HOME WORK

**#1.1,1.2,1.3**

**2020380029**

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**#1.1**

**2.** Which of these are propositions? What are the truth values of those that are propositions?

**a)** Do not pass go. Not a proposition

**b)** What time is it? Not a proposition

**c)** There are no black flies in Maine. **False, Proposition. This sentence is a proposition because it can either be truth or false. Its truth value is false because black flies exist everywhere**.

**d)** 4 + *x* = 5. Not a proposition

**e)** The moon is made of green cheese. **False, Proposition. This sentence is a proposition because it can either be truth or false. Its truth value is false because the moon is not made from green cheese.**

**f)** 2*n* ≥ 100. Not a proposition

**14.** Let *p*, *q*, and *r* be the propositions

*p* :You get an A on the final exam.

*q* :You do every exercise in this book.

*r* :You get an A in this class.

Write these propositions using *p*, *q*, and *r* and logical connectives (including negations).

**a)** You get an A in this class, but you do not do every exercise in this book.

**r ∧ ¬q**

**b)** You get an A on the final, you do every exercise in this book, and you get an A in this class.

**p ∧ q ∧ r**

**c)** To get an A in this class, it is necessary for you to get an A on the final.

**p → r**

**d)** You get an A on the final, but you don’t do every exercise in this book; nevertheless, you get an A in this class.

**p ∧ ¬q ∧ r**

**e)** Getting an A on the final and doing every exercise in this book is sufficient for getting an A in this class.

**(p ∧ q) → r**

**f)** You will get an A in this class if and only if you either do every exercise in this book or you get an A on the final.

**r ↔ (p ∨ q)**

**26.** Write each of these propositions in the form “*p* if and only if *q*” in English.

**a)** For you to get an A in this course, it is necessary and sufficient that you learn how to solve discrete mathematics problems.

**You’ll get an A in this course if and only if you learn how to solve discrete mathematics.**

**b)** If you read the newspaper every day, you will be informed, and conversely.

**You’ll be informed everyday if and only if you read the newspaper every day.**

**c)** It rains if it is a weekend day, and it is a weekend day if it rains.

**It rains if and only if it is a weekend day.**

**d)** You can see the wizard only if the wizard is not in, and the wizard is not in only if you can see him.

**You can see the wizard if and only if the wizard is not in.**

**30.** How many rows appear in a truth table for each of these compound propositions?

**a)** *(q* →￢*p)* ∨ *(*￢*p* →￢*q)* ***4***

**b)** *(p* ∨￢*t)* ∧ *(p* ∨￢*s)* **8**

**c)** *(p* → *r)* ∨ *(*￢*s* →￢*t)* ∨ *(*￢*u* → *v)* **64**

**d)** (*p* ∧ *r* ∧ *s)* ∨ *(q* ∧ *t)* ∨ *(r* ∧￢*t)* **32**

**36.** Construct a truth table for each of these compound propositions.

**a)** *(p* ∨ *q)* ∨ *r*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| p | Q | R | (P ∨ Q ) | (P ∨ Q ) ∨ R |
| T | T | T | T | T |
| T | T | F | T | T |
| T | F | T | T | T |
| T | F | F | T | T |
| F | T | T | T | T |
| F | T | F | T | T |
| F | F | T | F | T |
| F | F | F | F | F |

**b)** *(p* ∨ *q)* ∧ *r*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| p | q | r | (p ∨ q) | (p ∨ q) ∧ r |
| T | T | T | T | T |
| T | T | F | T | F |
| T | F | T | T | T |
| T | F | F | T | F |
| F | T | T | T | T |
| F | T | F | T | F |
| F | F | T | F | F |
| F | F | F | F | F |

**c)** *(p* ∧ *q)* ∨ *r*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| p | q | r | (p ∧ q) | (p ∧ q) ∨ r |
| T | T | T | T | T |
| T | T | F | T | T |
| T | F | T | F | T |
| T | F | F | F | F |
| F | T | T | F | T |
| F | T | F | F | F |
| F | F | T | F | T |
| F | F | F | F | F |

**d)** *(p* ∧ *q)* ∧ *r*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| p | q | r | (p ∧ q) | (p ∧ q) ∧ r |
| T | T | T | T | T |
| T | T | F | T | F |
| T | F | T | F | F |
| T | F | F | F | F |
| F | T | T | F | F |
| F | T | F | F | F |
| F | F | T | F | F |
| F | F | F | F | F |

**e)** *(p* ∨ *q)*∧￢*r*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| p | q | r | ￢r | (p ∨ q) | (p ∨ q)∧￢r |
| T | T | T | F | T | F |
| T | T | F | T | T | T |
| T | F | T | F | T | F |
| T | F | F | T | T | T |
| F | T | T | F | T | F |
| F | T | F | T | T | T |
| F | F | T | F | F | F |
| F | F | F | T | F | F |

**f )** *(p* ∧ *q)*∨￢*r*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| p | q | r | ￢r | (p ∧ q) | (p ∧ q)∨￢r |
| T | T | T | F | T | T |
| T | T | F | T | T | T |
| T | F | T | F | F | F |
| T | F | F | T | F | T |
| F | T | T | F | F | F |
| F | T | F | T | F | T |
| F | F | T | F | F | F |
| F | F | F | T | F | T |

**43.** Find the bitwise *OR*, bitwise *AND*, and bitwise *XOR* of each of these pairs of bit strings.

**a)** 101 1110

010 0001

|  |  |  |
| --- | --- | --- |
| OR | AND | XOR |
| 111 1111 | 000 0000 | 111 1111 |

**c)** 00 0111 0001

10 0100 1000

|  |  |  |
| --- | --- | --- |
| OR | AND | XOR |
| 10 0111 1001 | 00 0100 0000 | 10 0011 1001 |

**#1.2**

In Exercises 1–6, translate the given statement into propositional logic using the propositions provided.

