/* part1: variable,data type, operators,string, Boolean expression*/

1) What is the output of the following programs (if any)?

```
public class xyz
{
    public static void main(String[] args)
    {
        int t;
        System.out.println(t);

    }
}
```

a) 0
b) Compilation error
c) Runtime error
d) None of the above

2) What is the output of the following programs (if any)?

```
public class xyz
{
    public static void main(String[] args)
    {
        double a = 9;
        double t = a;
        System.out.println("a"+ t);

    }
}
```

a) 81
b) a*t
c) Compilation error
d) a9.0

3) What is the output of the following programs (if any)?

```
 public class xyz
{
 public static void main(String[] args)
 {
      int a=3, b=0;
      System.out.println(a == b/1+a);
      `
 }
}
```

a) Compilation error
b) true
c) a==b/1+a
d) None of the above

4) What is the output of the following programs (if any)?

```
 public class xyz
{
 public static void main(String[] args)
 {
     int x=0, y=1,z=x/y;
     x=(x++ + --y) *z--;
     System.out.println(x+z);
 }
}
```

a) 0
b) -1
c) -2
d) 1

5) What is the output of the following programs (if any)?

```
 public class xyz
{
    public static void main(String[] args)
    {
        boolean a=true, b=false;

        System.out.println(b!=a);

    }
}
```

a) false
b) true
c) Compilation error
d) None of the above

6) What will be the output of the following code?

```
public class Mid1Qs {
     public static void main(String args[])
    {
        int a = 34; double d = 20.5;
        d+=a; a+=d;
        System.out.print(" d = " + ++d + " : ");
        System.out.println(" a = " + a-- );
    }
}
```

a) d = 55 : a = 88
b) d = 55.5 : a = 88.5
c) Compilation error
d) d = 55.5 : a = 88

7) What will be the output of the following code?

```
 public class xyz {
public static void main(String[] args)
{
     int i = 3;
     int j=0;
     j += i%34;
     System.out.println(j);
```

```
    }
}
```

a) Compilation error
b) 2
c) 4
d) None of the above

8) What will be the output of the following code?

```
public class increment {
   public static void main(String args[]) {
    double var1 = 1 + 5;
    int var2 = var1 / 4;
    int var3 = 1 + 5;
    int var4 = var3 / 4;
    System.out.print(var2 + "     " + var4);}}
```

a) 1   1
b) 1.5   1
c) 1.5   1.0
d) Compilation error

9) What is the output of the following programs (if any)?

```
public class Output {
 public static void main(String args[]) {
int x , y;
x = 10;
x++;
--x;
y = x++;
System.out.println(x + "    " + y); }}
```

a) 11   11
b) 10   10
c) 11   10
d) 10   11

10) What is the output of the following programs (if any)?

```
public class Operators {
 public static void main(String args[]) {
int i = 3, j = 5;
int k = i++ + j;
System.out.println(i + " " + j + " " + k);
}
}
```

a) Compilation Error
b) 3 5 8
c) 4 5 8
d) 4 5 9

11) Which of the following expressions is equivalent to the Boolean expression

```
!(varA < 5 && varB != varC)
```

assume any value for varA, varB and varC

a) varA > 5 || varB != varC
b) varA >= 5 || varB == varC
c) !(varA < 5) || (varB != varC)
d) None of the above

12) What is the output of the following program (if any)?

```
public class Operators {
 public static void main(String args[]) {
 System.out.println(5 + 15 / 3 * 2 - 8 % 3);
 }
 }
```

a) Compilation Error
b) 13
c) 5
d) 1

13) What is the output of the following program (if any)?

```
public class CompareToClass {
public static void main(String args[]){
 String str1 = "Hello";
 String str2 = "Java";
 String str3 = "111CS";
 System.out.println(str1.equals("hello")+ " "+
(str2.compareTo("java")<0)+" " + (str3.compareTo("CS111")>0));
}
```

```
}
```
a) false false false
b) false true false
c) true false true
d) Compilation Error

14) What is the output of the following segment (if any)?

```
double d = 10.5;
int i = (int)d;
System.out.println(i+ " " + d);
```

a) Compilation fails
b) 10 10.5
c) 10.5 10.5
d) 10 10.0

15) Suppose you have the following code segment:

```
x = 1.0;
integerVariable = x + 10;
```

Which of the following statements is true?

a) integerVariable is of type int.
b) x is of type int.
c) integerVariable is of type double.
d) a && b.

