In a popular story, a British Detective (Sherlock Holmes) solved seemingly impossible cases.

1. In the story, Sherlock Holmes had an arch rival the villainous Professor Moriarty. If we use the letters in his title “Professor” then:
   a) How many different titles could Moriarty create using the same letters?

   b) How many different titles could Moriarty create, if s the vowels are kept together?

   c) How many different titles could Moriarty create, that end with an ‘r’?

   d) How many different titles could Moriarty create, if he kept the consonants in alphabetical order?

   e) How many different titles could Moriarty create, if he used each letter only once?

2. Sherlock Holmes was created by Sir Arthur Conan Doyle, who wrote 56 short stories and 4 novels about this famous detective, in the late 19th and early 20th centuries. For this question, assume that all 56 short stories are individually bound. Express your answers using factorial notation.
   a) In how many different arrangements, can all 56 short stories and 4 novels be arranged on a book shelf?

   b) How many different arrangements of all 56 short stories and 4 novels are there if they arranged on a book shelf with the novels placed on the far left edge of the book shelf (i.e. the first four books on the left side of the book shelf are the novels)?

   c) In how many different arrangements, can all 56 short stories and 4 novels be arranged on a book shelf, if the novels are placed together as a group among the short stories?
3. Holmes generally solves difficult cases using his tremendous powers of observation and logic. In addition, he utilizes several other skills to assist in solving some cases. One such example is that he is also a competent cryptanalyst as he relates to Watson, "I am fairly familiar with all forms of secret writing, and am myself the author of a trifling monograph upon the subject, in which I analyze one hundred and sixty separate ciphers." One such scheme is solved in "The Adventure of the Dancing Men" which uses a series of stick figures.

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a) How many different ways can Sherlock Holmes select 5 of the above stick men (none of the stick men are identical)?

b) If those 5 stick men are arranged into two rows, one row of three stick men and the other of two, then how many ways can Sherlock Holmes arrange the 5 stick men chosen above?

c) After solving the case, Sherlock Holmes arranges all the stick men from the diagram above into three equal rows. How many different arrangements can be made using all the stick men?

4. Generally Sherlock Holmes and his trusted friend Dr. John H. Watson visited crime scenes early in the story to look for clues. In the short story The Murders in the Rue Morgue, Holmes, Watson and eight police officers (known as "Bobbies") were at the crime scene looking for clues.

a) If Holmes requires the police to apprehend a suspect, then in how many ways can he dispatch three of the eight bobbies?

b) Suppose that Holmes believes the suspect is dangerous. In how many ways could he dispatch Watson and at least four bobbies to apprehend the dangerous suspect?