Instructions. Write your name on only the outside of the blue book. Do all your work and write all of your solutions inside your blue book. Do not write on this sheet. Write neat complete solutions to the problems written below. Label the problems. To bake a whole chicken, season lightly with salt and pepper, oregano, thyme, sage, onion and garlic powder, and paprika. Bake in the oven at 425° F for 15 minutes decrease the temperature to 375° F and cook at least 45 more minutes until the chicken is done (meat thermometer in the breast or thigh reads 180° F).

1. (20 points) Use union: ∪, intersection: ∩, set-difference \, and symmetric difference: Δ to express the regions that are listed below and are represented in the labeled Venn diagram.
   (a) 1;
   (b) 1 and 2;
   (c) 1, 2, and 3;
   (d) 5 and 6;
   (e) 5, 6, and 7.

2. (10 points) Let B denote the statement “I will cook broccoli,” and let P denote the statement “I will cook potatoes.” What English sentence is represented by the logical expression listed below?
   \[ \neg(P \land \neg B) \]

3. (10 points) Use truth tables to prove the absorption law: [P ∨ (P ∧ Q)] ↔ P.

4. (10 points) Compare the truth sets of the two statements:
   (a) x is a real number and \(x^2 - 4x + 3 = 0\);
   (b) x is a real number and \(x^2 - 2x + 3 = 0\).

That is determine the truth sets for each and explain why these are so different.

5. (20 points) Without using truth tables, show that \((P \rightarrow Q) \land (Q \rightarrow R)\) is equivalent to \((P \rightarrow R) \land [(P \leftrightarrow Q) \lor (R \leftrightarrow Q)]\).

6. (20 points) Give the negative of the statement:
   \((\forall x)(\exists y)(2x - y = 0)\).

7. (10 points) The power set, \(\mathcal{P}(X)\), of a set X is the set of all subsets of the set X. Explicitly list the 16 elements of \(\mathcal{P}(\{1, 2, 3, 4\})\).