Solutions 3.

1.) $\rho \subseteq \{1,2,3\} \times \{1,2,3\}$

a.) $\rho = \{(1,1); (1,2); (1,3); (2,1); (2,2); (2,3); (3,1); (3,2); (3,3)\}$

R: ✓ ; S: ✓ ; A: ✗ ; T: ✓

b.) $\rho = \{(1,1); (1,2); (1,3); (2,1); (2,2); (3,1); (3,3)\}$

R: ✓ ; S: ✓ ; A: ✗ ; T: ✗ $\quad ((1,1) \in \rho \wedge (1,3) \in \rho \Rightarrow (2,3) \notin \rho)$

c.) $\rho = \{(1,2); (1,3); (2,1); (3,1)\}$

R: ✗ ; S: ✓ ; A: ✗ ; T: ✗ $\quad ((1,2) \in \rho \wedge (2,1) \in \rho \Rightarrow (1,1) \notin \rho)$

d.) $\rho = \{(1,2); (2,3); (3,1)\}$

R: ✗ ; S: ✗ ; A: ✓ ; T: ✗

e.) $\rho = \{(1,2)\}$

R: ✗ ; S: ✗ ; A: ✓ ; T: ✓

f.) $\rho = \{(1,2); (2,1); (2,3); (3,2)\}$

R: ✗ ; S: ✓ ; A: ✗ ; T: ✗

g.) HW

h.) HW

3) a.) $R = \{(a,b) \in \mathbb{N} \times \mathbb{N} \mid a \cdot b \text{ is odd}\}$

$dmn(R) = \{\text{odd numbers}\}$

$rng(R) = \{\text{odd numbers}\}$

reflexive: ✗ ; e.g. $(2,2) \notin R$

irreflexive: ✗ ; e.g. $(1,1) \in R$

symm: ✓ , because multiplication is commutative ($a \cdot b$ is odd $\Rightarrow b \cdot a$ is odd)

anti-sym: ✗

transitive: ✓ ($a \cdot b$ is odd $\Rightarrow a$ is odd and b is odd; $b \cdot c$ is odd $\Rightarrow c$ is also odd $\Rightarrow a \cdot c$ is odd)

b.) $S \Leftrightarrow$ "<"

$dmn(S) = B \setminus \{\text{students with the longest names}\}$

$rng(S) = B \setminus \{\text{students with the shortest names}\}$

r: ✗

i: ✓

s: ✗

a: ✓

t: ✓

c.) HU

d.) HU

5.) a.) $\{(1,1), (2,2), (3,3), (4,4)\}$

b.) $\{(1,2)\}$

c.) $\{(1,2), (2,1)\}$

d.) $\{(1,1)\}$

e.) $\{(1,2), (2,1), (3,1)\}$

f.) HU

g.) HU