16) What is the output of the following code segment, if any:

```
double x = 7.8;
double y = (int)x;
System.out.println("x = " + x + ", y = " + y);
```

a) x = 7.8, y = 7.0
b) x = 6.8, y = 7.0
c) x = 7.0, y = 7.0
d) x = 7.0, y = 7.8

17) What is the output of the following java snippet code?

```
int a=3, b=8;
boolean c = a>5 && ++b>6;
System.out.println(b);
```

a) 8

b) 9

c) 6

d) Compiler error

18) What will be the output of following statements?

```
int x = 3;
int y = x++ * 4;
System.out.print(y);
```

a) 16
b) 24
c) 12
d) 25

/*part2:2-1: control structure conditional statements(if…Switch)*/

19) After execution of the following code, what will be the value of cnt?

```
int cnt = 20;
if (cnt> 6)
cnt = cnt + 5;
else if (cnt> 10)
cnt = cnt + 15;
else cnt = 9;
System.out.println(cnt);
```

a) 20
b) 25
c) 18
d) 17

20) What is the output of the following segment (if any)?

```
int var1=1, var2=2, var3=3;
if(++var1 > var2++ || var1-- > 0)
```

```
 var3++;
else
 var3--;
System.out.println(var1+" "+var2+" "+var3);
```

a) 2 3 2
b) 1 3 4
c) 2 2 4
d) Compilation fails

21)

```
public class MyJavaProgram {
public static void main(String[] args) {
  int x = 7 , y = 10;
  if(!(x < 10 && y == 3));
  System.out.println("we are here");
  System.out.println("we are not here");
 }
}
```

a) we are here
b) we are not here
c) we are here
   we are not here
d) compilation error

22) What is the output of the following segment (if any)?

```
int odd = 1;
if(odd){
 System.out.println("odd");
}
else{
 System.out.println("even");
}
```

a) odd
b) even
c) It runs, but no output
d) Compilation error

23) Which of the following statements are equivalent?

(I)	**(II)**

`if (i > 0)`
`  if(j > 0)`
`  x = 0;`
`  else`
`  if (k > 0)`
`  y = 0;`
`  else z = 0;`
	`if (i > 0) {`
	`  if (j > 0)`
	`  x = 0;`
	`  else if (k > 0)`
	`  y = 0;}`
	`else z = 0;`

(III)	**(IV)**

`if (i > 0)`
`  if (j > 0)`
`  x = 0;`
`  else if (k > 0)`
`  y = 0;`
`  else`
`  z = 0;`
	`if (i > 0)`
	`  if ((j > 0)&& (i > 0))`
	`  x = 0;`
	`  else if (k > 0)`
	`  y = 0;`
	`else`
	`  z = 0;`

a) They are no equivalent statements.
b) (I), (II), and (IV) are equivalent.
c) (I), (III), and (IV) are equivalent.
d) (I), (II), and (III) are equivalent.

24) Are the following two statements equivalent?

(I)	**(II)**

`if (income <= 10000)`
`  tax = income * 0.1;`
`else if (income <= 20000)`
`  tax = 1000 +`
`  (income - 10000) * 0.15;`
	`  if (income <= 10000)`
	`  tax = income * 0.1;`
	`else if (income > 10000 &&`
	`  income <= 20000)`
	`  tax = 1000 +`
	`  (income - 10000) * 0.15;`

a) Yes.
b) No.
c) (I) has a compilation error.
d) (II) has a compilation error.

