**Problem Set 2**

**Part 1 (one point total).** *For each of the rows in the table below, mark the row ‘***A’** *if the expression in column A is a well-formed formula (WFF) and the expression in column B is not; mark the row ‘***B’** *if the expression in B is a WFF and the expression in A is not; mark the row ‘***C’** *if the expression in both Columns are WFFs; and mark the row with a ‘***D’** *if neither column contains a WFF for that row.*

|  |  |  |
| --- | --- | --- |
| # | Column A | Column B |
| 1 | P&Q | PQ |
| 2 | (PQ) | (P&Q) |
| 3 | P&Q→C | (P&Q)→C |
| 4 | (P&Q)→(C∨D) | (P&Q)→(C~D) |
| 5 | ~→P | ~~P |
| 6 | ~~~P↔~P | ~~P→~ |
| 7 | (P→Q)(R→S) | (P→Q)~R→S |
| 8 | ~P~↔Q | (~P)~↔(Q) |
| 9 | (P→(P&~~P))↔P | (P→(P~&~P))↔P |
| 10 | (((P→(Q∨R))↔(T&(Q→~R)))∨(~(P→(~Q→R)))) | ~(((P→(Q∨R))↔(T&(Q→~R)))∨(~(P→(~Q→R)))) |

Solution:

1. D
2. B
3. B
4. A
5. B
6. D
7. D
8. D
9. A
10. C

**Part 2 (one point total).** *For each of the following formulae, identify the main connective.*

1. ~P
2. ~P&Q
3. ~(P&Q)
4. ~(P&Q)→(T∨R)
5. ~((P&Q)→T)∨R
6. (~((P&Q)→T)∨R)
7. ~(((P&Q)→T)∨R)
8. ~((P&Q)→T)∨R→S
9. ~((P&Q)→T)∨(R→S)
10. ~(((P&Q)→T)∨R)→S

Solution:

1. ~
2. &
3. ~
4. →
5. ∨
6. ∨
7. ~
8. → (The fifth connective)
9. ∨
10. → (The fifth connective)

**Part 3 (one point total).** *For each of the following English sentences, provide a translation into SL, using the following translation key (ignore issues of tense for now): (you may use parentheses dropping conventions.)*

T: Tyrion has a drink.

C: Cersei gets angry.

S: Jon Snow broods.

L: Littlefinger plots.

A: Arya checks another name off her list.

R: Robert has a drink.

D: Dany releases the dragons.

J: Jaime trusts Cersei

1. Tyrion has a drink.
2. Jon Snow does not brood.
3. Tyrion has a drink, and Jon Snow broods.
4. Tyrion does not have drink, but Jon Snow broods.
5. Robert has a drink.
6. Robert or Tyrion has a drink.
7. Neither Robert nor Tyrion have drinks.
8. If Cersei gets angry, then neither Robert nor Tyrion have drinks.
9. Neither Robert nor Tyrion have drinks only if Cersei gets angry.
10. Neither Robert nor Tyrion have drinks if and only if Cersei gets angry

Solution:

1. T
2. ~S
3. T&S
4. ~T&S
5. R
6. R∨T
7. ~( R∨T)
8. C→~( R∨T)
9. ~( R∨T) →C
10. ~( R∨T)↔C

**Part 4 (one point total).** *For each of the following English sentences, provide a translation into SL, using the following translation key (ignore issues of tense for now): (you may use parentheses dropping conventions.)*

T: Tyrion has a drink.

C: Cersei gets angry.

S: Jon Snow broods.

L: Littlefinger plots.

A: Arya checks another name off her list.

R: Robert has a drink.

D: Daenerys releases the dragons.

J: Jaime trusts Cersei

1. Robert and Tyrion have a drink.
2. If both Robert and Tyrion have a drink, then Cersei gets angry.
3. If it is not the case that both Robert and Tyrion have drinks, then Cersei does not get angry.
4. If neither Robert nor Tyrion have a drink, then Cersei gets angry.
5. If neither Robert nor Tyrion have a drink, then Cersei will get angry if and only if Dany releases the dragons.
6. If neither Robert nor Tyrion have a drink, then Cersei will get angry if and only if Dany releases the dragons and Jon Snow broods.
7. Either Arya checks another name off her list, or if neither Robert nor Tyrion have a drink, then Cersei will get angry if and only if Dany releases the dragons.
8. Either Arya checks another name off her list and Littlefinger plots, or if neither Robert nor Tyrion have a drink, then Cersei will get angry if and only if Dany releases the dragons.
9. It is not the case that either Arya checks another name off her list and Littlefinger plots, or if neither Robert nor Tyrion have a drink, then Cersei will get angry if and only if Dany releases the dragons.
10. If it is not the case that either Arya checks another name off her list and Littlefinger plots, or if neither Robert nor Tyrion have a drink, then Cersei will get angry if and only if Dany releases the dragons, then Jaime trusts Cersei only if Robert has a drink.

Solution:

1. R&T
2. R&T→C
3. ~(R&T) →~C
4. ~( R∨T) →C
5. ~( R∨T) →(C↔D)
6. ~( R∨T) →(C↔D&S)
7. A∨(~( R∨T) →(C↔D))
8. (A&L)∨(~( R∨T) →(C↔D))
9. ~((A&L)∨(~( R∨T) →(C↔D)))
10. ~(A&L)∨(~( R∨T) →(C↔D))