B. Suppose, for the sake of contradiction, that R is a recognizer for A. Let P be a Turing machine that, on input $\langle M, w\rangle$, does this:

1. Build a Turing machine N that accepts all inputs.
2. Run R on $\langle M, N, w\rangle$, and output whatever R outputs.

Then P accepts $\langle M, w\rangle$ if and only if R accepts $\langle M, N, w\rangle$, which happens if and only if M does not accept w, which is true if and only if $\langle M, w\rangle \in ACC_{TM}{}^c$. So P is a recognizer for $ACC_{TM}{}^c$. But that language is unrecognizable. This contradiction implies that A is also not recognizable.

C. The criterion can be restated as "$L(M)$ does not contain any strings of length less than 5". So it depends not on the implementation of M but only on $L(M)$. This language A is what we call a property of recognizable languages. Moreover, it's non-trivial, because some $\langle M\rangle$ are in the language (e.g., M rejects all inputs) and some $\langle M\rangle$ aren't (e.g., M accepts all inputs). So the desired result is an immediate consequence of Rice's theorem.

D. Assume for the sake of contradiction that A is context-free. Let p be a pumping length for A. Let

$$s = (00)^p(11)^p01(00)^p(11)^p.$$

Then $s \in A$ and $|s| = 8p + 2 \geq p$, so s can be pumped in the usual way. I see four cases of interest, for where vxy can be, in $s = uvxyz$.

1. If vxy is a substring of the first $(00)^p(11)^p$, then pumping $uvxyz$ to uv^2xy^2z gives a string in which the first part (before the 01 divider) is longer than the second part, so this string is not in A.

2. If vxy is a substring of the second $(00)^p(11)^p$, then pumping $uvxyz$ to uv^2xy^2z gives a string in which the second part is longer than the second part, so this string is not in A.

3. If vy contains any part of the 01 divider in the middle of the string, then there are several subcases. In each subcase, pumping $uvxyz$ to uv^2xy^2z damages or repeats the divider, so that the pumped string is not in A. (Per the prompt, this case's argument leaves out some detail.)

4. Otherwise, v is a substring of the first $(11)^p$ and y is a substring of the second $(00)^p$. Then pumping $uvxyz$ to uv^2xy^2z gives a string in which the first part mismatches the second part, so this string is not in A.

In all four cases, s can be pumped to leave A, in contradiction of the pumping lemma. This contradiction shows that A is not context-free.

E. I use a two-tape Turing machine. Upon startup, it puts a beginning-of-tape marker such as $\vdash$ on the second tape.

Then it starts scanning the input, loading all as onto the second tape. As soon as it finds a b in the input, it starts matching the bs on the first tape (still scanning rightward) with the as on the second tape (scanning leftward). As soon as it finds a c in the input, it starts matching the cs on the first tape (still scanning rightward) with the as on the second tape (scanning rightward). As soon as it finds a d in the input, it starts matching the ds on the first tape (still scanning rightward) with the as on the second tape (scanning leftward).

In the end, the two-tape Turing machine accepts if the numbers of as, bs, cs, and ds all agree, with no other errors (such as finding an a after a c) along the way. Otherwise, it rejects.