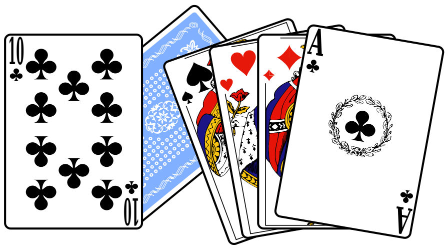
English name: ____________________

Unit 7 – Coding Project – Playing Cards

This assignment is intended to solidify your understanding of your understanding of classes and objects (instances of classes) that you learned in Unit 5.

A standard deck of French-suited playing cars consists of 52 cards. This is divided into four suits – spades, diamonds, clubs, hearts – represented, respectively, by the symbols: ♠ ♦ ♣ ♥.



Each suit consists of 13 ranks. The ranks are:
Ace, 2, 3, 4, 5, 6, 7, 8, 9, 10, Jack, Queen, King.

Thus, if we pair the rank and suit, and represent the named cards by their first letter, the table below shows all the cards that should be in a standard deck of 52 cards:

A♠	2♠	3♠	4♠	5♠	6♠	7♠	8♠	9♠	10♠	J♠	Q♠	K♠
A♦	2♦	3♦	4♦	5♦	6♦	7♦	8♦	9♦	10♦	J♦	Q♦	K♦
A♣	2♣	3♣	4♣	5♣	6♣	7♣	8♣	9♣	10♣	J♣	Q♣	K♣
A♥	2♥	3♥	4♥	5♥	6♥	7♥	8♥	9♥	10♥	J♥	Q♥	K♥

This project starts with two classes, a `PlayingCard` class that represents individual playing cards, and a `Deck` class that represents a group of cards. A partial declaration of the `PlayingCard` class is given in the box below.

```
public class PlayingCard {
   // Characters for the different suits
   public static final String spade   = "♠";
   public static final String diamond = "♦";
   public static final String club    = "♣";
   public static final String heart   = "♥";

   // Array containing all the suits
   public static final String[] suits =
      { spade, diamond, club, heart };

   // Array containing all the ranks
   public static final String[] ranks = {
      "A", "2", "3", "4", "5", "6", "7", "8", "9", "10", "J", "Q", "K"
   };

   // Instance Fields
   private final String suit;
   private final String rank;

   public PlayingCard(String suit, String rank) {
      this.suit = suit;
      this.rank = rank;
   }

   public String toString() {
      return this.rank + this.suit;
   }

   // There may be other methods that are not shown
}
```

The `PlayingCard` class, above, defines some class fields (`static` fields). As these fields are modified with the keyword "`static`", they can be accessed through the class name, for example `PlayingCard.diamond` is equal to the string `"♦"`. You will need to use both the static field `suits` and the static field `ranks` to complete the constructor and receive full marks.

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A partial declaration of the Deck class is given in the box below.

```
public class Deck {

   ArrayList<PlayingCard> cards;

   public Deck() {
      // You will implement this constructor in part (a)
   }

   @Override
   public String toString() {
      // You will implement this method in part (b)
   }

   public PlayingCard draw() {
      // You will implement this method in part (c)
   }

   public PlayingCard drawRandom() {
      // You will implement this method in part (d)
   }

   public void shuffle() {
      // You will implement this method in part (e)
   }

   // There may be other methods that are not shown

}
```

1. Complete the implementation of the Deck class according to the following specifications. It is highly recommended that you write test code to test each individual method you write, and **thoroughly test each method** before you go on to write the next method. Example test code and the expected for part (1) is given at the end of part (1).

   a) **Implement the zero-parameter constructor for class Deck according to the following specifications.**

   The constructor must use the field named ranks and the field named suits from the PlayingCard class – as lists of all the possible ranks and suits – to create a standard deck of cards that includes one card of each of all the 52 combinations of rank and suit that make up a standard set of playing cards. (Those combinations that are in the table on page 1).

   b) **Implement the method toString according to the following specifications.**

   For each PlayingCard in the Deck, call the card's toString method to generate a combined string containing all the cards from the Deck, in order, with a space between each card, and a newline character after every 13 cards, and a newline at the end of the Deck.

   c) **Implement the method draw according to the following specifications.**

   The method drawRandom shall return the last PlayingCard from the cards in the Deck, and remove that card from the Deck.

   Consider why this method specifies to remove the <u>last</u> card from the Deck rather than the first. *Hint*: it has to do with efficiency when the underlying implementation uses an array (or ArrayList) to store the values.

   If this method is repeatedly called, the number of cards in the Deck will eventually reach zero. If there is an attempt to remove a card from an empty Deck, the method should return null.

d) **Implement the method `drawRandom` according to the following specifications.**

The method `drawRandom` shall return a random `PlayingCard` from the cards in the `Deck`, and remove that card from the `Deck`.

For example, if the `Deck` is a newly created deck with 52 cards, and the random card turns out to be the *Queen of Hearts* (“`Q♥`”), then after the method has completed, the `Deck` should contain 51 cards – all the cards of the standard deck except the *Queen of Hearts*.

