Start Time: **Your name:**

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Time limit 15 minutes, not counting download and upload. Please add explanation below if over 17 minutes total.

1. Use unary predicates $Dog(x)$ and $Cat(x)$, the binary predicate $Likes(x, y)$, the constant symbol $Spot$, the unary function $Mother(x)$ and the equality sign $=$ to express the following English sentences in first-order logic. $Dog(x)$ means "x is a dog" and $Cat(x)$ means "x is a cat". $Likes(x, y)$ means "x likes y". $Mother(x)$ denotes the mother of x. Variables ranges over the universe of all dogs and cats.

  (a) *Spot* likes every cat.

  (b) All cats like *Spot*.

  (c) Some cat likes *Spot*.

  (d) At least two cats like *Spot*.

  (e) All dogs like each other.

  (f) No dog is the mother of a cat.

  (g) Each cat that likes themself also likes *Spot*.

  (h) The mother of any cat is a cat.

  (i) Every cat and their mother like each other.

  (j) *Spot* is not a mother.