25) What is the output of the following program (if any)?

```
public class Equals{
 public static void main(String [] args){
 int x = 100;
 double y = 100.1;
 boolean b = (x = y);
 System.out.println(b);}}
```

a) It runs, but no output
b) true
c) false
d) Compilation fails

26) What is x after the following switch statement is executed?

```
int x = 3;
switch (x) {
case 3:x = 1;
case 4:x = 2;
      break
case 2:x = 3;}
System.out.println(x);
```

a) 1
b) 3
c) 2
d) 4

27) What is the output of this code, if any?

```
int number = 3;
if ((number % 2) != 0)
   Number/=2;
else
   Number -= 1;
System.out.print(number);
```

a) 1
b) 1.5
c) Compilation error
d) 3

28) **What is the output of the following java code?**

```
public class testClass {
```

```
    public static void main(String[] args) {
        int x=3;
        switch(x) {
            default: System.out.print("true");
            case 1: System.out.print("1");break;
            case 2: System.out.print("2");
        }}}
```

a) true1
b) 12
c) Compilation error
d) None of the above

29) What is the output of the following java code?

```
public class testClass {
    public static void main(String[] args) {
        int i;
        if(i==0 || i>0)
            System.out.println("Yes");
            if(i!=0) System.out.println("No");
            else System.out.println("Both");
        }}
```

a) Yes
b) No
c) Compilation error
d) Both

30) What is the output of the following java code?

```
public class testClass {
     public static void main(String[] args) {
          int i=0,j=9;
          if(i==0 || j/i>1)
               System.out.print("Yes");
               if(i!=0) System.out.print("No");
               else System.out.print("Both");}}
```

a) YesNo

b) No

c) Compilation error

d) YesBoth

/* part2:2-2: control structure loop*/

31) What will be the output of the program if i = 1 and j = 10, x = 3?

```
do {
if(i++ > --j)
     x++;
} while (i < 5);
System.out.println(i + " " + j);
```

a) i = 5 and j = 6
b) i = 5 and j = 5
c) i = 6 and j = 6
d) i = 6 and j = 5

32) How many times this while loop will execute?

```
int x = 2;
int y = 0;
while (x>0 && y<20) {
     if (y % x != 0){
          System.out.println(“even”);
          y++;
     }
     else{
          System.out.print(“odd”);
          y++;
     }
}
```

a) 20 times
b) 2 times
c) 0 times
d) Infinite times

33) What is the output of the following code segment, if any:

```
int x = 1;
while(x % 6 != 5)
x++;
System.out.println(x);
```

a) 1
b) 5
c) 6
d) Infinite loop.

34) What will be the output of the following code?

```
int sum = 0;
int i=0, j=0;
while (i < 7 && j < 6){
     sum += i;
     ++i; j = i + 1;
}
System.out.println(sum);
```

a) 5
b) 6
c) 10
d) compilation error

35) What is the value of i when System.out.print(i) is executed?

```
int sum = 0;
int i = 0;
while (i < 5){
sum = sum + i;
i++;
}
System.out.print(i);
System.out.print(" ");
System.out.print(sum);
```

a) 6
b) 5
c) 4
d) 3

36) What will be the output of the following code?

```
int num=24;
  while(++num%2!=0){
System.out.println(num);
      if(num>=25)
num++;
  } // end of while
```

a) 24
b) No output
c) Infinite loop
d) Error

37) What will be the output of the following code?

```
for(int i=1; i<=10; i++);
 System.out.print(i);
```

a) 12345678910
b) 11
c) compilation error
d) 1 2 3 4 5 6 7 8 9 10

38) What will be the output of the following code?

```
int i;
for(i=1; i<=10; i++);
System.out.print(i);
```

a) 12345678910
b) 11
c) compilation error
d) 1 2 3 4 5 6 7 8 9 10

39) What will be the output of the following code?

```
 int m = 0;
 while (m++ < 2)
 System.out.print(m + " ");
```

a) 0 1 2
b) 1 2
c) 2
d) 1

40) What will be the output of the program?

```
public class test1
{
 public static void main(String [] args)
 {
 int i = 1;
 do{
 while ( i < 1 )
 System.out.print("i is " + i);
 }while ( ++i > 1 ) ;
 }
}
```

a) i is 1
b) i is 1 i is 1
c) No output is produced.
d) Compilation error

41) What output will be produced by the following code?

```
public class Test {
public static void main(String[] args){
int i = 1;
 while (i < 5) {
 for (int j = i; j > 0; j--)
 System.out.print(j + " ");
 System.out.print("****");
 System.out.println();
 i++;
 }
 }
}
```

