1. (1 percent) As shown in Fig. 1 of the Smotherman paper (or Fig 4.18 of your text), what is the function of the decoder?

2. (2 percent) For each of the four assembly language instructions supported by the Smotherman machine, provide the following information:
   (a) The machine language op code.
   (b) The operation performed by that instruction stated using RTN.
   (c) The number of time steps required to fetch, decode and execute that instruction.

3. (1 percent) Name the Smotherman machine registers that are visible to an assembly language programmer (i.e., the registers that are part of the Instruction Set Architecture (ISA)).

4. (1 percent) Why is it not possible to perform the following two micro-operations in the same time step?
   \[ \text{PC\_out, MDR\_out} \]

5. (1 percent) Explain the purpose of the temp register and why it is needed in the Smotherman machine but not in MARIE.

6. (1 percent) What are the inputs and outputs of the control unit in the Smotherman machine?

7. (1 percent) A control unit can be hardwired or micro-programmed, are the same control signals sent in either case? Briefly explain the difference between a hardwired controller and a micro-programmed controller.

8. (1 percent) Does the control store shown in Fig. 6 of the Smotherman paper contain a specific micro-program or all possible micro-instructions?

9. (1 percent) In the context of the Smotherman paper, what is the meaning of the term firmware?