Solutions

2.1

- $2^4 = 16$ ✓.

2.2

- Bijective – shifts never merge inputs and every integer is hit ✓.

2.3

- Symmetric about the diagonal: matrix = its transpose ✓.

3.1

- $A \cup B = \{1, 2, 3, 4, 6\}$: 5; $A \cap B = \{2, 4\}$: 2 ✓.
- $A - B = \{1, 3\}$: 2; $B - A = \{6\}$: 1 ✓.
- Check: $5 = 4 + 3 - 2$ ✓ – inclusion-exclusion holds.
- Functions $A \to B$: each of 4 inputs picks one of 3 outputs – $3^4 = 81$ (multiplication rule) ✓.
- Injections $B \to A$: 4 choices, then 3, then 2 – 24 ✓.

3.2

- R_1: all four properties hold (identity relation) ✓.
- R_2: symmetric, not reflexive (no loops); transitivity fails on the round trip without (a, a) ✓.
- R_3: transitive requires the composite (a, c) – its absence decides ✓.
- Equivalence = reflexive + symmetric + transitive: only R_1 qualifies ✓.