**2.**

**Intro**

In this problem, we will see how probability can be used in the court room. We will see a prosecutor and a defender using probabilistic reasoning to support their causes. Unfortunately, their arguments are based on unsolid math, and our job is to find their mistakes.

**Solution**

a)

Events

A - defendant is innocent

B - defendant has the blood type found at the crime scene

P(B = true) = 1%

The prosecutor's fallacy is a well known case of probability misunderstanding. Quoting the prosecutor, he states "There is a 1% chance that the defendant would have the crime blood if he were innocent". So, he is saying that $P(B = true|A = true) = 1\%$. The prosecutor is confusing the concept of prior with the concept of conditional probability.

b)

The defender's fallacy is the counterpart to the prosecutor fallacy. Quoting the defender: 'The evidence has provided a probability of just 1 in 8000 that the defendant is guilty, and thus has no relevance'. The problem with this line of thought is it neglects that the blood test together with other evidences can raise the probability of the suspect. Being more specific, there are other evidences besides the blood test in a trial. The union of all evidences will raise the probability of the the defendant being the criminal. Thus, the blood test has relevance and must not be disregarded.

**Conclusion**

The lesson to be learned here is the following: if there were no evidences at all, all people in the city would have the same chance of being the criminal. The sample space is too big, and we don't have any additional information to give more weight to a suspect. When an evidence as the blood test exist, the sample space shrinks (now, only people with the correspoding blood type are in the sample space). We just have to be careful to not fall for the prosecutor's fallacy (which exagerate the evidence) or the defender's fallacy (which neglects the evidence).