If this method is repeatedly called, the number of cards in the `Deck` will eventually reach zero. If there is an attempt to remove a card from an empty `Deck`, the method should return `null`.

e) **Implement the method `shuffle` according to the following specifications.**

The `shuffle` method rearranges the cards in the `Deck` such that their order is randomized. This method must call the `drawRandom` method from part (b) to receive full marks. You may assume that the `drawRandom` method works correctly as specified above, even if the code you wrote may not work to specifications.

Hint: One way to implement this is as follows:

- Create a new `ArrayList` of `PlayingCard`.
- For each card you take from the `Deck` using `drawRandom`, you add it to the new `ArrayList`.
- Once the `Deck` is empty, have the `Deck` use the new `ArrayList` as its list of cards.

Write the completed code in the box immediately below.

Example Test Code for Class `Deck` and Class `PlayingCard`

```
public class TestDeck {

    public static void main(String[] args) {

        Deck deck = new Deck();

        System.out.println("New Deck:\n" + deck);

        System.out.println("Drawing random card: "
                           + deck.drawRandom());
        System.out.println("Remaining Deck:\n" + deck);

        System.out.print("\nDrawing more random cards:");
        for(int i = 0; i < 5; i++) {
            System.out.print(" " + deck.drawRandom());
        }
        System.out.println("\nRemaining Deck:\n" + deck);

        deck = deck.shuffle();
        System.out.println("\nShuffled Deck:\n" + deck);

        System.out.println("\nDrawing remainder of deck:");
        PlayingCard p = deck.draw();
        while(p != null) {
            System.out.print(" " + p);
            p = deck.draw();
        }
        System.out.println();

        System.out.println("\nRemaining Deck:\n" + deck);

    }

}
```

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Output of Example Test Code for Class `Deck` and Class `PlayingCard`

```
New Deck:
A♠ 2♠ 3♠ 4♠ 5♠ 6♠ 7♠ 8♠ 9♠ 10♠ J♠ Q♠ K♠
A♦ 2♦ 3♦ 4♦ 5♦ 6♦ 7♦ 8♦ 9♦ 10♦ J♦ Q♦ K♦
A♣ 2♣ 3♣ 4♣ 5♣ 6♣ 7♣ 8♣ 9♣ 10♣ J♣ Q♣ K♣
A♥ 2♥ 3♥ 4♥ 5♥ 6♥ 7♥ 8♥ 9♥ 10♥ J♥ Q♥ K♥

Drawing random card: 6♦
Remaining Deck:
A♠ 2♠ 3♠ 4♠ 5♠ 6♠ 7♠ 8♠ 9♠ 10♠ J♠ Q♠ K♠
A♦ 2♦ 3♦ 4♦ 5♦ 7♦ 8♦ 9♦ 10♦ J♦ Q♦ K♦ A♣
2♣ 3♣ 4♣ 5♣ 6♣ 7♣ 8♣ 9♣ 10♣ J♣ Q♣ K♣ A♥
2♥ 3♥ 4♥ 5♥ 6♥ 7♥ 8♥ 9♥ 10♥ J♥ Q♥ K♥

Drawing more random cards: 5♣ K♦ 4♦ 8♣ K♠
Remaining Deck:
A♠ 2♠ 3♠ 4♠ 5♠ 6♠ 7♠ 8♠ 9♠ 10♠ J♠ Q♠ A♦
2♦ 3♦ 5♦ 7♦ 8♦ 9♦ 10♦ J♦ Q♦ A♣ 2♣ 3♣ 4♣
6♣ 7♣ 9♣ 10♣ J♣ Q♣ K♣ A♥ 2♥ 3♥ 4♥ 5♥ 6♥
7♥ 8♥ 9♥ 10♥ J♥ Q♥ K♥

Shuffled Deck:
J♣ 10♦ J♦ 8♥ 7♠ Q♠ 4♣ A♣ 3♣ 10♣ 5♦ 5♠ K♣
6♣ 2♦ 4♠ A♠ A♦ J♠ 2♠ 9♠ 2♣ 3♠ 7♥ 3♥ 2♥
9♣ 8♦ 10♠ 9♦ 3♦ 5♥ 9♥ Q♥ Q♣ 6♥ 6♠ A♥ 4♥
7♣ K♥ 10♥ Q♦ J♥ 7♦ 8♠

Drawing remainder of deck:
 8♠ 7♦ J♥ Q♦ 10♥ K♥ 7♣ 4♥ A♥ 6♠ 6♥ Q♣ Q♥ 9♥ 5♥ 3♦ 9♦ 10♠ 8♦ 9♣ 2♥ 3♥ 7♥
3♠ 2♣ 9♠ 2♠ J♠ A♦ A♠ 4♠ 2♦ 6♣ K♣ 5♠ 5♦ 10♣ 3♣ A♣ 4♣ Q♠ 7♠ 8♥ J♦ 10♦ J♣

Remaining Deck:
```

2. Consider a card game you enjoy playing. Preferably it will be a simple game, such as BlackJack, or you can think of a simplified version of it. Write a class that uses the `Deck` class and implements the game. You might use more than one additional class to effectively divide the functionality into manageable parts. Graphical interfaces add complexity, it is better if you can implement the functionality using text. For user input, look into the `Scanner` class. (User input, such as the `Scanner` class, is not covered by the *AP Java Subset*, so don't worry about obtaining a thorough understanding of how to implement that correctly).