

Q1.

Some interpreted it as saying: every substring u of length more than 2 should have both a and b .
Some interpreted it as saying: every substring u of length more than 2 should have ab as a substring.
Gave points for above.

Missed stating some states as accepting states and rest ok: 4.5 points
Some students just did: w is of length ≤ 2 or w contains b : 2 points.
(this is not what the question asked; you needed this property for all substrings of w)
Multiple errors in the DFA: 2--3 points

Q2: Most students got this correct.
Some students just tried to claim it by saying $(R+\epsilon) \neq (S+\epsilon)$ (or something similar),
rather than proving non-equivalence of the formula or giving counterexample. They lose some points based on what exactly they did.

Q3: Some students missed the case when # a 's on LHS of c is odd but # a 's on LHS of $c < 2$ # b 's on RHS of c .
(for example, they miss $abcb$). They get 4.5 points.
Some other minor kind errors: they get 4.5 points

Some correctness/tries: get 1/2 to 1 point.

Other attempts: mostly get 2--3 points, based on how much they got it correct (and explanation).

Q4: Almost all got part (a) correct (worth 2 points).
For part b, if you have correct language (and state it), but still ambiguous: 2 points
For part b, if you have wrong language: 0--1 points

Q5: Stating it false, almost always will get 0 marks (the claim is true).
Note that Rice's theorem cannot be used, as this question is not about TMs.
Also, many student just converted the containment in language $(a,b)^*aba(a,b)^*$ to CFG containment and saying that is undecidable.
The undecidability result is for general CFG not specific. So you cannot use that here.
Moreover, the language $(a,b)^*aba(a,b)^*$ is regular.
In some cases, I gave one point to students who had the right "idea" for getting "true" proof, but didn't get the correct proof and stated false.

Just stating true (with not good enough argument) gets 1 point.

Some students basically simulated PDA for G and DFA for $(a,b)^*aba(a,b)^*$ in parallel,
accepting if both accept. And then checking if it is emptyset. Or something similar.
You needed to complement the DFA above, otherwise it doesn't work. These students get 2--3 points based on what they did.

Some students did some kind of simulations (along with stating true). Depending on what they did, they get 1--2 points.

Q6. Stating that the claim is false gets one point.

Some students in proof either tried Rice's theorem (not applicable; question is not about machines), or tried to do reductions from non-recursive sets. Those proofs didn't work.

Note that for this type of question, usually you need to give a counterexample.

Some students used the timed universal machine language: $L = \{1^i 1^j 1^t : M_i(w_j) \text{ accepts in } \leq t \text{ steps}\}$ (or some similar coding)

and then took the substrings of form $1^i 1^j$ to claim that this part is not recursive. This proof doesn't work as there may be strings $1^k 1^j$ such that $M_k(w_j)$ accepts in t steps and $k > i$. In which case $1^i 1^j$ will be a substring of a string in L .

(same applies if they just used some symbols for code, without specifying the coding method).

As their proof is almost there, I gave them 4 points.

Some students noted that deciding it requires checking for infinitely many y : they get 2 points as this is not a proof but just an intuition.

Similarly some other attempts get 2 points.

Q7: In the reduction, in some special cases, the finite language constructed by students could be $\{\epsilon\}$. In which case their argument doesn't work. However, no points were deducted for this.

In some cases, students accepted $(aa)^*$ and $\{a\}$ and claimed this machine would be in L_7 . However, since aaa is rejected but $aaaaaa$ is accepted, that is not the case. However, as they have most of the idea of the proof, then get 4 points.

Some constructions which don't work but students have some ideas: 1--2 points.

Q8: Showing in NP: 1 point

If students don't clearly do the analysis of yes to yes and no to no answers, they may lose 1/2-1 points.

If reduction is not stated clearly (though they seem to have the main idea about it based on rest of the proof): lose up to 1 point.

Some students did the reduction from Q8 to 3SAT rather than the other way around: they get up to 2 points total (assuming showed in NP).