $b$, reverse the algorithm.

\[
3 = 2463 - 164 \cdot 15
\]

\[
= 2463 - 164(4941 - 2 \cdot 2463)
\]

\[
= 329 - 2643 - 164 \cdot 4941
\]

\[
= 329(12345 - 2 \cdot 4941) - 164 - 4941
\]

\[
= 329 \cdot 12345 - 822 \cdot 4941
\]

\[
= 329 \cdot 12345 - 822(54321 - 4 \cdot 12345)
\]

\[
= 3617 \cdot 12345 - 822 \cdot 54321
\]