

### 3. Object Oriented Programming

- (a) It is said that the “four pillars” of object oriented programming are: Abstraction, Encapsulation, Inheritance and Polymorphism. Explain the meaning of **two** of these concepts with relation to OO programming in Java. [4]
- (b) Fractional values in Java are usually stored using the IEEE-754 floating point standard. Inherent in the standard is a possible loss of precision; this can be avoided for *common* fractions by storing the value as a numerator and a denominator separately.
  - i. Design a class, `Fraction`, that stores a common fraction as an integer numerator and an integer denominator. You should provide three constructors (a default constructor, an  $\frac{n}{1}$  constructor and an  $\frac{n}{m}$  constructor). [3]
  - ii. Write appropriate accessor and mutator methods for your class. [2]
  - iii. Write appropriate methods for adding and subtracting two `Fraction` objects. [3]
  - iv. Write appropriate methods for multiplication and division of two `Fraction` objects. [3]
  - v. Write a method, `reduce`, that returns the `Fraction` in its most reduced form. [5]