Module 1 Graded Quiz

Due Jan 24, 2021 at 11:59pm **Points** 10
Questions 10 **Available** after Jan 10, 2021 at 11:59pm
Time Limit 300 Minutes **Allowed Attempts** 3

Take the Quiz Again

Attempt History

	Attempt	Time	Score
KEPT	Attempt 2	7 minutes	10 out of 10
LATEST	Attempt 2	7 minutes	10 out of 10
	Attempt 1	16 minutes	8 out of 10

Score for this attempt: **10** out of 10
Submitted Jan 19, 2021 at 11:40am
This attempt took 7 minutes.

Question 1

1 / 1 pts

Apply unit propagation on the formula $p \wedge (p \vee q) \wedge (\neg p \vee \neg q) \wedge (q \vee r) \wedge (\neg q \vee \neg r)$ starting with an empty set U of literals. What are the resulting formulas F from the first three iterations?

- $F\_1 = p \wedge r, F\_2 = r, F\_3 = T$
- $F\_1 = q \wedge (q \vee r) \wedge (\neg q \vee \neg r), F\_2 = (q \vee r) \wedge (\neg q \vee \neg r), F\_3 = T$
- **Correct!** $F\_1 = \neg q \wedge (q \vee r) \wedge (\neg q \vee \neg r), F\_2 = r, F\_3 = T$
- $F\_1 = \neg q \wedge (q \vee r) \wedge (\neg q \vee \neg r), F\_2 = \neg q, F\_3 = T$

Question 2

1 / 1 pts

Apply unit propagation on the formula $p \wedge (p \vee q) \wedge (\neg p \vee \neg q) \wedge (q \vee r) \wedge (\neg q \vee \neg r)$ starting with an empty set U of literals. What are the resulting set U of literals from the first three iterations?

- $U\_1 = \{p\}, U\_2 = \{p, r\}, U\_3 = \{p, r, \neg q\}$
- $U\_1 = \{p\}, U\_2 = \{\neg q\}, U\_3 = \{r\}$
- **Correct!** $U\_1 = \{p\}, U\_2 = \{p, \neg q\}, U\_3 = \{p, \neg q, r\}$
- $U\_1 = \{p\}, U\_2 = \{r\}, U\_3 = \{\neg q\}$

Question 3

1 / 1 pts

Which option correctly shows how entailment and satisfiability are related?

- **Correct!** $\{p, q\} \models r$ iff $\{p, q, \neg r\}$ is unsatisfiable
- $\{p, q\} \models r$ iff $\{\neg p, \neg q, r\}$ is unsatisfiable
- $\{p, q\} \models r$ iff $\{r\}$ is satisfiable
- $\{p, q\} \models r$ iff $\{p, q, r\}$ is satisfiable

Question 4

1 / 1 pts

Let F be a propositional formula. Is the following statement true or false?

F is a tautology iff ¬F is satisfiable.

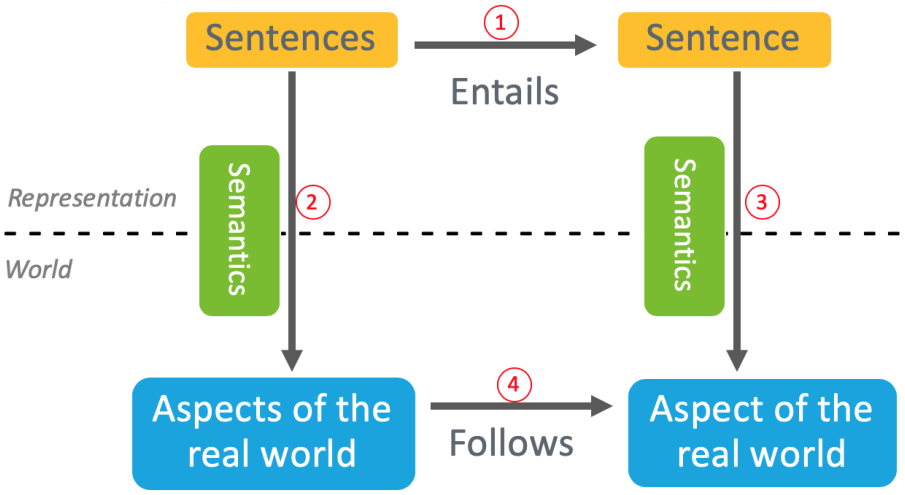
- True
- False

Correct!

Question 5

1 / 1 pts

Consider the following graph where each arrow is denoted by a number in red. Which sequence of arrows best explains the steps for knowledge representation and reasoning?



Correct!

- 2 1 3 4
- 2 4 1 3
- 2 3 1 4
- 4 3 1 2

Question 6

1 / 1 pts

Which option is to have a conclusion that is likely to be true even though we do not have enough evidence?

- Abductive reasoning
- Deductive reasoning
- Default reasoning

Correct!

- Model finding

Question 7

1 / 1 pts

Recall the definition of propositional formula below.

A propositional formula of signature σ is defined recursively as follows:

- Every atom is a formula
- Both 0-place connectives are formulas
- If F is a formula then ¬F is a formula
- For any binary connective ⊙, if F and G are formulas then (F⊙G) is a formula

Which option is a propositional formula according to the definition?

- $(\neg(a) \vee b)$

Correct!

- $\bot$
- $(\bot\ \neg\top)$
- $a \rightarrow b$

Question 8

1 / 1 pts

Suppose p is an atom. Is the following statement true or false?

{⊥} entails ⊥.

Correct!

- (•) True
- ( ) False

Question 9

1 / 1 pts

If a propositional signature has n atoms, how many interpretations are there?

- ( ) n
- ( ) 2*n

Correct!

- (•) 2^n
- ( ) n^2

Question 10

1 / 1 pts

Determine which of the following pairs of formulas are equivalent. (select all that apply)

Correct!

- [x] F∨(G↔H) and (F∨G)↔(F∨H)

Correct!

- [x] (F∧G)∧H and F∧(G∧H)

Correct!

- [x] (F∨G)∨H and F∨(G∨H)

Correct!

- [x] F→(G∧H) and (F→G)∧(F→H)
- [ ] F∧(G↔H) and (F∧G)↔(F∧H)

Quiz Score: **10** out of 10

Module 2 Graded Quiz

Due Feb 7, 2021 at 11:59pm **Points** 10 **Questions** 10
Available Jan 24, 2021 at 12am - Feb 7, 2021 at 11:59pm 15 days
Time Limit 300 Minutes **Allowed Attempts** Unlimited

This quiz was locked Feb 7, 2021 at 11:59pm.

Attempt History

	Attempt	Time	Score
KEPT	Attempt 2	2 minutes	10 out of 10
LATEST	Attempt 2	2 minutes	10 out of 10
	Attempt 1	24 minutes	8 out of 10

Score for this attempt: **10** out of 10
Submitted Feb 3, 2021 at 8:56pm
This attempt took 2 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?

- Object constant
- Predicate

Correct!

- Quantifier
- Variable

Function constant

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. $(\neg F)^I = \neg\left(F^I\right)$
3. $\exists w F(w)^I = t$ **iff, for some object constant** $c, F(c)^I = t$

3

1, 2

Correct!

2

1, 3

Question 3

1 / 1 pts

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

∀x(dog(x) ∨ cat(x) ∨ animal(x))

∀x(dog(x) ∧ cat(x) ∧ animal(x))

Correct!

∀x(dog(x) ∨ cat(x) → animal(x))

∀x(dog(x) ∧ cat(x) → animal(x))

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!

- [x] ¬∃x(¬Male(x) ∧ Parent(Me, x))
- [ ] ∃x(Male(x) ∧ Parent(Me, x))
- [ ] ∀x (Male(x) ∧ ¬Parent(Me, x))

Correct!

- [x] ∀x (Parent(Me, x) -> Male(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 ξ ∈ |I|, P^I(ξ) = 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!

- [x] [(∃xP(x))∧(∀x∀y (P(x) ∧ P(y))→(x=y))]∨ (¬∃xP(x))

Correct!

- [x] ∀x∀y [(P(x) ∧ P(y))→(x=y)]
- [ ] ∀x∀y(x=y ∨ ¬P(y))

- [ ] [(∃xP(x))∧(∀x∀y (P(x) ∧ P(y))→(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.