**2.** You can see the movie only if you are over 18 years old or you have the permission of a parent. Express your answer in terms of *m*: “You can see the movie,” *e*: “You are over 18 years old and *p*: “You have the permission of a parent.”

**m→ (e ∨ p)**

**4.** To use the wireless network in the airport you must pay the daily fee unless you are a subscriber to the service. Express your answer in terms of *w*: “You can use the wireless network in the airport,” *d*: “You pay the daily fee,” and *s*: “You are a subscriber to the service.”

**w→ (d ∨ s)**

Exercises 32–38 are puzzles that can be solved by translating statements into logical expressions and reasoning from these expressions using truth tables.

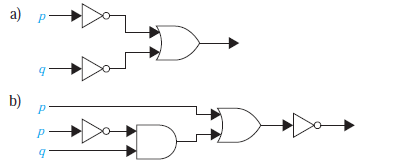
**32.** The police have three suspects for the murder of Mr. Cooper: Mr. Smith, Mr. Jones, and Mr. Williams. Smith, Jones, and Williams each declare that they did not kill Cooper. Smith also states that Cooper was a friend of Jones and that Williams disliked him. Jones also states that he did not know Cooper and that he was out of town the day Cooper was killed. Williams also states that he saw both Smith and Jones with Cooper the day of the killing and that either Smith or Jones must have killed him. Can you determine who the murderer was if

**a)** One of the three men is guilty, the two innocent men are telling the truth, but the statements of the guilty man may or may not be true?

**b)** Innocent men do not lie?

**Jones is the killer.**

**40.** Find the output of each of these combinatorial circuits.



**A) ￢p ∨￢q**

**B) ￢ (p ∨ (￢p ∧ q))**

**#1.3**

**8.** Use De Morgan’s laws to find the negation of each of the following statements.

**a)** Kwame will take a job in industry or go to graduate school.

**Kwame will not take a job in industry and not go to graduate school**.

**b)** Yoshiko knows Java and calculus.

**Yoshiko does not know Java or does not know calculus.**

**c)** James is young and strong.

**James is not young or not strong.**

**d)** Rita will move to Oregon or Washington.

**Rita will not move to Oregon and will not move to Washington.**

**28.** Show that *p* ↔ *q* and ￢*p* ↔￢*q* are logically equivalent.

**p ↔ q ≡￢p ↔￢q**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| p | q | ￢p | ￢q | p ↔ q | ￢p ↔￢q |
| 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 0 | 0 | 1 | 1 |

**30.** Show that *(p* ∨ *q)* ∧ *(*￢*p* ∨ *r)* → *(q* ∨ *r)* is a tautology.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| p | q | r | ￢p | (p ∨ q) | (￢p ∨ r) | (p ∨ q) ∧ (￢p ∨ r) | (q ∨ r) | (p ∨ q) ∧ (￢p ∨ r) → (q ∨ r) |
| 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 |
| 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 |

***[(P* ∨ *q)* ∧ *(*￢*p* ∨ *r)]* → *(q* ∨ *r) ≡T***

**36.** When does *s*∗ = *s*, where *s* is a compound proposition?

**S is equivalent with a variable (p, q, r, etc.) or the negation of variable for example, ￢p.**

**40.** Find a compound proposition involving the propositional variables *p*, *q*, and *r* that is true when *p* and *q* are true and *r* is false, but is false otherwise. [*Hint:* Use a conjunction of each propositional variable or its negation.]

**p∧ q ∧￢r is only true when p , q and ￢r are true and thus when p true and r is false.**

**48.** Construct a truth table for the logical operator *NOR.*

|  |  |  |
| --- | --- | --- |
| p | q | p ↓ q |
| 1 | 1 | 0 |
| 1 | 0 | 0 |
| 0 | 1 | 0 |
| 0 | 0 | 1 |

**54.** Show that *p* | *(q* | *r)* and *(p* | *q)* | *r* are not equivalent, so that the logical operator | is not associative.

**Two propositions are logically equivalent,if they have the same truth value for any combination of. truth values for the variables p,q,r, etc.**

p NAND q is true if and only if p or q or both are flase

p NAND q is notated as p│q

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| P | q | r | p│r | p│q | p│(q│r) | (p│q)│r |
| 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 1 | 1 | 1 | 1 |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 |

**Since the last two columns of the truth table do NOT contain the same truth value in every row, the row expressions are NOT logically equivalent**.

***p* | *(q* | *r)* and *(p* | *q)* | *r* are not equivalent.[Proved]**

**58.** How many of the disjunctions *p* ∨￢*q*, ￢*p* ∨ *q*, *q* ∨ *r*, *q* ∨￢*r*, and ￢*q* ∨￢*r* can be made simultaneously true by an assignment of truth values to *p*, *q*, and *r*?

**The truth Values are determined for every disjunction is the following truth table.**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| p | q | r | ￢p | ￢q | ￢r | p ∨￢q | ￢p ∨ q | q ∨ r | q ∨￢r | ￢q ∨￢r | Number of disjunction that are true |
| 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 4 |
| 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 5 |
| 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 3 |
| 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 3 |
| 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 3 |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 4 |
| 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 4 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 4 |

**So, in this way it is possible when all the disjunction to become true. The answer is 5 .**