Solutions to old exam questions

Question 1A [4]

What will be printed by the following program? Write your answer below the program.

```
class ABC
{
    public static void main(String[ ] args)
    {
        char[][] x = {{'i', 'j'}, {'4', '5'}};
        char[][] y = {{'x', 'y'}, {'a', 'b'}};
        int i;
        char t;

        for (i = 0; i < 2; i=i+1)
        {
           t = y[(i+1)%2][1];
           y[i][(i+1)%2] = x[i][0];
           y[(i+1)%2][1] = t;
        }

        System.out.print(y[0][1]);
        System.out.println(y[1][0]);
    }
}
```

t = y[1][1] = ‘b’

y[0][1] = x[0][0]=‘i’

y[1][1] = ‘b’

t=y[0][1] = ‘i’

y[1][0] = x[1][0] = ‘4’

y[0][1] = ‘i’

Question 1B

Answer: i4

Question 1B [4]

```
class C1
{
   private int[] v1 = {1,4,9};
   public int v3;

   public static int m1 (C2 p)
    {
       ...
    }
   private C1 m2 (int m)
    {
       ...
    }
}
```

```
class C2
{
    public static char v3;

    public C2 (int n)
    {
       ...
    }

    private void m3 (int m)
    {
       ...
    }
}
```

Suppose that the following instructions are used in the **main()** method in a class **Test**. Each choice should be considered **independently** – as it if were in its own **main()** method. Circle the letter of the statement which does NOT cause a compilation error.

Question 1B

(a)	int v2 = C1.m1(this);	Error: m1 expects object of type C2 as parameter
(b)	char v3 = C2.v3;	No error
(c)	C1 x = new m2(4);	Error: no constructor m2
(d)	C1 w = new C1(); w.v1[2] = 3;	Error: v1 is private in C1
(e)	C2 y = new C2(); int z = C1.m1(y);	Error: no constructor with zero arguments in C2

Question 2 [8]

```
class AClass
{
  public static void main(String[ ] args)
  {
    aMethod(137210);
    System.out.println( );
  }

 public static void aMethod(int i)
  {

     // see next slide

  }


}
```

- Here is a program that uses recursion.
- What is printed by this program?

Question 2

```
public static void aMethod(int i)
  {
    if (i == 0)
    {  ; // do nothing
    }
    else
    {
      if ( i%10 == 1 )
      {
        System.out.print( "one " );
      }
      else
      {
         if ( i%10 == 2 )
         {
           System.out.print( "two " );
         }
         else
         {
            if ( i%10 == 3 )
            {
              System.out.print( "three " );
            }
            else
            {    ; // do nothing
            }
         }
      }
      aMethod(i/10);
    }
  }
```

Question 2

Answer: one two three one

Question 3 [15]

Write a recursive Java method to test if an array of characters is a palindrome.

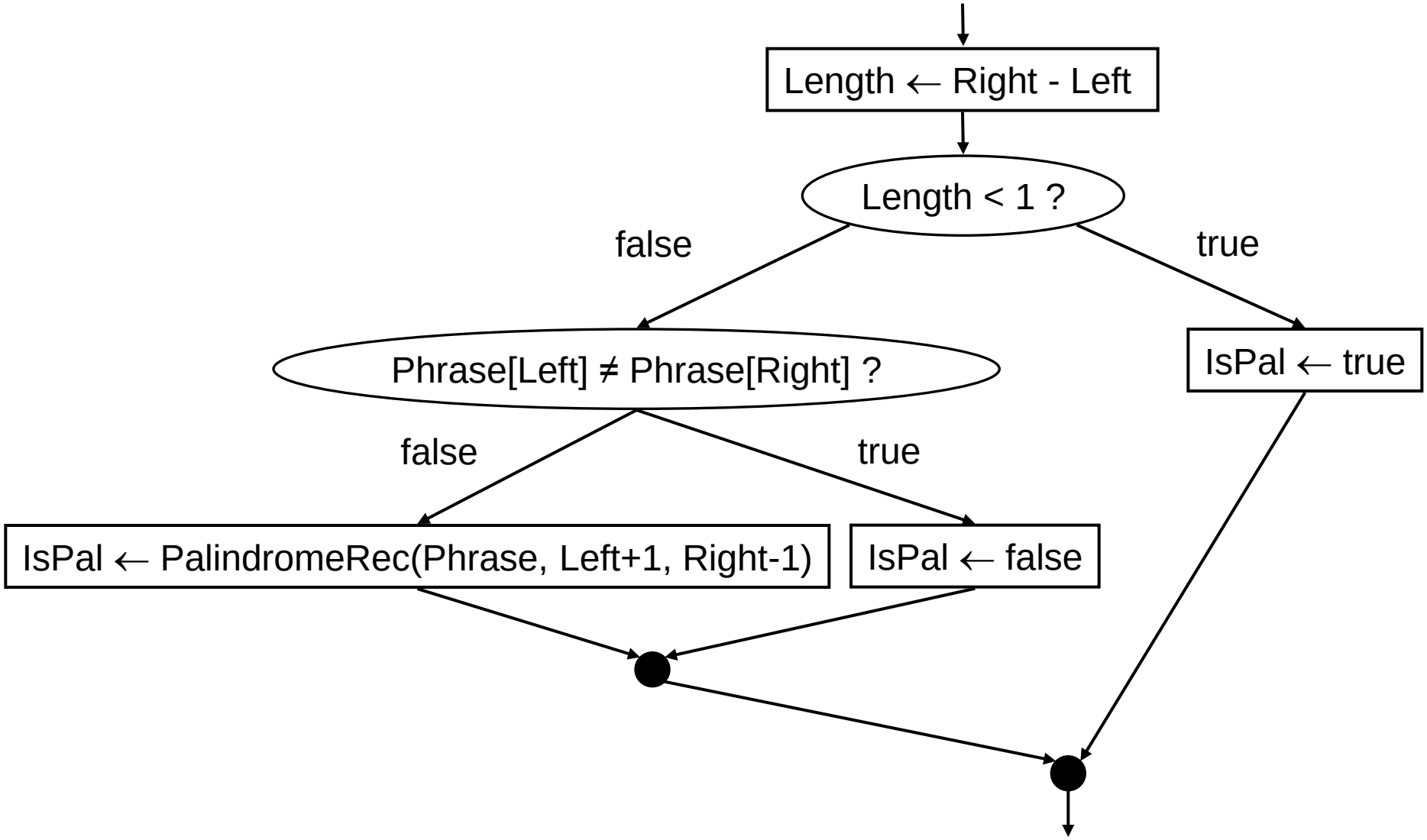
GIVENS:
Phrase: *(an array of characters representing a phrase to be checked)*
Left: *(index of leftmost character to check in Phrase)*
Right: *(index of rightmost character to check in Phrase)*

