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page 581/3 relations on set $\{1, 2, 3, 4\}$

a) $\{(2,2), (2,3), (2,4), (3,2), (3,3), (3,4)\}$

- not reflexive because $(1,1)$ and $(4,4)$ are not present
- not symmetric because $(2,4)$ is present, but $(4,2)$ is not
- not antisymmetric because $(2,3)$ and $(3,2) \in R$, but $2 \neq 3$.
- $(2,3)$ & $(3,2)$ $\rightarrow$ $(2,2)$ ✓
  $(2,3)$ & $(3,3)$ $\rightarrow$ $(2,3)$ not of interest
  $(2,3)$ & $(3,4)$ $\rightarrow$ $(2,4)$ ✓
  $(2,4)$ & ... nothing
  $(3,2)$ & $(2,3)$ $\rightarrow$ $(3,3)$ ✓
  $(3,2)$ & $(2,4)$ $\rightarrow$ $(3,4)$ ✓
  $(3,4)$ & ... nothing

therefore, it is transitive

c) $\{(2,4), (4,2)\}$

- not reflexive because $(1,1), (2,2), (3,3), (4,4)$ are not present
- symmetric because $(2,4)$ and $(4,2)$ are present
- not antisymmetric because $(2,4), (4,2) \in R$, but $2 \neq 4$
- not transitive, because $(2,4)$ & $(4,2) \rightarrow (2,2)$ not present

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page 581 | 3 $R: A \to B$, $A = \{0,1,2,3,4\}$, $B = \{0,1,2,3\}$

b) $\{(1,1),(1,2),(2,1),(2,2),(3,3),(4,4)\}$

- reflexive, because all: $(1,1),(2,2),(3,3),(4,4)$ are present
- symmetric, because $(1,2)$ & $(2,1)$ are present
- not antisymmetric, because $(1,2), (2,1) \in R$, but $1 \neq 2$ ✓
- transitive, because $(1,2)$ & $(2,1) \to (1,1)$ present ✓

d) $\{(1,2),(2,3),(3,4)\}$

- not reflexive (no $(1,1),(2,2),(3,3),(4,4)$)
- not symmetric ($(1,2)$ but no $(2,1)$)
- antisymmetric $(1,2)$ but no $(2,1)$ ✓; $(2,3)$ but no $(3,2)$ ✓; $(3,4)$ but no $(4,2)$ ✓
- not transitive $(1,2)$ & $(2,3) \to (1,3)$ not present

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e) {(1,1), (2,2), (3,3), (4,4)}

- reflexive (all: (1,1), (2,2), (3,3), (4,4) are present)
- symmetric (no (a,b), where a ≠ b are present)
- antisymmetric (no (a,b) where a ≠ b are present)
- transitive (no "jumps" are present)

f) {(1,3), (1,4), (2,3), (2,4), (3,1), (3,4)}

- not reflexive (no (1,1), (2,2), (3,3), (4,4))
- not symmetric ((1,3) is present, but (3,1) is not)
- not antisymmetric (both (1,3) and (3,1) are present, but 1 ≠ 3)
- not transitive, (1,3) & (3,1) → (1,1) not present