Correct!

- [x] Q(x, a)∧¬∃y[Q(x, y)∧Q(y, a)]
- [ ] Q(a, x)∧¬P(x)
- [ ] Q(a, x)

Correct!

- [x] Q(x, a)∧∀y[Q(x, y)->(y=a∨Q(a, y))]

Question 7

1 / 1 pts

Is the following first-order formula satisfiable?

∀xy(x = y)

Correct!

- (●) Satisfiable
- ( ) Unsatisfiable

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.

∀x,y (P(x,y) → P(y,x))

- [ ] {P(a,b)}

Correct!

- [x] {P(a,a), P(a,b), P(b,a)}

Correct!

- [x] {P(a,a)}

Correct!

- [x] ∅ (empty set)

Question 9

1 / 1 pts

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

(¬P(a) ∨ ⊥) ∧ (∃x P(x))

- [ ] $P(a)' = f$
- [ ] $P(a)' = t$

Correct!

- [x] $P(a)' = f, P(b)' = t$

- [ ] $P(a)' = t, P(b)' = t$

Question 10

1 / 1 pts

Which option contains the free variables in the following formula?

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

- [ ] x

Correct!

- [x] Both x and y
- [ ] y
- [ ] No free variable

Quiz Score: **10** out of 10

Module 3 Graded Quiz

Due Feb 21 at 11:59pm **Points** 10 **Questions** 10
Available Feb 7 at 11:59pm - Feb 21 at 11:59pm 14 days
Time Limit 300 Minutes **Allowed Attempts** 3

Take the Quiz Again

Attempt History

	Attempt	Time	Score
KEPT	Attempt 2	9 minutes	10 out of 10
LATEST	Attempt 2	9 minutes	10 out of 10
	Attempt 1	45 minutes	7.5 out of 10

ⓘ Answers will be shown after your last attempt

Score for this attempt: **10** out of 10
Submitted Feb 21 at 3:19pm
This attempt took 9 minutes.

Question 1 — 1 / 1 pts

What is the stable model of the following one-rule program?

p :- not p.

- ○ ø
- ○ {p}
- ◉ No stable model

Question 2

1 / 1 pts

Assuming the signature consists of p, q, r. Which of the options are **models** of the following program?

$p \leftarrow q \wedge r$

$q \leftarrow p$

$r \leftarrow p$

Choose all that apply.

- [x] ∅ (empty set)
- [ ] {q, r}
- [x] {q}
- [ ] {p, q}
- [x] {r}
- [ ] {p}
- [x] {p, q, r}

Question 3

1 / 1 pts

Assuming the signature consists of p, q, r. Which of the option is the stable model of the following program?

$p \leftarrow q \wedge r$

$q \leftarrow p$

$r \leftarrow p$

- ∅ (empty set)
- {q}
- {q, r}
- {p, r}
- {p}
- {p, q, r}
- {p, q}
- {r}

Question 4

1 / 1 pts

Which option is a positive program in the language of clingo?

- #const k=2.

  fullTimeStudent, partTimeStudent :- student.

  student :- k=1..3.

- number(1).

  small_number(1).

  big_number(X) :- number(X), not small_number(X).

- cloudy, rain :- not sunny.

  wet :- rain.

```
#const n=5.
composite(N) :- N=1..n, I=2..N-1, N\I=0.
prime(N) :- N=2..n, not composite(N).
```

Question 5

1 / 1 pts

How many atoms are there in the stable model of the following clingo program?

pair(0..1, (1..2)*(2..3)).

- 4
- 2
- 16
- 8 (selected)

Question 6

1 / 1 pts

The propositional image of a clingo program consists of the instances of its rules rewritten as propositional formulas. Which option is equivalent to the propositional image of the following clingo program?

p(3..6).

q(X*2) :- p(X), X<5.

- $p(3) \wedge p(6)$
  $q(6) \leftarrow p(3)$

$p(3)$
$p(4)$
$p(5)$
$p(6)$
$q(6) \leftarrow p(3)$
$q(8) \leftarrow p(4)$
$q(10) \leftarrow p(5)$
$q(12) \leftarrow p(6)$

$p(3) \wedge p(4) \wedge p(5) \wedge p(6)$
$q(6) \leftarrow p(3)$
$q(8) \leftarrow p(4)$

$p(3)$
$p(6)$
$q(6) \leftarrow p(3)$
$q(8) \leftarrow p(4)$
$q(10) \leftarrow p(5)$
$q(12) \leftarrow p(6)$

Question 7

1 / 1 pts

Which option is equivalent to the following clingo program?

p(1,1). p(1,2). p(2,1). p(2,2).

p(X, X**|X-Y|) :- X=1..2, Y=2..3.

p(1..2, 1..2).

p(1;2, 1;2).

p(X,Y) :- X=1..2, Y=1..X.

Question 8

1 / 1 pts

Which of the statements about the following clingo program Π is true?

a :- not b.

b :- not a.

- {a, b} is a stable model of Π
- The minimal models of the propositional image of Π happen to be the same as the stable models of Π.
- The models of the propositional image of Π happen to be the same as the stable models of Π.
- ∅ (i.e., empty set {}) is a model of the propositional image of Π.

Question 9

1 / 1 pts

Which of the clingo programs can represent “either a is true or b is true”?

- a :- not a.
  b :- not b.
- a :- not b.
  b :- not a.
- a.
  b.

p(a;b).

Question 10

1 / 1 pts

True or False? For any propositional formula F, every stable model of F is a model of F.

- (•) True
- ( ) False

Quiz Score: **10** out of 10

Mid Term Practice Quiz

1. Which of the following propositional formulas or set of propositional formulas are satisfiable? Choose all that apply.
    a. {p -> q, q -> ¬p}
    b. {p -> q, ¬p, ¬q}
    c. {p v q, ¬p ∧ ¬q}
    d. { p -> q, q, p -> ¬q}

2. Determine which of the following formulas are tautologies. Choose all that apply.
    a. [¬ p ∧ (p ∨ q)] → q
    b. [(p → q) ∧ (q → r)] → [p → r]
    c. (p -> q) -> (q -> p)
    d. (p -> q) ∧ (q -> p)

3. Is the following first-order formula satisfiable?

    ∀x y (x ≠ y)

    a. Unsatisfiable
    b. Satisfiable

4. What are the free variables in the following formula?
    $\exists x\,(P(x, y) \rightarrow \forall y\,P(y, x))$
    a. y
    b. x
    c. Both x and y
    d. No Free variable

5. Which is a stable model of the given program?

    $p \leftarrow \neg q$

    $q \leftarrow \neg r$

    a. {p, q, r}
    b. {p, q}
    c. {p}
    d. {q}

6. Every positive program has a model. True or False?

a. True
b. False

7. What do you think is the number of stable models of the given program?

   {p(1..3)}. {q(1..3)}.

   a. 8
   b. 16
   c. 32
   d. 64

8. How many rules are there in the given clingo program?

   {p(I) : I = 1..7}

   a. 1
   b. 2
   c. 7
   d. 8

9. Select all the minimal models for the formula p ∨ q, given the signature {p, q}.
   a. {p}
   b. {q}
   c. {p, q}
   d. All of the above

10. Given the signature: **σ** {a, b, P}, which are the Herbrand interpretations for the given formula?

    P(a) ∧ ¬P(b) ∧ ∃x ¬P(x)

    a. Ø
    b. {P(a)}
    c. {P(b)}

{P(a), P(b)}

Mid-term Practice Quiz Solutions

Q1.

Answer: a, b, d

Explanation: Based on the truth table, for option c, none of the combinations is true.

Q2.

Answer: a, b

Explanation: Based on the truth table for the following formulas, only a and b have all trues in the table.

Q3.

Answer: Unsatisfiable

Explanation: No matter what interpretation I, we define, it's universe must be non-empty. Let's say the universe is |I| = {apple, …} Then the formula ∀x y (x ≠ y) is true indicates that at least the following formula { apple ≠ apple } is true, which is not.

Q4.

Answer: x

Explanation: An occurrence of a variable in a formula F is free if v is not bounded by any quantifier. A variable v is a free variable of F if v has at least 1 free occurrence

Q5.

