# **Section 5 - Propositions (120 points)**

To receive credit, you must show your work on the worksheet.

**112/120**

1. (21 points) Determine if the following statements are true or false *given p: true, q: true, r: false, s: false*
   1. (3 pts) p ⊕ q ∧ ¬p

1 either or 1 and 0

1 either or 0

1

True

* 1. (4 pts) (p ∧ ¬p) ∧ (q ∨ ¬r)

(1 and not 1) and (1 or not 0)

0 and 1

0

false

* 1. (4 pts) ((p ∨ q) ∧ ¬s)

((1 or 1) and not 0)

(1 and 1)

true

* 1. (5 pts) ((r ∨ s) → ¬q) → ¬p

( not (0 or 0) or not 1) → not 1

not ( 1 or 0) or not 1

0 or 0

false

* 1. (5 pts) (((r → q) ⊕ p) ∨ ¬s)

(((0 → 1) either or 1) or not 0

(((not 0 or 1) either or 1) or not 0)

((1 either or 1) or not 0)

0 or not 0

1

true

1. (30 points) Write the truth table for the following expressions:
   1. (5 pts) ¬(p ∨ q)

|  |  |  |  |
| --- | --- | --- | --- |
| N | P | Q | OUT |
| 1 | 0 | 0 | 1 |
| 2 | 1 | 0 | 0 |
| 3 | 0 | 1 | 0 |
| 4 | 1 | 1 | 0 |

The answers are the same just reversed order

* 1. (10 pts) (p ∧ ¬p) ∧ (q ∨ ¬r)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | P | Q | R | OUT |
| 1 | 0 | 0 | 0 | 0 |
| 2 | 1 | 0 | 0 | 0 |
| 3 | 0 | 1 | 0 | 0 |
| 4 | 1 | 1 | 0 | 0 |
| 5 | 0 | 0 | 1 | 0 |
| 6 | 1 | 0 | 1 | 0 |
| 7 | 0 | 1 | 1 | 0 |
| 8 | 1 | 1 | 1 | 0 |

* 1. (15 pts) (((r → q) ⊕ p) ∨ ¬s) (((not R or Q) either or P) or not s)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| N | P | Q | R | S | OUT |
| 1 | 0 | 0 | 0 | 0 | 1 |
| 2 | 1 | 0 | 0 | 0 | 1 |
| 3 | 0 | 1 | 0 | 0 | 1 |
| 4 | 1 | 1 | 0 | 0 | 1 |
| 5 | 0 | 0 | 1 | 0 | 1 |
| 6 | 1 | 0 | 1 | 0 | 1 |
| 7 | 0 | 1 | 1 | 0 | 1 |
| 8 | 1 | 1 | 1 | 0 | 1 |
| 9 | 0 | 0 | 0 | 1 | 1 |
| 10 | 1 | 0 | 0 | 1 | 0 |
| 11 | 0 | 1 | 0 | 1 | 1 |
| 12 | 1 | 1 | 0 | 1 | 0 |
| 13 | 0 | 0 | 1 | 1 | 0 |
| 14 | 1 | 0 | 1 | 1 | 1 |
| 15 | 0 | 1 | 1 | 1 | 1 |
| 16 | 1 | 1 | 1 | 1 | 0 |

The answers are the same just in a different order

1. (8 points) State the **converse** of the following implications
2. (4 pts) If it snows this weekend, then I will go skiing.

If I go skiing, then it will snow this weekend.

1. (4 pts) The river will freeze over if Texas has a heat wave.

If Texas has a heat wave, then the river will freeze over.

I mixed up the order because the if was after the then in this case

1. (8 points) State the **contrapositive** of the following implications
   1. (4 pts) If the DJ has a deep voice then there is another song to play

if there is not another song to play, the DJ will not have a deep voice

* 1. (4 pts) Hockey is a great sport if frogs have fleas.

If frogs do not have fleas, hockey is not a great sport.

I mixed up the order again because the if was after the then in this case

1. (6 points) If p → q is false, can you determine the truth value of the following? Explain your answer.
   1. (¬p) ∨ (p ↔ q)

p → q == not p or q, if not p or q == false p == true, q == false

(not 1) or ((p → q) and (q → p))

0 or ((not 1 or 0) and (not 0 or 1))

0 or (0 and 1)

0 or 0

0

false, the truth can be determined as there is only one possibility for what p and q equal.

1. (6 points) If p → q is true, can you determine the truth value of the following? Explain your answer.
   1. (¬p → q) ∧ ¬p

p → q == not p or q, if not p or q == true there are multiple possible combinations: (p,q) (0,0), (0,1),or (1,1)

The truth cannot be determined due to a lack of information of what p and q equal.

1. (30 points) Use a truth table to demonstrate that the following is a tautology, a contradiction (absurdity), or neither.
   1. (10 pts) (¬p ∧ (p ∨ q) → p )

(not p and not (p or q) or p)

|  |  |  |  |
| --- | --- | --- | --- |
| N | P | Q | Out |
| 1 | 0 | 0 | 1 |
| 2 | 1 | 0 | 1 |
| 3 | 0 | 1 | 0 |
| 4 | 1 | 1 | 1 |

Neither because its neither always false or always true.

* 1. (10 pts) (q ∧ r) ∧ (¬(p ∨ q))

(q and r) and (not (p or q))

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | P | Q | R | OUT |
| 1 | 0 | 0 | 0 | 0 |
| 2 | 1 | 0 | 0 | 0 |
| 3 | 0 | 1 | 0 | 0 |
| 4 | 1 | 1 | 0 | 0 |
| 5 | 0 | 0 | 1 | 0 |
| 6 | 1 | 0 | 1 | 0 |
| 7 | 0 | 1 | 1 | 0 |
| 8 | 1 | 1 | 1 | 0 |

Contradiction because it is always false

* 1. (10 pts) (p → (q ∧ r)) ↔ ((p ∧ q) →p)

(not p or (q and r)) ↔ ((not p or not q) or p)

((not p or (q and r)) → ((not p or not q) or p)) and (((not p or not q) or p) → (not p or (q and r)))

(not (not p or (q and r)) or ((not p or not q) or p)) and

(not ((not p or not q) or p) or (not p or (q and r)))

((p and (not q or not r)) or ((not p or not q) or p)) and

(((p and q) and not p) or (not p or (q and r)))

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| N | P | Q | R | OUT |
| 1 | 0 | 0 | 0 | 1 |
| 2 | 1 | 0 | 0 | 0 |
| 3 | 0 | 1 | 0 | 1 |
| 4 | 1 | 1 | 0 | 0 |
| 5 | 0 | 0 | 1 | 1 |
| 6 | 1 | 0 | 1 | 0 |
| 7 | 0 | 1 | 1 | 1 |
| 8 | 1 | 1 | 1 | 1 |

Neither because its neither always false or always true.

1. (15 points) Use the laws of logic to show whether the following is equivalent:
   1. p ↔ (p ∧ r) ≡ ¬p ∨ r

(p → (p and r)) and ((p and r) → p)

(not p or (p and r)) and (p or not (p and r))

((not p or p) and (not p or r)) and (p or (not p or not r))

(not p or r) and (p or (not p or not r))

not p or r

Yes the are Equivilant