HOMEWORK PROBLEMS 8

1) Why is it better to get random numbers from the `Random` class than to get them from the famous book, *10,000 Random Numbers Arranged in Ascending Order*?

2) Give a statement that displays a random integer between 10 and 100 (inclusive). Assume `r` is a reference to a `Random` object.

3) Suppose `s1` and `s2` point to `String` objects. Give the statement that displays `ASCENDING` if the `s2` strings follows the `s1` string lexicographically.

4) Write a statement that reads in one `double` value using `kb`, where `kb` is a reference variable to a `Scanner` object.

5) Give the statement that converts the string "`1.23456`" to a `double` value and assigns the result to a `double` variable.

6) Compile the program in `C8h6.java` to confirm it compiles correctly. Remove the `import` statement and re-compile. What happens? Now compile without the `import` statement but use the fully-qualified name for `Random` (`java.util.Random`) in the program. What happens?

7) What is displayed by the program below? Run it to check your answer.

```
class C8h7
{
   public static void main(String[] args)
   {
      String s1, s2, s3, s4;
      s1 = "hello";
      s2 = "hello";
      if (s1 == s2)
         System.out.println("s1 == s2");
      s3 = new String("hello");
      s4 = new String("hello");
      if (s3 == s4)
         System.out.println("s3 == s4");
   }
}
```

From this example, can you conclude that the construction of the strings that occurs as a result of

```
s1 = "hello";
s2 = "hello";
```

is the exactly the same as the construction of strings that occurs as a result of

```
s3 = new String("hello"):
s4 = new String("hello")
```

8) What are the possible values assigned to `x` by

```
x = (r.nextInt(5) + r.nextInt(5))/2;
```

where `x` is type `int` and `r` is a reference to a `Random` object. Write a program that executes the statement above 1,000,000 times and counts the number of times each integer between 0 and 4 (inclusive) is assigned to `x`. Your program should display the final counts. Use a `switch` statement (see homework program 7 in Chapter 4). Based on your results, does it appear that 0, 1, 2, 3, and 4 are equally likely?

9) Same as homework problem 8 but for the following statement:

```
x = (int)(5.0 * r.nextGaussian());
```

10) The following code demonstrates the auto-boxing and unboxing between `Integer` and `int`:

```
Integer i;
int j;
i = 5;   // 5 is auto-boxed in an Integer object
j = i;   // int in i is auto-unboxed and assigned to j
```

But does auto-boxing and unboxing work between `Object` and `int`? Is the following code legal:

```
Object obj;
int j;
obj = 5;    // is 5 auto-boxed?
obj = new Integer(5);
j = obj;    // is the integer in the obj object auto-unboxed?
```

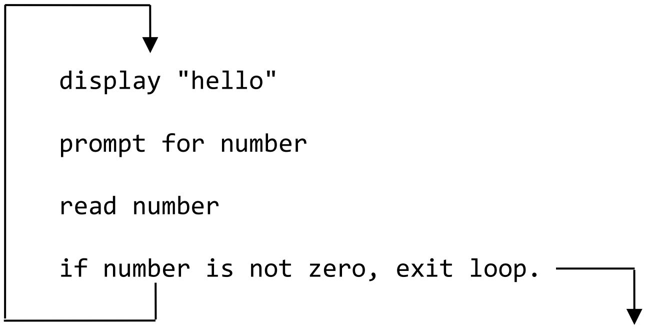
Run a test program to check your answer.

11) Write a program that reads in a string from the keyboard, and then determines and displays the number of occurrences of vowels (a, A, e, E, i, I, o, O, u, and U).

12) Write a program that displays `hello` repeatedly as long as the user enters 0 after each display. Entering any non-zero integer terminates the program. Sample session:

```
hello
enter non-zero integer to stop
0
hello
enter non-zero integer to stop
0
hello
enter non-zero integer to stop
1      ◄——program terminates at this point
```

This program naturally calls for a loop with the following structure:



```
display "hello"

prompt for number

read number

if number is not zero, exit loop.
```

Notice the loop has a **trailing exit test** (i.e., the exit test is at the bottom of the loop). Because the `while` loop has a leading exit test, implement the loop you need for this problem using a `do-while` loop (it has a trailing exit test). Its form is

```
do
   statement
while (true/false expression);
```

where the embedded statement can be either a simple statement or a compound statement (i.e., a sequence of statements enclosed with braces). The exit occurs at the bottom of the loop if the true/false expression is false.

13) If a variable is declared within a `do-while` loop, does its scope (i.e., where it can be used) extend to the true/false expression. For example, is the following loop legal:

```
do
{
   int i = 1;
   System.out.println(i);
   i++;
} while (i <= 5);
```

Run a test program to check your answer.

14) Write a program that reads in an integer by executing the `nextInt` method in a `Scanner` object. What happens if you enter a non-integer rather than an integer when `nextInt` executes? Try entering `"hello"`, `3.5` and `3.0`. What happens if you enter an integer that is too big, such as 999999999999999?

