**Natural Deduction Exercises: *Rules of Replacement***

Using the rules of inference and replacement, provide a deduction of the conclusion of each argument from the premises provided. (Hint: if you are worried about the problem, do a tree first in order to check if the argument if valid; if the tree closes and the argument is valid, then you can be confident there is a proof).

I.

1. (P 🡒 (Q 🡒 R))

2. (P ∧ Q)

3. (R 🡒 Z) / Z

II.

1. (¬P ∨ ¬R)

2. ((P ∧ R) 🡒 ¬T)

3. (Q ∨ T)

4. (Q 🡒 Z) / Z

III.

1. ¬(¬P ∧ ¬Q)

2. ((P ∨ Q) 🡒 T) / (S 🡒 T)

IV.

1. (P ∨ (Q ∧ R))

2. ¬Q

3. (P 🡒 ¬Z)

4. (¬Z 🡒 ¬W) / ¬W

V.

1. ((P ∨ ¬S) ∧ V)

2. ((¬P ∨ S) ∧ T)

3. (¬(P ≡ Q) ∨ Z) / Z

VI.

1. ((P ∨ (Q ∨ R)

2. (¬Q ∧ Z)

3. (P ∨ R) 🡒 Z) / Z

VII.

1. (P 🡒 Q) 🡒 (¬R 🡒 ¬T)

2. ¬(¬R 🡒 ¬T)

3. ((P 🡒 Q) ∨ Z) / Z

VIII.

1. ((P ∨ Q) ∧ R)

2. (R 🡒 Z)

3. (P ∨ Q) 🡒 V)

4. (T 🡒 ¬(Z ∧ V)) / ¬T

IX.

1. (P ∨ Q)

2. (Q 🡒 R)

3. (¬P ∧ S) / (R ∧ S)

X.

1. ((P  Q) ∨ ¬R)

2. (R ∨ (S ∨ T))

3. (¬S ∧ ¬T)

4. P / Q

X.

1. ((P 🡒 R) 🡒 T)

2. (T 🡒 V)

3. (¬V ∧ W)

4. (¬(P 🡒 R) ∧ W) 🡒 Z / Z