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1 Discrete Mathematics: Mathematical Logic (15)

1.1 First Order Logic (13) top

1.1.1 First Order Logic: GO Classes 2024 | Weekly Quiz 9 | First Order Logic | Question: 1 top

Consider the following predicates:

- $\text{bird}(x)$: x is a bird.
- $\text{penguin}(x)$: x is a penguin.
- $\text{fly}(x)$: x can fly.

Consider the following sentence:

All birds except penguins' fly. (Note that Penguins may or may not fly)

Which of the following is/are a formula in first-order logic expressing the given fact?

A. $\forall x.\left[(\text{bird}(x) \wedge \neg \text{ penguin }(x)) \rightarrow \text{fly}(x)\right]$
B. $\forall x.\left[\neg \text{ bird}(x) \vee \neg \text{ penguin }(x) \vee \text{ fly }(x)\right]$
C. $\forall x.\left[\neg \text{ bird }(x) \vee \text{ penguin }(x) \vee \text{ fly }(x)\right]$
D. $\forall x.\left[\text{bird}(x) \vee \text{ penguin }(x) \vee \text{ fly }(x)\right]$

goclasses2024_wq9 goclasses mathematical-logic first-order-logic multiple-selects 1-mark

Answer key

1.1.2 First Order Logic: GO Classes 2024 | Weekly Quiz 9 | First Order Logic | Question: 10 top

Which of the following formulas is a formalization of the sentence: "All babies are illogical"

A. $\forall \mathrm{x}(\text{baby}(\mathrm{x}) \wedge \text{illogical}(\mathrm{x}))$
B. $\forall \mathrm{x}(\text{baby}(\mathrm{x}) \rightarrow \text{illogical}(\mathrm{x}))$
C. $\neg \exists \mathrm{x}(\text{baby}(\mathrm{x}) \wedge \neg \text{illogical}(\mathrm{x}))$
D. $\exists \mathrm{x}(\text{baby}(\mathrm{x}) \wedge \neg \text{illogical}(\mathrm{x}))$

goclasses2024_wq9 goclasses mathematical-logic first-order-logic multiple-selects 2-marks

Answer key

1.1.3 First Order Logic: GO Classes 2024 | Weekly Quiz 9 | First Order Logic | Question: 11 top

Consider the following predicates:

- sqroot((x) : x has a square root.
- negative (x) : x is negative.

Which of the following formulas is a formalization of the sentence, if the domain is set of all numbers:
"Every number is either negative or has a square root but not both"

A. $\forall \mathrm{x} \neg(\text{ negative }(\mathrm{x}) \leftrightarrow \text{sqroot}(\mathrm{x}))$
B. $\neg \exists \mathrm{x}((\text{negative }(\mathrm{x}) \leftrightarrow \text{ sqroot }(\mathrm{x}))$
C. $\forall \mathrm{x}((\text{ negative }(\mathrm{x}) \wedge \neg \text{sqroot}(\mathrm{x})) \vee (\neg \text{ negative }(\mathrm{x}) \wedge \text{sqroot}(\mathrm{x})))$
D. $\forall \mathrm{x}(\text{ negative }(\mathrm{x}) \vee \text{sqroot}(\mathrm{x}))$

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Answer key

1.1.4 First Order Logic: GO Classes 2024 | Weekly Quiz 9 | First Order Logic | Question: 12 top

Consider the following predicates:

- $\text{Real}(\mathrm{x})$: x is a real number.
- $\text{Integer}(\mathrm{x})$: x is an integer.

Which of the following formulas is a formalization of the sentence, if the domain is set of all integers. "Some integers

are not real numbers."

