

4. (a) Explain the usefulness of *virtual machines* as targets of compilation instead of creating object code directly. [8]
- (b) Describe *activation stacks*, and explain how they support the use of non-local names for languages with static binding. [8]
- (c) Describe the sequence of instructions that need to be performed when calling and returning from functions. In your explanation consider the following function, assuming that the values of the non-local integer variables  $x$  and  $y$  should not be modified and that the language uses dynamic binding:

```
f (x, y)
{ int z;
  z := 3 ;
  x := x * 3 ;
  y := g(x) + y ;
  return (x * y) }
```