

Name of the Student: \_\_\_\_\_

**There are 3 questions in the exam.  
You have 30 minutes to answer them.**

**Question 1 (30%)**

State as true or false:

- (a) — *frown* has exactly as many *t*'s as *smile*.
- (b) — For any alphabet  $\Sigma$ , any language  $L$  defined over  $\Sigma$  is such that  $L \in \mathcal{P}(\Sigma^*)$ . ( $\mathcal{P}(X)$  denotes the power set of  $X$ , namely the set of all the subsets of  $X$ .)
- (c) — For any language  $L$ ,  $L \cup \{\epsilon\} = L$ .

**Question 2 (30%)**

Let  $A = \{a, b\}$  and  $B = \{a, b, c\}$ .

- (a) What is  $A \cup B$ ?
- (b) What is  $AB$ ?
- (c) Describe in English the language  $B^* - A^*$ ?

**Question 3**

Given the alphabet  $\{0, 1\}$ , express the following languages using sets, union, concatenation and Kleene star:

- (a) (10%) Strings with exactly one 1.
- (b) (10%) Strings with even length (0 is even).
- (c) (20%) Strings that start and end with the same symbol.