Get in small groups (about 4 students maximum) and work out these problems on the whiteboard. Ask one of the teaching assistants for help if your group gets stuck. You do **not** need to turn anything in.

1. Define the following terms in English. Also specify whether the conditions are satisfiable or unsatisfiable.
   (a) tautology
   (b) contradiction
   (c) contingency

2. Translate these English sentences into 2 unique propositions. Additionally, use truth tables to show that the 2 propositions you made are logically equivalent.
   (a) Tony and Rachel like chocolate, but neither Tucker nor Nihar do.
   (b) If it is raining, then Nihar only brings an umbrella when he doesnt wear a jacket.

3. Reduce the following expressions to their simplest form. Also mention whether the following the statements are a tautology, contradiction or contingency
   (a) $p \wedge (p \vee \neg p)$
   (b) $p \vee \neg(p \wedge \neg p)$
   (c) $(p \vee (q \wedge \neg q)) \wedge (q \wedge (p \vee \neg p))$

4. Determine whether each of these compound propositions is satisfiable - *Hint:* First reduce the propositions into a simple expression and then use a truth table.
   (a) $(p \vee \neg q) \wedge (\neg p \vee q) \wedge (\neg p \vee \neg q)$
   (b) $(p \to q) \wedge (p \to \neg q) \wedge (\neg p \to q) \wedge (\neg p \to \neg q)$
   (c) $(p \leftrightarrow q) \wedge (\neg p \leftrightarrow q)$

5. Prove the following using a proof by contraposition:
   (a) Let $x \in \mathbb{Z}$; If $x^2 - 6x + 5$ is even, then x is odd.
   (b) If a product of two positive real numbers is greater than 100, then at least one of the number is greater than 10.