15) Write a program that displays 30 random integers between 10 and 15 inclusive.

16) Write a program that prompts for and reads in a `double` number and then determines and displays its square root. Your program should do this repeatedly until the user enters a negative number. Use `Math.sqrt` to compute square roots. Use the class name `C8h16` for your program. The output your program creates should look like that in the following sample session:

```
Enter double
9.0
Square root of 9.0 = 3.0
Enter double
100.0
Square root of 100.0 = 10.0
Enter double
-3.0      ←——— program terminates at this point
```

After you have tested your program, create a file named `C8h16.txt` with a text editor. The file should contain the data 9.0, 100.0, and -3.0 (do *not* include the commas). Then run your program by entering

```
java C8h16 < C8h16.txt
```

The angle bracket here **redirects** input so that it is from the specified file rather than the keyboard.

17) What happens if you pass a negative number to `Math.sqrt`? Run a test program to find out.

18) Write a program than prompts for and reads in the radius of a circle and then displays its area. Use the constant `Math.PI` in the `Math` class for π.

19) Is the following a legal statement:

```
            i = r1 + r2;
```

where `i` is an `int` variable and `r1` and `r2` are `Integer` reference variables that point to `Integer` objects? Run a test program to check your answer.

20) Write a program in which `main` passes `f` references to two `Integer` objects. `f` should return the sum of the two integers in the `Integer` objects. Its return type should be `int. main` should display the value returned by `f`.

21) Write a program that prompts the user for an integer. Your program should read in the integer and display `POSITIVE`, `NEGATIVE`, or `ZERO`, according to the value of the number. The output your program creates should look like that in the following sample session:

```
   Enter integer
   3
   3 is positive ◄——— program terminates at this point
```

22) Suppose two packages `java.a` and `java.b` each have an `XXX` class. If you want to use both `XXX` classes in your program, how would you do it? Would you use `import` statements?

23) Do the wrapper classes have constructors with no parameters. For example, is the following code legal:

```
            Integer i = new Integer();
```

Run a test program to check your answer.

24) Can a `String` object be concatenated to a `StringBuffer` object. For example, if `sb` points to a `Stringbuffer` object, is the following statement legal:

```
            System.out.println(sb + "xyz");
```

Run a test program to check your answer.

25) Can a `StringBuffer` object be cast to a `String`. For example, if `s` and `sb` have type `String` and `StringBuffer`, respectively, is the following statement legal:

```
            s = (String)sb;
```

Run a test program to check your answer.

26) Write a program that prompts for an integer, reads in an integer with `nextInt`, prompts for a string and reads in a string with `nextLine`, in that order. Your program should then display the integer and the string on separate lines, in that order. *Hint*: When your program reads in the integer, it consumes only the integer, not the end-of-line marker at the end of the current input line. If `nextLine` is then executed, it returns the empty string terminated by the end-of-line marker. It does not read in the next line.

27) Write a program that displays the current time and date. Use the `Date` class. Consult a Java class reference to determine how to use `Date`.

28) Incorporate the following code in a program and execute:

```
   System.out.println(Integer.toBinaryString(257));
```

It displays 257 in binary. Do you now see why the following code assigns 1 to `b`?

```
int i = 257;
byte b = (byte)i;
```

29) Suppose `r1` and `r2` have type `Integer`. Do `r1` and `r2` point to the same object if the following statements are executed?

```
r1 = 5;
r2 = 5;
```

Do `r1` and `r2` point to the same object if the following statements are executed?

```
r1 = new Integer(10);
r2 = new Integer(10);
```

Run a test program to check your answers.

30) Write a `Graph` class that has methods `countIt` and `graphIt`. `countIt` should use five counters (`c0`, `c1`, `c2`, `c3`, and `c4`) to count the number of 0's, 1's, 2's, 3's, and 4's it is passed. Use a `switch` statement to determine which counter to increment (see homework problem 7 in Chapter 4). `graphIt` should display the final counts in the form of a bar graph, with one bar for each count. Each bar should consist of a horizontal line of consecutive asterisks. If the largest count is greater than 50, scale the size of the bars so that the largest bar has 50 asterisks.

Write a program that uses your `Graph` class. It should generate 1,000,000 random integers all of which are 0, 1, 2, 3, or 4. For each integer, your program should call `countIt` in a `Graph` object. After all the integers have been counted, your program should call `graphIt`.

31) Write a program that estimates the probability of getting three heads when three coins are tossed. Let 0 represent tails, 1 heads. Simulate the tossing of a coin by generating a random integer equal to 0 or 1. To toss three coins, generate three random integers. A sum of 3 indicates three heads has occurred. Toss three coins 1,000,000 times. Determine the fraction of times the outcome is three heads. This fraction approximates the theoretical probability of getting three heads when tossing three coins.

32) Write a program in which you read a line from the keyboard, and then display the line with its characters reversed. Display both the original and the reversed strings.

