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| **Status** | Beendet |
| **Begonnen** | Dienstag, 27. Mai 2025, 18:42 |
| **Abgeschlossen** | Dienstag, 27. Mai 2025, 18:58 |
| **Dauer** | 15 Minuten 44 Sekunden |
| **Bewertung** | **10,00** von 10,00 (**100**%) |

**Frage 1**

Richtig

Erreichte Punkte 1,00 von 1,00

Let

$$\mathbf{t}: \exists y \forall x(P(x, g(y)) \wedge P(g(x), y))$$

be the starting formula of a tableau branch. Which of the following terms are suitable substitutes for the variable $y$ in the subsequent steps of a tableau proof, when applying the corresponding quantifier rule?

**Note:** Multiple answers may be correct.

- [x] $d$
- [ ] $f(d, c)$
- [x] $e$
- [x] $b$

**Frage 2**

Richtig

Erreichte Punkte 1,00 von 1,00

In this question we consider tableau proofs with only one branch and we will represent them as a sequence. That is, the sequence $(\mathbf{t}: P(a), \mathbf{f}: \neg P(a))$ corresponds to the tableau proof:

$$\mathbf{t}: P(a)$$
$$\mathbf{f}: \neg P(a)$$

Considering this, which one of the following tableau proofs are closed? **Multiple** answers may be correct.

- [ ] a. $(\mathbf{t}: \forall x(Q(x) \vee R(x)), \mathbf{t}: Q(c), \mathbf{f}: \exists x R(x), \mathbf{f}: R(c), \mathbf{f}: \neg R(c))$
- [x] b. $(\mathbf{t}: \forall x(Q(x) \vee R(x)), \mathbf{t}: Q(b), \mathbf{t}: \forall x R(x), \mathbf{f}: R(a), \mathbf{t}: R(a))$
- [ ] c. $(\mathbf{t}: \forall x(Q(x) \vee R(x)), \mathbf{t}: Q(b), \mathbf{f}: \exists x \neg\neg R(x), \mathbf{t}: Q(b), \mathbf{t}: \neg R(a), \mathbf{f}: \neg\neg R(b))$
- [x] d. $(\mathbf{t}: \forall x(Q(x) \wedge \neg Q(x)), \mathbf{t}: Q(b) \wedge \neg Q(b), \mathbf{f}: \exists x R(x), \mathbf{t}: Q(b), \mathbf{t}: \neg R(a), \mathbf{t}: \neg Q(b), \mathbf{f}: Q(b))$

**Frage 3**

Richtig

Erreichte Punkte 1,00 von 1,00

Which is the formula in First-Order Logic that best captures the natural language sentence "*Logan likes neither economics nor dancing.*"?

- a. $\neg Likes(logan, economics) \land \neg Likes(logan, dancing)$
- b. $\neg Likes(logan, economics) \lor \neg logan(Likes, dancing)$
- c. $\neg Likes(likes, economics \land dancing)$
- d. $\neg Likes(likes, economics \lor dancing)$

**Frage 4**

Richtig

Erreichte Punkte 1,00 von 1,00

Let $A$ be the $\mathcal{T}_E$-formula $a = b \land a \neq b$. Which of the following statements is true?

- a. $A$ is not satisfiable in $\mathcal{T}_E$.
- b. $A$ is satisfiable but not valid in $\mathcal{T}_E$.
- c. $A$ is valid in $\mathcal{T}_E$.

**Frage 5**

Richtig

Erreichte Punkte 1,00 von 1,00

Which one of the formulas below is a prenex normal form of $\neg\forall y((\forall x Q(x,y) \land \neg S(y)) \lor (\exists y R(y) \to P(c)))$?

- a. $\forall x_0 \forall x_1 \forall x_2((Q(x_1, x_0) \land \neg S(x_0)) \lor (\neg R(x_2) \lor P(c)))$
- b. $\exists x_0 \exists x_1 \exists x_2((\neg Q(x_1, x_0) \lor S(x_0)) \land (R(x_2) \land \neg P(c)))$
- c. $\exists x_0 \exists x_1 \exists x_2((\neg Q(x_1, x_0) \lor S(x_0)) \lor (R(x_2) \land \neg P(c)))$
- d. $\forall x_0 \exists x_1 \exists x_2((\neg Q(x_1, x_0) \lor S(x_0)) \land (R(x_2) \land \neg P(c)))$

**Frage 6**

Richtig

Erreichte Punkte 1,00 von 1,00

What is the first-order formula which best captures the following natural language sentence: "*If there is a dog that barks loudly, then the neighbor will be annoyed.*"?

- a. $Annoyed(neighbor) \to \exists x(Dog(x) \land BarksLoudly(x))$
- b. $\exists x(Dog(x) \land BarksLoudly(x) \to Annoyed(neighbor))$
- c. $\exists x(Dog(x) \land BarksLoudly(x)) \to Annoyed(neighbor)$
- d. $\forall x(Dog(x) \land BarksLoudly(x) \to Annoyed(neighbor))$

**Frage 7**

Richtig

Erreichte Punkte 1,00 von 1,00

Let $A$ be the $\mathcal{T}_E$-formula $f(c) \neq a \wedge g(b) = f(a) \wedge c = a$. Which are the congruence classes in the congruence closure of $=$ over $A$?

- a. $[[g(b), f(a), f(c)], [a], [b], [c]]$
- b. $[[b, f(c)], [g(b)], [a, f(a), c]]$
- c. $[[g(b), b, c], [f(c)], [a, f(a)]]$
- d. $[[g(b), f(a), f(c)], [b], [a, c]]$

**Frage 8**

Richtig

Erreichte Punkte 1,00 von 1,00

Consider the formula $x > c + 1$ to be interpreted in the standard way over integers, with $x$ denoting a variable and $c$ being a constant. Let $I$ be an interpretation such that $I(x) = I(c) = 0$.

- a. $I$ is a model of $x > c + 1$
- b. $x > c + 1$ is unsatisfiable
- c. $x > c + 1$ is valid
- d. $x > c + 1$ is satisfiable in $I$

**Frage 9**

Richtig

Erreichte Punkte 1,00 von 1,00

Which one of the following is a suitable new tableau rule that could be applied to formulas of the form $\mathbf{f}{:}\neg\forall x F(x)$ in tableau proofs?.

- a. $\frac{\mathbf{f}{:}\neg\forall x F(x)}{\mathbf{f}{:}F(t/x)}$ for $t$ a variable-free term
- b. $\frac{\mathbf{f}{:}\neg\forall x F(x)}{\mathbf{f}{:}F(c/x)}$ for $c$ a new constant
- c. $\frac{\mathbf{f}{:}\neg\forall x F(x)}{\mathbf{t}{:}F(t/x)}$ for $t$ a variable-free term
- d. $\frac{\mathbf{f}{:}\neg\forall x F(x)}{\mathbf{t}{:}F(c/x)}$ for $c$ a new constant

**Frage 10**

Richtig

Erreichte Punkte 1,00 von 1,00

Let F be the formula $x = y \rightarrow y = e$, where $x, y$ are variables and $e$ a constant. Let $\alpha$ be the sort of $x, y, e$.

- a. $F$ is satisfiable but not valid in the class of interpretations that interpret $\alpha$ to be the domain $D = \{0\}$
- b. $F$ is unsatisfiable in the class of interpretations that interpret $\alpha$ to be the domain $D = \{0\}$
- c. $F$ is valid in the class of interpretations that interpret $\alpha$ to be the domain $D = \{0\}$