Status	Beendet
Begonnen	Mittwoch, 30. April 2025, 10:17
Abgeschlossen	Mittwoch, 30. April 2025, 10:35
Dauer	18 Minuten 6 Sekunden
Bewertung	**10,00** von 10,00 (**100**%)

Frage 1

Richtig

Erreichte Punkte 1,00 von 1,00

Assume that $\forall m(h(d, i(m)) \rightarrow o(k(d))) \vee e(d)$ is a well-formed formula. Classify each symbol as either a function or a predicate by drag-and-dropping it to the correct location.

Important: The symbols should be specified in alphabetical order. For instance, in $a(b) \wedge c(d)$, the predicate symbols should be specified as a, c and the function symbols as b, d. Furthermore, note that constants are 0-ary functions.

- The predicate symbols are e, h, o.
- The function symbols are d, i, k.

Frage 2

Richtig

Erreichte Punkte 1,00 von 1,00

Consider the signature □ with $\{P\ (arity\ 2), Q\ (arity\ 2)\} \subseteq$ □, $\{a\ (arity\ 0), b\ (arity\ 0), f\ (arity\ 2), g\ (arity\ 1)\} \subseteq$ □ and $\{x, y\} \subseteq$ □ predicates, functions and variables, respectively. Which formulas are **not** well-formed formulas in First-Order Logic?

Important: Note that there can be more than one correct answer.

- [ ] a. $\exists x(Q(a, b) \rightarrow Q(a, x)) \rightarrow P(a, f(a, a))$
- [x] b. $\forall x P(f(x, b), g(x)) \wedge \neg(P(f(a), b) \wedge Q(g(b)))$
- [x] c. $\exists x P(f(x, b), g(f(x, b))) \wedge \neg(f(b, b) \vee Q(g(a)))$
- [x] d. $(P(a, b) \vee Q(g(a))) \rightarrow \forall(x \wedge y)Q(f(x, b), g(x))$

Frage 3

Richtig

Erreichte Punkte 1,00 von 1,00

Consider the signature □ with $\{Q\ (arity\ 2), P\ (arity\ 2)\} \subseteq$ □, $\{a\ (arity\ 0), b\ (arity\ 0), g\ (arity\ 1), f\ (arity\ 2)\} \subseteq$ □ and $\{x\} \subseteq$ □ predicates, functions and variables, respectively. How many **different terms** occur in the formula $\forall x(Q(a, b) \rightarrow P(g(x), b)) \wedge P(f(a, b), f(a, a))$? Note that if a term occurs twice, it only counts as one.

Example: The formula $P(f(x), g(x), f(a))$ contains 4 unique terms - x, $f(x)$, $g(x)$, $f(a)$.

Antwort: 6

Frage **4**

Richtig

Erreichte Punkte 1,00 von 1,00

Consider the signature □ with $\{P\ (arity\ 2)\} \subseteq$ □, $\{f\ (arity\ 2), g\ (arity\ 1)\} \subseteq$ □ and $\{z, x, y\} \subseteq$ □ predicates, functions and variables, respectively. Which variables have free occurrences in the formula $\forall x(P(f(x,x), f(x,y)) \wedge \forall z P(f(z,y), g(z)))$? Note that variables that have both free and bound occurrences should also be listed.

Important: In order for your answer to be properly validated, input your variables comma-separated and with no white-spaces in between. For instance, for the formula $\forall y P(x,y) \wedge P(x,y)$ your answer should be: *x,y*

Antwort: y

Frage **5**

Richtig

Erreichte Punkte 1,00 von 1,00

Consider the signature □ with $\{P\ (arity\ 2), Q\ (arity\ 2)\} \subseteq$ □, $\{g\ (arity\ 1), a\ (arity\ 0), f\ (arity\ 2), b\ (arity\ 0)\} \subseteq$ □ and $\{x\} \subseteq$ □ predicates, functions and variables, respectively. How many **subformulas** does the formula $(\exists x P(g(x), x) \rightarrow Q(a, g(a))) \wedge P(f(a,b), g(a))$ have? Note that if a subformula occurs twice, it only counts as one.

Antwort: 6

Frage **6**

Richtig

Erreichte Punkte 1,00 von 1,00

How is the correct formalization of the natural language sentence "All questions have an answer."?

- a. $\forall x(\text{Question}(x) \rightarrow \text{HaveAnswer}(x))$
- b. $\forall x\ \text{Question}(x) \rightarrow \forall x\ \text{HaveAnswer}(x)$
- c. $\forall x\ \neg\text{Question}(x) \vee \forall x\ \text{HaveAnswer}(x)$
- d. $\text{Question}(x) \rightarrow \forall x\ \text{HaveAnswer}(x)$

Frage **7**

Richtig

Erreichte Punkte 1,00 von 1,00

Which formula is equivalent to the **negation** of $\exists x\ \neg P(x)$?

- a. $\neg\forall x\ \neg P(x)$
- b. $\forall x\ P(x)$
- c. $\forall x\ \neg P(x)$
- d. $\neg\forall x\ P(x)$

Frage 8

Richtig

Erreichte Punkte 1,00 von 1,00

Which one of the following entailments holds?

- a. $\exists x(P(x) \rightarrow Q(x)), P(a) \models \exists y\, Q(y)$
- b. $\exists x(P(x) \vee Q(x)) \models \forall x\, Q(x)$
- c. $\forall x(P(x) \wedge Q(x)), P(a) \models \forall x\, Q(x)$ ✓
- d. $\exists x(P(x) \wedge Q(x)), \exists y\, P(y) \models P(b)$

Frage 9

Richtig

Erreichte Punkte 1,00 von 1,00

Consider the formula $\varphi := \forall x P(x,x) \wedge \forall x \exists y \neg P(y,x)$. Given the structure $\square = (D_\square, I_\square)$ with domain $D_\square = \{a,b\}$, your task is to specify the relation $P^\square$ associated to the predicate symbol P by $I_\square$, such that the formula φ is satisfied by $\square$.

Note: List the tuples in $P^\square$ comma-separated, with no spaces in between. In case $P^\square$ should not contain any elements, input "empty" (without the quotes) in the field below. Furthermore, note that multiple correct answers may be possible.

Example: For $\exists x P(x,x)$ and $\square = (\{a,b\}, I_\square)$, a possible input could be: *(a,a),(a,b)*

Antwort: (a,a),(b,b) ✓

Frage 10

Richtig

Erreichte Punkte 1,00 von 1,00

Which of the following interpretations is **not** a model of the formula $\forall x \forall y(P(x,y) \rightarrow P(y,x))$? Note that more than one answer may be correct.

- [ ] a. $\square = (D_\square, I_\square)$ with $D_\square = \{a,b\}$ and $P^\square = \{(a,a),(b,b)\}$
- [x] b. $\square = (D_\square, I_\square)$ with $D_\square = \{a,b\}$ and $P^\square = \{(a,a),(b,b),(b,a)\}$ ✓
- [ ] c. $\square = (D_\square, I_\square)$ with $D_\square = \{a,b\}$ and $P^\square = \emptyset$
- [x] d. $\square = (D_\square, I_\square)$ with $D_\square = \{a,b\}$ and $P^\square = \{(a,a),(a,b)\}$ ✓