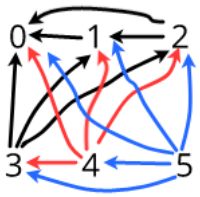
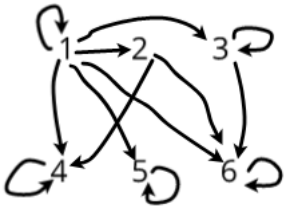
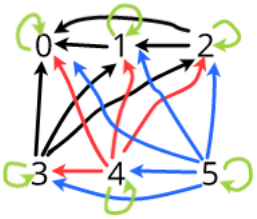
1. $R = \{(a, b) \in A \times A : a - b \in \mathbb{N}\}$.



2. $R = \{(a, b) \in A \times A : b = ax, x \in \mathbb{Z}\}$



3. $R = \{(a, b) \in A \times A : a - b \in (\mathbb{N} \cup \{0\})\}$



4. $A = \{a \in \mathbb{Z} : 0 \leq a \leq 5\}$ and $R = \{(0,0), (0,4), (1,1), (1,3), (1,5), (2,2), (2,4), (3,3), (3,1), (4,4), (4,0), (4,2), (5,5), (5,1)\}$
5. $A = \{a \in \mathbb{Z} : 0 \leq a \leq 5\}$ and $R = \{(1,2), (2,5), (3,3), (4,3), (4,2), (5,0)\}$
6. $R = \{(x, y) \in \mathbb{Z} \times \mathbb{Z} : 5|(x - y)\}$
7. $R = \{(x, y) \in \mathbb{Z} \times \mathbb{Z} : y - x \in \mathbb{N}\}$
8.

1 2 3

4 5 6

9. $|A \times A| = |A| * |A| = 6 * 6 = 36$, so $|powerset(A \times A)| = 2^{36} = 68,719,476,736$.
10. Since xRy for any $x, y \in \mathbb{R}$ unless $x = y$ (by def. of set difference), it follows that R is the relation $\neq$ on $\mathbb{R}$.
11. $|powerset(A \times A)| = 2^{|A \times A|} = 2^{|A|^2}$.
12. $\forall x, y \in \mathbb{R}, x \geq y$
13. $\forall x, y \in \mathbb{R}, x \neq y$
14. $\forall x, y \in \mathbb{Z}, y > x$
15. $\forall x, y, \in \mathbb{Z}, x \equiv y \pmod 3$