Question 1 part (a): (P->4) 17-(-18 V4) (A -> B= -AUB) = (7 & V 4) 1 7 (7 P V 4) = (-4 V Y) 1 (-78 1 -18) (DeMorgans (um) = (-PV4)1(P1-4) (12A=A) = (-PA(PA-P) V (YN(PA-Y) (Distributivity) = (np/14)V(4/19/14) (Associativity of1) = L-P1P1V(P1-41e) (comA1B=O1A) = (-P1914) V (I19) (nANA=1) = (-p19191V) (11x=11 = (7/19/19/ (AVIEA) part (b): It is sound. Informally, 7 MI is just VI hus with De Morgan's Can applied to it. 1.e. 7(7+17B) = A V8. we could uso sohow it is a derived rafe.

@ Q1. part (c): (i) " x is smallest value in xs" hecomes Vy: Nat \$i: Na+ ((x5!!i)=y → +x 7541 (ii) "the value offer occurs at tenst twice in xs " be comes ∃i: Nat ∃j: Nat [-(i=j) / ((x5:!i)=z) / ((x5!!i)=x)] (in the All values in me account least twice in ys" Vx: Nat Vi: Nat [(xs:11) = x -> = a: Nat 76:Nat 7(a=6)1 ((ys:10) (ini) 4 tll values in 25 occur at trice in 954 becomes \x: Nat \i: Nat [(25! | i |= x → twice (2, ys)] (iv) "There are exactly two values that are repeated in xs "] 7: Na+] y: Na+ [7(x=y) / +wice(2,x) / +wice(y,xs) 1(YZ: Nat [twice (Z,xs) -) (Z=x) V(E=y)]