RESULT:
IsPal *(true if Phrase is a palindrome, and false otherwise)*

INTERMEDIATES:
Length *(length of the interval examined in Phrase)*

HEADER: IsPal ← PalindromeRec(Phrase, Left, Right)

BODY:


Length ← Right - Left
Length < 1 ?
false
true
Phrase[Left] ≠ Phrase[Right] ?
IsPal ← true
false
true
IsPal ← PalindromeRec(Phrase, Left+1, Right-1)
IsPal ← false

Question 3

```
public boolean palindromeRec (char [] phrase, int left, int right)
 {  int length;
      boolean isPal;

      length = right - left;
      if (length < 1)
      {  isPal = true;
      }
      else
      {
         if (phrase[left] != phrase[right])
         {  isPal = false;
         }
         else
         {  isPal = palindromeRec(phrase, left + 1, right - 1);
         }
      }
      return isPal;
 }
```

Answer

GIVENS:

Votes	(array of integers)
N	(length of array)
Diff	(minimum difference in number of votes)

INTERMEDIATES:

First	(the highest number of votes in the array)
Second	(the second highest number of votes in the array)

RESULTS:

Recount	(Boolean: true if recount is needed, false otherwise)

HEADER:

Recount ← VotesRecountNeeded(Votes, N, Diff)

BODY:

Question 4 [15]

- A "magic square" is a square matrix of integers where every row and every column can be summed to the same single value. For example, in the matrix ***A*** below, the sum of every row and column is 15.

$$A = \begin{bmatrix} 2 & 9 & 4 \\ 7 & 5 & 3 \\ 6 & 1 & 8 \end{bmatrix}$$

- Write a Java method that will take a square matrix of integers ***A*** and returns true if A represents a "magic square" and false otherwise. Your method should be efficient.

```
public static boolean isMagic( int[][] a )
```

Question 4

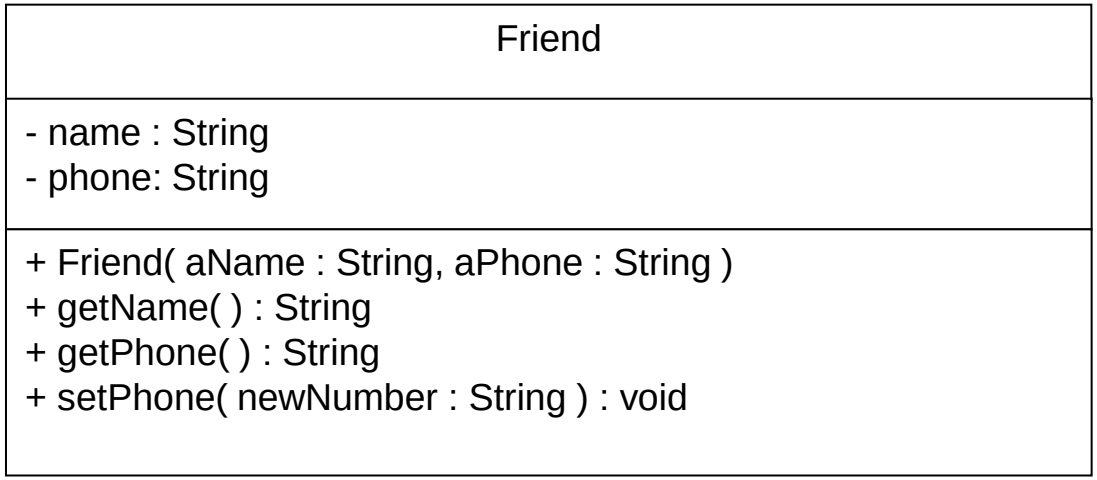
```
public static boolean isMagic( int[][] m )
  {
     int magicSum;
     int sum;
     int row;
     int col;
     boolean magic;

     magic = true;
     magicSum = -1;
     row = 0;
     while ( row < m.length && magic )
     {
        sum = 0;
        col = 0;
        while ( col < m[row].length )
        {
           sum = sum + m[row][col];
           col = col + 1;
        }
```

