Compiler Construction

(a) A Java static method is defined in class C by

```java
class C {
    public static int f(int x, int y) { int z = x; ...; return x+y*z;
    }
}
```

where ‘...’ represents commands the details of which are not important to this question. It is called in an expression e of the form

```
f(f(1,2), f(3,4))
```

Give JVM (or other stack machine) code corresponding to the expression e and explain how this is derived from the syntax tree for e. [6 marks]

(b) Explain how the body of f above is mapped into JVM (or other stack machine) code, explaining the rôle of the registers FP and SP (precise details are not important, but their rôle should be well explained). You may write ‘...’ for the translation of the ‘...’ in f. [6 marks]

(c) Consider the Java class definitions:

```java
class A {
    public int a1, a2;
    public void m() { println("I am an A with " + a1 + " and " + a2);
    }
}
class B extends A {
    public int b1, b2;
    public void m() { println("I am a B with " + a1 + " and " + a2 + " also with " + b1 + " and " + b2);
    }
}
```

Describe the run-time storage layout for objects of class A and for those of class B, particularly noting the size and offsets of members and how a cast of an object of type class B to one of class A can be achieved.

Explain how calls to m() work, particularly in code like:

```java
public static void g(B x) { h(x); }
public static void h(A x) { x.m(); }
```

[8 marks]