Person.java | FootballPlayer.java | Cricketer.java | TestPerson.java | Time.java

```java
package lab5;
import java.util.*;
public abstract class Time {
    protected int seconds,minutes,hours;

    protected Time() {
        seconds = 0;
        minutes = 0;
        hours = 0;
    }

    protected Time(int hh,int mm,int ss) {
        seconds = ss;
        minutes = mm;
        hours = hh;
        minutes += seconds/60;
        hours += minutes/60;
        seconds %= 60;
        minutes %= 60;
    }

    public int getSeconds() {
        return seconds;
    }
    public int getMinutes() {
        return minutes;
    }
    public int getHours() {
        return hours;
    }

    public  void display(){
        System.out.println(hours+"hrs "+minutes+"mts "+seconds+"sec");
    }
    public static void main(String[] args) {
        // TODO Auto-generated method stub
    }
}
```

Q1. Base Class

Time.java | TwentyFrHrClock.java | TwelveHrClock.java | TestTime.java

Q1. Derived class 1

```
1  package lab5;
2  import java.util.*;
3  public class TwentyFrHrClock extends Time {
4      TwentyFrHrClock(){
5          super();
6      }
7
8      TwentyFrHrClock(int hh,int mm,int ss){
9          super(hh,mm,ss);
10     }
11
12     @Override
13     public void display() {
14         System.out.println(hours+":"+ minutes +":"+seconds);
15     }
16
17
18     public void timeElapsed(int ss) {
19         seconds += ss;
20         minutes += seconds/60;
21         hours += minutes/60;
22         seconds %= 60;
23         minutes %= 60;
24     }
25     public static void main(String[] args) {
26         // TODO Auto-generated method stub
27
28     }
29
30 }
31
```

Time.java | TwentyFrHrClock.java | TwelveHrClock.java | TestTime.java

```java
package lab5;
import java.util.*;
public class TwelveHrClock extends Time {

    TwelveHrClock(){
        super();

    }

    TwelveHrClock(int hh,int mm,int ss){
        super(hh,mm,ss);

    }

    @Override
    public void display() {
        if(hours>=12) {
            System.out.println(hours-12+":"+minutes+":"+seconds+"P.M. ");
        }
        else
            System.out.println(hours+":"+minutes+":"+seconds+"A.M. ");
    }

    int difference(Time t2) {
        int res = 0,hh =0,mm = 0,ss = 0;

        int sec1 = this.getHours()*3600 + this.getMinutes()*60 + this.getSeconds();
        int sec2 = t2.getHours()*3600 + t2.getMinutes()*60 + t2.getSeconds();
        return Math.abs(sec1-sec2);
    }


    public static void main(String[] args) {
        // TODO Auto-generated method stub

    }

}
```

