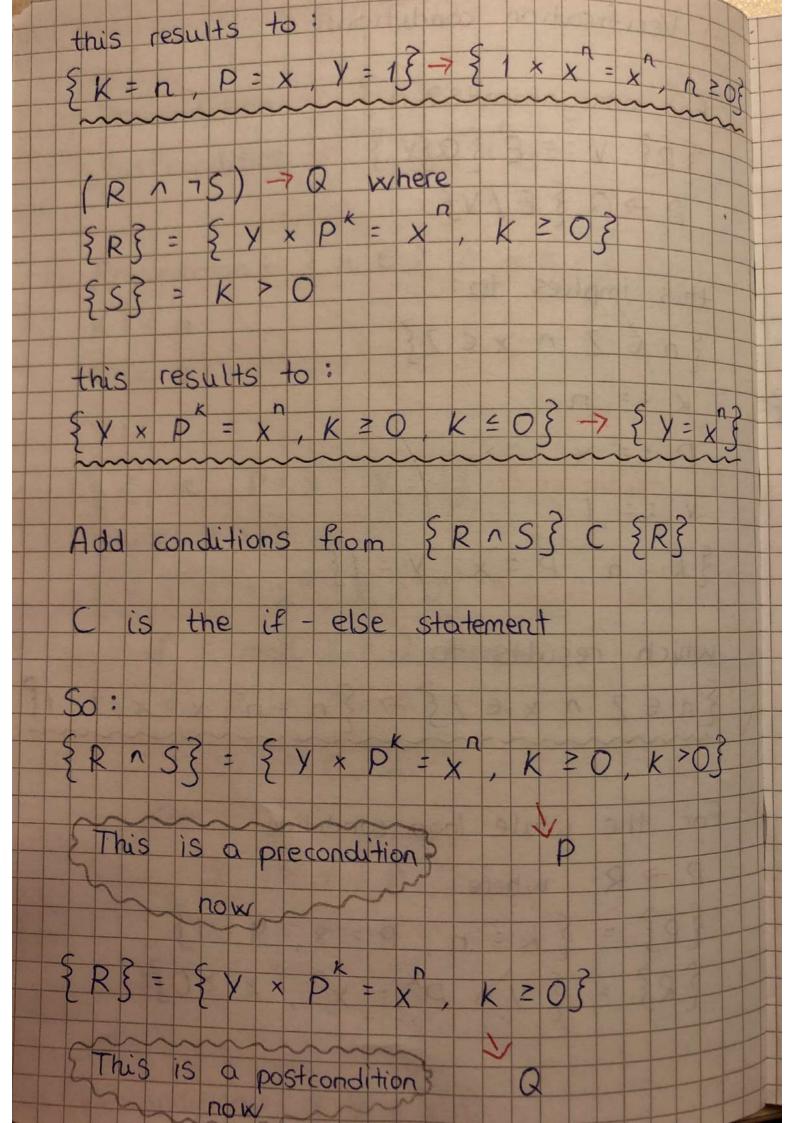
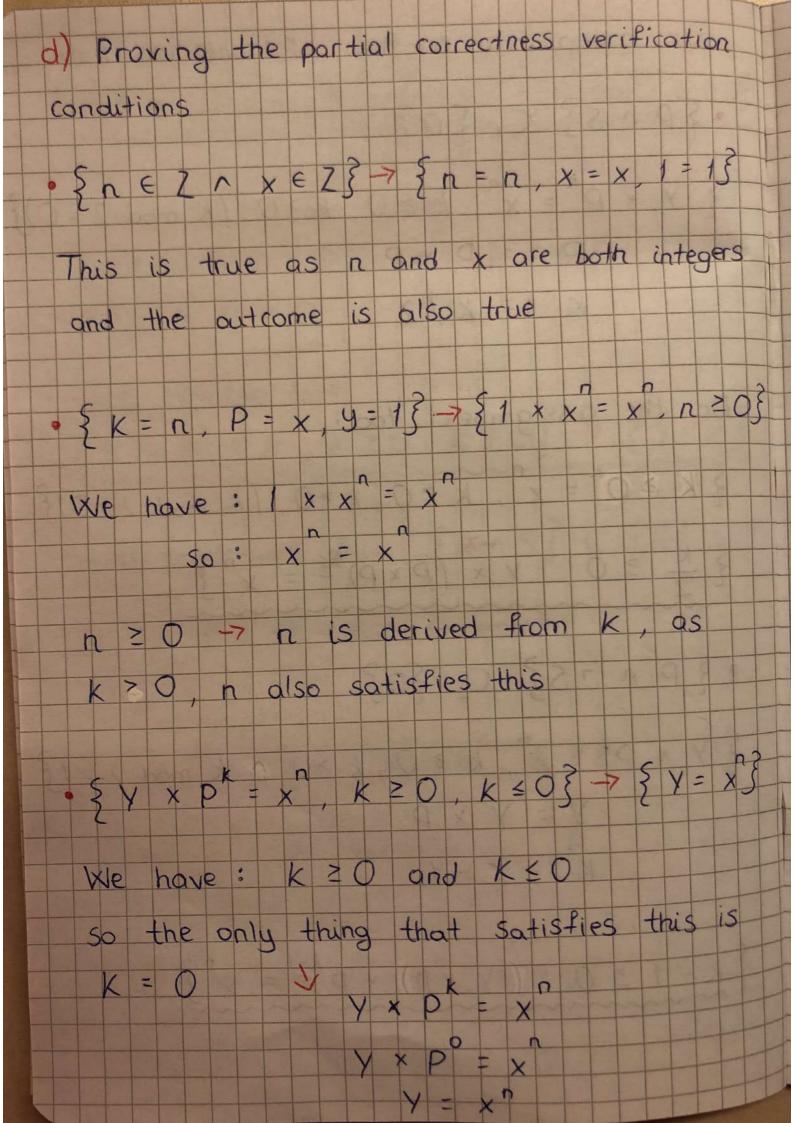
