

Name: \_\_\_\_\_

Entry number: \_\_\_\_\_

There are 2 questions for a total of 10 points.

---

1. (5 points) Prove or disprove: Let  $f : \mathbb{Z}^+ \rightarrow \mathbb{R}^+$  and  $g : \mathbb{Z}^+ \rightarrow \mathbb{R}^+$  be any functions such that:

1.  $f(n)$  is  $O(g(n))$ , and
2.  $p$  and  $q$  are functions mapping  $\mathbb{Z}^+$  to  $\mathbb{R}^+$  where  $p(n) = \log f(n)$  and  $q(n) = \log g(n)$ .

Then  $p(n)$  is  $O(q(n))$ .

2. (5 points) Consider the following problem:

**SAME-BEHAVIOUR:** Given descriptions  $\langle A \rangle, \langle B \rangle$  of algorithms  $A$  and  $B$  respectively, determine if the behaviour of algorithms  $A$  and  $B$  are the same on all inputs.

*(Algorithms  $A$  and  $B$  are said to have the same behaviour on input  $x$ , if either they both halt (exclusive-) or both do not halt.)*

An algorithm  $P$  is said to solve the above problem if  $P(\langle A \rangle, \langle B \rangle)$  halts and outputs 1 when  $A$  and  $B$  have the same behaviour on all inputs, and it halts and outputs 0 otherwise.

Prove: There does not exist an algorithm  $P$  that solves the problem SAME-BEHAVIOUR.