Laboratory work #2 (10 points)

Deadline: 8th week, your practice time. Read carefully class requirements. Remember about naming conventions. Keep your classes separately.

Problem 1

a. Create the abstract class for 3D shapes, with methods `volume()`, `surfaceArea()` (add other methods at your choice!). Then create data types `Cylinder, Sphere, Cube` extending this class.

b. You are designing a system for a library. You have different types of items, such as books, DVDs, and magazines. Each item has some common properties (e.g., title, author, and publication year), but also specific properties. Create an abstract class `LibraryItem`. Additionally, you need to create concrete class for one of the classes - `Book, DVD,` and `Magazine` that inherit from `LibraryItem` and implement the specific properties and methods for each type of item.

Problem 2

Write any valid superclass and subclass at your choice; provide `equals` and `hashcode` methods for both parent and child classes; override some superclass method in your subclass (not equals). Check the quality of your `equals` and `hashcode` methods by adding several objects to a `HashSet` and checking whether it allows duplicate items. Demonstrate polymorphism in your test class using the overridden method.

Problem 3

Create a data type for chess pieces. Inherit from the base abstract class `Piece` and create subclasses `Rock`, `King` and so on. Include a method `isLegalMove(Position a, Position b)` that determines whether the given piece can move from a to b.

Bonus (1-4 points, depending on your result):

Make a class `Board` and some test class in order to fully imitate chess game. Think of how you will store the current state of the game, take moves from user, drawing the board on a console, checking for illegal moves, etc.

Problem 4

```
public class Account
{
 private double balance;  //The current balance
 private int accNumber;  //The account number

 public Account(int a)
 {
      balance=0.0;
      accNumber=a;
 }

 public void deposit(double sum) { ,,, }

 public void withdraw(double sum) { ,,,}

 public double getBalance(){,,,}

 public double getAccountNumber(){,,,}

 public void transfer(double amount, Account other){}


 public String toString() {
      ,,,
 }

 public final void print()
 {
      //Don't override this,override the toString method
      System.out.println( toString() );
}}
```

Write the **`Account`** class and using it as a base class, write two derived classes called **`SavingsAccount`** and **`CheckingAccount`**.

A **`SavingsAccount`** object, in addition to the attributes of an `Account` object, should have an interest rate variable and a method which adds interest to the account. A **`CheckingAccount`** object (here there is a charge for each transaction), in addition to the attributes of an `Account` object, should have a counter variable, that will store the number of transactions done by user, and variable FREE_TRANSACTIONS – number of free transactions. Here you also will have a method `deductFee()`, that withdraws money for made transactions from account (suppose there is $0.02 for each transaction - withdraw or deposit). Ensure that you have overridden methods of the `Account` class as necessary in both derived classes.

- Now create a **`Bank`** class, an object of which contains a Vector of **`Account`** objects. Accounts in the Vector could be instances of the **`Account`** class, the **`SavingsAccount`** class, or the **`CheckingAccount`** class. Create some test accounts (some of each type).
- Write an `update` method in the bank class. It iterates through each account and deposits/withdraws money from accounts. After that Savings accounts get interest added (via the method you already wrote); CheckingAccounts get fees deducted .
- The `Bank` class requires methods for opening and closing accounts.

Problem 5

When electricity moves through a wire, it is subject to electrical friction or *resistance*. When a resistor with resistance R is connected across a potential difference V, Ohm's law asserts that it draws current I = V / R and dissipates power V^2 / R. A network of resistors connected across a potential difference behaves as a single resistor, which we call the *equivalent resistance.*

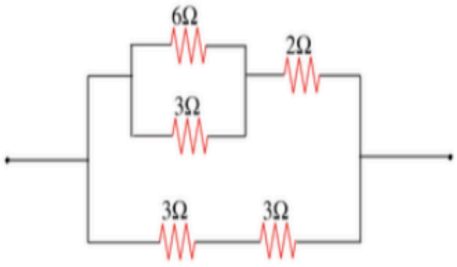
You should have: an abstract superclass **`Circuit`** that encapsulates the basic properties of a resistor network. For example, each network has a method **`getResistance`** that returns the equivalent resistance of the circuit.

```
public abstract class Circuit {
    public abstract double getResistance();
    public abstract double getPotentialDiff();
    public abstract void applyPotentialDiff(double V);

    public double getPower() {
            ///your code
    }

    public double getCurrent() {
            ///your code
    }
      }
```

A series-parallel resistor network is either (i) a single resistor or (ii) built up by connecting two resistor networks in series or parallel. So create three **`Circuit`** class subclasses **`Resistor, Series, and Parallel.`** Your goal is to be able to compose circuits as in the following code fragment, which represents the circuit depicted below.




```
Circuit a = new Resistor(3.0);
Circuit b = new Resistor(3.0);
Circuit c = new Resistor(6.0);
Circuit d = new Resistor(3.0);
Circuit e = new Resistor(2.0);
Circuit f = new Series(a, b);
Circuit g = new Parallel(c, d);
Circuit h = new Series(g, e);
Circuit circuit = new Parallel(h, f);
double R = circuit.getResistance();
```

The class **`Resistor`** contains a constructor which sets the resistance in Ohms and an accessor method to return it. It also has a private field `pottentialDifference` and get/set mehods to it. The class **`Series`** contains a constructor which takes two resistor circuit objects as inputs and represents a circuit with the two components in series.

The class **`Parallel`** is almost identical to `Series` except that it uses the reciprocal rule instead of the additive rule to compute the equivalent resistance.

The potential difference across each section depends on whether the circuit is series or parallel. For a parallel circuit, the potential difference across each branch is equal to the potential difference across the whole parallel circuit. For a series circuit, first find the current (I) from Ohm's law I = V/R, where V is the potential difference across the series circuit and R is its total resistance. The potential difference across each resistor is equal to the current times the resistance of that resistor.