Answer: {q}

Explanation: This is the only stable model. First, r must be false since there is no rule to derive r. Second, q must be true due to the second rule. Finally, p cannot be true.

Q6.

Answer: True

Explanation: Consider any positive program P that you guess may not have a model. Think of an interpretation I that contains all atoms in P and see if I satisfies P.

Q7.

Answer: 64

Explanation: p and q both have 3 choices. {p(1); p(2); p(3)}, {q(1); q(2); q(3)}. 8 stable models are possible for each p and q. So, there are 8x8 = 64 stable models possible.

Q8.

Answer: 1

Explanation: There is only 1 rule. I is a local variable and the local variable just expands the rule rather than creating new rules.

Q9.

Answer: {p}, {q}

Explanation: The models {p} and {q} individually satisfies the given formula. That is why there are minimal models. In case of {p, q}, the model provides more information which is not minimal.

Q10.

Answer: {P(a)}

Explanation: The only model that satisfies the given formula is when P(a) is true, and P(b) is false. Try to substitute these values in the given formula.

CSE579: Knowledge Representation and Reasoning

Practice Questions for Midterm (Set II)

---

1. Which formulas are equivalent to each other?

A. $(p \rightarrow q), (p \vee \neg q)$
B. $\big(p \wedge (q \vee r)\big), (p \wedge q) \vee (p \wedge r)$
C. $(p \rightarrow q), (\neg p \vee q)$
D. $((p \wedge q) \vee \neg r), (p \vee q) \wedge (p \vee \neg r)$

---

2. $F \models G$ (read as F entails G), if and only if $F \wedge \neg G$ is

A. satisfiable
B. unsatisfiable

---

3. Which of the following is the correct representation of the following statement.

"some real numbers are rational"

A. $\exists x(real(x) \vee rational(x))$
B. $\forall x\big(real(x) \rightarrow rational(x)\big)$
C. $\exists x(real(x) \wedge rational(x))$
D. $\exists x\big(rational(x) \rightarrow real(x)\big)$

---

4. $Parent(p, q)$ is a binary predicate meaning "p is the parent of q",

$Male(p)$ is a unary predicated meaning "p identifies as a male",

and me is an object constant referring to the self.

Then, for the following First-order logic formula,

$$\exists x \exists y(Parent(x, me) \wedge Parent(x, y) \wedge Male(y))$$

what is the correct interpretation?

A. Both my parents are male
B. My grandfather has a brother
C. I am the parent of two boys
D. I have a brother

---

5. Let F_1 be $P(a) \wedge \exists x(\neg P(x))$

Find the Herbrand Models of F_1, whose signature is $\{a, b, P\}$.

A. {P(a), P(b)}
B. { }
C. {P(a)}
D. {P(b)}

---

6. Consider the following program that solves the N-Queens puzzle.

```
1 {queen(R,1..n)} 1 :- R=1..n.

:- queen(R1,C), queen(R2,C), R1!=R2.

:- queen(R1,C1), queen(R2,C2), R1!=R2, |R1-R2|=|C1-C2|.
```

What is the correct command line to obtain all 92 models when there are 8 queens?

A. clingo queens.lp n=8
B. clingo queens.lp -c n=8
C. clingo queens.lp -c n=8 0
D. clingo queens.lp n=8 0

---

7. Consider the following program.

```
p :- q, r.

q :- p, r.

r :- p, q.
```

Which of the following is true?

A. This program is unsatisfiable.
B. This program is satisfiable.
C. The minimal model of this program is {p, q, r}.
D. The minimal model of this program is { }.

---

8. Consider the following program.

```
shadow(0,1).

shadow(N+1, F*(N+1)) :- shadow(N,F), N=0..8.

shadow(F) :- shadow(N,F).

#show shadow/1.
```

Given the command line “clingo shadowProgram.lp -c n=5”, which of the following will be present in the output stable model?

A. shadow(24)
B. shadow(120)
C. shadow(720)
D. shadow(5040)

---

9. How many stable models does the following program give rise to?

```
{q(I,J): J=1..4} :- I=1..2.
```

A. 64
B. 256
C. 512
D. 4096

10. Which component of the pattern is ASP weeds out the elements of the search space that do not represent solutions?

A. Generate

B. Define

C. Test

Solutions to Practice Questions for Midterm (Set II)

---

1. B, C

Drawing out the truth tables for these formulas will highlight the equivalences.

(Hint: F is equivalent to G, if F↔G is a tautology)

---

2. B

The rules of entailment and satisfiability dictate that $F \models G$, iff $F \wedge \neg G$ is Unsatisfiable.

---

3. C

The actual translations of the options are as follows.

A. "There exist some numbers which are either real OR rational"
B. "All real numbers are rational"
C. "There exist some numbers which are both real AND rational"
D. "There exist some numbers for which rational implies real"

---

4. D

This rule is to be read as follows:

- There exists an x that is my parent.
- There exists a y, whose parent is also x.
- y identifies as a male.
- Hence, y is my brother.

---

5. C

The formula is satisfied only when $P(a) = T$ and $P(b) = F$.

---

6. C

clingo queens.lp -c n=8 0
The above command line will enumerate all 92 models.

---

7. B, D

The program is satisfiable, and its minimal model is the empty set. The atoms in the head are not explicitly stated as true, but the program will satisfy when all atoms are interpreted as false.

---

8. A, B, C

Upon inspection, it will be evident that this program is like the clingo program that generates factorials. For a given n, the program generates factorials from 1 to n+1. Hence, for n=5, the factorials of 1 through 6 will be generated as atoms. So, the output will be:

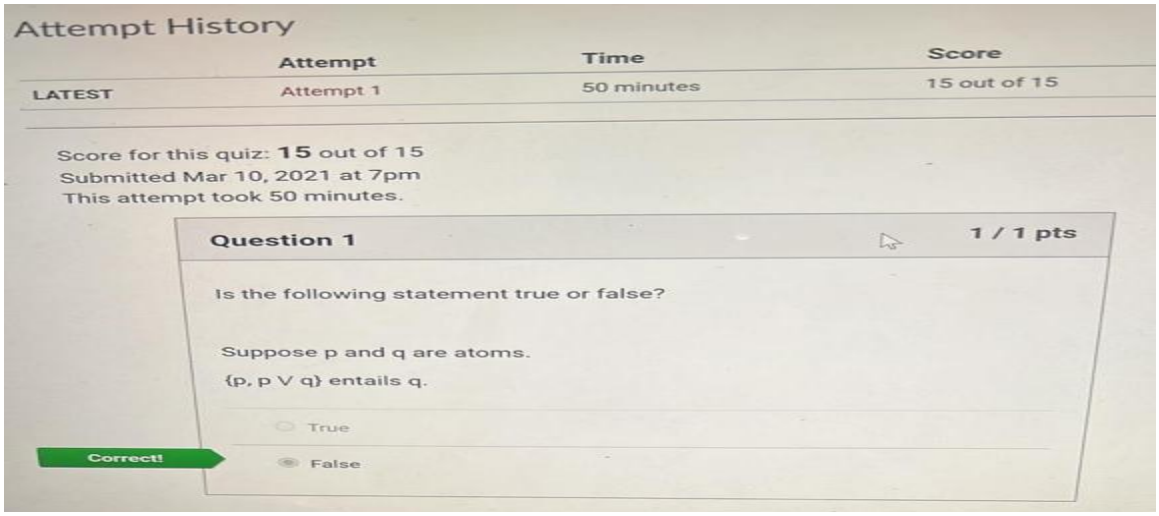
```
shadow(1) shadow(2) shadow(6) shadow(24) shadow(120) shadow(720)
```

