Just in case anybody does both grad and undergrad for number 4, give grads 3 extra points and undergrads 6 extra points.

1. (6 points) What is the power set of a, b, c,d?

   $\{\}, \{a\}, \{b\}, \{c\}, \{d\}, \{ab\}, \{ac\}, \{ad\}, \{bc\}, \{bd\}, \{cd\}, \{abc\}, \{abd\}, \{acd\}, \{bcd\}, \{abcd\}$

   Note: a fast check is for 16 items. If there aren't 16 it's wrong.

2. (6 points) Suppose $A \subset B$. Show that $2^A \subset 2^B$.

$$\begin{aligned} \text{Let } & X \in 2^A \\ & X \subset A \subset B \\ & X \subset B \qquad \text{as shown in class} \\ & X \in 2^B \end{aligned}$$

3. (6 points) Let A = {2,4,6,8,10,12}, B = {1,3,6,9,12} and then $\Omega = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$. What are:

   What are each of the following:

   - $\Omega \setminus (A \cup B)$

     $$\{5, 7, 11\}$$

   - $A \cap B$

     $$\{6, 12\}$$

   - $A \cup B$

     $$\{1, 2, 3, 4, 6, 8, 9, 10, 12\}$$

   - (7 points)
     - Undergrad: Show $A^C \cap B^C = (A \cup B)^C$
       * Let $x \in A^C \cap B^C$
       * x is in both A^C and B^C so $x \notin A$ and $x \notin B$
       * $x \notin A \cup B$
       * Therefore $x \in (A \cup B)^C$
       * Therefore $A^C \cap B^C \subset (A \cup B)^C$
       * Let $y \in (A \cup B)^C$
       * Then $y \notin A \cup B$ so $y \notin A$ and $y \notin B$
       * Then $y \in A^C$ and $y \in B^C$
       * $y \in A^C \cap B^C$

    - Therefore $(A \cup B)^C \subset A^C \cap B^C$
    - Therefore $A^C \cap B^C = (A \cup B)^C$
  - Grad: Show $A^C = (A^C \cap B) \cup (A^C \cap B^C)$
    - $(A^C \cap B) \cup (A^C \cap B^C) = (A^C \cup (A^C \cap B^C)) \cap (B \cup (A^C \cap B^C))$
    - $= (A^C \cup A^C \cap A^C \cup B^C) \cap (B \cup A^C \cap B \cup B^C)$
    - $= (A^C \cap A^C \cup B^C) \cap (B \cup A^C \cap \phi)$
    - $= (A^C) \cap (B \cup A^C)$
    - $= A^C$

Undergraduate students can use Venn Diagram, membership table to prove set equalities.