Exercise sheet 2

Chapter 1: Hoare Logic

(OPTIONAL) Exercise: Formal Proof of a Hoare Triple: while loop
If you had trouble with question 4 of Exercise Sheet 1, please solve this exercise. These formal proofs are important and I will gladly correct them if you need it.
Formally prove the correctness of the following Hoare triple in detail! :

{int $n \wedge n > 0$ }

```
num=0;
while (num<n){
 num = num+1
}
```

{ num $= n$ }

Hint: use $inv \equiv \text{num} \leq n$ and $var = n - \text{num}$.

Chapter 2: Propositional Logic

Exercise 1: Checking validity and satisfiablility using proof rules
Use the proof rules from the slides (p. 7-8) to show whether these formulas are valid and/or satisfiable:
(Please note: we use right-associativity and the operator precedence is: (from strongest to least binding): $\neg, \wedge, \vee, \rightarrow, \leftarrow, \leftrightarrow$))

- $(A \rightarrow B) \leftrightarrow (\neg B \rightarrow \neg A)$
- $(A \vee B) \rightarrow (A \wedge B)$

Remember, when you have shown that a formula is not satisfiable, you do not need to check for validity, as non-validity is implied.
Similarly, a formula being valid implies it being satisfiable as well, so no need to check that.

6 points

Exercise 2: NNF, CNF and DNF of propositional formulae
Tranform the following propositional formulas into their equivalent formulas in NNF, CNF and DNF form. Use the equivalences listed on the slides (p. 18-20):

- $\neg((\neg P \vee Q) \rightarrow \neg R)$
- $((P \wedge Q) \rightarrow (Q \rightarrow (P \wedge Q))) \wedge P$

6 points