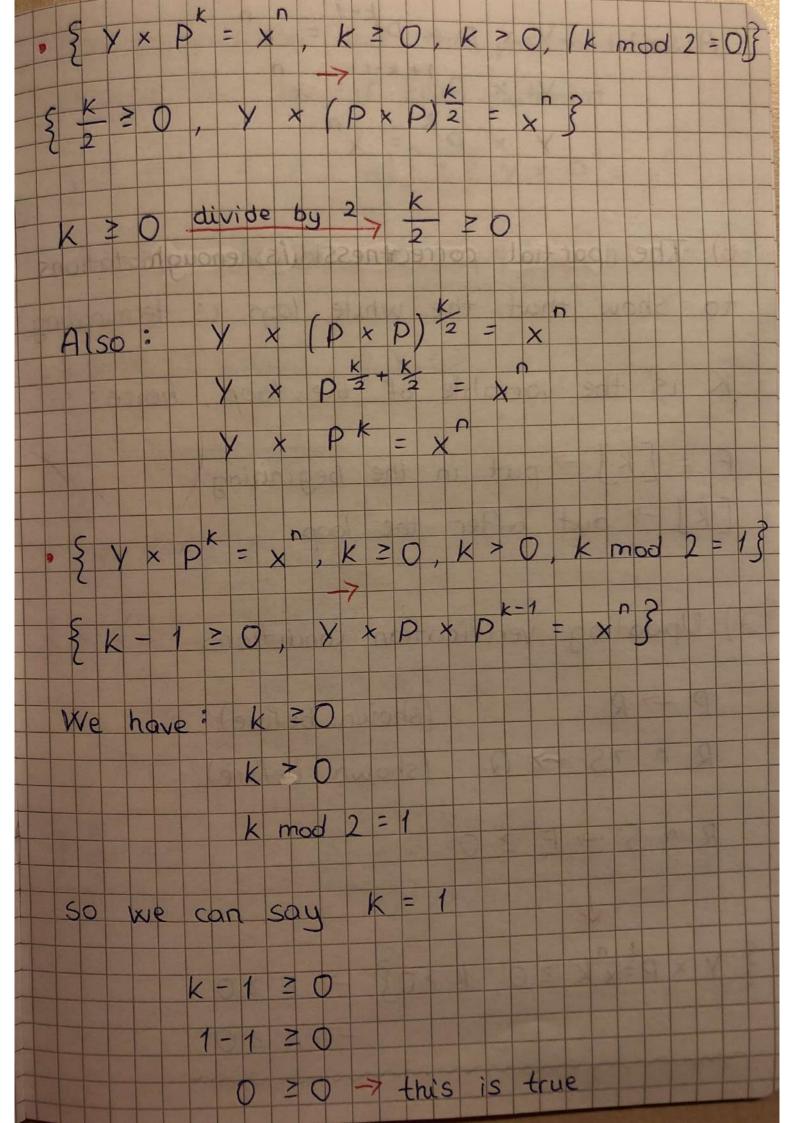