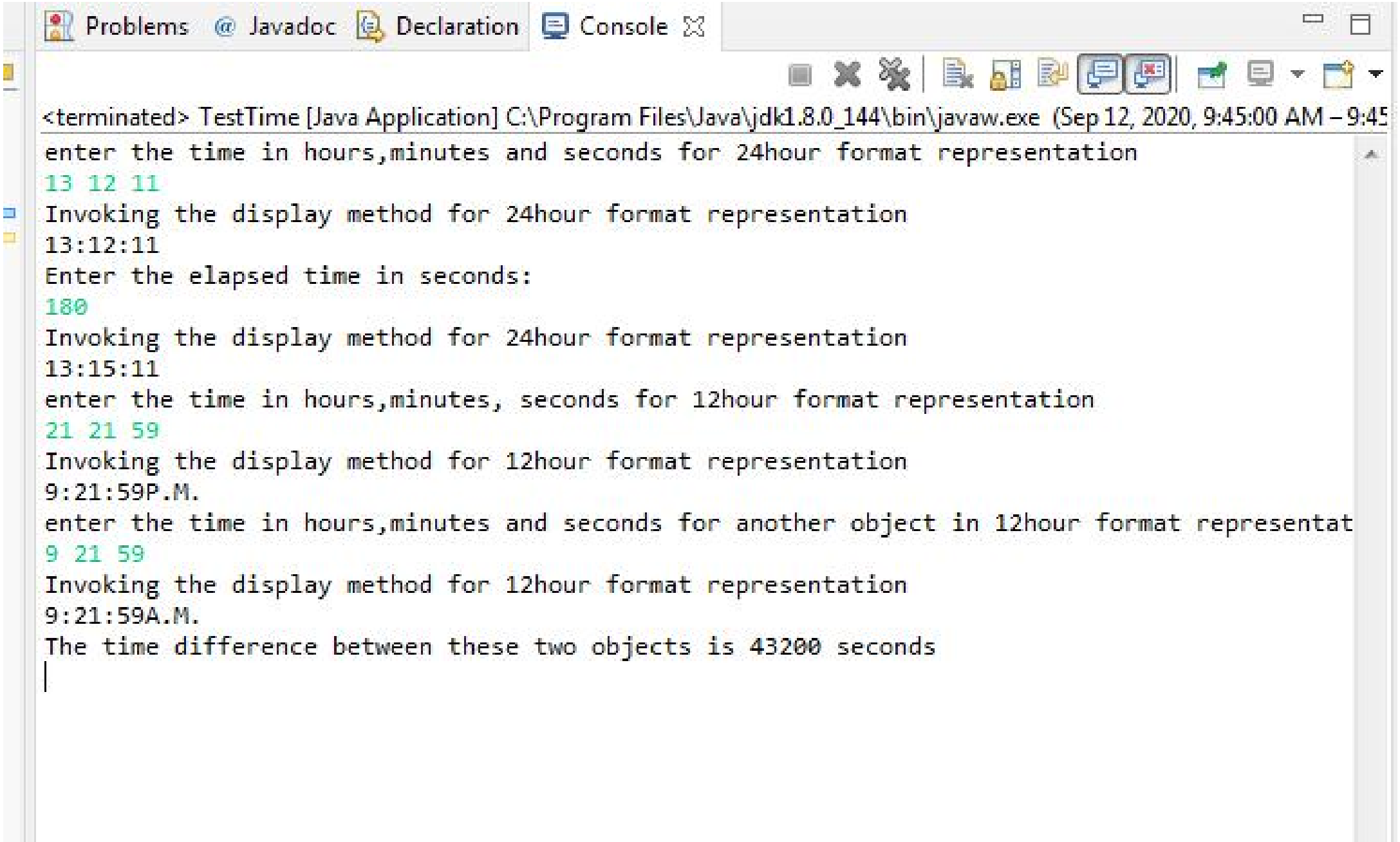
Q1. Derived Class 2

Time.java | TwentyFrHrClock.java | TwelveHrClock.java | TestTime.java

Q1. Tester Class

```java
package lab5;
import java.util.*;
public class TestTime {

    public static void main(String[] args) {
        // TODO Auto-generated method stub
        Scanner sc = new Scanner(System.in);
        System.out.println("enter the time in hours,minutes and seconds"
                + " for 24hour format representation");
        TwentyFrHrClock obj1 = new TwentyFrHrClock(sc.nextInt(),sc.nextInt(),sc.nextInt());

        System.out.println("Invoking the display method for 24hour format representation");
        obj1.display();

        System.out.println("Enter the elapsed time in seconds:");
        obj1.timeElapsed(sc.nextInt());

        System.out.println("Invoking the display method for 24hour format representation");
        obj1.display();

        System.out.println("enter the time in hours,minutes, seconds"
                + " for 12hour format representation");
        TwelveHrClock obj2 = new TwelveHrClock(sc.nextInt(),sc.nextInt(),sc.nextInt());



        System.out.println("Invoking the display method for 12hour format representation");
        obj2.display();

        System.out.println("enter the time in hours,minutes and seconds"
                + " for another object in 12hour format representation");
        TwelveHrClock obj3 = new TwelveHrClock(sc.nextInt(),sc.nextInt(),sc.nextInt());
        System.out.println("Invoking the display method for 12hour format representation");
        obj3.display();

        System.out.println("The time difference between these two objects is "+
        obj2.difference(obj3)+" seconds");
    }
```

Q1. OUTPUT


Problems
Javadoc
Declaration
Console
<terminated> TestTime [Java Application] C:\Program Files\Java\jdk1.8.0_144\bin\javaw.exe (Sep 12, 2020, 9:45:00 AM – 9:45
enter the time in hours,minutes and seconds for 24hour format representation
13 12 11
Invoking the display method for 24hour format representation
13:12:11
Enter the elapsed time in seconds:
180
Invoking the display method for 24hour format representation
13:15:11
enter the time in hours,minutes, seconds for 12hour format representation
21 21 59
Invoking the display method for 12hour format representation
9:21:59P.M.
enter the time in hours,minutes and seconds for another object in 12hour format representat
9 21 59
Invoking the display method for 12hour format representation
9:21:59A.M.
The time difference between these two objects is 43200 seconds