9. B

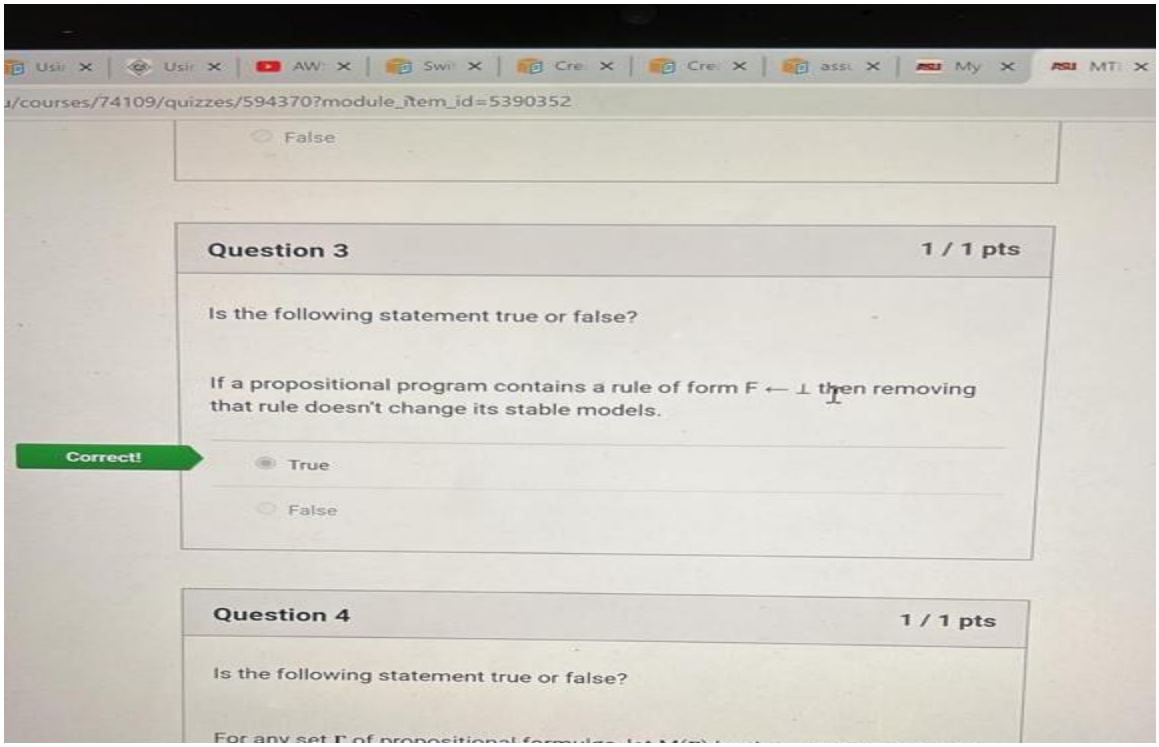
Plugging this code in clingo will produce 256 stable models.

10. C

The TEST part performs this function.

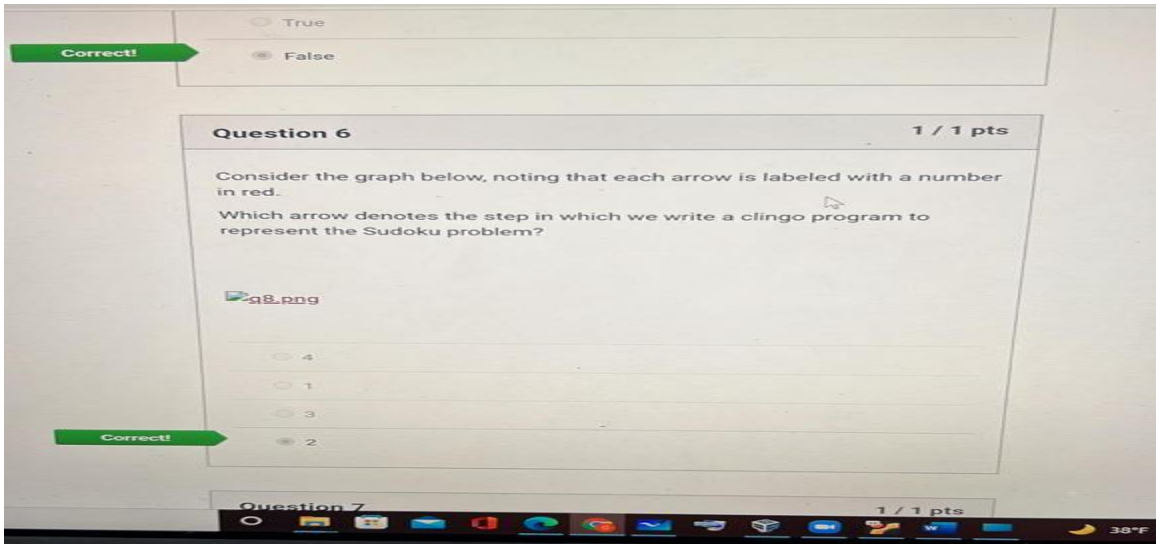


Is the following statement true or false?
Suppose p and q are atoms (p, p V q) entails q (intersection)
Ans. False



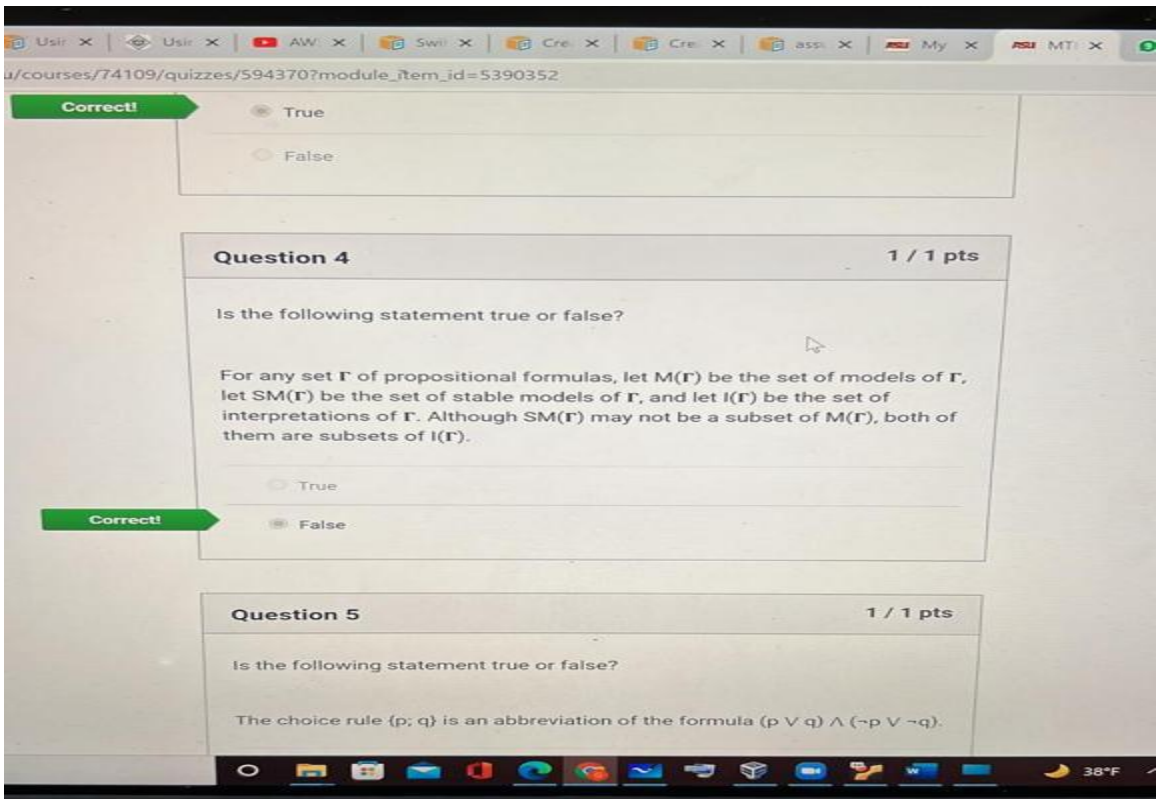
Is the following statement true or false?
If a propositional program contains a rule of form F <- Inverted T then removing that rule doesn't change its stable models

A. True



Consider the graph below, noting that each arrow is labeled with a number in red.
Which arrow denotes the step in which we write a clingo program to represent the Sudoku problem?

