Midterm 1 Practice Exercises

1. Develop a pseudo code algorithm to tabulate the function $(K = 2^n)$
   for n = 1, 2, 3, 4,……,50. Note that each term can be obtained from the previous term using multiplication.

   For example:

   $2 \wedge 1 = 2$

   $2 \wedge 2 = 4$

   $2 \wedge 3 = 8$

   …

   Now translate the algorithm into a Java program.

2. The square of the integers 1, 2, 3, … can be generated by a method that involves adding successive odd numbers to the previous square, that is:

   $1 \wedge 2 = 0 \wedge 2 + 1 = 1$

   $2 \wedge 2 = 1 \wedge 2 + 3 = 4$

   $3 \wedge 2 = 2 \wedge 2 + 5 = 9$

   or in general

   $(k + 1) \wedge 2 = k \wedge 2 + (2k + 1)$

   Develop a pseudo code algorithm which uses this technique to generate the squares of integers from 1 to a given number n. Translate the algorithm into a Java program.

3. Develop a pseudo code algorithm to find all positive integers less than 1000 which do not end in zero and have the property that if the rightmost digit is deleted, the integer obtained divides evenly into the original. For example, 39 is such an integer since 3 remains after deleting the rightmost digit and 3 divides 39 evenly.
   Translate the algorithm into a Java method.

4. Develop a Java method which accepts an integer value as an argument to the method. The method displays each digit of the given number on a separate line. For example, if the input to the method is 749 the output will be

   9
   4
   7

5. Write a method that accepts an integer as a parameter (e.g. 4) and prints the following output:

   1
   1 2
   1 2 3
   1 2 3 4

6. Convert to Java expressions using the pre-defined methods:

$$\sqrt{x+7} \qquad \frac{-b+\sqrt{b^2-4ac}}{2a} \qquad |x-y|$$

$$x^{y+7} \qquad \frac{\sqrt{time+tide}}{nobody} \qquad \frac{\frac{x+y}{3}-\frac{x-y}{5}}{4x} \qquad \left(x+\sqrt{y}\right)^7$$

7. Write a Java method that converts a Celsius temperature to its Fahrenheit equivalent. The formula is:
$$Fahrenheit = \frac{9}{5}Celsius + 32$$

8. Write a method to calculate the diameter, the circumference, and the area of a circle for a given radius.

9. Write a Java program that takes a floating-point number from the keyboard and prints only its fractional part.

10. Design and write a Java application that takes as input a single letter and displays the corresponding digit on the telephone. The letters and digits on a telephone are grouped this way:

> 2 = ABC
> 3 = DEF
> 4 = GHI
> 5 = JKL
> 6 = MNO
> 7 = PRS
> 8 = TUV
> 9 = WXY

No digit corresponds to either Q or Z. For these two letters, your application should display a message they are not used on a telephone. (A natural extension of this question is to accept a single word (instead of a single letter) and output the corresponding digits. A further extension of this would be to accept a collection of words.)

11. What is the output of the following Java code segment?
```java
int years = 2;
while (years <= 8) {
    System.out.print("Year " + years + "\t");
    double rate = 8;
    while (rate <= 11) {
        System.out.printf("%8.2f", years * rate / 100);
        rate += 0.5;
    }
    System.out.println();
    years++
}
System.out.println("End of Loop.");
```

Slightly harder problems

1. The four-digit number 3025 has the following property: if the number formed by considering only the first two digits (30) is added to the number formed by considering only the last two digits (25), the total will be 55, and if this number (55) is squared, the result will be the original number. Develop an algorithm to find all four-digit numbers having this property. Then translate the algorithm into a Java program.

2. The greatest common divisor (GCD) of two numbers is the largest factor of both numbers. For example, the GCD of 54 and 63 is 9. Develop a pseudo code algorithm which will compute the GCD of any two given numbers. Translate your algorithm into a Java method.

3. The least common multiple (LCM) of two numbers is the smallest integer evenly divisible by both numbers. For example, the LCM of 9 and 12 is 36. Develop a pseudo code algorithm which will find the LCM of any two given numbers. Translate your algorithm into a Java method.

4. A number is said to be a perfect number if it is equal to the sum of its factors other than itself. For instance, the number 28 is a perfect number since 1+2+4+7+14 = 28. Develop an algorithm which will test a given number to determine if it is a perfect number. Translate your algorithm into a Java method.

5. A number is said to be "balanced" if the largest digit in the number is equal to half the sum of the digits.
   For example, 312 is a "balanced" number; 3 is the largest digit; (3+1+2)/2=3.
   Design and write a Java method that would return a Boolean value indicating if the number passed as a parameter is balanced.

6. A palindrome is a word that is spelled the same forward and backward, such as "radar". Write a Java function that will accept a string as a parameter and determines whether or not the word is a palindrome. The word "aabbcbbaa" should be considered a palindrome even though it is not legitimate English word.