Person.java | FootballPlayer.java | Cricketer.java | TestPerson.java

Q2. Base Class

```java
package lab5;
import java.util.*;
public abstract class Person {

    protected String name;
    protected int age;
    protected double height;
    protected double weight;

    protected Person() {

    }
    protected Person(String name, int age ,double height, double weight) {
        this.name = name;
        this.age = age;
        this.height = height;
        this.weight = weight;
    }

    public String getName() { return name; }
    public int getAge() { return age; }
    public double getHeight() { return height; }
    public double getWeight() { return weight; }


    public String toString() {
        String res = "";
        res += "Name: "+name;
        res += "\nAge: "+age;
        res += "\nHeight: "+height;
        res += "\nWeight: "+weight;
        return res;
    }

    public static void main(String[] args) {
        // TODO Auto-generated method stub

    }

}
```

Person.java | FootballPlayer.java | Cricketer.java | TestPerson.java

Q2. Derived Class 1

```java
package lab5;
import java.util.*;
public class FootballPlayer extends Person {
    private String teamName;
    private int UniformNo;
    private int NoOfGoals;
    public FootballPlayer() {   }
    public FootballPlayer(String name, int age ,double height, double weight) {
        super(name,age,height,weight);
    }
    public FootballPlayer(String name, int age ,double height, double weight,String teamName,int UniformNo,int NoOfGoals) {
        super(name,age,height,weight);
        this.teamName = teamName;
        this.UniformNo = UniformNo;
        this.NoOfGoals = NoOfGoals;
    }
    public int getNoOfGoals() { return NoOfGoals; }
    public String getTeamName() { return teamName; }
    public int getUniformNo() { return UniformNo; }
    @Override
    public String toString() {
        String res = "";
        res += "Name: "+this.getName();
        res += "\nAge: "+this.getAge();
        res += "\nHeight: "+this.getHeight();
        res += "\nWeight: "+this.getWeight();
        res += "\nTeam: "+this.getTeamName();
        res += "\nUniformNo: "+this.getUniformNo();
        res += "\nGoals: "+this.getNoOfGoals();
        return res;
    }
    public static void main(String[] args) {
        // TODO Auto-generated method stub

    }

}