A. $\exists x \neg \text{Real}(x)$
B. $\neg \forall x \, \text{Real}(x)$
C. $\exists x (\text{Integer}(x) \wedge \neg \text{Real}(x))$
D. $\exists x (\text{Integer}(x) \rightarrow \neg \text{Real}(x))$

goclasses2024_wq9 goclasses mathematical-logic first-order-logic multiple-selects 2-marks

Answer key

1.1.5 First Order Logic: GO Classes 2024 | Weekly Quiz 9 | First Order Logic | Question: 13 top

Which of the following formulas is a formalization of the sentence :
Not all that glitters is gold

A. $\forall x$ [glitter(x) $\rightarrow \text{gold}(x)]$
B. $\neg \exists x [\text{glitter}(x) \wedge \text{gold}(x)]$
C. $\neg \forall x (\text{glitter}(x) \rightarrow \text{gold}(x))$
D. $\exists x (\text{glitter}(x) \wedge \neg \text{gold}(x))$

goclasses2024_wq9 goclasses mathematical-logic first-order-logic multiple-selects 2-marks

Answer key

1.1.6 First Order Logic: GO Classes 2024 | Weekly Quiz 9 | First Order Logic | Question: 14 top

Let $P(x), Q(x), R(x)$ and $S(x)$ denote the following predicates with domain $\mathbb{Z}$:

$$P(x) : x \leq 0,$$
$$Q(x) : x^2 = 1,$$
$$R(x) : x \text{ is odd},$$
$$S(x) : x = x + 1.$$

Which of the following statements is/are true?

A. $\forall x \in \mathbb{Z}, \quad R(x) \rightarrow S(x)$
B. $\forall x \in \mathbb{Z}, \quad S(x) \rightarrow R(x)$
C. $\exists x \in \mathbb{Z}$ such that $Q(x) \wedge \sim R(x)$
D. $\exists x \in \mathbb{Z}$ such that $P(x) \rightarrow S(x)$

goclasses2024_wq9 goclasses mathematical-logic first-order-logic multiple-selects 2-marks

Answer key

1.1.7 First Order Logic: GO Classes 2024 | Weekly Quiz 9 | First Order Logic | Question: 15 top

For a given predicate $\text{P}(\text{x})$, you might believe that the statements $\forall x \text{P}(\text{x})$ or $\exists \text{x} \text{P}(\text{x})$ are either true or false. $\exists x (\neg P(x))$ is false if and only if

A. $\exists \text{x}(\text{P}(\text{x}))$ is true.
B. $\forall \text{x}(\text{P}(\text{x}))$ is true.
C. $\forall \text{x}(\neg \text{P}(\text{x}))$ is true.
D. $\forall x (\neg P(x))$ is false.

goclasses2024_wq9 goclasses mathematical-logic first-order-logic 2-marks

Answer key

1.1.8 First Order Logic: GO Classes 2024 | Weekly Quiz 9 | First Order Logic | Question: 2 top

Consider the following English sentence:
"Agra and Gwalior are both in India".

A student has written a logical sentence for the above English sentence in First-Order Logic using predicate $\mathrm{In}(x, y)$, which means x is in y, as follows.

$\mathrm{In}(\mathrm{Agra}, \mathrm{India}) \vee \mathrm{In}(\mathrm{Gwalior}, \mathrm{India})$

Which one of the following is correct with respect to the above logical sentence?

A. It is syntactically valid but does not express the meaning of the English sentence
B. It is syntactically valid and expresses the meaning of the English sentence also
C. It is syntactically invalid but expresses the meaning of the English sentence
D. It is syntactically invalid and does not express the meaning of the English sentence

goclasses2024_wq9 goclasses mathematical-logic first-order-logic 1-mark

Answer key

1.1.9 First Order Logic: GO Classes 2024 | Weekly Quiz 9 | First Order Logic | Question: 5 top

Consider the following predicates.

- $\mathrm{Rabbit}(x) = x$ is a rabbit.
- $\mathrm{Cute}(x) = x$ is cute.

Consider the following statement E, where the domain of every variable is set of all animals in a jungle J.

$$\mathrm{E} = \forall x(\mathrm{Rabbit}(x) \wedge \mathrm{Cute}(x))$$

If statement E is true, then which of the following is true?

A. There is no animal other than rabbits in the jungle J.
B. Every rabbit is cute in jungle J.
C. It is possible that there is some animal in J who is not a rabbit but is cute.
D. There is some rabbit who is cute in jungle J.

goclasses2024_wq9 goclasses mathematical-logic first-order-logic multiple-selects 1-mark

Answer key

1.1.10 First Order Logic: GO Classes 2024 | Weekly Quiz 9 | First Order Logic | Question: 6 top

Let $p(x), q(x)$ denote the following open statements.

$$p(x): \quad x \leq 3 \quad q(x): \quad x + 1 \text{ is odd}$$

Let $r(x)$ be the open statement "$x > 0$."

