

9 Logic and Proof (lp15)

- (a) In the context of automatic theorem proving, provide one-sentence definitions of each of the following concepts: *satisfiable*, *sound*, *complete*. You may take as given the definitions of all underlying concepts. [3 marks]
- (b) Mordred has written a resolution theorem prover, but there are bugs in his code. Very rarely, one of the following errors occurs: a literal is deleted from a clause; an entire clause is deleted; the “occurs check” of unification is not performed. Briefly describe, with justification, the consequences of each type of error. [3 marks]
- (c) For each of the following sets of clauses, either derive the empty clause or demonstrate that the set is satisfiable by exhibiting a model. Below,  $a$  and  $b$  are constants, while  $x$ ,  $y$  and  $z$  are variables.

(i)

$$\begin{array}{ll} \{R(a)\} & \{\neg R(x), \neg Q(f(x)), \neg R(a)\} \\ \{Q(z), P(z)\} & \{\neg P(y), \neg R(y)\} \end{array}$$

[7 marks]

(ii)

$$\begin{array}{ll} \{R(a), R(b)\} & \{\neg R(x), \neg Q(f(x)), \neg R(y)\} \\ \{Q(x), \neg P(y)\} & \{Q(z), P(z)\} \end{array}$$

[7 marks]