Q1

(a) The relation is reflexive. Since for all $(a,a) \in \mathbb{Z}^+ \times \mathbb{Z}^+$, (a,a) is in R_1.

The relation is transitive. Assume that (a,b) and (b,c) are in R_1, then we can have $\frac{1}{a} \leq \frac{1}{b}$, $\frac{1}{b} \leq \frac{1}{c}$. So $\frac{1}{a} \leq \frac{1}{c}$ and (a,c) is in R_1.

The relation is not symmetric. We pick $a=2$, $b=1$, $(2,1)$ is in R_1 since $\frac{1}{2} \leq 1$, but $(1,2)$ is not in R_1 since $1 > \frac{1}{2}$.

The relation is antisymmetric. Assume that (a,b) and (b,a) are in R_1, that is $\frac{1}{a} \leq \frac{1}{b}$ and $\frac{1}{b} \leq \frac{1}{a}$, since, $a, b \in \mathbb{Z}^+$, $a \leq b$ and $b \leq a$, so $a=b$.

R_1 is neither partial order nor total order.

(b). R_2 is reflexive. Since for all $(a,a) \in \mathbb{Z}$, $|a-a| = 0 \leq 2$, so (a,a) is in R_2.

R_2 is not transitive. Assume that $a, b, c \in \mathbb{Z}$ that $c = a+4$, $b = a+2$ (c,b), (b,a) are in R_2 since $|c-b| = 2 \leq 2$, $|b-a| = 2 \leq 2$. However, $|c-a| = 4 > 2$, so (c,a) is not in R_2.

R_2 is symmetric. Assume that $(a,b) \in R_2$. So there exist $k \in \mathbb{Z}$ and $k \in [0,2]$ that $|a-b| = k$. Since $|b-a| = k$, $(b,a) \in R_2$

R_2 is neither partial order nor total order.

(c)