13 Types (AMP)

(a) Give the rules for typing the ML expressions for function abstraction and
application, reference creation, dereferencing and assignment. [5 marks]

(b) What is the value-restricted form of the typing rule for let-expressions in ML?
Briefly explain what is the purpose of imposing the value restriction on the
typing rule. [5 marks]

(c) Which of the following typing judgements are provable in the ML type system
with the value-restricted typing rule for let-expressions? Justify your answer in
each case.

(i) \{\} \vdash \text{let } r \text{ = ref } (\lambda x (x \text{ true})) \text{ in } (r := \lambda z (\text{true})) : \text{unit}

(ii) \{\} \vdash \text{let } r \text{ = ref } (\lambda x (x \text{ true})) \text{ in } (!r (\lambda y (r := \lambda z (\text{true})))) : \text{unit}

(iii) \{\} \vdash \text{let } r \text{ = } (\lambda x (\lambda y (x))) \text{ true in } r () : \text{bool}

(iv) \{\} \vdash \text{let } r \text{ = } \lambda y (\text{true}) \text{ in } r () : \text{bool}

[10 marks]