

Module2-quiz-SP23

Due Feb 5 at 11:59pm

Points 10

Questions 10

Available Jan 22 at 12am - Feb 6 at 2:59am

Time Limit 300 Minutes

Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	4 minutes	10 out of 10

 Correct answers will be available on Feb 6 at 11pm.

Score for this quiz: **10** out of 10

Submitted Jan 27 at 2:30pm

This attempt took 4 minutes.

Question 1

1 / 1 pts

What are the free variables in the below Formula F1?

F1: $\exists x P(x) \rightarrow \forall y Q(y)$

☐ x

☐ x, y

☐ y

☒ None

There are no free variables. Both x and y are bounded variables. With the help of parse tree you can find bound and free variables.

Question 2

1 / 1 pts

What will be the Herbrand model for the below formula whose signature is {a, b, P}?

$\neg P(a) \wedge P(b) \wedge (\exists x P(x))$

☐ $P^I(a) = f, P^I(b) = f$

☒ $P^I(a) = f, P^I(b) = t$

For $\neg P(a)$ to be true, $P^I(a)$ will be false and for $P(b)$ to be true, $P^I(b)$ has to be true. And there exists some x that P can be True

☐ $P^I(a) = t, P^I(b) = t$

☐ $P^I(a) = t, P^I(b) = f$

Question 3

1 / 1 pts

Suppose $\sigma = \{a, P, Q\}$, where a is object constant, P is Unary and Q is binary predicate constant.

Statement: $Q(a)$ is a Formula. True or False?

☐ True

☒ False

As Q is binary predicate constant, the above statement is not a formula because it has only one predicate and syntactically not allowed.

Question 4

1 / 1 pts

The following 3 questions use the function *MapColor* and predicates *In(x,y)*, *Borders(x,y)*, and *Country(x)*, whose arguments are geographical regions, along

with constant symbols for various regions.

For this question, consider the English sentence "There is a country that borders both Iraq and Pakistan."

Choose the correct answer for the possible equivalent logical statement

$\exists c \text{ Country}(c) \Rightarrow [\text{Borders}(c, \text{Iraq}) \wedge \text{Borders}(c, \text{Pakistan})]$

- ☐ has correct syntax and accurately expresses the English sentence
- ☒ syntactically valid but does not express the meaning of the English sentence

This incorrectly reads: If there is a country, then that country borders Iraq and Pakistan.

The correct expression would be: $\exists c \text{ Country}(c) \wedge \text{Borders}(c, \text{Iraq}) \wedge \text{Borders}(c, \text{Pakistan})$

- ☐ syntactically invalid and therefore meaningless

Question 5

1 / 1 pts

Choose the correct logical expression for the following English sentence: "Paris and Marseilles are both in France."

- ☐ $\text{In}(\text{Paris}, \text{France}) \vee \text{In}(\text{Marseilles}, \text{France})$
- ☒ $\text{In}(\text{Paris}, \text{France}) \wedge \text{In}(\text{Marseilles}, \text{France})$

this expression correctly expresses the English sentence

- ☐ $\text{In}(\text{Paris} \wedge \text{Marseilles}, \text{France})$

Question 6

1 / 1 pts

Choose the correct logical expression for the following English sentence: "No two adjacent countries have the same map color."



$$\forall x \forall y (Country(x) \wedge Country(y) \wedge Borders(x, y) \wedge \neg(x = y)) \Rightarrow \neg(MapColor(x) = MapColor(y))$$

this accurately expresses the English sentence. Notice that we also need to make sure that x and y are not the same country



$$\forall x \forall y Country(x) \wedge Country(y) \wedge Borders(x, y) \wedge \neg(MapColor(x) = MapColor(y))$$



$$\forall x \forall y \neg Country(x) \vee \neg Country(y) \vee \neg Borders(x, y) \vee \neg(MapColor(x) = MapColor(y))$$



$$\forall x \forall y (Country(x) \wedge Country(y) \wedge Borders(x, y)) \Rightarrow MapColor(x \neq y)$$

Question 7

1 / 1 pts

Let the underlying signature be $\{a, P, Q\}$, where a is an object constant, P is a unary predicate constant, and Q is a binary predicate constant. Assume object variables range over the set N of nonnegative integers, and the signature is interpreted as follows:

- a represents the number 10,
- $P(x)$ represents the condition "x is a prime number,"
- $Q(x, y)$ represents the condition "x is less than y."

Which of the following first-order logic formulas express the following English sentence?

"x equals 9."

Choose all that apply.

☐ $Q(a, x) \wedge \neg P(x)$

☒ $Q(x, a) \wedge \neg \exists y [Q(x, y) \wedge Q(y, a)]$

☒ $Q(x, a) \wedge \forall y [Q(x, y) \rightarrow (y = a \vee Q(a, y))]$

☐ $Q(a, x)$

Question 8

1 / 1 pts

Statement: Following first-order formula is satisfiable. True or False?

$\forall xy(x = y)$

☒ True

☐ False

Question 9

1 / 1 pts

Assume that the signature consists of the object constant Me, the unary predicate constant Male, and the binary predicate constant Parent, and nothing else. Which of the following first-order logic formulas express the following English sentence?

"I have no daughters"

Choose all that apply. (Hint: there are 2 correct answers.)

☒ $\neg \exists x (\neg \text{Male}(x) \wedge \text{Parent}(\text{Me}, x))$

☐ $\forall x (\text{Male}(x) \wedge \neg \text{Parent}(\text{Me}, x))$

☐ $\exists x (\text{Male}(x) \wedge \text{Parent}(\text{Me}, x))$

☒ $\forall x (\text{Parent}(\text{Me}, x) \rightarrow \text{Male}(x))$

Question 10**1 / 1 pts**

Which of the following statements are true for any first-order formula F and G , and for any interpretation I ?

$$(F \wedge G)^I = \wedge(F, G)$$

$$(\neg F)^I = \neg(F^I)$$

$$\exists w F(w)^I = t \text{ iff, for some object constant } c, F(c)^I = t$$

☐ 3

☒ 2

☐ 1,3

☐ 1,2

Quiz Score: **10** out of 10