Checking your solutions with Otter-lambda or Prover9 is advisable.

1. [10 points] Establish the satisfiability or unsatisfiability of the following sets of clauses by the resolution method. If a set is satisfiable, give an assignment that shows this.
   a. \{p \lor q, p \lor \neg r, \neg p \lor r, \neg q \lor r, q \lor \neg r\}
   b. \{p \lor q, \neg p \lor r, \neg p \lor \neg q, \neg q \lor r, q \lor \neg r\}

2. [10 points] Determine whether each pair of terms is unifiable, and if so, give the most general unifier. Note: u, v, w, x, y, z are variables; a, b, c, d are constants.
   a. p(f(x, g(y)), y) vs. p(f(g(a), z), b)
   b. p(x, f(y, a), y) vs. p(f(a, b), v, z)
   c. p(x, f(x)) vs. p(g(a), f(h(a)))

3. [20 points] Establish the satisfiability or unsatisfiability of the following sets of clauses by resolution. If a set is satisfiable, give an interpretation that shows this.
   a. \{p(x), q(y, a) \lor \neg p(y), \neg q(b, a)\}
   b. \{p(a), q(y, a) \lor \neg p(a), q(b, x)\}
   c. \{q(x), \neg p(y) \lor \neg p(g(a)) \lor \neg q(a), p(z) \lor \neg q(w)\}

4. [20 points] Transform each formula into an equivalent set of clauses.
   a. \exists y \forall x (p(x, y) \rightarrow q(x))
   b. \forall x \exists y (p(x, y) \lor \exists z q(x, y, z))

5. [40 points] Prove each formula by the resolution method:
   a. \forall x (p(x) \rightarrow q(x)) \rightarrow ((\forall x p(x)) \rightarrow (\forall x q(x)))
   b. \forall x (p(x) \rightarrow q(x)) \rightarrow ((\exists x p(x)) \rightarrow (\exists x q(x)))
   c. \exists x (p(x) \rightarrow \forall x p(x))
   d. ((\exists x p(x)) \rightarrow (\forall x q(x))) \rightarrow (\forall x (p(x) \rightarrow q(x)))