1. **S3.4, Exercise 6:** Show that if $a, b, c$, and $d$ are integers such that $a|c$ and $b|d$, then $ab|cd$.

   If $a|c$, then there exists an integer $m$ such that $am = c$, and if $b|d$, then there exists an integer $n$ such that $bn = d$. Then $cd = (am)(bn) = (mn)(ab)$, and thus $ab|cd$.

2. **S3.4, Exercise 24:** Prove that if $n$ is an odd positive integer, then $n^2 \equiv 1 \pmod{8}$.

   If $n$ is odd, we can write $n = 2k + 1$ for some integer $k$. Then $n^2 = (2k + 1)^2 = 4k^2 + 4k + 1$. To show that $n^2 \equiv 1 \pmod{8}$, it is sufficient to show that $8|(n^2 - 1)$. We have that $n^2 - 1 = 4k^2 + 4k = 4k(k + 1)$. Now, we have two cases to consider: if $k$ is even, there is some integer $d$ such that $k = 2d$. Then $n^2 - 1 = 4(2d)(2d + 1) = 8d(d + 1)$, and clearly this is divisible by 8 since it is a multiple of 8. If $k$ is odd, then there is some integer $d$ such that $k = 2d + 1$. Then $n^2 = 4(2d + 1)(2d + 2) = 8(2d + 1)(d + 1)$, and again, this is divisible by 8. Thus, in both cases, $n^2 - 1$ is divisible by 8, so $n^2 \equiv 1 \pmod{8}$. 