2.) a.) $\gcd(2, 10) = 2$, $\operatorname{lcm}(2, 10) = 10$

b.) $\gcd(20, 8) = 4$, $\operatorname{lcm}(20, 8) = 40$

c.) $\gcd(12, 40) = 4$, $\operatorname{lcm}(12, 40) = 120$

d.) $\gcd(21, 50) = 1$, $\operatorname{lcm}(21, 50) = 1050$

e.) $\gcd(p^2q^2, pq^3) = pq^2$, $\operatorname{lcm}(p^2q^2, pq^3) = p^2q^3$

7.) Let $a, b \in \mathbb{Z}$ and $n \in \mathbb{N}$. Assume $a \equiv b \pmod{n}$, thus $a = b + kn$ for some $k \in \mathbb{Z}$. $a = b + kn \implies a - b = kn \implies n \mid a - b$, thus $a \equiv b \pmod{n} \implies n \mid a - b$.

Next, assume $n \mid a - b$, thus $ln = a - b$ for some $l \in \mathbb{Z}$. $ln = a - b \implies a = b + ln \implies a \equiv b \pmod{n}$, thus $n \mid a - b \implies a \equiv b \pmod{n}$,

Thus $a \equiv b \pmod{n} \iff n \mid a - b$. Q.E.D.

18.) $8^1 \equiv 3 \pmod{5}$, $8^2 \equiv 4 \pmod{5}$, $8^3 \equiv 2 \pmod{5}$, $8^4 \equiv 1 \pmod{5}$, $8^5 \equiv 3 \pmod{5}$, thus $8^{402} \equiv (8^4)^{100} \times 8^2 \equiv 1^{100} \times 4 \equiv 4 \pmod{5}$

58.) Define a relation $R$ on $\mathbb{R}$ where $a \sim b \implies a - b \in \mathbb{Z}$ for $a, b \in \mathbb{R}$. Since for all $a \in \mathbb{R}$, $a - a = 0$, we know that $a \sim a$, thus $R$ is reflexive.

Next, assume $a \sim b$, thus $a - b \in \mathbb{Z}$. Let $n = a - b$; $n = a - b \implies -n = -(a - b) = b - a$. Since $n \in \mathbb{Z} \implies -n \in \mathbb{Z}$, we know that $b \sim a$, thus $R$ is symmetric. ***

60.) awd