Sample Exam Subject

I. Short theoretical quiz (2p)

II. 1. Write a B abstract machine corresponding to the following description: (3p)

> A machine controlling the operation of a jukebox offers listeners a number of facilities. It contains a set *TRACK* of pieces that can be selected for playing in the jukebox, each such piece having associated a unique *identifier*. It offers the facility of purchasing *credits* up to a maximum of *limit*, which may then be used in the selection of particular tracks for playing. It maintains a *playset* of tracks that are still to be played. Initially, the machine contains no credits and no tracks for playing. The machine offers three operations:
> - *pay*, which allows the purchase of a specified amount of credits;
> - *select*, which allows the track with the specified identifier to be selected in the playset. Normally, a credit is deducted for this choice, but the machine also has a facility whereby it occasionally allows the customer to choose the track for free;
> - *play*, which chooses some arbitrary track to play from the playset and returns its identifier

2. Write the proof obligation corresponding to the *select* operation of the previous machine and prove it. (1p)

III. Given the Kripke structure $M = (S, \delta, I, L)$, with $S = \{p, q, r, s, t\}$, $\delta = \{(p, q), (q, r), (r, s), (s, s), (s, p), (p, t), (t, t)\}$, $I = \{p, s\}$, $L(p) = \emptyset$, $L(q) = \{a\}$, $L(r) = \{a, b\}$, $L(s) = \{b\}$, $L(t) = \{b\}$ and the CTL formula $\varphi = A\,(a \mathrel{U} b) \wedge EX\,(AG\,b)$, indicate the states s such that $M, s \models \varphi$. (3p)