11A.

a ① reflexive. $\forall (a,b) \in \mathbb{Z}\times\mathbb{Z}$, $\frac{b-a}{n} \in \mathbb{Z}$, $(\frac{b-a}{n}, \frac{b-a}{n}) \in \mathbb{Z}$.

② symmetric. $\forall (a,b) \in \mathbb{Z}\times\mathbb{Z}$, $\frac{b-a}{n} \in \mathbb{Z}$ $(\frac{b-a}{n} \cdot b\text{-}a) \in \mathbb{Z}$

③ transitive. $\forall (a,b) \in \mathbb{Z}\times\mathbb{Z}$, $(\frac{b-a}{n}, a') \in \mathbb{Z} \Rightarrow (\frac{b-a}{n}, b) \in \mathbb{Z}$.

b. i). $\frac{(b+b')-(a+a')}{n} = \frac{b+b'-a-a'}{n} = \frac{b-a'+b-a}{n}$

$= \frac{b'-a'}{n} + \frac{b-a}{n} = \frac{b+b-(a+a)}{n} \in \mathbb{Z}$.

So if $a \equiv b \pmod{n}$ and $(a' \equiv b')$, $a+a' \equiv (b+b') \pmod{}$ is true.

ii). $(\frac{b-a}{n}) \times a' = \frac{ba'-aa'}{a'n} \in \mathbb{Z}$

$\Rightarrow \frac{ba'-aa'}{n} \in \mathbb{Z} \cdot a'$

$\Rightarrow \frac{ba'-aa'}{n} \in \mathbb{Z}$

$(\frac{b'-a'}{n}) \times b = \frac{bb'-a'b}{nb} \in \mathbb{Z}$

$\Rightarrow \frac{bb'-a'b}{n} \in \mathbb{Z} \cdot b$

$\Rightarrow \frac{bb'-ba'}{n} \in \mathbb{Z}$

$\frac{ba'-aa'}{n} + \frac{bb'-ba'}{n} = \frac{bb'-aa'}{n} \in \mathbb{Z}$.

$\therefore a \times a' \equiv b \times b' \pmod{n}$.

iii) $\because$ $b-a \in \mathbb{Z}$

$\therefore b+a \in \mathbb{Z}$.

$(b-a)(b+a) = b^2-a^2$

$(b^2-a^2)(b^2+a^2) = b^4-a^4$.

$\cdots$

$\therefore a^c \equiv b^c \pmod{n}$.

c. ~~$4^6 \equiv 1 \pmod 7$~~

~~$4^4 \equiv 4 \pmod 7$~~

~~$4^6 \times 4^4 = 1 \times 4$~~

~~$4^{10} = 4$~~

~~$4^{10} \times 4^{10} = 16$~~

$\frac{1-4^6}{7} = -585$

$\frac{1-4^{1000}}{7} \in \mathbb{Z}$.

$\because a^c \equiv b^c \pmod{n}$

$\therefore r = 1$