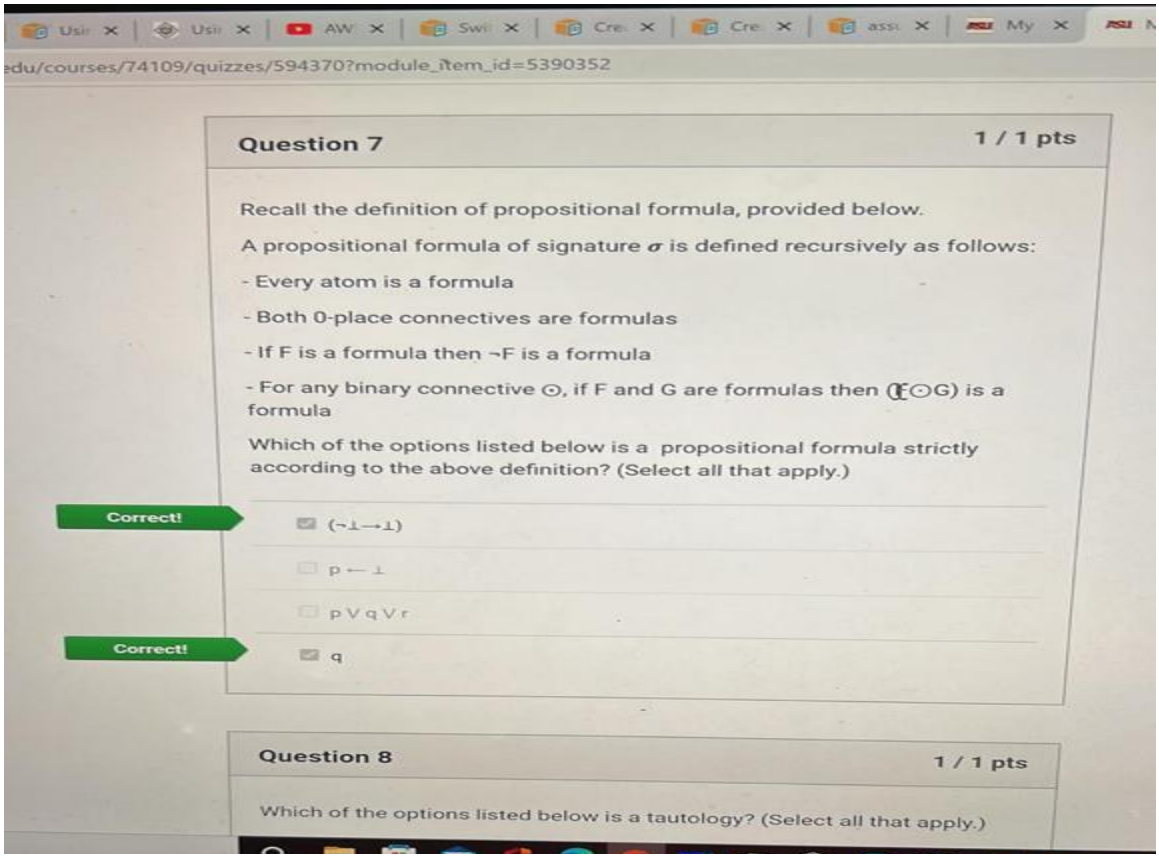
A. 2



Is the following statement true or false?

For any set T of propositional formulas; let M(T) be the set of models of T, let SM(T) be the set of stable models of T, and let I(T) be the set of interpretations of T. Although SM(T) may not be a subset of M(T), both of them are subsets of I(T)?

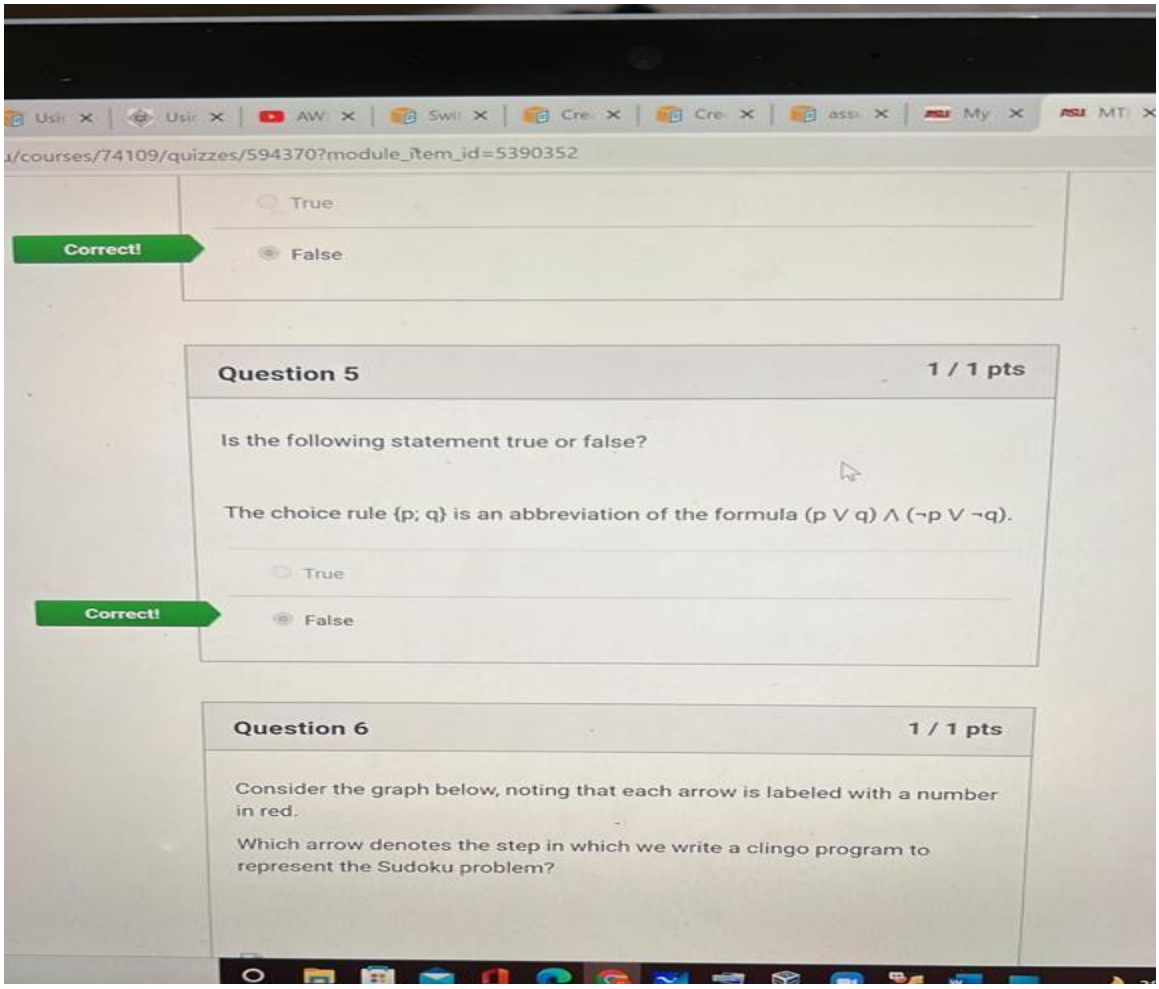
A. False



Recall the definition of propositional formula, provided below.
A propositional formula of signature O(sigma) is defined recursively as follows:

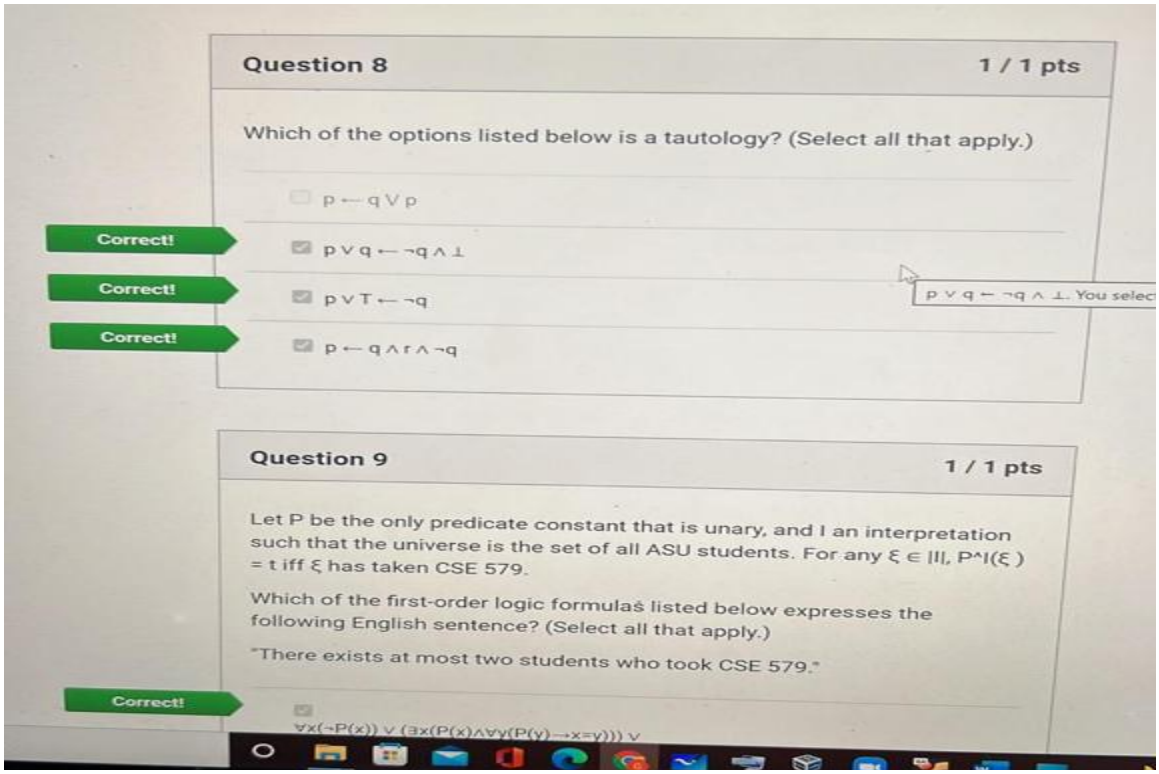
- Every atom is a formula
- Both 0-place connectives are formulas
- If F is a formula then ~F is a formula
- For any binary connective dot (.), if F and G and formulas then (F(.)G) is a formula

Which of the options listed below is a propositional formula strictly according to the above definition(select all that apply) ?
Ans: A & D (q)

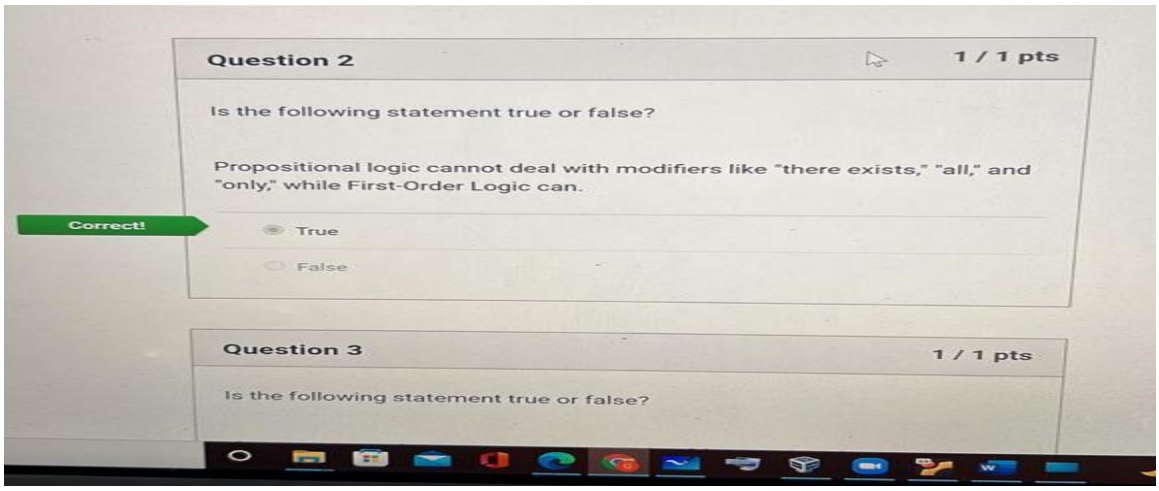


Is the following statement true or false?

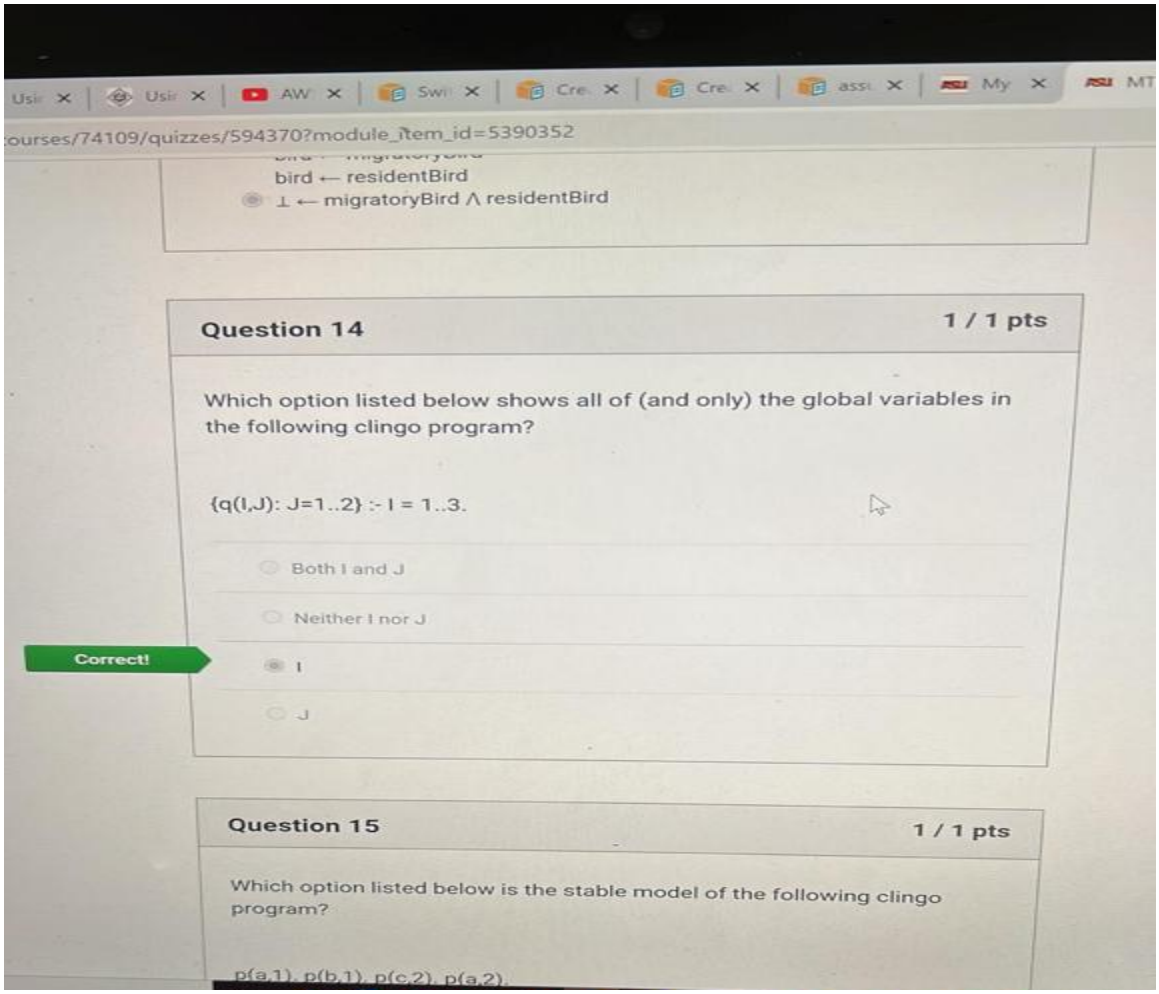
The choice rule (p, q) is an abbreviation of the formula (p V Q) ^ (~p V ~q).
And: False



