

### 3004 Computational Complexity problem sheet 4.

1. Is the following function computable?

$f(m, n)$  is the maximum number of steps any halting computation can take on a Turing machine defined on an alphabet  $\Sigma = \{0, 1, \sqcup, \triangleright\}$  with  $m$  states on an input of length  $n$ .

Which of the two possibilities holds?

- (a) This function is computable
- (b) This function is not computable.

Give an argument which justifies your answer.

2. Recall the following theorem,

**Theorem:** *A partial function  $f : \mathbb{N}^k \rightarrow \mathbb{N} \cup \text{undefined}$  is computable by an unlimited register machine (URM) if and only if it is computable by a standard TM.*

Sketch in detail a proof of this theorem.