Concepts in Programming Languages

(a) Give an overview of the LISP abstract machine (or execution model) and comment on its merits and drawbacks from the viewpoints of programming, compilation, execution, etc. [5 marks]

(b) Define the following parameter-passing mechanisms: pass-by-value, pass-by-reference, pass-by-value/result, and pass-by-name. Briefly comment on their merits and drawbacks. [5 marks]

(c) What is aliasing in the context of programming languages? Explain the contexts in which it arises and provide examples of the phenomenon. [5 marks]

(d) Consider the Simula declarations

```
CLASS A; A CLASS B;
```

which have the effect of producing the subtype relation \( B <: A \), and

```
REF(A) a; REF(B) b;
```

Recall that Simula uses the semantically incorrect principle that

```
if B <: A then REF(B) <: REF(A)
```

and consider now the following Simula code

```
PROCEDURE ASSIGNa( REF(A) x )
BEGIN x := a END;

ASSIGNa(b);
```

Does it statically type check? If so, will it cause a run-time type error?

Justify your answers. [5 marks]