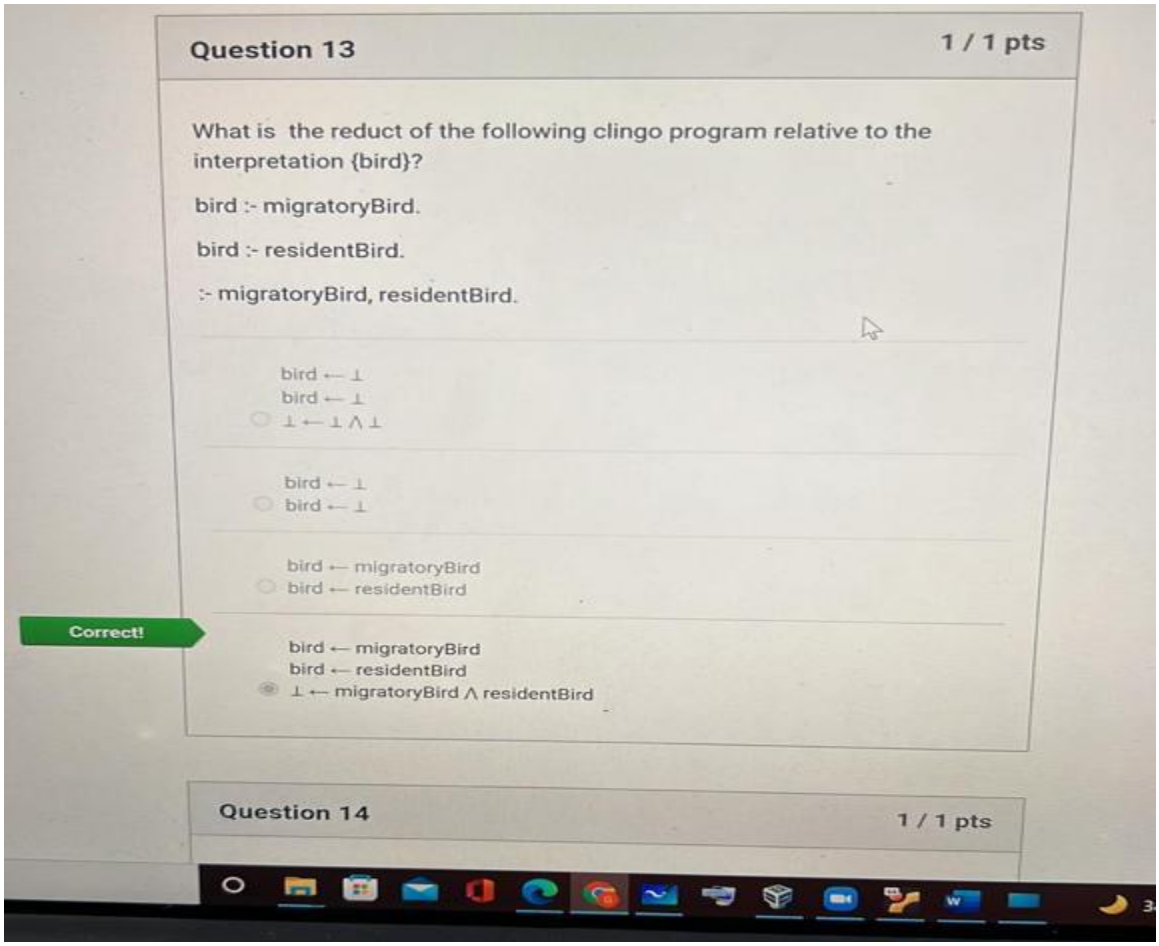
Which of the options listed below is a tautology? (Select all that apply)
Ans: BCD
P V q <- ~q ^ (Inverted T)
P V T <- ~q
P <- q ^ r ^ ~q



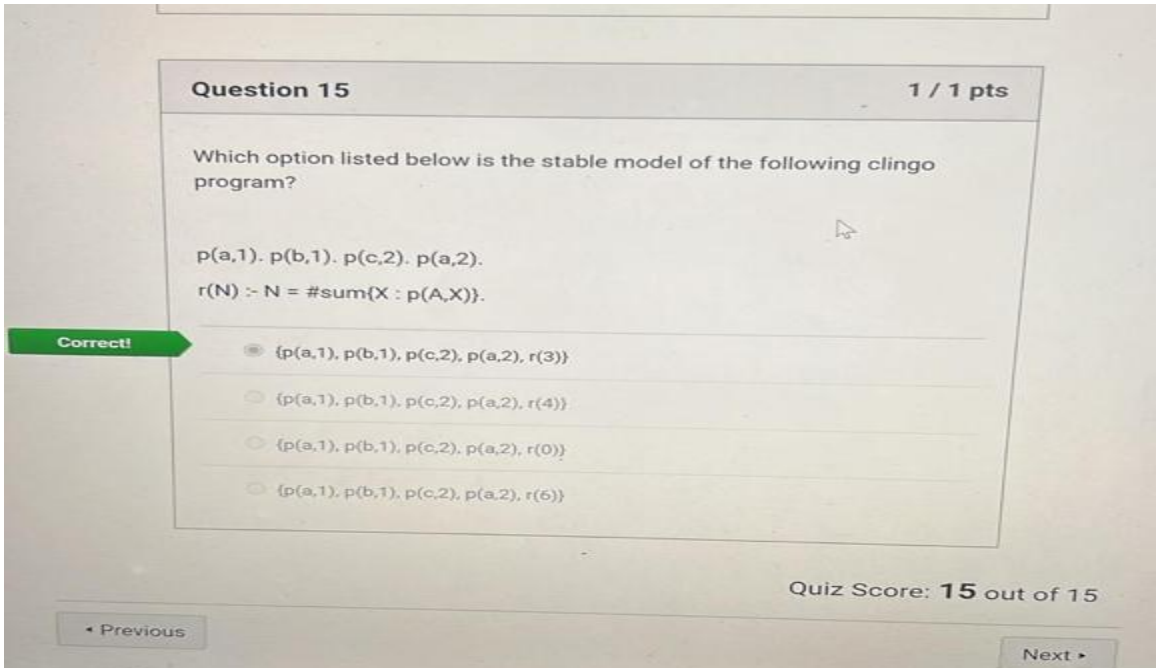
Is the following statement true or false?
Propositional logic cannot deal with modifiers like “there exists.” “all” and “only”, while First Order Logic can?
Ans: True



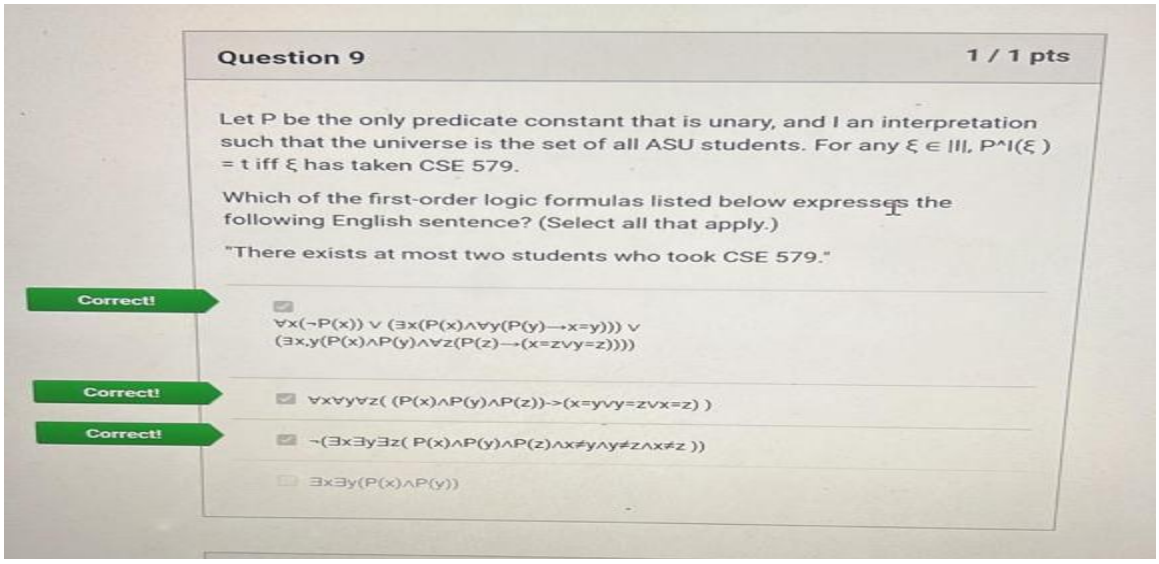
Which option listed below shows all of (and only) the global variables in the following clingo program?
{q(I,J) : J = 1..2} :- I = 1..3.
Ans: I (Option C)