a)

```
1 ****
2 1 ****
3 2 1 ****
4 3 2 1 ****
```

b)

```
1 0 ****
2 1 0 ****
3 2 1 0 ****
4 3 2 1 0 ****
```

c)

```
1 **
2 1 **
3 2 1 **
4 3 2 1 **
```

d)

```
1 ***
2 1 ***
3 2 1 ***
4 3 2 1 ***
```

/*part4 :class, object, methods…*/

42) What output will be produced by the following code?

```
Class People{
 /**Postcondition: Returns the number of people in
 numberOfCouples couples.*/

 public int countPeople(int numberOfCouples){
 return 2 * numberOfCouples;
 }
 /**Postcondition: Returns the number of children,
 assuming that each couple has 2.3 children. */

 public double countPeople(int numberOfCouples){
 return 2.3 * numberOfCouples;
 }
}

Class TestPeople{
 public static void main(String[] args){
 People p = new People();
 p.countPeople(1000);
}
```

a) The code has a compilation error
b) 2000
c) 2300
d) 2.300

43) Consider the class MyClass:

```
class MyClass
{
public void service1(char letter)
{
 System.out.println(letter);
}
}
```

Which of the following is a valid statement to invocate service1:

a) MyClass.service1('a');
b) MyClass ref = newMyClass();
   System.out.println(ref.service1('$'));
c) MyClass ref = new MyClass(); ref.service1('$');
d) All the above

44) Consider the class MyClass:

```
class MyClass
{
public int service2 ()
{
 return 2+3+4;
}
}
```

Which of the following is a valid statement to invocate service2:

a) MyClass.service2('a');
b) System.out.println(MyClass.service2());
c) MyClass ref = new MyClass();
   System.out.println(ref.service2());
d) All the above.

45) Consider the class MyClass:

```
class MyClass
{

public double service3(int i)
{
 return i + 0.0;
}
}
```

Which of the following is a valid statement to invocate service3:

a) MyClass.service3(-7);
b) MyClass ref = new MyClass();
   System.out.println(ref.service3(-7));
c) int j = MyClass.service3(5));
d) All the above.

46) Assume that you have the following two classes in TestMain.java. What is the output:

```
public class Test {

     public int number;

     public void writeOutput()

     {          int number = 3;

                number = this.number - number * this.number;

                System.out.println(number);    }}

public class TestMain {

     public static void main(String[] args) {

                Test t1 = new Test();

                t1.number = 10;

                t1.writeOutput();}}
```

a) 3
b) 10
c) -6
d) -20
e) Compilation Error

47) Given the following class:

```
class Q2 {
  private int a;
  private int b;
  private int c;
  public void setA(int a){this.b = a;}
  public void setB(int b){this.c = b;}
  public void setC(int c){this.a = c;}
  public int getA(){return a;}
  public int getB(){return b;}
  public int getC(){return c;}
}
```

Given the following code snippet:

```
Q2 obj1 = new Q2();
Q2 obj2 = new Q2();
obj1.setA(0); obj1.setB(0); obj1.setC(10);
obj2 = obj1;
obj2.setA(4); obj2.setB(5); obj2.setC(-1);
System.out.println(obj1.getA() + obj2.getB());
```

What is the output of the program?

a) 10
b) 3
c) 9
d) 14
e) 5

48) What is the output of the following program:

```
class Test {
     private int a = 10;
     public void setA(int a){
          a = a;
     }
     public int getA(){
          return a;
     }
}

public class TestMain {
     public static void main(String args[]){
          Test obj1 = new Test();
          obj1.setA(3);
          System.out.println("obj1.a = " + obj1.getA());
     }
}
```

a) obj1.a = 10
b) obj1.a = 0
c) Compilation error
d) 0
e) 10

49) What is the output of the following program:

```
class Test {
     private int x = 10;
     public int calc(){
          int x = 3;
          return 10 / x;
     }}
```

```
public class TestMain {
     public static void main(String args[]){
          Test obj = new Test();
          System.out.println(obj.calc());}}
```

a) 1
b) 3
c) Compilation error
d) 3.333
e) 10

50) What is the output of the following program:

```
class Test {
     private int x = 10;
     int y = 20;
}
public class TestMain {
     public static void main(String args[]){
          Test obj = new Test();
          System.out.println(obj.x * obj.y); }}
```

