1.11.1(b): p ↔ q  
 p ∨ q  
 ∴ p

|  |  |  |  |
| --- | --- | --- | --- |
| p | q | p V q | p ↔ q |
| T | T | T | T |
| T | F | T | F |
| F | T | T | F |
| F | F | F | T |

**True**

---------------------------------------------------------------------------------------------------------------------

1.11.1(g):   
q → p  
¬q

∴ p

|  |  |  |  |
| --- | --- | --- | --- |
| p | q | -p | q → p |
| T | T | F | T |
| T | F | F | T |
| F | T | T | F |
| F | F | T | T |

**False, p = F q=F**

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1.11.3(c)

The patient has high blood pressure or diabetes or both.  
The patient has diabetes or high cholesterol or both.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
∴ The patient has high blood pressure or high cholesterol.

P = The patent has high blood pressure, Q = The patient has diabetes, R = The patient has high cholesterol

P V Q

Q V R

\_\_\_\_\_\_

؞ P V R

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| P | Q | R | P V R | Q V R | P V R |
| T | T | T | T | T | T |
| T | T | F | T | T | T |
| T | F | T | T | T | T |
| T | F | F | T | F | T |
| F | T | T | T | T | T |
| F | T | F | F | T | F |
| F | F | T | T | T | T |
| F | F | F | F | F | F |

**True**

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1.12.1(a)

Sally had a side effect or Sally took the medication.

Sally took the medication.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

∴ Sally did not have side effects.

P = Sally had a side effect

Q = Sally took the medication

P V Q

Q

\_\_\_\_\_\_

؞ ¬P

**Invalid, Sally had a side effect = T, Sally took the medication = T**

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1.12.1(d)

If Sally had side effects, then she took the medication.

Sally did not take the medication.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

∴ Sally did not have side effects.

P = Sally had a side effect

Q = Sally took the medication

P → Q

¬Q

\_\_\_\_\_\_\_\_\_

؞ ¬P

**Valid, modus tollens**

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1.12.2(f)

p → q

r → u

p ∧ r

\_\_\_\_\_\_

∴ q ∧ u

1. **p ∧ r, hypothesis**
2. **r, simplification 2**
3. **r → u, hypothesis**
4. **u, modus ponens 2&3**
5. **p → q, hypothesis**
6. **¬p V q, conditional identities 5**
7. **q, addition 6**
8. **q ꓥ u, conjunction 4&7**

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1.12.4(a)

If I drive on the freeway, I will see the fire.

I will drive on the freeway or take surface streets (or both).

I am not going to take surface streets.

∴ I will see the fire.

p = drive on the freeway

q = see the fire

r = take surface streets

p → q

p V r

¬r

\_\_\_\_\_\_\_\_

؞ q

1. **p V r, hypothesis**
2. **p, addition 1**
3. **p → q, hypothesis**
4. **q, modus ponens 2&3**
5. **¬r, hypothesis**
6. **q, simplification 4&5**

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1.13.1(a)

P(x) = practices hard

Q(x) = plays badly

Ɐx(P(x) V Q(x))

ⱻx(¬P(x))

\_\_\_\_\_\_\_\_\_\_\_\_

؞ Q(x)

1. **Ɐx(P(x) V Q(x)), hypothesis**
2. **ⱯxQ(x), addition 1**
3. **Q(x), Universal instantiation 2**
4. **ⱻx(¬P(x)), hypothesis**
5. **Q(x), simplification 3&4**

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1.13.5(a)

Every student on the honor roll received an A.

No student who got a detention received an A.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

No student who got a detention is on the honor roll.

P(x) = x was on the honor roll

Q(x) = x received an A

R(x) = x got detention

Ɐx(P(x) → Q(x))

Ɐx(R(x) → ¬Q(x))

\_\_\_\_\_\_\_\_\_\_\_\_

؞ Ɐx(R(x) → ¬P(x))

**Valid**

1. **Ɐx(P(x) → Q(x)), hypothesis**
2. **P(x) → Q(x), Universal instantiation 1**
3. **¬P(x) V Q(x), conditional identities 2**
4. **Ɐx(R(x) → ¬Q(x)) , hypothesis**
5. **R(x) → ¬Q(x), Universal instantiation 4**
6. **¬R(x) V ¬Q(x), conditional identities 5**
7. **Ɐx(R(x) → ¬P(x)), hypothesis**
8. **R(x) → ¬P(x), Universal instantiation 7**
9. **¬R(x) V ¬P(x), conditional identities 8**
10. **¬R(x) V ¬P(x), Resolution 3&6**

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1.13.5(c)

Every student who missed class got a detention.

Penelope is a student in the class.

Penelope got a detention.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Penelope missed class.

P(x) = x missed classs

Q(x) = x got detention

**Invalid**

**P(F)**

**P(T)**