33) Write a program that reads in two strings from a single line entered from the keyboard. Use the `next` method in the `Scanner` class. Convert the strings to type `int` using `Integer.parseInt`. Add the two values and display the sum. Enter `20 30` when your run the program.

34) Write a program that prompts for and reads in an integer number, displays `hello` that number of times, and then terminates. Sample session:

```
Enter integer
2
hello
hello
```

35) Same as homework problem 34 except that the program should repeat after displaying `hello` the requested number of times. The program should stop only when the user enters a non-positive integer. Sample session:

```
Enter integer
2
hello
hello
Enter integer
1
hello
Enter integer
0          ←—— program terminates at this point
```

36) Write a program that plays the game Nim with the user of the program. The program and the user alternate turns, picking up one, two, or three straws on each turn. The program goes first. The player to pick up the last straw loses. Your program should start by generating and displaying a random integer (which represents the number of straws) between 10 and 20 inclusive. If this number is 1 more than a multiple of 4, add 1. For example, if the random integer is 20, then start with 20 straws. But if the random integer is 17 (which is 1 more than a multiple of 4), start with 18. On a user's turn, your program should prompt for, read in, and process the user's input (which should 1, 2, or 3—the number of straws to pick up). On the program's turn, it should determine its move by generating a random number between 1 and 3. At the end of each game, your program should display

```
Do you want to play another game?
```

It should then read in the user's yes/no response, and proceed accordingly. Use a `do-while` loop to control the repetition of games (see homework problems 12 and 13). If either a user's move or the program's move is greater than the number of straws, then all the remaining straws should be picked up, resulting in a loss. For example, if there are 2 straws left, and the user's move is 3, the remaining 2 straws should be picked up, causing the user to lose.

37) Same as homework problem 36 with this change in the program's strategy. If the number of straws is 1 more than a multiple of 4, it should pick up 1 straw. Otherwise, it should pick up the number of straws that leaves 1 more than a multiple of 4. For example, if the number of straws is 12, 11, or 10, your program should pick up 3, 2, or 1, respectively, leaving 9 straws (which is 1 more than 2×4).

38) Write a program that simulates the dropping of a one-inch needle on a paper that has two horizontal lines two inches apart. The lower part of the needle can land anywhere between the two lines. The angle of the needle with respect to the horizontal lines can be any value between 0 and π (which is the radian equivalent of 180 degrees). Your program should simulate the dropping of the needle 1,000,000 times. It should count how many drops resulted in the needle touching or crossing the top horizontal line. It should then divide this count *into* the number of drops and display the result. Does the result displayed by your program approximate some well-know constant?

39) What does the `next` method in the `Scanner` class return each time it is called if the input is

```
bye,     goodbye    ,   all done
```

Now try this experiment: Before calling `next`, execute

```
kb.delimiter(",");
```

where `kb` is the reference to the `Scanner` object. For the same keyboard input, what does `next` return? Repeat your experiment, but execute before calling `next`

```
kb.delimiter("");
```

40) Write a program that reads in a string and displays the number e's in the string. Test with the word "Tennessee".

41) Write a program that reads in a string and displays all its characters except the vowels a, e, i, o, and u. Test your program with the word "`international`".

42) Write a program that reads in a string and an integer. Your program should display the character in the string whose index is given by the integer entered. Test by entering the string "`This is a test`" and 8.

43) Write a program that reads in a string and displays `True` if any two adjacent characters are the same, and `False` otherwise. Test by entering "`hello`". Test also with "`characters`".

44) Write a program that generates a string of 10,000 numbers, either 0 or 1 randomly generated. Your program should determine the largest run of consecutive 1's and the largest run of consecutive 0's. Display the number of 1's in the largest run of 1's and the number of 0's in the largest run of 0's.

45) Write a program that generates a random integer between 1 and 100. Use

```
number = r.nextInt(100) + 1;
```

where `r` is a `Random` object. Then execute a loop up to six times. Each time through the loop, prompt the user to enter a guess for the number. If the user guesses the number, immediately break out of the loop and display "`You Win`". Otherwise display either "`Your Guess is too high`" or "`Your guess is too low`". If the users does not guess the number after six tries, your loop terminates. In that case, display "`You lose`".

46) What is displayed when the following program is executed:

```
class C8h46
{
   public static void main(String[] args)
   {
      String s = "A\nB";
      int i = 0;
      while (i < s.length())
      {
         System.out.print(s.charAt(i));
         i++;
      }
   }
}
```

Modify the program so that with the given string (i.e., do *not* modify the `s` string) it displays the following four characters:

```
A\nB
```

Hint: In the loop, check if the current character is the newline. If it is, display the two characters `\` and `n` instead of the new line character.

47) Write a program that reads in a string from the keyboard. Your program should display the string with each group of three characters on a separate line. For example, if the input string is

```
AB DEFG
```

Then your program should display

```
AB
DEF
G
```