Instructions:

- This is a **simulated practice midterm**. You will **not** be graded on your performance on this exam.

- Nevertheless, please treat this as if it is a real exam. That means that you may not discuss with your neighbors, reference outside material, or use your devices during the next 50 minute period.

- If you get stuck on a problem, consider moving on and coming back later. In the actual exam, there will likely be opportunity for partial credit.

- There are 3 problems on this exam, totaling 60 points.
1. **Predicate Translation** [20 points]
Let the domain of discourse be people. Translate the following statements to predicate logic, using the following predicates:

\[
\text{Student}(x) := x \text{ is a student} \\
\text{Professor}(x) := x \text{ is a professor} \\
\text{EnrolledInClass}(x, y) := x \text{ is enrolled a class taught by } y
\]

You may also use = and ≠ as predicates.

(a) (5 points) Every professor has at least one student enrolled in their class.

(b) (5 points) There’s a student who is enrolled in two different professors’ classes.

(c) (5 points) There’s a professor who is enrolled in another professor’s class.

(d) (5 points) All students are enrolled in some class, taught by some professor. (May not be the same professor for everyone).
2. Set Proof [20 points]
Suppose that for sets $A, B, C$, the facts $A \subseteq B$ and $B \subseteq C$ are given. Write an English proof to show that $B \times A \subseteq C \times C$. 
3. **Induction** [20 points]
Prove by induction on $n$ that for all integers $n \geq 0$ the inequality $(3 + \pi)^n \geq 3^n + n\pi 3^{n-1}$ is true.