```

Person.java | FootballPlayer.java | Cricketer.java | TestPerson.java

Q2. Derived Class 2

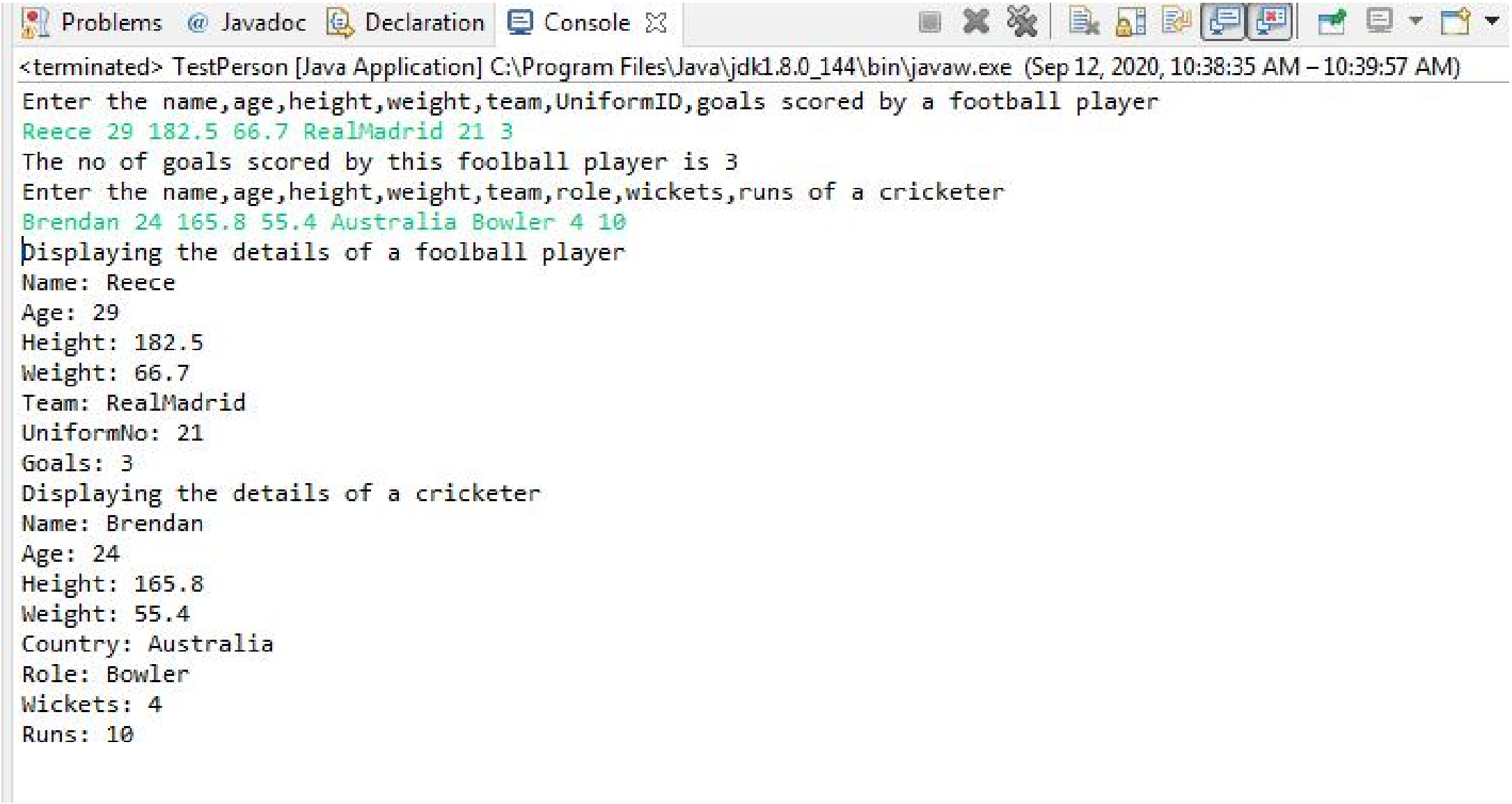
```java
package lab5;
import java.util.*;
public class Cricketer extends Person{
    private String country;
    private String role;
    private int wickets;
    private int runs;
    public Cricketer() { }
    public Cricketer(String name, int age ,double height, double weight) {
        super(name,age,height,weight);
    }
    public String getCountry() { return country; }
    public int getRuns() { return runs; }
    public int getWickets() { return wickets; }
    public String getRole() { return role; }
    public Cricketer(String name, int age ,double height, double weight,String teamName,String role,int wickets,int runs) {
        super(name,age,height,weight);
        this.country = teamName;
        this.role = role;
        this.wickets = wickets;
        this.runs = runs;
    }
    @Override
    public String toString() {
        String res = "";
        res += "Name: "+this.getName();
        res += "\nAge: "+this.getAge();
        res += "\nHeight: "+this.getHeight();
        res += "\nWeight: "+this.getWeight();
        res += "\nCountry: "+this.getCountry();
        res += "\nRole: "+this.getRole();
        res += "\nWickets: "+this.getWickets();
        res += "\nRuns: "+this.getRuns();
        return res;
    }
    public static void main(String[] args) {
        // TODO Auto-generated method stub
    }
```

Q2. Tester Class

Person.java | FootballPlayer.java | Cricketer.java | TestPerson.java

```
1  package lab5;
2  import java.util.*;
3  public class TestPerson {
4      public static void main(String[] args) {
5          // TODO Auto-generated method stub
6          Scanner sc = new Scanner(System.in);
7          System.out.println("Enter the name,age,height,weight,team,UniformID,goals scored by a football player");
8          FootballPlayer obj1 = new
9                  FootballPlayer(sc.next(),sc.nextInt(),sc.nextDouble(),sc.nextDouble(),sc.next(),sc.nextInt(),sc.nextInt());
10         System.out.println("The no of goals scored by this foolball player is "+obj1.getNoOfGoals());
11
12
13
14         System.out.println("Enter the name,age,height,weight,team,role,wickets,runs of a cricketer");
15         Cricketer obj2 = new
16                 Cricketer(sc.next(),sc.nextInt(),sc.nextDouble(),sc.nextDouble(),sc.next(),sc.next(),sc.nextInt(),sc.nextInt());
17
18
19         System.out.println("Displaying the details of a foolball player\n"+obj1.toString());
20
21         System.out.println("Displaying the details of a cricketer\n"+obj2.toString());
22
23
24
25
26     }
27
28 }
29
```

