Q. 1) **(Ross #1.8 - Theoretical)** Prove that

\[
\binom{m+n}{r} = \binom{n}{0} \binom{m}{r} + \binom{n}{1} \binom{m}{r-1} + \cdots + \binom{n}{r} \binom{m}{0}.
\]

**Hint:** Consider a group of \(n\) men and \(m\) women. How many groups of size \(r\) are possible?

Q. 2) **(Ross #2.10)** Sixty percent of the students at certain school wear neither a ring nor a necklace. Twenty percent wear a ring and 30 percent wear a necklace. If one of the students is chosen randomly, what is the probability that this student is wearing

(a) a ring or a necklace;
(b) a ring and a necklace?

Q. 3) **(Ross #2.45)** A woman has \(n\) keys, of which one will open her door.

(a) If she tries the keys at random, discarding those that do not work, what is the probability that she will open the door on her \(k\)-th try?
(b) What if she does not discard previously tried keys?

Q. 4) **(Ross #2.52)** A closet contains 10 pairs of shoes. If 8 shoes are randomly selected, what is the probability that there will be

(a) no complete pair;
(b) exactly one complete pair?
Q. 5) (Ross #2.20 - Theoretical) Consider an experiment whose sample space consists of a countably infinite number of points. Show that not all points can be equally likely. Can all points have positive probability of occurring? Why or why not?