1) Some programming languages are typeless. What are the obvious advantages and disadvantages of having no types in a language?

The advantage of a typeless language is flexibility; any variable can be used for any type values. The disadvantage is poor reliability due to the ease with which type errors can be made, coupled with the impossibility of type checking detecting them.

2) Dynamic type binding is closely related to implicit heap-dynamic variables. Explain this relationship.

Implicit heap-dynamic variables acquire types only when assigned values, which must be at runtime. Therefore, these variables are always dynamically bound to types.

Consider the following JavaScript skeletal program:

```
// The main program
var  x;
function  sub1() {
  var  x;
  function  sub2() {
    . . .
  }
}
function  sub3() {
  . . .
}
```

Assume that the execution of this program is in the following unit order:

main calls sub1

sub1 calls sub2

sub2 calls sub3

a. Assuming static scoping, in the following, which declaration of x is the correct one for a reference to x?

    i. sub1

    ii. sub2

    iii. sub3

b. Repeat part a, but assume dynamic scoping.

(a) i. sub1

  ii. sub1

  iii. main

(b) i. sub1

  ii. sub1

  iii. sub1

4)

7. Assume the following JavaScript program was interpreted using static-scoping rules. What value of x is displayed in function sub1? Under dynamic-scoping rules, what value of x is displayed in function sub1?

```
var x;
function sub1() {
    document.write("x = " + x + "");
}
function sub2() {
    var x;
    x = 10;
    sub1();
}
x = 5;
sub2();
```

4)

Static scoping: `x is 5`

Dynamic scoping: `x is 10`