Q2. OUTPUT


Problems
Javadoc
Declaration
Console
<terminated> TestPerson [Java Application] C:\Program Files\Java\jdk1.8.0_144\bin\javaw.exe (Sep 12, 2020, 10:38:35 AM – 10:39:57 AM)
Enter the name,age,height,weight,team,UniformID,goals scored by a football player
Reece 29 182.5 66.7 RealMadrid 21 3
The no of goals scored by this foolball player is 3
Enter the name,age,height,weight,team,role,wickets,runs of a cricketer
Brendan 24 165.8 55.4 Australia Bowler 4 10
Displaying the details of a foolball player
Name: Reece
Age: 29
Height: 182.5
Weight: 66.7
Team: RealMadrid
UniformNo: 21
Goals: 3
Displaying the details of a cricketer
Name: Brendan
Age: 24
Height: 165.8
Weight: 55.4
Country: Australia
Role: Bowler
Wickets: 4
Runs: 10

Q3. Modification in base class due to interface

Invoice.java | TaxCalculator.java | InvoiceTest.java

```
1  package lab4;
2  import java.util.*;
3  public class Invoice implements TaxCalculator {
4      private String partNo;
5      private String description;
6      private int quantity;
7      private double price;
8      static double discountRate;
9
10     Date d;
11
12
13     Invoice(){
14         quantity = 0;
15         price = 0.0;
16         d = new Date();
17     }
18     Invoice(String partNo, String desc, double price){
19         this.partNo = partNo;
20         description = desc;
21         this.price = price;
22         d = new Date();
23     }
24     Invoice(String partNo, String desc, double price, int quantity){
25         this.partNo = partNo;
26         description = desc;
27         this.price = price;
28         this.quantity = quantity;
29         d = new Date();
30     }
31
32     public double calculateTax() {
33         return salestaxrate * this.displayTotal();
34     }
35
36     public static void modifyDiscountRate(double newVal) {
37         discountRate = newVal;
38     }
```

Problems | Javadoc | Declaration | Console

```
<terminated> InvoiceTest [Java Application] C:\Program Files\Java\jdk1.8.0_144\bin\javaw.ex
For any object, the default values for quantity is 0 and price 0.0
Enter the following details for obj1
Enter the partNo:
A12
Enter the description:
Userfriendly
Enter the Quantity:
3
Enter the price:
10
*****OBJECT-1******
PartNo: A12
Description: Userfriendly
Quantity: 3
Price: 10.0
InvoiceAmount: 30.0
Enter the discount rate
0.25
The payable amount of obj1 including discount is 22.5
You need to pay 6.75 as tax
```

