7 Hoare Logic (MJCG)

(a) Explain informally the difference between Gödel’s completeness theorem and his first incompleteness theorem. [8 marks]

(b) State the meaning of Hoare triples \( \{P\} C \{Q\} \) in separation logic. [3 marks]

(c) For each Hoare triple (i), (ii) and (iii) below state whether the triple is true. Explain your answer and if the triple is true give a proof using separation logic. You may assume \( \vdash P \) if \( P \) is a true separation statement (e.g. \( \vdash X \mapsto 0 \Rightarrow X \mapsto \_ \)). Such assumed statements should be stated explicitly and informally justified.

(i) \( \{X = 0\} [X] :=1 \{0 \mapsto 1\} \)

(ii) \( \{X \neq 0\} [X] :=1 \{0 \mapsto 1\} \)

(iii) \( \{X \neq 0 \land X \mapsto 0\} [X] :=1 \{0 \mapsto 1\} \)

[9 marks]