1. The legal system is, unfortunately, not perfect. Sometimes the guilty go free and the innocent go to jail. Jane Doe has recently been arrested for drug trafficking. Court records show that the conviction rate in that area is 90% and the probability that an individual is guilty of trafficking *and* is convicted is 73%. Also, the probability of an individual being innocent given that they were not convicted is 30%

(a) What is the probability of being guilty given that you are convicted? (7 pts)

(b) What is the probability that Jane will be convicted, given that she is truly innocent of the crime? (7pts)
2. The following are True or False questions. Circle one answer for each question: (3 pts each)

(a) TRUE or FALSE: If $A \cap B = \emptyset$, then $A$ and $B$ are independent.

(b) TRUE or FALSE: If the support of a Random Variable $Y$ is $\{0, 1, 2, 3, 4\}$, then $\sum_{y=0}^{4} p(y) = 1$, where $p(y)$ is the probability mass function of $Y$.

(c) TRUE or FALSE: $P(A|B) = 1 - P(\overline{A}|\overline{B})$.

(d) TRUE or FALSE: A researcher wishes to conduct an experiment on the effect of pressure, temperature and catalyst on the yield in a refining process. If there are 3 settings for pressure, 4 for temperature, and 2 for catalyst, then the total number of experimental settings possible is $3!4!2!$.

3. We discussed many different named distributions for discrete Random Variables. Four scenarios are given below. Label the correct distribution for each scenario. (3 pts each)

(a) The mean number of cars arriving at a tollbooth during a given hour is 80. Let $Y$ be the number of cars arriving at the tollbooth during a randomly selected hour.

(b) A new surgical procedure is successful 70% of the time. Suppose 10 surgeries are done and are the results independent. Let $Y$ be the number of successful surgeries.

(c) A shipment of 200 cameras include 12 that are defective. We will inspect 10 cameras for defectiveness. Let $Y$ be the number of defective cameras in our sample of 10 cameras.

(d) A geological study indicates that an exploratory oil well should strike oil with probability 0.2. Let $Y$ be the number of exploratory wells until the fifth strike is found.

(a) $Y$ follows a ________________

(b) $Y$ follows a ________________

(c) $Y$ follows a ________________

(d) $Y$ follows a ________________
4. Five firms $F_1, F_2, F_3, F_4, F_5$ each offer bids on three separate contracts. The contracts are distinctly different and any one firm will be awarded at most one contract.

(a) How many sample points are there altogether in this experiment involving assignment of contracts to the firms? (7 pts)

(b) Assuming assignments are equally likely, find the probability that $F_3$ is awarded a contract. (7 pts)

5. In a gambling game a person draws a single card from an ordinary 52 card playing deck. A person is awarded $15 for drawing a Jack or a Queen and $5 for drawing a King or an Ace. A person who draws any other card loses $5.

(a) Identify or derive the pmf of $Y = \text{net money won or lost in this game}$. (This may or may not be a standard named distribution). (7 pts)

(b) Find the expected value of $Y$ and the variance of $Y$. (5 pts each)
6. The owners of a ski resort are interested in the average time it takes resort skiers to go down their black diamond slope. They collected data on 100 randomly selected skiers on the black diamond slope and the histogram of their times in seconds is given below.

(a) What is the population, sample and inferential objective (parameter of interest)? (2 pts each)

(b) Using the histogram, approximately what proportion of times was between 60 and 65 seconds? (4 pts)

(c) What proportion was greater than 75 seconds? (4 pts)

(d) Is the empirical rule appropriate here? Why or why not? (4 pts)
7. A large group of people is to be checked for two common symptoms of a certain disease. 20% of the people possess symptom A alone, 30% possess symptom B alone, and 10% possess both symptoms, with the remainder being symptom free. For a person chosen randomly from this population, find the probability that:

(a) The person has at least 1 symptom (4 pts)

(b) The person has neither symptom (4 pts)

(c) The person has both symptoms, given that they have symptom B (4 pts)