Q3. INTERFACE

Invoice.java | TaxCalculator.java | InvoiceTest.java

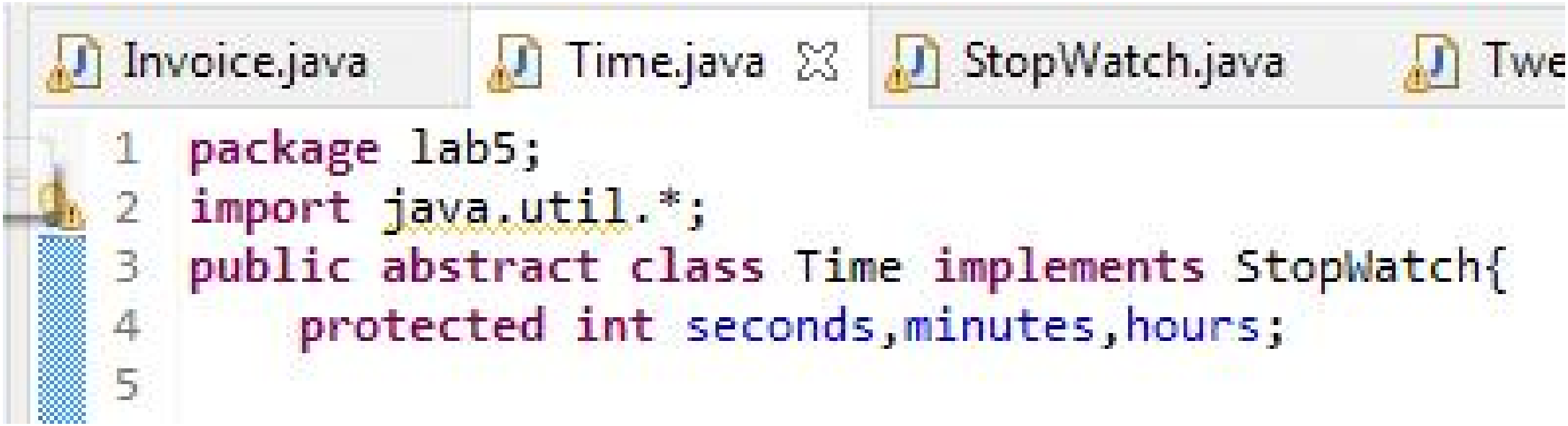
```
1  package lab4;
2
3  public interface TaxCalculator {
4      public static final double salestaxrate = 0.30;
5      public abstract double calculateTax();
6  }
7
```

Invoice.java | TaxCalculator.java | InvoiceTest.java

Q3. Tester Class invoking interface method as highlighted

```
1  package lab4;
2  import java.util.*;
3  public class InvoiceTest {
4
5      public static void main(String[] args) {
6          // TODO Auto-generated method stub
7          Scanner sc = new Scanner(System.in);
8          Invoice obj1 = new Invoice();
9          System.out.println("For any object, the default values"
10                 + " for quantity is "+obj1.getQuantity()+" and price "
11                 +obj1.getPrice());
12         System.out.println("Enter the following details for obj1");
13         obj1.getDetails();
14         obj1.displayDetails("*****OBJECT-1******");
15
16         System.out.println("Enter the discount rate");
17         Invoice.discountRate = sc.nextDouble();
18
19         System.out.println("The payable amount of obj1 "
20                 + "including discount is "+obj1.displayTotal());
21
22         double tax = obj1.calculateTax();
23         System.out.println("You need to pay "+tax+" as tax");
```

Q4. Modification in base class due to interface



Q4. INTERFACE

Invoice.java | Time.java | StopWatch.java | Twelv

```
1  package lab5;
2  import java.util.*;
3  public interface StopWatch {
4      public static final int TimerSeconds  = 20;
5      public abstract void StartTimer();
6
7  }
8
```

Q4.

IMPLEMENTING INTERFACE METHOD IN DERIVED CLASS

Invoice.java | Time.java | StopWatch.java | TwelveHrClock.java | TwentyFrHrClock.java | TestTime.java

```
1  package lab5;
2  import java.util.*;
3  public class TwentyFrHrClock extends Time {
4      TwentyFrHrClock(){
5          super();
6      }
7
8      TwentyFrHrClock(int hh,int mm,int ss){
9          super(hh,mm,ss);
10     }
11     public void StartTimer() {
12         System.out.println("StopWatch begins!");
13         System.out.println("RunningTime-RemainingTime");
14         for(int i=0;i<=TimerSeconds;i++)
15             System.out.println(i+"\t\t"+(TimerSeconds-i));
16     }
```

Q4. TESTER CLASS

Invoice.java | Time.java | StopWatch.java | TwelveHrClock.java | TwentyFrHrClock.java | TestTime.java

```
1  package lab5;
2  import java.util.*;
3  public class TestTime {
4
5      public static void main(String[] args) {
6          // TODO Auto-generated method stub
7          Scanner sc = new Scanner(System.in);
8          System.out.println("enter the time in hours,minutes and seconds"
9                  + " for 24hour format representation");
10         TwentyFrHrClock obj1 = new TwentyFrHrClock(sc.nextInt(),sc.nextInt(),sc.nextInt());
11         System.out.println("Calling the method from interface - StopWatch");
12         obj1.StartTimer();
```