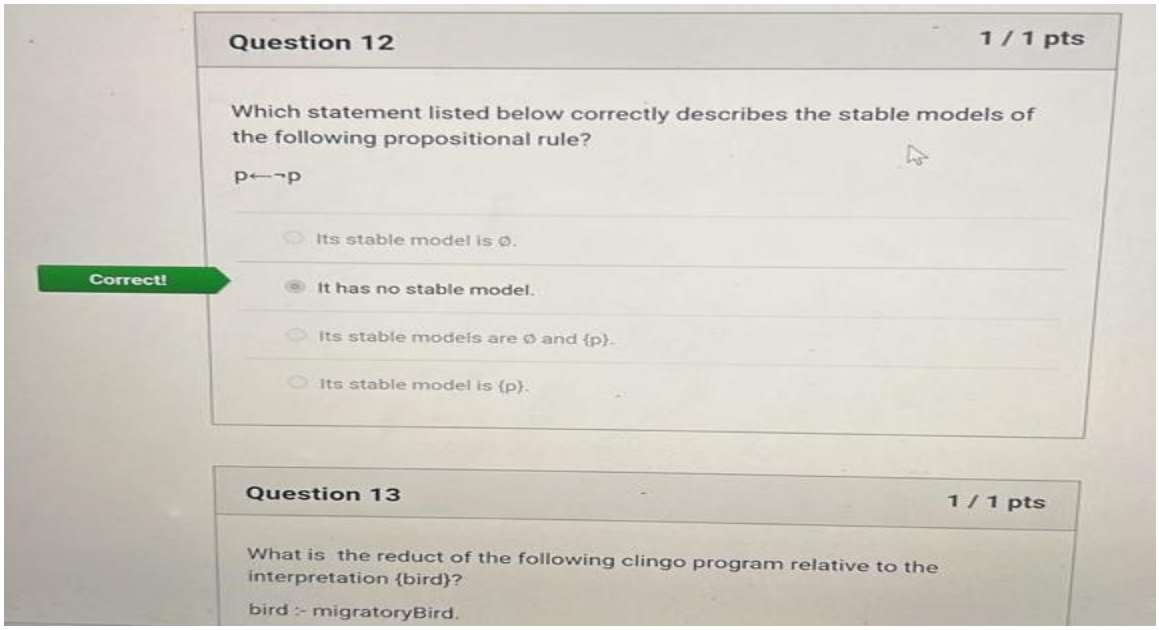
What is the reduct of the following clingo program relative to the interpretation (bird) ?
bird :- migratoryBird
bird :- residentBird.
:- migratoryBird, residentBird
Ans: D



Which option listed below is the stable models of the following clingo program ?
P (a,1).p(b,1).p(c,2).p(a,2).
r(N) :- N = #sum{X : p(A, X) }.
Ans: A



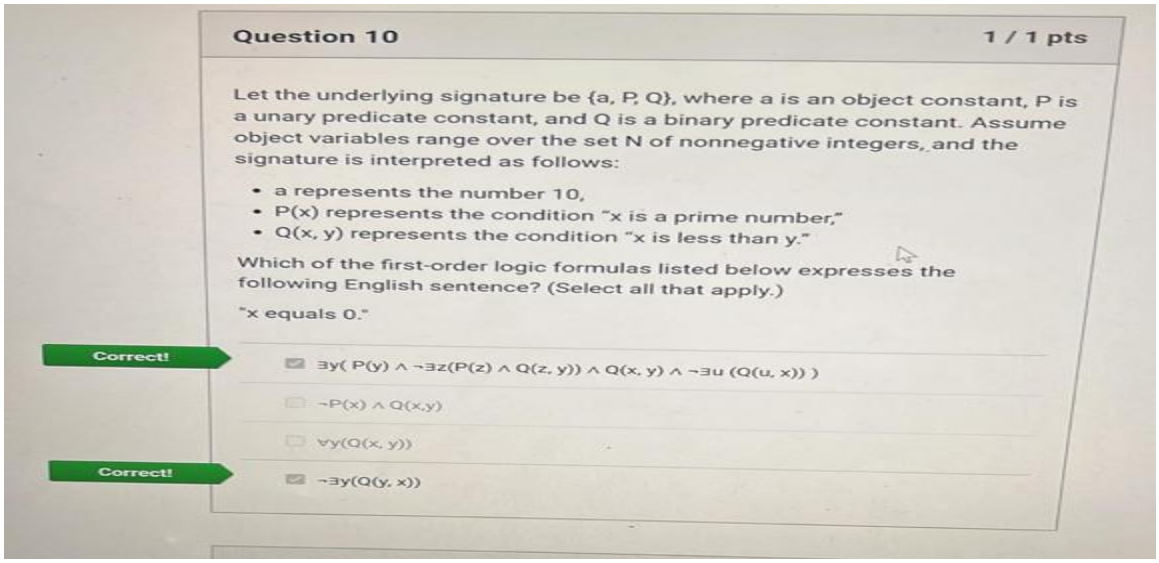
Let P be the only predicate constant that is unary, and I an interpretation such that the universe is the set of all ASU students. For any E(Episilon) Equals | I |, P ^ I (E) = t iff E has taken CSE 579/.
Which of the first order logic formulas listed below expresses the following English sentence? (Select all that apply.)
“There exists at most two students who took CSE 579.”
Ans : A, B, C



Which statement listed below correctly describes the stable models of the following propositional rule?

P <- ~p

Ans : It has no stable model (B)



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

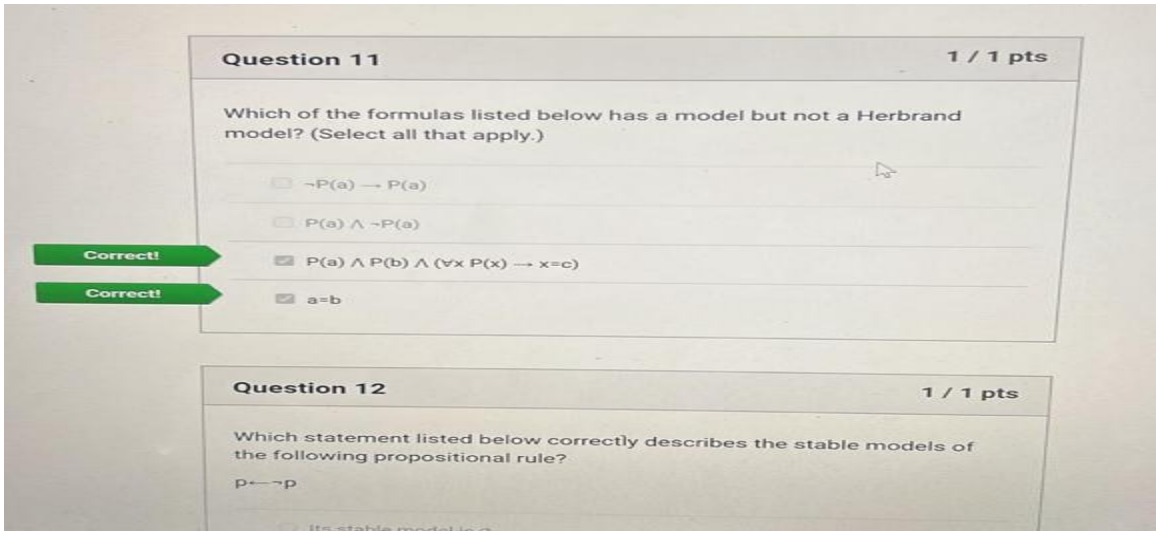
a represents the number 10,

P(x) represents the condition “x is a prime number.”

Q(x,y) represents the condition “x is less than y.”

Which of the first order logic formulas listed below expresses the following English sentence? (Select all that apply)?

Ans : A, D



Which of the formulas listed below has a model but not a Herbrand model? (Select all that apply.)
Ans : C, D