# 1.

## (a).

## (b).

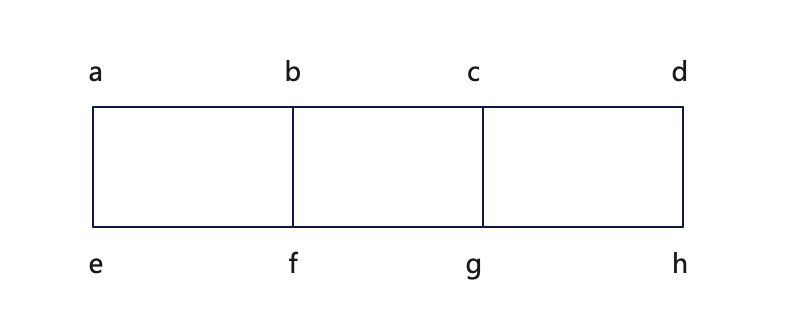
## (c).

## (d).

# 2.

## (a).

### (i).

****

### (ii).

### (iii).

≈

### (iv).

## (b).

# 3.

## (a).

(x ∧ 1') ∨ (x' ∧ 1)

= (x ∧ (x ∨ x')') ∨ (x' ∧ 1) Complement with ∨

= (x ∧ (x ∨ x')') ∨ x' Identity of ∧

= (x ∧ (x' ∧ x'')) ∨ x' De Morgan's, ' over ∨

= (x ∧ (x' ∧ x)) ∨ x' Double complement

= (x ∧ (x ∧ x')) ∨ x' Commutatitivity of ∧

= (x ∧ 0) ∨ x' Complement with ∧

= 0 ∨ x' Annihilation of ∧

= x' ∨ 0 Commutatitivity of ∨

= x' Identity of ∨

## (b).

(x ∧ y) ∨ x

= (x ∧ y) ∨ (x ∧ 1) Identity of ∧

= x ∧ (y ∨ 1) Distributivity of ∧ over ∨

= x ∧ 1 Annihilation of ∨

= x Identity of ∧

## (c).

y' ∧ ((x ∨ y) ∧ x')

= y' ∧ (x' ∧ (x ∨ y)) Commutatitivity of ∧

= y' ∧ ((x' ∧ x) ∨ (x' ∧ y)) Distributivity of ∧ over ∨

= y' ∧ ((x ∧ x') ∨ (x' ∧ y)) Commutatitivity of ∧

= y' ∧ (0 ∨ (x' ∧ y)) Complement with ∧

= y' ∧ ((x' ∧ y) ∨ 0) Commutatitivity of ∨

= y' ∧ (x' ∧ y) Identity of ∨

= (x' ∧ y) ∧ y' Commutatitivity of ∧

= x' ∧ (y ∧ y') Associativity of ∧

= x' ∧ 0 Complement with ∧

= 0 Annihilation of ∧

# 4.

# 5.

## (a).

¬(p → q)

≡ ¬(¬p ∨ q) Implication

≡ ¬¬p ∧ ¬q De Morgan's, ¬ over ∨

≡ p ∧ ¬q Double negation

(¬p → ¬q)

≡ ¬¬p ∨ ¬q Implication

≡ p ∨ ¬q Double negation

## (b).

((p∧q) → r)

≡ ¬(p ∧ q) ∨ r Implication

≡ (¬p ∨ ¬q) ∨ r De Morgan's, ¬ over ∧

≡ r ∨ (¬p ∨ ¬q) Commutatitivity of ∨

≡ r ∨ (¬q ∨ ¬p) Commutatitivity of ∨

≡ (r ∨ ¬q) ∨ ¬p Associativity of ∨

≡ ¬p ∨ (r ∨ ¬q) Commutatitivity of ∨

≡ ¬p ∨ (¬q ∨ r) Commutatitivity of ∨

≡ ¬p ∨ (q → r) Implication

≡ (p → (q→r)) Implication

## (c).

((p ∨ (q∨r)) ∧ (r∨p))

≡ ((p ∨ q) ∨ r) ∧ (r ∨ p) Associativity of ∨

≡ (r ∨ (p ∨ q)) ∧ (r ∨ p) Commutatitivity of ∨

≡ r ∨ ((p ∨ q) ∧ p) Distributivity of ∨ over ∧

≡ r ∨ (p ∧ (p ∨ q)) Commutatitivity of ∧

≡ r ∨ ((p ∧ p) ∨ (p ∧ q)) Distributivity of ∧ over ∨

≡ r ∨ (p ∨ (p ∧ q)) Idempotence of ∧

≡ (r ∨ p) ∨ (p ∧ q) Associativity of ∨

≡ ((p∧q) ∨ (r∨p)) Commutatitivity of ∨

# 6.

## (a).

## (b).

## (c).

# 7.

## (a).

## (b).

### (i).

### (ii).

### (iii).

### (iv).

## (c).

# 8.

## (a).

## (b).