Variables and expressions

1. What is the type and value of the following expressions
   - 1.1. 22 / 7
   - 1.2. 7 / 22
   - 1.3. 22 % 7
   - 1.4. 7 % 22

2. Suppose you have to evenly distribute a bunch of candies to a group of children. How many candies will each child get? How many candies will be left? Write the variables and appropriate C expressions to help you solve the problem.

3. Assuming that <u>side</u> and <u>area</u> are variables representing *integers* containing the length of one side in cm and the area of a square in square cm, write a C statement that will display this information in this form:

   The area of a square whose side length is ___ cm is ___ square cm.
   - a) What if the side and area are *real numbers*?

4. Write a program that computes and displays the circle's area using its radius (a real number).

5. Choose the most suitable options to evaluate $nC3$. Given that n is integer.
   a) n* (n-1) *(n-2)/6.0
   b) n/2 * (n/3) * (n-2)
   b) n * (n-1)/2 * (n-2)/3
   b) n/6 * (n-1) * (n-2)

6. What is the output of the following lines of code (assume all relevant code is present above)

   ```
   int a = 22.2/7;
   printf("%d",a);
   ```

   - a) 3
   - b) 3.214286
   - c) Some garbage value
   - d) Compilation error

Input/Output

7. Write a program that takes two real numbers as a rectangle's <u>height</u> and <u>width</u> and prints the rectangle's <u>area</u> and perimeter.

8. Write a program to calculate the simple interest and compound interest given (Number of years , principal amount and rate of interest)

9. Write a program that takes three characters from the user and prints them in reverse order as they were entered, one per line.
   Example:

   Input: 'a', 'b', 'c',
   Output
   c
   b
   a

10. Rewrite the program in Q3 above so it takes the <u>side</u> from the user and computes the area.

11. Write a program that takes three sides of a triangle as input and print area and perimeter of it. (Hint: You can use Heron's formula to find the area).

12. What will be the value of 'a'?(ans can be compilation error as well)
    Code:
    a.)   int a;
            a=1,2,3;
    b.)   int a;
            a=(1,2,3);
    c.)   int a =1,2,3;

13. What would be the output?
    Code :
    ```
    int a=1,b=2,c=3,d;
    if(( b>a) || (a=c))
            d=a+b;
    else
            d=a-b;
    printf("%d %d",a,d);
    ```

14. Write a program that takes a three digit number and finds the reverse of that number.
    For example : The reverse of the number 427 is 724.

Functions

15. Suppose you work for ESPN. You have a device that the time each athlete took (seconds) to complete a 100-meter race. Let's assume you stored this value in a variable time_for_100m. Write a program that takes this value from the user and reports the athlete's running speed in km/h. Design at least two intermediate functions using the design recipe discussed in class.

    Some examples:
    World records: Usain Bolt (M) 9.58, Florence Griffith-Joyner (W) 10.49
    National records: Amlan Borgohain (M) 10.25, Dutee Chand (W) 11.17

16. We have used the C library stdio.h for input and output. There are several other useful libraries. One of them is math.h. It has a function double sqrt(double) that, as expected, computes the square root of the given number. Use it to define a function that computes the hypotenuse of a right-angle triangle given its other two sides.
    (Here is the official documentation of the sqrt function. It has many more details than most of you are ready to digest at this point, so enter at your own risk.)

17. For any integer n > 0, n! is defined as the product n x n - 1 x n - 2 ... x 2 x 1.
    0! is defined to be 1.
    It is sometimes useful to have a closed-form definition instead; for this purpose, an approximation can be used. R.W. Gosper proposed the following such approximation formula:

    $$n! \ = \ n^n e^{-n} \sqrt{(2n \ + \ 1/3)\pi}$$

    Create a program that prompts the user to enter an integer n, uses Gosper's formula to approximate n!, and then displays the result. The message displaying the result should look something like this:

    5! equals approximately 119.97003

    Your program will be easier to debug if you use some intermediate values instead of trying to compute the result in a single expression. If you are not getting the correct results, then you can compare the results of your intermediate values to what you get when you do the calculations by hand. Use at least two intermediate values - one for 2n + 1/3 and one for the square-root term.