c) Verification conditions For assignments {P} V:= E {Q} P->Q { E/V} this implies to:  $\{n \in Z \land x \in Z\}$ which results to  $\{n \in \mathbb{Z} \mid n \times \in \mathbb{Z}\} \rightarrow \{n = n, x = x\}$ For the while loop condition P -> R where P} = { K = n, P = x, y = 1} R} = { Y x P = x , k = 0}



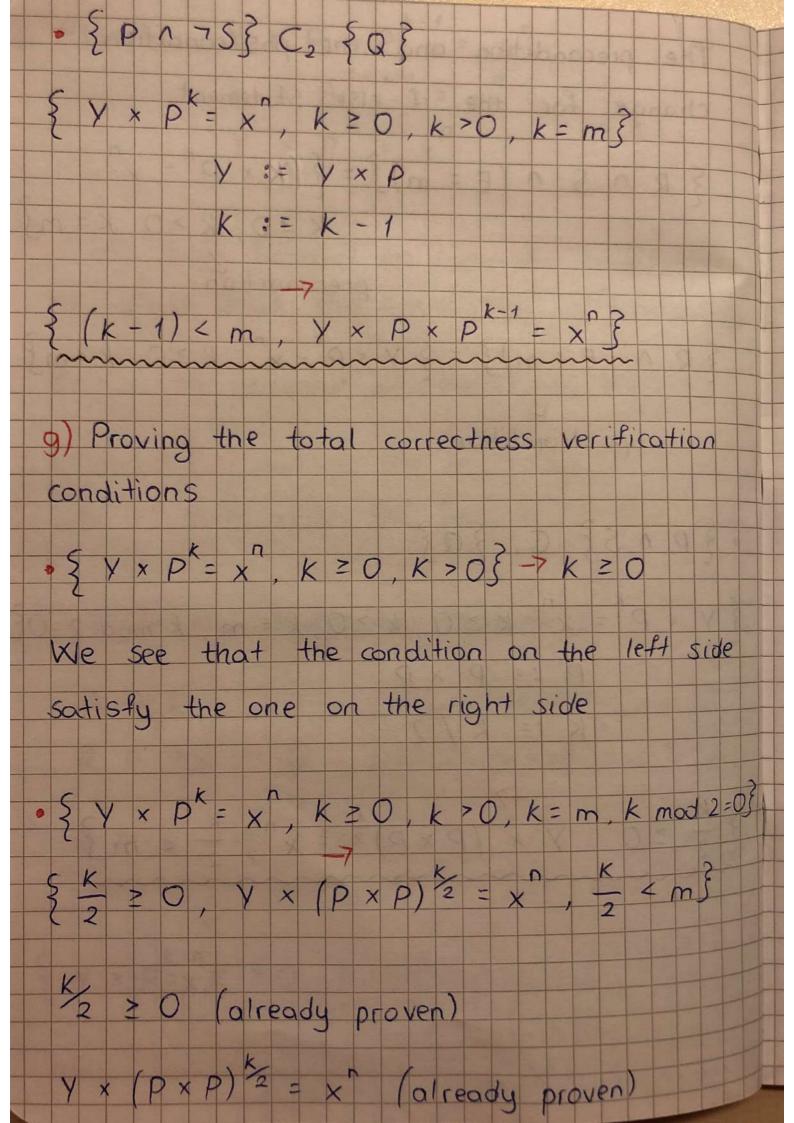
We bump into another if condition now · § P n S } C, { Q } { Y x P = x , K ≥ 0, K > 0, (K mod 2 = 0)} K:= K/2 Do the assignment too: \$ y x P = x , k ≥ 0, k > 0, (K mod 2 = 0)}  $\begin{cases} \frac{1}{2} \geq 0, \quad \frac{7}{2} = \frac{1}{2} \\ \frac{7}{2} \geq 0, \quad \frac{7}{2} = \frac{1}{2} \end{cases}$ {P n 75} C2 {Q} Y x pk = x, k ≥ 0, k > 0, k mod 2 = 15





x p x p = x Also: e) We need to put an additional annotation to show that the while loop is terminating K is the variable of the loop, hence: F = [K] > put in the beginning [K] -> put ofter the loop f) Updating verification conditions (Shown before) R 1 75 -> Q (shown before) RNSTEZO Y x P=x,K = 0, K > 0} -> E = 0

The precondition and the post-condition change for the if-else Statement 1 5 1 (E = m) 5 = { Y x p = x " precondition n (E < m)} = { Y × P = x , k ≥ 0, k < m } postcondition  $P^k = x^n, K \ge 0, K$ k mod 2=0}



We have : k = m m this is true  $\{y \times P = x^{n}, k \geq 0, k \geq 0, k = m\}$  $\frac{1}{2}(k-1) < m, Y \times P \times P^{k-1} = x^{3}$ Y x P x P = x (already proven) We have : k = m So: k-1 < m m-1 < m -> this is true