A formula φ is a **tautology** if, and only if, it is true under every truth-value assignment.

A formula φ is a **contradiction** if, and only if, it is false under every truth-value assignment.

Two formulas φ and ψ are **equivalent** if, and only if, they are true under exactly the same truth-value assignments.

A set of formulas S is **consistent** if, and only if, there is at least one truth-value assignment under which they are all true.

An argument of propositional logic is **valid** if, and only if, there is no assignment of truth values to the propositional variables on which the premises are true while the conclusion is false.

1. Determine if the following are formulas of propositional logic:
   1. This is not a formula; there is no rule that goes from to .
   2. This is a formula; the main operator is .
   3. This is a formula; the main operator is .
2. Determine if the following arguments are valid:
   1. Valid
   2. Valid
   3. Valid
   4. Valid
   5. Invalid
3. Answer the following questions:
   1. If the premises of an argument are inconsistent, can I determine whether the argument valid? Yes If so, is it valid? Yes
   2. If the conclusion of an argument is a contradiction, can I determine whether the argument valid? No If so, is it valid?
   3. If the premises of an argument are consistent, can I determine whether the argument valid? No If so, is it valid?
   4. If the conclusion of an argument is a tautology, is the argument valid? Yes
4. **(Hard)** Determine if the following arguments are valid:
   1. Valid
   2. Invalid
5. Consider the following three formulas:

Now, answer the following questions:

1. Do these three formulas form a consistent set? Yes
2. Is the argument valid? Yes
3. Are (2) and (3) equivalent? No
4. Is the argument valid? No