The universe comprises all integers.

Determine the number of values of x for which $[p(x) \wedge q(x)] \wedge r(x)$ results in a true statement.

goclasses2024_wq9 numerical-answers goclasses mathematical-logic first-order-logic 1-mark

Answer key

1.1.11 First Order Logic: GO Classes 2024 | Weekly Quiz 9 | First Order Logic | Question: 7 top

Let $p(x), q(x)$, and $r(x)$ denote the following open statements.

$$p(x): \quad x^2 - 8x + 15 = 0$$
$$q(x): \quad x \text{ is odd}$$
$$r(x): \quad x > 0$$

For the universe of all integers, which of the following statements is/are false?

A. $\forall x[p(x) \rightarrow q(x)]$

B. $\forall x[q(x) \rightarrow p(x)]$

C. $\exists x[p(x) \rightarrow q(x)]$

D. $\exists x[q(x) \rightarrow p(x)]$

goclasses2024_wq9 goclasses mathematical-logic first-order-logic multiple-selects 2-marks

Answer key

1.1.12 First Order Logic: GO Classes 2024 | Weekly Quiz 9 | First Order Logic | Question: 8 top

Let $p(x), q(x)$, and $r(x)$ denote the following open statements.

$$p(x): \quad x^2 - 8x + 15 = 0$$
$$q(x): \quad x \text{ is odd}$$
$$r(x): \quad x > 0$$

For the universe of all integers, which of the following statements is/are true?

A. $\exists x[r(x) \rightarrow p(x)]$

B. $\forall x[\neg q(x) \rightarrow \neg p(x)]$

C. $\exists x[p(x) \rightarrow (q(x) \wedge r(x))]$

D. $\forall x[(p(x) \vee q(x)) \rightarrow r(x)]$

goclasses2024_wq9 goclasses mathematical-logic first-order-logic multiple-selects 2-marks

Answer key

1.1.13 First Order Logic: GO Classes 2024 | Weekly Quiz 9 | First Order Logic | Question: 9 top

Which of the following formulas is a formalization of the sentence "No dogs are intelligent"

A. $\forall x(\text{dog}(x) \wedge \neg \text{Intelligent}(x))$

B. $\forall x(\text{Intelligent}(x) \rightarrow \neg\, \text{dog}(x))$

C. $\forall x(\text{dog}(x) \rightarrow \neg \text{Intelligent}(x))$

D. $\neg \exists x(\text{dog}(x) \wedge \text{Intelligent}(x))$

goclasses2024_wq9 goclasses mathematical-logic first-order-logic multiple-selects 2-marks

Answer key

1.2 Fuzzy Set (1) top

1.2.1 Fuzzy Set: GO Classes 2024 | Weekly Quiz 9 | First Order Logic | Question: 4 top

One approach to handling fuzzy logic data might be to design a computer using ternary $(\text{base-}3)$ logic so that data could be stored as "true," "false," and "unknown." If each ternary logic element is called a flit, minimum how many flits are required to represent at least 256 different values?

goclasses2024_wq9 numerical-answers goclasses mathematical-logic fuzzy-set 1-mark

Answer key

1.3 Propositional Logic (1) top

1.3.1 Propositional Logic: GO Classes 2024 | Weekly Quiz 9 | First Order Logic | Question: 3 top

A binary operator is defined as follows

$$P \Updownarrow Q = \sim P \wedge Q$$

Which of the following statement is equivalent to $P \rightarrow Q$

A. $\sim P \Updownarrow Q$

B. $\sim (P \Updownarrow Q)$

C. $\sim (\sim P \Updownarrow Q)$

D. $\sim (\sim P \Updownarrow \sim Q)$

goclasses2024_wq9 goclasses mathematical-logic propositional-logic 1-mark

Answer key

Answer Keys

1.1.1	A;C	1.1.2	B;C	1.1.3	A;B;C	1.1.4	A;B;C;D	1.1.5	C;D
1.1.6	B;D	1.1.7	B	1.1.8	A	1.1.9	A;B;D	1.1.10	1

1.1.11	B	1.1.12	A;B;C	1.1.13	B;C;D	1.2.1	6	1.3.1	D