a) 30
b) 20
c) Compilation error
d) 200
e) runtime error

51) What is the output of the following program:

```
class Test {
     private int x = 10;
     private int y = 20;
     public int clac(int x, int y) {
          return x * y;
     }
}
```

```
public class TestMain {

     public static void main(String args[]){

          Test obj = new Test();

          System.out.println(obj.calc(10));

     }

}
```

a) 10
b) 30
c) 200
d) Compilation error
e) runtime error

52) What is the output of the below Java program with a final local variable?

```
public class AClass {
     private int item;
     void change(int cars) {
          this.item = cars;
} }
```

```
public class Test {
public static void
main(String[] args){
AClass obj = new AClass();
obj.change(30);
System.out.println(obj.item);
} }
```

a) 50
b) 30
c) 20
d) Compilation error

53) What is the output of the below java class?

```
public class Constructor {
private int count;
Constructor(int count) {
System.out.println("Count="
+ this.count);} }
```

```
public class Test {
public static void main(String[]
args){
Constructor con =new
constructor();
       } }
```

a) Count=0
b) Count=10
c) Compilation error

d) None of the above

54) What is the output of the below Java program?

```
public class Constructor {
 int birds;
 Constructor() {
     this(20);
}
 Constructor(int birds) {
  this.birds=birds;
  System.out.println("Birds="
+ birds);
     } }
```

```
public class Test {
public static void
main(String[]args)
{
Constructor con = new
Constructor();
 }

}
```

a) Birds=0
b) Birds=10
c) Birds=20
d) Compilation error

55) What is the output of the below Java program with multiple methods?

```
public class Question {
void show(int a, char b) {
System.out.print("KSU ");
}
void show(char a, int b) {
System.out.println("CCIS ");
} }
```

```
public class Test {
public static void main(String[]
args){
Question obj = new Question();
obj.show(10, 'A');
obj.show('B', 10);
}    }
```

a) KSU KSU
b) CCIS CCIS
c) KSU CCIS
d) Compilation error

56) What is the output of following program?

```
public class AClass {
     public static int
var1;
}
```

```
public class Test {
public static void main(String[]
args){
AClass.var1=5;
AClass obj1 = new AClass();
AClass obj2 = new AClass();
obj1.var1++;
System.out.println(obj2.var1);
} }
```

a) 5
b) 6
c) 0
d) Compilation error

57) What is wrong in the following code (given that both classes are written in the same java file)?

```
class TempClass {
  int i;
  public void TempClass(int j) {
    int i = j;
  }
}

public class C {
  public static void main(String[] args) {
    TempClass temp = new TempClass(2);
  }
}
```

a) The program has a compilation error because TempClass does not have a default constructor.
b) The program has a compilation error because TempClass does not have a constructor with an int argument.
c) The program compiles fine, but it does not run because class C is not public.
d) The program compiles and runs fine.

58) What is the output of the following program, if any?

```
public class Customer {
public String name; // line 2
public int id;
public Customer(String n, int d) //line 5
    { set(n,d); }
public void set(String s, int i){//line 8
    name = "null";
    id = 10; }
}
```

```
import java.util.Scanner;
public class FinalTest {
public static void main(String[] args)
 {
Scanner kb = new
Scanner(System.in);
Customer cst = new Customer("Saad",
1111);
System.out.println("name="+cst.name+"
ID="+ cst.id);
}
}
```

a) name=Saad ID=1111
b) name=null ID=10
c) There will be a compilation error caused by line 2 in the class "Customer".
d) There will be a compilation error caused by line 5 in the class "Customer".
e) There will be a compilation error caused by line 8 in the class "Customer".

