Relations

Problems: For the given A and R and each of the properties: A. reflexive, B. symmetric, C. anti-symmetric and D. transitive, decide if R has the property. If it has the property then prove it has that property or if it doesn't have the property then give a counterexample to show the property fails. (I.e. Prove or disprove.)

1. A is the set of real numbers and $aRb \iff a \leq b$.
2. A is the set of real numbers and $aRb \iff a < b$.
3. A is the set of real numbers and $aRb \iff 0 \leq a - b \leq 2$.
4. A is the set of real numbers and $aRb \iff |a - b| < 2$.
5. A is the set of odd positive integers and $aRb \iff a \neq b$ and a evenly divides b.
6. A is the set of real numbers and $aRb \iff a^2 - b^2 = 0$.
7. A is the set of positive integers and $aRb \iff a \quad \text{divides} \quad b$.
8. A is the set of integers and $aRb \iff a - b$ is odd.
9. A is the set of positive integers and $aRb \iff a \equiv 1 \mod b$.
10. A is the set of integers and $aRb \iff a \cdot b$ is even.
11. A is the set of points in the plane and $(a,b)R(c,d) \iff (a-c)^2 + (b-d)^2 \leq 5$.
12. A is the set of points in the plane and $(a,b)R(c,d) \iff a + b = c + d$.
13. A is the set of points in the plane and $(a,b)R(c,d) \iff |a - b| = |c - d|$.
14. A is the set of points in the plane and $(a,b)R(c,d) \iff a = c$.
15. A is the set of points in the plane and $(a,b)R(c,d) \iff a = d$.
16. A is the set of triangles in the plane and $tRs \iff$ triangle t has the same area as triangle s.
17. A is the set of triangles in the plane and $tRs \iff$ triangle t is similar to triangle s.
18. A is the set of triangles in the plane and $tRs \iff$ triangle t has either at least as much area as triangle s, or triangle t has at least as large perimeter as triangle s.
19. A is the set $\{1, 2, 3, \{1\}, \{1, 3\}, \{2\}\}$ and $aRb \iff a \in b$.
20. A is the set power set of $\{1, 2, 3\}$ and $aRb \iff a \subseteq b$.