**1. Provide an example of the concepts of Prior, Posterior, and Likelihood.**

Prior probability: Before conducting a survey, you believe that 40% of the population supports a particular policy.

Likelihood probability: After conducting the survey, you find that 60% of the respondents support the policy.

Posterior probability: Based on the survey results, you update your belief and calculate that there is a 70% chance that the population supports the policy.

**2. What role does Bayes' theorem play in the concept learning principle?**

Bayes' theorem plays a crucial role in the concept learning principle by enabling the update of prior beliefs (prior probabilities) based on observed data (likelihood probabilities) to obtain updated beliefs (posterior probabilities).

**3. Offer an example of how the Nave Bayes classifier is used in real life.**

An example of how the Naive Bayes classifier is used in real life is in email spam filtering. The classifier uses features such as the presence of certain keywords or email metadata to estimate the probability that an incoming email is spam, allowing email providers to automatically filter and categorize emails accordingly.

**4. Can the Nave Bayes classifier be used on continuous numeric data? If so, how can you go about doing it?**

Yes, the Naive Bayes classifier can be used on continuous numeric data. It is common to assume a probability distribution (e.g., Gaussian distribution) for each feature and use the probability density function to estimate likelihood probabilities. Alternatively, the data can be discretized into bins or converted into categorical variables.

**5. What are Bayesian Belief Networks, and how do they work? What are their applications? Are they capable of resolving a wide range of issues?**

Bayesian Belief Networks (BBNs) are graphical models that represent probabilistic relationships between variables using directed acyclic graphs. They work by propagating beliefs or probabilities through the network based on conditional probability tables. BBNs have applications in various domains, such as medical diagnosis, risk assessment, and decision making under uncertainty.

**6. Passengers are checked in an airport screening system to see if there is an intruder. Let I be the random variable that indicates whether someone is an intruder I = 1) or not I = 0), and A be the variable that indicates alarm I = 0). If an intruder is detected with probability P(A = 1|I = 1) = 0.98 and a non-intruder is detected with probability P(A = 1|I = 0) = 0.001, an alarm will be triggered, implying the error factor. The likelihood of an intruder in the passenger population is P(I = 1) = 0.00001. What are the chances that an alarm would be triggered when an individual is actually an intruder?**

Ans: P(I = 1|A = 1) = (0.98 \* 0.00001) / (0.98 \* 0.00001 + 0.001 \* (1 - 0.00001))

**7. An antibiotic resistance test (random variable T) has 1% false positives (i.e., 1% of those who are not immune to an antibiotic display a positive result in the test) and 5% false negatives (i.e., 1% of those who are not resistant to an antibiotic show a positive result in the test) (i.e. 5 percent of those actually resistant to an antibiotic test negative). Assume that 2% of those who were screened were antibiotic-resistant. Calculate the likelihood that a person who tests positive is actually immune (random variable D).**

**Ans:** 0.0986

**8. In order to prepare for the test, a student knows that there will be one question in the exam that is either form A, B, or C. The chances of getting an A, B, or C on the exam are 30 percent, 20%, and 50 percent, respectively. During the planning, the student solved 9 of 10 type A problems, 2 of 10 type B problems, and 6 of 10 type C problems.**

**1. What is the likelihood that the student can solve the exam problem?**

The likelihood that the student can solve the exam problem can be estimated by considering the proportion of problems solved correctly for each type (A, B, C) and the prior probabilities of each problem type. Ans:1.7

**2. Given the student's solution, what is the likelihood that the problem was of form A?**

Given the student's solution, the likelihood that the problem was of form A can be calculated by considering the proportion of correctly solved type A problems among all the correctly solved problems.

**9. A bank installs a CCTV system to track and photograph incoming customers. Despite the constant influx of customers, we divide the timeline into 5 minute bins. There may be a customer coming into the bank with a 5% chance in each 5-minute time period, or there may be no customer (again, for simplicity, we assume that either there is 1 customer or none, not the case of multiple customers). If there is a client, the CCTV will detect them with a 99 percent probability. If there is no customer, the camera can take a false photograph with a 10% chance of detecting movement from other objects.**

**1. How many customers come into the bank on a daily basis (10 hours)?**

The average number of customers coming into the bank on a daily basis can be calculated by multiplying the probability of a customer coming in each 5-minute interval by the number of intervals in a day.

**2. On a daily basis, how many fake photographs (photographs taken when there is no customer) and how many missed photographs (photographs taken when there is a customer) are there?**

On a daily basis, the number of fake photographs (false positives) can be calculated by multiplying the probability of a false photograph in each 5-minute interval by the total number of intervals in a day.

**3. Explain likelihood that there is a customer if there is a photograph?**

The number of missed photographs (false negatives) would be the number of intervals without a customer multiplied by the probability of detecting movement from other objects.

**10. Create the conditional probability table associated with the node Won Toss in the Bayesian Belief network to represent the conditional independence assumptions of the Nave Bayes classifier for the match winning prediction problem in Section 6.4.4.**

The conditional probability table associated with the node "Won Toss" in the Bayesian Belief network would represent the probabilities of winning the match based on the outcome of the coin toss. The table would list the conditional probabilities for each possible outcome of the coin toss (e.g., heads, tails) and the corresponding probabilities of winnin