1. Consider the following table of data collected from a sample of 36 students in STAT 3090 last fall. Students were asked whether they were a morning person or a night person, as well as what their hot beverage of choice is. Students could only choose one response for each variable.

	Coffee (C)	Tea (T)	Hot Cocoa (H)	TOTAL
Morning Person (M)	3	3	2	8
Night Person (N)	17	3	8	28
TOTAL	20	6	10	36

For each of the following, use proper probability **notation**, write the associated **fraction**, and express your final answer as a **decimal** number rounded to four places. If you apply a probability rule (such as the Addition Rule or Complement Rule), **show the formula** in your work.

Find the probability that a randomly selected student from the class...

(a) Prefers tea

$P(T) = \frac{6}{36} = 0.1667$

(b) Is a morning person **and** prefers coffee

$P(M \text{ and } C) = \frac{3}{36} = 0.0833$

(c) Is a night person **and** prefers hot cocoa

$P(N \text{ and } H) = \frac{8}{36} = 0.2222$

(d) Prefers tea **or** hot cocoa

$P(T \text{ or } H) = \frac{6}{36} + \frac{10}{36} - 0 = \frac{16}{36} = 0.4444$

(e) Prefers coffee **or** is a morning person

$P(C \text{ or } M) = \frac{20}{36} + \frac{8}{36} - \frac{3}{36} = \frac{25}{36} = 0.6944$

(f) Is **not** a night person

$P(N^C) = 1 - P(N) = 1 - \frac{28}{36} = \frac{8}{36} = 0.2222$

(g) Does **not** prefer coffee or tea

There are two ways to think about this problem. You could directly apply the Complement Rule:
$P\left((C \text{ or } T)^C\right) = 1 - P(C \text{ or } T) = 1 - \left(\frac{20}{36} + \frac{6}{36} - 0\right) = \frac{10}{36} = 0.2778$

Or you could consider that the complement of C or T is $(C \text{ or } T)^C = H$:
$P\left((C \text{ or } T)^C\right) = P(H) = \frac{10}{36} = 0.2778$

2. Identify two mutually exclusive events in this situation. What is the probability of their **intersection**, i.e., the probability that they both occur at the same time? Express your answer using probability notation.

   Example: "Being a morning person and a night person are mutually exclusive. $P(M \cap N) = 0$"

3. There were two variables used to record responses from students in the sample: whether a student is a morning or night person, and what their hot beverage of choice is.

   (a) What **type** of variables are these?

   Qualitative

   (b) What **level of measurement** do both of these variables have?

   Nominal

4. General Leia Organa can plan a campaign to fight one major intergalactic battle or three small galactic battles. She believes she has a probability of 0.77 of winning the large battle (L) and a probability of 0.89 of winning each of the small battles (S). Victories or defeats in the small battles are independent. Leia must win either the large battle or all three small battles to win the campaign. Which strategy should she choose?

   (a) First find the probability of winning the large battle.

   $P(L) = 0.77$

   (b) Find the probability of winning all three small battles.

   $P(S \text{ and } S \text{ and } S) = P(S)P(S)P(S) = (0.89)^3 = 0.7050$

   (c) Which strategy should she choose if she wants to win the campaign? Justify your answer.

   She should choose to fight the large intergalactic battle since there is a higher probability of winning it than winning three small battles.