Directions: You may work to solve these problems in groups, but all written work must be your own. **Show your work**; See "Guidelines and advice" on the course webpage for more information.

1. Let $A = \{1, 2, 3\}$, $B = \{\{1, 2\}, 2, 3\}$, $C = \{\{1, 2, 3\}\}$, and $D = \{\varnothing\}$.
   (a) Determine the sizes of each of the sets A, B, C, and D.
   (b) Determine $A \cap B$, $C \triangle D$, and $B - A$.
   (c) True or False: $A \subseteq C$
   (d) True or False: $A \in \mathcal{P}(C)$.
   (e) True or False: $C \in \mathcal{P}(A)$.
   (f) True or False: $C \subseteq \mathcal{P}(A)$.
   (g) True or False: $B \cup D = B$.
   (h) True or False: $D \in \mathcal{P}(C)$.
   (i) True or False: $D \in \mathcal{P}(\mathcal{P}(C))$.
   (j) Determine the set $\mathcal{P}(B) - \mathcal{P}(A)$.
2. Let $[n] = \{1, 2, 3, \ldots, n\}$. Describe a way to pair the subsets of $[n]$ of size k with the subsets of size $n - k$. What can you conclude about $\binom{n}{k}$ and $\binom{n}{n-k}$? Hint: if you find this question confusing, generate data for small cases. With $n = 5$ and $k = 2$, list the subsets of $\{1, 2, 3, 4, 5\}$ of size 2 in one column and size $n - k$ or 3 in a second column. Try to find a natural way to pair them up. If it still unclear, generate more data. When ready, generalize.