

| a) | $p \wedge q \vee r$ | | | | |
|----|---------------------|---|--------------|---|---------------------|
| | p | q | $p \wedge q$ | r | $p \wedge q \vee r$ |
| | v | v | v | v | v |
| | v | v | v | f | v |
| | v | f | f | v | v |
| | v | f | f | f | f |
| | f | v | f | v | v |
| | f | v | f | f | f |
| | f | f | f | v | v |
| | f | f | f | f | f |

| b) | $\neg(p \wedge q)$ | | | |
|----|--------------------|----------|-------------------|--------------------|
| | p | $\neg q$ | $p \wedge \neg q$ | $\neg(p \wedge q)$ |
| | v | f | f | v |
| | v | v | v | f |
| | f | f | f | v |
| | f | v | f | v |

| c) | $\neg(p \wedge q) \vee \neg(q \leftrightarrow p)$ | | | | | | | |
|----|---|---|--------------|---|---|-----------------------|--------------------|-----------------------------|
| | p | q | $p \wedge q$ | p | q | $q \leftrightarrow p$ | $\neg(p \wedge q)$ | $\neg(q \leftrightarrow p)$ |
| | v | v | v | v | v | v | f | f |
| | v | f | f | v | f | f | v | v |
| | f | v | f | f | v | f | v | v |
| | f | f | f | f | f | v | v | v |

| d) | p∨¬r→q^r | | | | | | | | | | | | | | |
|----|----------|---|---|--|---|---|-----|--|---|----|------|--|------|-----|----------|
| | p | q | r | | q | r | q^r | | p | ¬r | p∨¬r | | p∨¬r | q^r | p∨¬r→q^r |
| | v | v | v | | v | v | v | | v | f | v | | v | v | v |
| | v | v | f | | v | f | f | | v | v | v | | v | f | f |
| | v | f | v | | f | v | f | | v | f | v | | v | f | f |
| | v | f | f | | f | f | f | | v | v | v | | v | f | f |
| | f | v | v | | v | v | v | | f | f | f | | f | v | v |
| | f | v | f | | v | f | f | | f | v | v | | v | f | f |
| | f | f | v | | f | v | f | | f | f | f | | f | f | v |
| | f | f | f | | f | f | f | | f | v | v | | v | f | f |

| e) | (p ↔ ~q) ↔ (q → p) | | | | | | | | | | | | | |
|----|--------------------|---|--|---|----|--------|--|---|---|-------|--|--------|-------|--------------------|
| | p | q | | p | ~q | p ↔ ~q | | q | p | q → p | | p ↔ ~q | q → p | (p ↔ ~q) ↔ (q → p) |
| | v | v | | v | f | f | | v | v | v | | f | v | f |
| | v | f | | v | v | v | | f | v | v | | v | v | v |
| | f | v | | f | f | v | | v | f | f | | v | f | f |
| | f | f | | f | v | f | | f | f | v | | f | v | f |

| f) | $\neg(p \rightarrow \neg q)$ | | | | |
|----|------------------------------|---|----------|------------------------|------------------------------|
| | p | q | $\neg q$ | $p \rightarrow \neg q$ | $\neg(p \rightarrow \neg q)$ |
| | v | v | f | f | v |
| | v | f | v | v | f |
| | f | v | f | v | f |
| | f | f | v | v | f |

| g) | $\neg p \rightarrow (q \rightarrow p)$ | | | | | | |
|----|--|---|---|---|-------------------|----------|--|
| | p | q | q | p | $q \rightarrow p$ | $\neg p$ | $\neg p \rightarrow (q \rightarrow p)$ |
| | v | v | v | v | v | f | v |
| | v | f | f | v | v | f | v |
| | f | v | v | f | f | v | f |
| | f | f | f | f | v | v | v |

| h) | $q \leftrightarrow \neg q \wedge p$ | | | | | |
|----|-------------------------------------|---|----------|---|-------------------|-------------------------------------|
| | p | q | $\neg q$ | p | $\neg q \wedge p$ | $q \leftrightarrow \neg q \wedge p$ |
| | v | v | f | v | f | f |

| | | | | | | | | | |
|--|---|---|--|---|---|--|---|---|---|
| | v | f | | v | v | | v | f | f |
| | f | v | | f | f | | f | v | f |
| | f | f | | v | f | | f | f | v |

| i) | (p->~(q v r)) ^ ~(q v (p <-> ~r)) | | | | | | | | | | | | | | | | | | | | | | | | |
|----|-----------------------------------|---|---|--|----|---|--------|--|---|--------|-------------|--|---|----|----------|--|---|----------|----------------|--|-------------------|--|-------------|-------------------|-----------------------------------|
| | p | q | r | | ~q | r | ~q v r | | p | ~q v r | p->(~q v r) | | p | ~r | p <-> ~r | | q | p <-> ~r | q v (p <-> ~r) | | ~(q v (p <-> ~r)) | | p->(~q v r) | ~(q v (p <-> ~r)) | (p->(~q v r)) ^ ~(q v (p <-> ~r)) |
| | v | v | v | | f | v | v | | v | v | v | | v | f | f | | v | f | v | | f | | v | f | f |
| | v | v | f | | f | f | f | | v | f | f | | v | v | v | | v | v | f | | f | | f | f | f |
| | v | f | v | | v | v | v | | v | v | v | | v | f | f | | f | f | f | | v | | v | v | v |
| | v | f | f | | v | f | v | | v | v | v | | v | v | v | | v | v | v | | f | | v | f | f |
| | f | v | v | | f | v | v | | f | v | v | | f | f | v | | v | v | v | | f | | v | f | f |
| | f | v | f | | f | f | f | | f | f | v | | f | v | f | | v | f | v | | f | | v | f | f |
| | f | f | v | | v | v | v | | f | v | v | | f | v | v | | f | v | v | | f | | v | f | f |
| | f | f | f | | v | f | v | | f | v | v | | f | v | f | | f | f | f | | v | | v | v | v |