Q4. OUTPUT

```
<terminated> TestTime [Java Application] C:\Program Files\Java\jdk1.8.0_144\bin\javaw.exe (Sep 12, 202(
enter the time in hours,minutes and seconds for 24hour format representation
1 2 3
Calling the method from interface - StopWatch
StopWatch begins!
RunningTime-RemainingTime
0                   20
1                   19
2                   18
3                   17
4                   16
5                   15
6                   14
7                   13
8                   12
9                   11
10                  10
11                  9
12                  8
13                  7
14                  6
15                  5
16                  4
17                  3
18                  2
19                  1
20                  0
```

Person.java | Cricketer.java | FootballPlayer.java | Testerlevel3.java

Q5. TESTER CLASS

```java
package lab5;
import java.util.*;
public class Testerlevel3 {
    public static void main(String[] args) {
        Scanner sc = new Scanner(System.in);
        System.out.print("Enter the no of players");
        int n = sc.nextInt();
        Person arr[] = new Person[n];
        char x;
        for(int i=0;i<n;i++) {
            System.out.println("Enter c for cricketers any other char for footballers");
            System.out.println("Then Enter their name,age,height and weight");
            x = sc.next().charAt(0);
            if(x == 'c') {
                arr[i] = new Cricketer(sc.next(),sc.nextInt(),sc.nextDouble(),sc.nextDouble());
            }
            else {
                arr[i] = new FootballPlayer(sc.next(),sc.nextInt(),sc.nextDouble(),sc.nextDouble());
            }
        }
        ArrayList<FootballPlayer>fp = new ArrayList<FootballPlayer>();
        for(Person a:arr) {
            System.out.print(a.getName()+" is a");
            if(a instanceof Cricketer) {
                System.out.println(" cricketer");
            }
            else if(a instanceof FootballPlayer) {
                System.out.println(" football player\nEnter the goals he scored");
                FootballPlayer obj = (FootballPlayer)a;
                obj.setGoals(sc.nextInt());
                fp.add(obj);
            }
        }
        Collections.sort(fp);
        System.out.println("Displaying the football players in the order of the goals scored");
        for(FootballPlayer f: fp) {
            System.out.println(f.getName() +" scored "+f.getNoOfGoals()+" goals");
        }
    }
```

Q5. Modifications due to Comparable Interface

Person.java | Cricketer.java | FootballPlayer.java | Testerlevel3.java

```
1  package lab5;
2  import java.util.*;
3  public class FootballPlayer extends Person implements Comparable<FootballPlayer>{
4      private String teamName;
5      private int UniformNo;
6      private int NoOfGoals;
7      public FootballPlayer() {   }
8      public FootballPlayer(String name, int age ,double height, double weight) {
9          super(name,age,height,weight);
10     }
11     public FootballPlayer(String name, int age ,double height, double weight,String teamName,int Unifor
12         super(name,age,height,weight);
13         this.teamName = teamName;
14         this.UniformNo = UniformNo;
15         this.NoOfGoals = NoOfGoals;
16     }
17     public int compareTo(FootballPlayer f) {
18         return this.NoOfGoals - f.NoOfGoals;
19     }
20
21     public void setGoals(int g) {this.NoOfGoals = g;}
22     public int getNoOfGoals() { return NoOfGoals; }
23     public String getTeamName() { return teamName; }
```

Problems @ Javadoc Declaration Console

<terminated> Testerlevel3 [Java Application] C:\Program Files\Java\jdk1.8.0_144\bin\javaw.exe (Sep 12, 2020, 11:49:32 PM – 11:52:09 PM)

```
Enter the no of players5
Enter c for cricketers any other char for footballers
Then Enter their name,age,height and weight
c
Neymar 27 177.5 65.7
Enter c for cricketers any other char for footballers
Then Enter their name,age,height and weight
f
Messi 32 173.9 73.9
Enter c for cricketers any other char for footballers
Then Enter their name,age,height and weight
f
Akrin 26 166.4 69.8
Enter c for cricketers any other char for footballers
Then Enter their name,age,height and weight
f
Rakir 21 171.1 61.9
Enter c for cricketers any other char for footballers
Then Enter their name,age,height and weight
c
Ross 29 179.4 76.4
Neymar is a cricketer
Messi is a football player
Enter the goals he scored
5
Akrin is a football player
Enter the goals he scored
3
Rakir is a football player
Enter the goals he scored
6
Ross is a cricketer
Displaying the football players in the order of the goals scored
Akrin scored 3 goals
Messi scored 5 goals
Rakir scored 6 goals
```

Q5. OUTPUT