

Module 2 Graded Quiz

Due Feb 6 at 11:59pm **Points** 10 **Questions** 10
Available after Jan 23 at 12am **Time Limit** 300 Minutes
Allowed Attempts 3

Take the Quiz Again

Attempt History

	Attempt	Time	Score
LATEST	<u>Attempt 1</u>	14 minutes	10 out of 10

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

Submitted Feb 6 at 4:15pm

This attempt took 14 minutes.

Question 1

1 / 1 pts

“Every child is younger than his mother” can be represented by the following first-order logic formula.

$$\forall x (C(x) \rightarrow Y(x, m(x)))$$

Which of the options is the category of C?

☐ Variable

☐ Object constant

☒ Predicate

☐ Quantifier

☐ Function constant

Correct!

Question 2**1 / 1 pts**

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

1. $(F \wedge G)^I = \wedge(F, G)$
2. $(\neg F)^I = \neg(F^I)$
3. $\exists w F(w)^I = t$ iff, for some object constant c , $F(c)^I = t$

☐ 1, 2

☒ 2

☐ 3

☐ 1, 3
Correct!**Question 3****1 / 1 pts**

Which of the options best represents the English sentence “dogs and cats are animals”?

☐ $\forall x(\text{dog}(x) \wedge \text{cat}(x) \rightarrow \text{animal}(x))$
☐ $\forall x(\text{dog}(x) \wedge \text{cat}(x) \wedge \text{animal}(x))$
☐ $\forall x(\text{dog}(x) \vee \text{cat}(x) \vee \text{animal}(x))$
☒ $\forall x(\text{dog}(x) \vee \text{cat}(x) \rightarrow \text{animal}(x))$
Correct!**Question 4****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.)

Correct!

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

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

Correct!

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

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

Question 5

1 / 1 pts

Let P be the only predicate constant that is unary, and I an interpretation such that the universe is the set of all ASU students. For any $\xi \in ||I||$, $P^I(\xi) = t$ iff ξ has taken CSE 579. Which of the following first-order logic formulas express the following English sentence?

"There exists at most one student who took CSE 579."

Choose all that apply.

Correct!

☒ $\forall x \forall y [(P(x) \wedge P(y)) \rightarrow (x=y)]$

Correct!

☒ $[(\exists x P(x)) \wedge (\forall x \forall y (P(x) \wedge P(y)) \rightarrow (x=y))] \vee (\neg \exists x P(x))$

☐ $\forall x \forall y (x=y \vee \neg P(y))$

☐ $[(\exists x P(x)) \wedge (\forall x \forall y (P(x) \wedge P(y)) \rightarrow (x=y))]$

Question 6**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.

☐ $Q(a, x)$

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

☐ $Q(a, x) \wedge \neg P(x)$

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

Correct!**Correct!****Question 7****1 / 1 pts**

Is the following first-order formula satisfiable?

$\forall xy(x = y)$

☐ Unsatisfiable

☒ Satisfiable

Correct!

Question 8

1 / 1 pts

Let σ be the signature $\{a, b, P\}$ where a, b are object constants and P is a binary predicate constant. Choose all Herbrand interpretations of σ that satisfy the following formula.

$$\forall x, y (P(x, y) \rightarrow P(y, x))$$

☐ $\{P(a, b)\}$
☒ $\{P(a, a)\}$
☒ $\{P(a, a), P(a, b), P(b, a)\}$
☒ \emptyset (empty set)

Correct!

Correct!

Correct!

Question 9

1 / 1 pts

Find the Herbrand model I of the following first-order formula whose signature is $\{a, b, P\}$.

$$(\neg P(a) \vee \perp) \wedge (\exists x P(x))$$

☒ $P(a)' = f, P(b)' = t$
☐ $P(a)' = t$
☐ $P(a)' = t, P(b)' = t$
☐ $P(a)' = f$

Correct!

Question 10

1 / 1 pts

Which option contains the free variables in the following formula?

$$\exists y P(x, y) \wedge \neg \exists x P(x, y)$$

Correct!

☒ Both x and y

☐ x

☐ No free variable

☐ y

Quiz Score: **10** out of 10