**Propositions and Compound propositions worksheet**

**A.** Indicate which of the following statements are propositions.

1. 2 + 3 = 7 **Proposition**
2. Julius Caesar was president of the United States **Proposition**
3. What time is it? **Not**
4. Be quiet ! **Not**
5. The difference of two primes. **Not**
6. 2 + 2 = 4. **Proposition**
7. Washington D.C. is the capital of New York. **Proposition**
8. How are you? **Not**

**B.**

* Let
  + m = Juan is a math major
  + c = Juan is a computer science major
  + How would we write “Juan is a math major but not a computer science major”

**M ^ ~C**

* Let s = stocks are increasing, i = interest rates are steady. How would we write
  + Stocks are increasing but interest rates are steady

**S ^ I**

* + Neither are stocks increasing nor are interest rates steady

**~S ^ ~I**

**C.** Let h = John is healthy, w = John is wealthy, s = John is wise.

Write compound propositions representing

1. John is healthy and wealthy but not wise

**W ^ ~S**

1. John is not wealthy but he is healthy and wise

**~W ^ (H ^ S)**

1. John is neither healthy, wealthy, nor wise

**~W ^ ~H ^ ~S**

1. John is neither wealthy nor wise, but he is healthy.

**~(W ^ S) ^ H**

1. John is wealthy, but he is not both healthy and wise.

**W ^ ~(H ^ S)**

D. Indicate whether each statement is true or false, assuming that the "or" in the sentence means the inclusive or. Then indicate whether the statement is true or false if the "or" means the exclusive or.

1. February has 31 days or the number 5 is an integer. **True. Inclusive.**

2. January has 31 days or the number 5 is an integer. **True. Inclusive.**

**Note:** When translating English sentences into logic we will always translate “or” as inclusive or unless it is explicitly stated that or is exclusive.

E. Complete the following truth tables

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| p | q | ¬p | ¬q | ¬p ∨ ¬q |
| T | T | F | F | F |
| T | F | F | T | T |
| F | T | T | F | T |
| F | F | T | T | T |

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

F. When evaluating a compound proposition that contains more than one logic operator you must make sure to follow the proper "order of operations". For logical operators this is: http://www.cs.uni.edu/~schafer/1800/symbols/not.PNG(negation), ˄ (conjunction), ˅ (disjunction). Notice that if we consider conjunction to be related to multiplication and disjunction related to addition than this is exactly the same order of operations that we use with arithmetic. The ¬ operator has higher precedence than ∧; ∧ has higher precedence than ∨.

Complete the truth table for p ∧ q ∨ p ∧ r. You need to figure out the order of operations.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| p | q | r | p ^ q | p ^ r | p ∧ q ∨ p ∧ r |
| T | T | T | T | T | T |
| T | T | F | T | F | T |
| T | F | T | F | T | T |
| T | F | F | F | F | F |
| F | T | T | F | F | F |
| F | T | F | F | F | F |
| F | F | T | F | F | F |
| F | F | F | F | F | F |