    Display each of these intermediate values to simplify debugging.
    Be sure to use a named constant for PI, and use the approximation 3.14159265. Test the program on nonnegative integers less than 8.

    You can use the pow function in the math library.

18. Using the function from the problem above to calculate factorial, write a program to compute the number of combinations possible in choosing r items out of n items (where order doesn't matter).

19. Using the pow function in math.h, create a function to calculate the geometric mean of 5 numbers. The geometric mean of n numbers is the nth root of their product.

Conditionals

20. Write a program to print the number of days in a month for a given year.
    INPUT: 2000 2
    OUTPUT: 29

    Here the first number represents the year and the second number represents the month no (here 2 means its february). As 2000 is a leap year, so the number of days in February is 29.

    Hint: break it down into several smaller functions.

21. Write a program to check if a given year is a leap year or not.
    Input:- 2024
    Output:- It is a leap year

    Input:- 1700
    Output:- it is not a leap year

22. You are hired by FlipZon, a popular e-commerce company. They have the following scheme for delivery charges based on the loyalty program points and the value of the cart a user has. Write a program that computes the appropriate delivery charges, given the total value of the cart and the user's loyalty points.

Cart total	Loyalty points	Delivery charges
0-1500	0-200	100
0-1500	201-500	50
0-1500	501 or above	20
1501-5000	0-200	80
1501-5000	201-500	30

1501-5000	501 or above	10
Above 5000	0-200	60
Above 5000	201-500	20
Above 5000	501 or above	0

23. Write a program that checks whether the entered three digit number is a palindrome or not. A number is a palindrome when the reverse of the number is the number itself. For example, the reverse of 591 is 195. Hence it is not a palindrome. Whereas, the reverse of 676 is 676. Hence it is a palindrome.

24. Using the geometric mean function in problem 18, check whether the arithmetic mean of five entered numbers is always greater than or equal to the geometric mean of the numbers.

25. Create three functions that return the areas of a square, circle and equilateral triangle by inputting side of square, radius of circle and side of equilateral. Write a program to find which of the three areas is greater and print it.

Recursion

26. Write a recursive function *power* that takes two non-negative integers *m* and *n* and returns m^n.

27. Write a recursive function *sum_series* that takes a non-neg. integer *n* and returns $\sum_{i=0}^{n} i$.

28. Write a recursive function *sum_series* that takes two non-neg. integers *m* and *n* and returns $\sum_{i=m}^{n} i$.

29. Implement the following function using recursion.
```
/*
    @brief: Print the character c n times in a row.
    Requires: n>0
    Example: printchars('*',5) should print "* * * * *"
*/
void printchars(char c, int n)
```

30. Now, use this function to implement the following function using recursion.
```
/*
    @brief: Given a positive integer n, print a "star-triangle"

    Example: For n = 5, the following should be printed:
        *
```

```
        *  *
        *  *  *
        *  *  *  *
        *  *  *  *  *
*/
void triangle(int n)
```

31. Implement a SINGLE function `void light(int n)` that prints the corresponding text to the console for the following parameter values:
    n<=1: "Is there a check-engine light?"
    n==2: "Is there a check the check-engine light light?"
    n==3: "Is there a check the check the check-engine light light light?"
    …and so on.
    You may use `main()` to print "Is there a" and "?".

32. Implement the following function:

```
/**
 * @brief Prints all positive factors of the given number
 *        one per line from the smallest to the largest.
 * Requires n > 0
 */
void print_factors(int n)
```

33. Implement the following function:
```
/**
 * @brief Returns if the given positive number is prime.
 *
 * Requires n > 0
 */
int is_prime(int n)
```

34. Write a function determining whether the given non-negative number is an Armstrong number. (An n-digit number that is the sum of the n-th powers of its digits). Ex: 153=1^3+5^3+3^3.

35. Write a function that returns the k-th Fibonacci number. Fibonacci series: 1, 1, 2, 3, 5, 8, …

36. Implement the following function using recursion, you may form a helper function if needed.
```
/*
    @brief: Given a positive integer n, print a "double
star-triangle"

    Example: For n = 5, the following should be printed:
        *
        *  *
```

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


*   /
```