Problem 1
a) Suppose that before the race, number are assigned to each horse. Let \( h_i, i=1,2,3 \) and 4 represent the \( i^{th} \) horse before the race.

First of all, one should realize that there are \( 4!=24 \) elements in the sample space. The sample space is 
\[ S = \{ (h_1, h_2, h_3, h_4), (h_1, h_2, h_4, h_3), \ldots, (h_4, h_3, h_1, h_2) \} \]. The last outcome for example represents the event where Kenny thinks that horse 4 will win the race, followed by horse 3, etc.

b) If it is assumed that each horse has the same chance to finish last in the race. The probability that Kenny correctly picks the horse that finishes last is \( \frac{1}{4} \).

Problem 2
\( P(A)=0.28, P(B)=0.31 \).

a) \( P(A \cup B) = P(A)+P(B) \) since the two event are mutually exclusive. Therefore, \( P(A \cup B) = 0.28+0.31 = 0.59 \).

b) The two events are mutually exclusive, which means exactly that when one occurs, the other one does not. Therefore, \( P(A \cap B) = P(A) = 0.28 \).

c) \( P(A \cap B) = 0 \). Since the two events are mutually exclusive.

d) Using De Morgan’s law, \( \overline{A \cup B} = \overline{A} \cap \overline{B} \). We have \( P(\overline{A \cap B}) = P(\overline{A} \cup B) = 1 - P(A \cup B) = 1 - 0.59 = 0.41 \).

Problem 3
a) Suppose the SUV’s are labelled \( SUV_1, SUV_2, SUV_3, SUV_4 \), the sedan are denoted \( S_1, S_2, S_3, S_4 \) and the mini-van are noted \( M_1, andM_2 \). There are \( (4+4+2)! = 10! \) different permutations of these cars.

b) Suppose we want the fifth car to be a mini-van. There are 2 different to select that mini-van. Once this done, we don’t care about the order of 9 remaining cars. Therefore, the probability that the fifth car is a mini-van is : \( \frac{2 \times 9!}{10!} = \frac{1}{5} \). Note that if we assume that the SUV’s, the sedans, and the mini-van are all identical among each order, we still have the same probability to find a mini-van in the fifth position. This probability is obtained as follows: \( \frac{2 \times 9!}{4!4!2!} = \frac{1}{5} \).

Problem 4
If you did draw the Venn diagram, you should realize that we are only interested in the probability of the union of the following disjoint sets: \( (A \cap B \cap C), (\overline{A} \cap B \cap C) \) and \( (\overline{A} \cap B \cap C) \). The hint is tell you to compute the probability of having all three of them and then to take out the intersections. Remember that the probability of an intersection of two events is the probability to observe these two events at the same time. We are interested in the occurrence of only one of them at a time. You should also realize that every time you take one intersection, you also take out the \( A \cap B \cap C \) section of the diagram. This is done three times, so you need to add it two times in order to balance the equation.

Problem 5
Let \( P_{ij}, i=1,2,3 \) and \( j=1,2 \) be the event that box \( j \) is coming from publisher \( i \). If it is assumed that the
boxes coming from the same publisher are not identical. There are 6! different ways to obtain a box on a
given day. One of such events is: \((P_{11}, P_{12}, P_{21}, P_{22}, P_{31}, P_{32})\).
There are 3 different publishers, from the same publisher you can receive the boxes 2 different ways. Once
you made sure that your last two boxes came from the same producer, you don’t care about the order in
which you received the previous 4 boxes. Putting all that together, the probability to receive the last 2 boxes
from the same publisher is: \(\frac{3 \times 2 \times 2 \times 4!}{6!} = \frac{1}{5}\).

Now if we assume that the boxes coming from the same publisher are identical, and we \(P_i\) be the event
that the boxes comes from publisher \(i\). We have something more like \(2P_1, 2P_2, 2P_3\). In this case, there are
\(\frac{6!}{2!2!2!} = 90\) different ways to receive these boxes. The probability to get the last two from the same publisher
is now: \(\frac{3 \times 4!}{2 \times 2!} = \frac{18}{90}\).