Module 2B Questions:

1. Suppose you take out two cards from a standard pack of cards (52) one after another, without replacing the first card. What is probability that the first card is the ace of spades, and the second card is a heart?

2. Example: In a forest, imagine that 1% of the trees are infected by a fungal rot and 0.1% have owl nests. What is the probability that a tree has both fungal rot and an owl nest if:

   A. The two events are independent?

   a. P(Owls)*P(rot) = 0.01*0.001
   b. P(owls) + P(rot) = 0.01+0.001
   c. P(Owls) + P(rot) – P(Owls)*P(rot) = 0.01+0.001-0.01*0.001

   B. The two events are mutually exclusive?

   a. 0
   b. 0.01*0.001
   c. 0.01+0.001

3. A large population of giant pandas has five alleles at one gene labeled: **A_1, A_2, A_3, A_4, A_5**. They have corresponding frequencies in the population **0.1, 0.15,0.6, 0.05, 0.1**. In this randomly mating population, the two alleles present in any individual are independently sampled from the population as a whole.
   a. What is the probability that a single allele chosen at random from this population either **A_1** or **A_4**
   b. What is the probability that the individual has **two A_1** alleles?
   c. What is the probability that an individual is ***not*** **A_1A_1**?
   d. What is the probability, if you drew two individuals at random from this population that neither of them would have an **A_1A_1** genotype?
   e. What is the probability, if you drew two individuals at random from this population that at least one of them would have an **A_1A_1** genotype? Hint: use NOT to solve this with the result from part d.
   f. What is the probability that three randomly chosen individuals would have ***no*** **A_2** or **A_3** alleles?

4. In a population of **100 laboratory mice**, genotyping reveals that:

- **45** carry a mutation in **Gene A**,
- **40** carry a mutation in **Gene B**,
- **35** carry a mutation in **Gene C**,
- **20** carry **both Gene A and Gene B** mutations,
- **23** carry **both Gene A and Gene C** mutations,
- **19** carry **both Gene B and Gene C** mutations,
- **12** carry mutations in **all three genes (A, B, and C)**.

Using a **Venn diagram**, determine the **probability that a randomly selected mouse carries a mutation in *exactly one* of the three genes**.