# Task 3

## Q(2 - a)

A conditional statement is true if the hypothesis is false. Thus it is very easy for the second of these propositions to be true-just have P(x) be something that is not always true, such as "The integer x is a multiple of 2.'' On the other hand, it is certainly not always true that if a number is a multiple of 2, then it is also a multiple of 4, so if we let Q(x) be "The integer xis a multiple of 4,'' then \ix(P(:r) _, Q(x)) will be false. Thus these two propositions can have different truth values. Of course, for some choices of P and Q, they will have the same truth values, such as when P and Q are true all the time.

## Q(14 - a)

Let S(x, y) mean that person x can speak language y . Then our statement is ∃x S(x, Hindi).

## Q(15)

b) There are two real numbers that satisfy n2 = 2, namely ±J2, but there do not exist any integers with this property, so the statement is false.

d) Squares can never be negative; therefore this statement is false.

## Q(19)

a) We want to assert that P(x) is true for some x in the universe, so either P(l) is true or P(2) is true or P(3) is true or P(4) is true or P(5) is true. Thus the answer is P(l) V P(2) V P(3) V P(4) V P(5).

c) This is just the negation of part (a): •(P(l) V P(2) V P(3) V P(4) V P(5))

## Q(25)

a) This means that everyone has the property of being not perfect: 't:/x •P(x). Alternatively, we can write this as --,::Jx P(x), which says that there does not exist a perfect person.

**Q(26)**

b) This is true, since 2 + 0 = 2 − 0.

c) This is false, since there are many values of y for which 1 + y ,= 1 − y .

f) This is true, since we can take y = 0 for each x.

g) This is true, since we can take y = 0.

**Q(28)**

b) false (no such y exists if x is negative)

**Q(29)**

a) This one is just the assertion that tautologies exist: :Jx T(x)

c) The words "can be" are expressing an existential idea-that there exist two contingencies whose disjunction is a tautology. Thus we have :Jx:Jy( -iT(x) /\ -iC(x) /\ -iT(y) /\ -iC(y) /\ T(x Vy)). The same final comment as in part (b) applies here. Also note the explanation about contingencies in the preamble.

**Q(36)**

b) Let C(x, y) mean that person x has chatted with person y . The given statement is ∃x∃y(y ,= x ∧ ∀z(z ,= x → (z = y ↔ C(x, z)))). The negation is therefore ∀x∀y(y ,= x → ∃z(z ,= x ∧ ¬(z = y ↔ C(x, z)))). In English, everybody in this class has either chatted with no one else or has chatted with two or more others.