59) What is the output of the following program ?

```
public class Test2 {
public double display(int x, int
y)
{
  System.out.print(x+y);
  return x+y;
}

public int display(int y, int x)
{
  System.out.print(x+y);
  return x+y;
}
```

```
Public class CTest2
{
public static void
main(String[]args)
{
 Test2 t2 = new Test2();
 double d = t2.display(3, 4);
}

}
```

a) Compiler error because methods have same signature, so we have duplicate method.
b) 7
c) 14
d) 7 7
e) A & B

60) Which of the following statements correctly creates an array of five empty `String`s?

```
1. String a[] = new String[5]; for(int i=0; i<5; i++) a[i]= "";
2. String a[] = {"","","","",""};
3. String a[5];
4. String [5]a;
```

a) Only 1 **b) Only 1 and 2** **c) Only 2 and 3** **d) All the above**

61) What, if any, is the output of the following code fragment?

```
int[] myArray = {1,2,3,4};

System.out.println( myArray.length() );
```

a) 3 **b) 4** **c) 0** **d) Compilation error**

62) Consider the following Java code fragment **(3 Marks).**

```
int[] x = {0, 1};
int[] y = {1, 2, 3};

// Location 1.
for (int i = 0; i < x.length; i++) {
        // Location 2.
        for (int j = 0; j < y.length; j++) {
                // Location 3.
                sum += x[i] + y[j];
        }
        System.out.print(sum + " ");
}
```

Suppose that the statement `int sum = 0;` is put into one of the three designated locations above. What will the resulting code fragment do?

	Compilation error	Print the following to standard output
Location 1	○	6 15
Location 2	○	6 9
Location 3	●	

63) What, if any, is the output of this program?

```
public class MyClass {

        private static int x=0;

        public MyClass(){ x++; }
```

```
        public static void main(String[] args)
        {
              MyClass obj1 = new MyClass();
              MyClass obj2 = new MyClass();
              System.out.println(x);
        }}
```

a) 0 **b) 1** **c) 2** **d) Compilation error**

64) Each code segment below compiles without compilation error. However, each code segment has one or more problems. First, underline the problematic statements, then, fix the code so that it works according to the supplied comments or the given output **(3 Marks).**

```
a) public class Holder {
      private int value;
      public Holder(int initialValue) { initialValue = value; }
      public int getValue() { return value; }
      public void addToValue(int toAdd) { int value += toAdd; }
      public static void main(String arg[]){
            Holder n = new Holder(4);
            System.out.println(n.getValue());
            n.addToValue(5);
            System.out.println(n.getValue());
      }

   }
```

The corrected version of the program above should produce the following output
4 9

Answer (two problems):

```
value = initialValue;                    0.5 mark
value += toAdd;                          0.5 mark
```

b)
```
/* If data has a non-zero length, prints each element of data,
 * one per line. Otherwise, prints nothing.

 */

public void test1(int[] data){

      for(int i = 0; i <= data.length; i++){

            System.out.println(data[i]);

      }

}
```

Answer (one problem):

`i < data.length` 1 mark

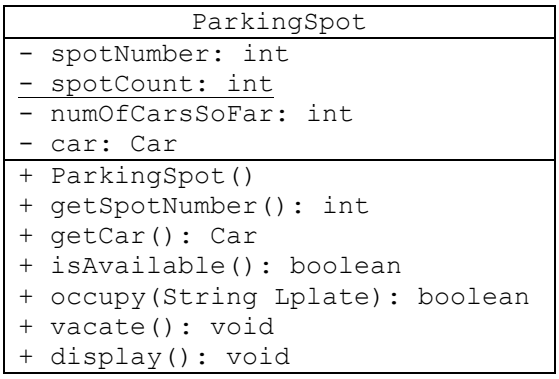
or `i <= data.length - 1`

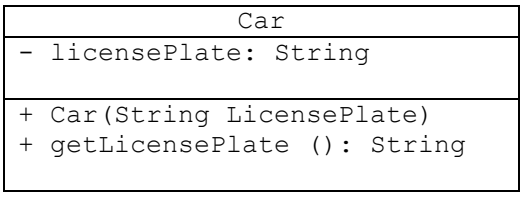
c)
```
/* Returns sum of all the even numbers from 0 to limit inclusive.
* Assumes limit is positive.
*/

   public int addEvens(int limit){

         int i = 0;

         int sum = 0;

         while(i != limit){

               sum += i;

               i+=2;

         }

         return sum;

   }
```

Answer (one problem):

`i <= limit` 1 mark

Consider the following UML diagrams for class **Car** and class **ParkingSpot**. Partial implementation of the two classes is given below with explanatory comments. Complete the implementation of both classes.





```
// Implementation of the Car class
public class Car {

	private String licensePlate;

	public Car(String LicensePlate) {
		this.licensePlate = LicensePlate;		// 0.5 mark
	}
	public String getLicensePlate() {		// 0.5 mark
		return licensePlate;
	}
}
```

