**Exercise 3.2.2**

*From page 49*

1 P → ~P

|  |  |
| --- | --- |
| P | ~P |
| T | F |
| F | T |

|  |  |  |
| --- | --- | --- |
| P | → | ~P |
| T | F | F |
| F | T | T |

This is valid iff P is false and ~P is true

It is only valid if the column under the main logical operator shows only ‘T’

2 P → ~~P

|  |  |
| --- | --- |
| P | ~P |
| T | F |
| F | T |

|  |  |  |
| --- | --- | --- |
| P | → | ~~P |
| T | T | T |
| F | T | F |

This is valid in both cases

Good

3 P ↔ ~~P

|  |  |
| --- | --- |
| P | ~P |
| T | F |
| F | T |

|  |  |  |
| --- | --- | --- |
| P | ↔ | ~~P |
| T | T | T |
| F | T | F |

This is valid in both cases

Good

4 P ↔ ~P

|  |  |
| --- | --- |
| P | ~P |
| T | F |
| F | T |

|  |  |  |
| --- | --- | --- |
| P | ↔ | ~P |
| T | F | F |
| F | F | T |

This is not valid in any case

Then the column under the main operator should have ‘F’.

5 (P ∨ Q) ∨ (~P & ~Q)

|  |  |
| --- | --- |
| P | Q |
| T | T |
| T | F |
| F | T |
| F | F |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| (P | ∨ | Q) | ∨ | (~P | & | ~Q) |
| T | T | T | T | F | F | F |
| T | T | F | T | F | F | T |
| F | T | T | T | T | F | F |
| F | F | F | T | T | T | T |

This is true in any case

Good, it is valid

6 P & ~~P

|  |
| --- |
| P |
| T |
| F |

|  |  |  |
| --- | --- | --- |
| P | & | ~~P |
| T | T | T |
| F | F | F |

This is true only if P is true

Good

7 P ∨ P

|  |
| --- |
| P |
| T |
| F |

|  |  |  |
| --- | --- | --- |
| P | v | P |
| T | T | T |
| F | F | F |

This is true only if P is true

Good

8 (P & (P → Q)) → Q

|  |  |
| --- | --- |
| P | Q |
| T | T |
| T | F |
| F | T |
| F | F |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| (P | & | (P | → | Q)) | → | Q |
| T | T | T | T | T | T | T |
| T | F | T | F | F | T | F |
| F | F | F | T | T | T | T |
| F | F | F | T | F | T | F |

This is true in any case

Good

9 (P ∨ Q) ↔ (Q ∨ P)

|  |  |
| --- | --- |
| P | Q |
| T | T |
| T | F |
| F | T |
| F | F |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| (P | ∨ | Q) | ↔ | (Q | ∨ | P) |
| T | T | T | T | T | T | T |
| T | T | F | T | F | T | T |
| F | T | T | T | T | T | F |
| F | F | F | T | F | F | F |

This is true in any case

Good

10 (P → Q) ↔ (~P ∨ Q)

|  |  |
| --- | --- |
| P | Q |
| T | T |
| T | F |
| F | T |
| F | F |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| (P | → | Q) | ↔ | (~P | ∨ | Q) |
| T | T | T | T | F | T | T |
| T | F | F | T | F | F | F |
| F | T | T | T | T | T | T |
| F | T | F | T | T | T | F |

This is true in any case

Good