7 Logic and Proof (mj201)

(*a*) Exhibit a model for the following set of formulas, or prove that none exists. Briefly explain your work in each step.

$$P \qquad P \to (R \to Q) \qquad P \lor \neg Q \lor \neg P \qquad Q \to S \land \neg T \qquad S \to Q \lor T$$

[6 marks]

(*b*) For each of the following sets of formulas, either exhibit an interpretation in S4 modal logic that satisfies them simultaneously at a particular world, w, or show through a formal proof that they cannot be satisfied.

(*i*) $\Diamond\Box P, \quad Q, \quad \Box\Diamond\Box\neg Q, \quad \Box(P \to \Diamond R \land \Diamond\neg R), \quad \Box(\Box\neg Q \lor \neg\Diamond P)$

[8 marks]

(*ii*) $\Box(P \lor Q), \quad \Diamond\neg P, \quad \neg\Diamond Q$

[6 marks]