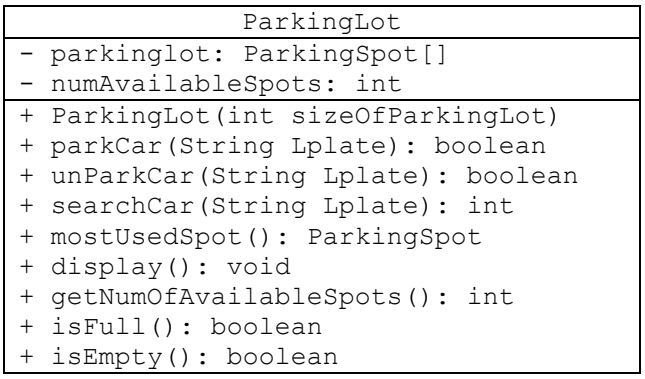
```
// Implementation of the ParkingSpot class
public class ParkingSpot {				// 1 mark

   /* spotNumber is an auto incremental number where the first spot
    * has the spotNumber=1
```

```
* spotCount is a static variable that holds the number of created spots
* numOfCarsSoFar is the number of cars parked in this spot so far
* car is the car currently parked at the spot. If no car parked at the
* spot, car=null
*/
private int spotNumber;
private static int spotCount =0;                    // 1 mark
private int numOfCarsSoFar;
private Car car;                                    // 1 mark

// A default constructor that assigns a number to each spot and
// increments the spotCount every time
public ParkingSpot() {
    spotCount++;                                     // 0.5 mark
    spotNumber = spotCount;                          // 0.5 mark

   // alternative solution
    spotNumber = ++spotCount;
    numOfCarsSoFar = 0;
    car = null;
}
public int getSpotNumber(){
    return spotNumber;
}

public Car getCar() {                               // 0.5 mark
        return car;
}
public int getNumOfCarsSoFar(){
    return numOfCarsSoFar;
}
```

```
// return true of this spot is available
public boolean isAvailable(){

    return car == null;                          // 1 mark
}
// Park the given car (by its license plate) in this spot if it is
// available, and return true if the car is parked successfully,
// otherwise false.
public boolean occupy(String Lplate) {

        if(isAvailable())             // 0.5 mark if-else and return
        {
              car = new Car(Lplate);        // 0.5 mark
              numOfCarsSoFar++;       // 0.5 mark
              return true;
        }
        else
              return false;
}
// Remove the car from this spot
public void vacate() {

    car = null;                                  // 1 mark
}
// display the spot number and availability of the spot
// if the spot is available, display the car's license plate
public void display() {                          // 1 mark
  System.out.print("Spot Number: " + spotNumber);
  if(isAvailable())
        System.out.print(" , is available" );
  else
```

```
            System.out.print(" , is unavailable , (License Plate: "
                    + car.getLicensePlate() + ")");
    }
}
```

