All the answers have to be mathematically justified (unless specified explicitly).

Exercise 1. Let A and B be two events of Ω with $\mathbb{P}(A|B) = 1$. Compute $\mathbb{P}(B^c|A^c)$.

Exercise 2. Two fair dice are rolled. What is the conditional probability that at least one lands on 6 given that the dice land on different numbers?

Exercise 3. A total of 46 percent of the voters in a certain city classify themselves as Independents, whereas 30 percent classify themselves as Liberals and 24 percent say that they are Conservatives. In a recent local election, 35 percent of the Independents, 62 percent of the Liberals, and 58 percent of the Conservatives voted. A voter is chosen at random. Given that this person voted in the local election, what is the probability that he or she is

1. an Independent?
2. a Liberal?
3. a Conservative?
4. What fraction of voters participated in the local election?

Exercise 4. The color of a person's eyes is determined by a single pair of genes. If they are both blue-eyed genes, then the person will have blue eyes; if they are both brown-eyed genes, then the person will have brown eyes; and if one of them is a blue-eyed gene and the other a brown-eyed gene, then the person will have brown eyes. (Because of the latter fact, we say that the brown-eyed gene is dominant over the blue-eyed one.) A newborn child independently receives one eye gene from each of its parents, and the gene it receives from a parent is equally likely to be either of the two eye genes of that parent. Suppose that Smith and both of his parents have brown eyes, but Smith's sister has blue eyes.

1. What is the probability that Smith possesses a blue-eyed gene?
2. Suppose that Smith's wife has blue eyes. What is the probability that their first child will have blue eyes?
3. If their first child has brown eyes, what is the probability that their next child will also have brown eyes?

Exercise 5. Genes relating to albinism are denoted by A and a. Only those people who receive the a gene from both parents will be albino. Persons having the gene pair A, a are normal in appearance and, because they can pass on the trait to their off- spring, are called carriers. Suppose that a normal couple has two children, exactly one of whom is an albino. Suppose that the non-albino child mates with a person who is known to be a carrier for albinism.

1. What is the probability that their first off- spring is an albino?
2. What is the conditional probability that their second offspring is an albino given that their firstborn is not?

Exercise 6.
Suppose that each child born to a couple is equally likely to be a boy or a girl, independently of the sex distribution of the other children in the family. For a couple having 5 children, compute the probabilities of the following events:

1. All children are of the same sex.
2. The 3 eldest are boys and the others girls.
3. Exactly 3 are boys.
4. The 2 oldest are girls.
5. There is at least 1 girl.