Question 4

```
  if ( row == 0 )
      {
         magicSum = sum;
      }
      else
      {
         magic = ( sum == magicSum );
      }
      row = row + 1;
    }
    col = 0;
    while ( col < m[0].length && magic )
    {
      sum = 0;
      row = 0;
      while ( row < m.length )
      {
         sum = sum + m[row][col];
         row = row + 1;
      }
      magic = ( sum == magicSum );
      col = col + 1;
    }
    return magic;
}
```

Question 5 [25]

- In this question, you will create a class AddressBook that will be able to store a collection of Friend objects.
- The class Friend, which has already been implemented, provides storage for a person's name and phone number. The class contains a constructor, and two accessor methods. A UML class diagram for the class Friend is as follows:



Question 5

Fill in the methods for AddressBook. Your AddressBook class should provide a constructor and three public methods that would permit the following class TestAddressBook to execute:

```
class TestAddressBook
{
 public static void main (String[] args)
 {
   AddressBook myBook = new AddressBook( 2 );
   myBook.addFriend( new Friend( "Alice", "555-1212" ) );
   myBook.addFriend( new Friend( "Tommy", "555-3434 " ) );
   myBook.addFriend( new Friend( "Pizza", "737-1111" ) );
   myBook.changePhone( "Tommy", "867-5309" );
   myBook.print();
   myBook.changePhone( "Pizza", "310-1010" );
 }
}
```

Question 5

Executing main() would result in the following being printed on the screen :

```
The address book is full.
Name: Alice, Phone: 555-1212
Name: Tommy, Phone: 867-5309
Pizza is not a name in the address book.
```

Complete the class AddressBook

Question 5

```
class AddressBook
{
// ATTRIBUTES: (3 marks)

 Friend [] list;
 int numElements;

// CONSTRUCTOR: (5 marks)
// Takes one integer parameter representing the
// maximum number of entries that can be put into
// the address book.

 public AddressBook(int n)
   {
     list = new Friend[n];
     numElements = 0;
   }
```

Question 5

```
// METHOD addFriend: (6 marks)
// Method parameters: a Friend object that should be added to
// the AddressBook.
// Results:  will print a message if the address book is full
// Modified:  the AddressBook object

public void addFriend( Friend newFriend)
{
  if (numElements < list.length)
  {
    list[numElements] = newFriend;
    numElements ++;
  }
  else
  {
    System.out.println("The address book is full.");
  }
}
```

Question 5

```
// METHOD print: (5 marks)
// Method parameters: (none)
// Returns: (none)
// This method prints a list of names and phone numbers in
// the address book.


public void print()
{
  int index;
  for (index=0; index < numElements; index++)
  {
   System.out.print("Name: " + list[index].getName() + ", ");
   System.out.println("Phone: " + list[index].getPhone());
  }
}
```

Question 5

```
// METHOD changePhone (6 marks)
// Updates the phone number of the first Friend with the
// specified name
// Method parameters: a String which is the name of a Friend,
// and a String which is a new phone number for that Friend.
// Result: an error message if the friend is not in the book

// NOTE:  recall that two strings s1 and s2 can be checked
// for equality with s1.equals(s2)
```

Question 5

```
public void changePhone(String aName, String aPhone)
 {
   int index;
   boolean found = false;
   for (index=0; index < numElements && !found; index++)
   {
     if (aName.equals( list[index].getName()))
     {
       list[index].setPhone(aPhone);
       found = true;
     }
   }
   if (!found)
   {
      System.out.println(aName +
          " is not a valid name in the address book.");
   }
 }

} // End of class AddressBook
```

Question 6 [10]

Write a **recursive** method that takes as a parameter a non-negative integer and generates the following pattern of stars.

You may use a loop to generate one line of stars, but **not** the entire pattern. If the non-negative integer is 4, then the pattern generated is:

```
****
***
**
*
*
**
***
****
```

The header of the method should be the following:

```
public static void stars(int n)
```

Question 6

```
public static void stars( int n )
 {
        int index;
        if ( n > 0 )
        {
            for (index = 0; index < n; index++ )
            {
                System.out.print("*");
            }
            System.out.println( );
            stars( n - 1 );
            for (index = 0; index < n; index++ )
            {
                System.out.print("*");
            }
            System.out.println( );
        }
 }
```