

- a. Express in a table the number of clock steps used for each of the instructions in Table 5-2, page 133. Note that the micro-operation that makes the current clock step be the last for the current instruction is $SC \leftarrow 0$. Hint: Get the answers from page 159.
- b. The “Indirect” step can be skipped for direct addressing mode memory instructions. Therefore, the time for one clock step can be saved for such instructions. However, this improvement will require a redesign of some of the control functions. Explain how to change Table 5-6 to implement this improvement.

Problem 5: Analyze what micro-operations are performed when the Mano basic computer executes the given program. Assume the initial register contents are those given in the table. To express your results in the given table:

- (1.) Cross out clock steps that are **not** taken.
- (2.) Write the name of the instruction for each instruction cycle. Cross out any unused instruction cycles.
- (3.) Every time a register (named in the table) value changes at the end of a clock step, **write the new value** in the corresponding box. When the register value doesn’t change, leave the box blank. If you change an entry (say to make it blank), write in English exactly what you intend and draw an arrow to the box it applies too. Ambiguities will cause loss of credit.

Original contents:		Registers				
		<i>PC</i>	<i>AC</i>	<i>E</i>	<i>AR</i>	<i>IR</i>
		200	0000	0	000	0000
Instruction	Clock	New Register Contents:				
	T_0					
	T_1					
	T_2					
	T_3					
	T_4					
	T_5					
ORG 200	T_0					
	T_1					
	T_2					
	T_3					
LDA NXT 200:2204 CIR 201:7080 ISZ NSY I 202:E205 BUN NXT 203:4204	T_0					
	T_1					
	T_2					
	T_3					
	T_4					
	T_5					
	T_6					
NXT, HLT 204:7001 NSY, HEX 206 205:0206 HEX FFFF 206:FFFF	T_0					
	T_1					
	T_2					
	T_3					
	T_4					
	T_5					
	T_6					
	T_0					
	T_1					
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