**1.4 Predicates and Quantifiers**

**Q12. Suppose that the domain of the propositional function P(x) consists of the integers 1, 2, 3, 4, and 5. Express these statements without using quantifiers, instead using only negations, disjunctions, and conjunctions.**

**a) ∃xP(x)**

P(1) ∨ P(2) ∨ P(3) ∨ P(4) ∨ P(5)

**b) ∀xP(x)**

P(1) ∧ P(2) ∧ P(3) ∧ P(4) ∧ P(5)

**c) ¬∃xP(x)**

¬ (P (1) ∨ P(2) ∨ P(3) ∨ P(4) ∨ P(5))

**d) ¬∀xP(x)**

¬ (P (1) ∧ P(2) ∧ P(3) ∧ P(4) ∧ P(5))

**e) ∀x((x = 3) → P(x)) ∨ ∃x¬P(x)**

(P (1) ∧ P(2) ∧ P(4) ∧ P(5)) ∨ ( ¬P(1) ∨ ¬P(2) ∨ ¬P(3) ∨ ¬P(4) ∨ ¬P(5))

**Q18. Translate each of these statements into logical expressions using predicates, quantifiers, and logical connectives.**

Let R(x) be “x is in the correct place”.

let E(x) be “x is in excellent condition”.

let T(x) be “x is tool”; and the domain of discourse will be every things.

**a) Something is not in the correct place.**

$x¬R(x).

**b) All tools are in the correct place and are in excellent condition.**

"x (T(x) → (R(x) ˄ E(x)))

**c) Everything is in the correct place and in excellent condition.**

"x (R(x) ˄ E(x))

**d) Nothing is in the correct place and is in excellent condition.**

"x ¬(R(x) Ù E(x))

**e) One of your tools is not in the correct place, but it is in excellent condition.**

$x (T(x) Ù ¬R(x) Ù E(x))

**Q38. Let P(x), Q(x), R(x), and S(x) be the statements “x is a baby,” “x is logical,” “x is able to manage a crocodile,” and “x is despised,” respectively. Suppose that the domain consists of all people. Express each of these statements using quantifiers; logical connectives; and P(x), Q(x), R(x), and S(x).**

**a) Babies are illogical.**

∀x(P(x) → ¬Q(x))

**b) Nobody is despised who can manage a crocodile.**

∀x(R(x) → ¬S(x))

**c) Illogical persons are despised.**

∀x(¬Q(x) →S(x))

**d) Babies cannot manage crocodiles.**

∀x(P (x) → ¬R(x))

**∗e) Does (d) follow from (a), (b), and (c)? If not, is there a correct conclusion?**

Yes The conclusion follows.

Suppose x is a baby. Then by the first premise, x is illogical,

And by the third premise, x is despised.

The second premise says that if x could manage a crocodile, then x would not be despised. Therefore, x cannot manage a crocodile.