Question 1. (10 Marks)
Consider the following UML diagram for class **ParkingLot** which uses the **ParkingSpot** class in question 3. Partial implementation of **ParkingLot** is given below with explanatory comments. Complete the implementation of the **ParkingLot** class**.**




```
// Implementation of the ParkingLot class
public class ParkingLot {

    /* parkinglot is an array of parking spots.
     * numAvailableSpots is the current number of available parking spots
     * in the parking lot.
     */

    private ParkingSpot [] parkinglot;                    // 1 mark
    private int numAvailableSpots;

    // a constructor which creates the parking lot of the given
    // size. Note that all parking spots are created in the constructor.
    public ParkingLot(int sizeOfParkingLot) {             // 1 mark
        parkinglot = new ParkingSpot[sizeOfParkingLot];
        for(int i= 0; i < sizeOfParkingLot; i++)
            parkinglot[i] = new ParkingSpot();
        numAvailableSpots = sizeOfParkingLot;
    }
```

```
public int getNumOfAvailableSpots() {                    // 0.5 mark
      return numAvailableSpots;
}

// returns true if all parking spots are occupied
public boolean isFull() {

      return numAvailableSpots == 0;                     // 1 mark
}
// returns true if all parking spots are available
public boolean isEmpty() {

      return numAvailableSpots == parkinglot.length;  // 1 mark
}
// display the status of the mallParking (parking spot
// numbers, availability and license plates of parked cars if any)
public void display() {
      for(int i= 0; i < parkinglot.length; i++)
      {
            parkinglot[i].display();
            System.out.println();
      }
}


// park the given car (by its license plate) in any available spot
// returns true if the car is successfully parked, otherwise false.
public boolean parkCar(String Lplate) {                  // 1 mark
      for(int i= 0; i < parkinglot.length; i++)
            if(parkinglot[i].isAvailable()) {
                  parkinglot[i].occupy(Lplate);
                  numAvailableSpots--;
```

```
                return true;
            }
        return false;
}
// search for a given car (by its license plate)in parking lot
// returns the parking spot number if found, otherwise -1
public int searchCar(String Lplate) {
        // 1 mark for finding the car
        // 0.5 mark for returning the spot number and -1 otherwise
        for(int i= 0; i < parkinglot.length; i++)
            if(!parkinglot[i].isAvailable())
        if(parkinglot[i].getCar().getLicensePlate().equals(Lplate)
                return parkinglot[i].getSpotNumber();
        return -1;
}

// unpark the given car(by its license plate)and make spot available
// returns true if the car is successfully unparked, otherwise false
public boolean unParkCar(String Lplate) {
        // 0.5 mark for finding the spot
        // 1 mark for removing the car and updating info
        for(int i= 0; i < parkinglot.length; i++)
          if(!parkinglot[i].isAvailable())
           if(parkinglot[i].getCar().getLicensePlate().equals(Lplate))
           {
                    parkinglot[i].vacate();
                    numAvailableSpots++;
                    return true;
           }
         return false;

        // alternative solution
```

```
            int spotnum = searchCar(Lplate);
            if(spotnum != -1) {
                  parkinglot[spotnum-1].vacate();
                  numAvailableSpots++;
                  return true;
            }
            return false;
      }
      // return the parking spot that has the maximum number of cars parked
      // so for, or return null if no cars parked in the parking lot
      public ParkingSpot mostUsedSpot() {
            // 0.5 mark for creating spot object and for-loop
            // 1 mark for finding and updating max
            ParkingSpot p =null;
            int max = 0;
            for(int i = 0 ; i < parkinglot.length; i++) {
                  if(parkinglot[i].getNumOfCarsSoFar() > max) {
                        p = parkinglot[i];
                        max = parkinglot[i].getNumOfCarsSoFar();
                  }
            }
            return p;
      }
}
```

Question 2. (Bonus Question: 3 Marks)
Using the implemented classes in questions 3 and 4, complete the **main** method below according to the given comments**.**

```
public class ParkingSystem {
   public static void main(String[] args) {

      // create a parking lot (e.g., mallParking) that has 4 parking spots.
```

```
        ParkingLot mallParking = new ParkingLot(4);     // 0.5 mark

// park a car that has license plate 123abc in the mallParking and
// print either the car was parked successfully or not
        if(mallParking.parkCar("123abc"))               // 0.5 mark
                System.out.println("Car is parked successfully");
        else
                System.out.println("No parking spot available");


// check if the car with license plate 321kkd is parked in the
// mallParking. If yes, print the spot number, otherwise print the
// car is not in the mallParking

        int spotnum = mallParking.searchCar("321kkd");  // 0.5 mark
        if(spotnum != -1)
        System.out.println("Car is parked at spot number " + spotnum);
        else
        System.out.println("Car is not parked in mall parking lot");

// print the spot number of the most used parking spot

        ParkingSpot p = mallParking.mostUsedSpot();     // 0.5 mark
        if(p != null)
        System.out.println("Most used parking spot is "
                                        + p.getSpotNumber());

// display the status of the mallParking (parking spot
// numbers, availability and license plates of parked cars if any)

        mallParking.display();                          // 0.5 mark
```

```
        // unpark the car that has license plate 123abc from the mallParking

              mallParking.unParkCar("123abc");                // 0.5 mark

}
```