1. [6] For each of the following state the type for the expression, i.e., to which type does it evaluate? An example is given. Be sure to specify only the type, not the actual value. Assume the following set of variable declarations and initializations.

```c
int j = 3;
char ch = 'a';
char *s = &ch;
int *v = &j;
```

- `j * 1` will produce a value of type `int`
- `j * 1.0` will produce a value of type `double`
- `&ch` will produce a value of type `char*`
- `*v` will produce a value of type `int`
- `(ch == *s)` will produce a value of type `char`
- `(j == 2) ? 'a' : 'b'` will produce a value of type `char`

2. [7] For each of the following what value is assigned to result? Assume the following variable definitions. Put your answer in the blank line.

```c
int x = 0;
int result;
int *p = &x;
int **f = &p;
```

- a. _______ result = (*p) ? 1 : 0;
- b. _______ result = (f) ? 1 : 0;
- c. _______ result = (**f * 50) + *p;
- d. _______ result = x + 3 - *p;
- e. _______ result = 2 * **f;
- f. _______ result = x - *p;
- g. _______ result = **f = *p = 4;

3. [6] Write a C++ function for the following algebraic equation to compute the volume of a cube from its length, x: \( \text{volume} = x^3 \). The header for the function is given below.

```c
int volume(int x) {
```
4. [5] Rewrite the following for loop using a while loop.

```cpp
int sum = 0;
for (int j = 0; j < 10; j += 4) {
    sum += j;
    cout << j << " " << sum << endl;
}
```

5. [5] What is printed by the for loop given above?

6. [5] Rewrite the for loop below using a break to exit the loop.

```cpp
int sum = 0;
for (int j = 0; ; j += 4) {
    // Code inside the loop
    break;
}
```
7. [5] Consider the following array:

\[
\begin{array}{ccccc}
  a & b & c & d & e \\
  f & g & h & i & j \\
\end{array}
\]

Write a complete C++ function that will initialize this array with the values listed (using a loop).

8. [5] Write a complete C++ function that will print this array as shown above with a space between each character and each row on a different line.

9. [5] Write a complete C++ function that will reverse the values in each row, e.g., the function should reverse the rows so that the array is the following after the function:

\[
\begin{array}{ccccc}
  e & d & c & b & a \\
  j & i & h & g & f \\
\end{array}
\]
10. [5] Write a function to copy a string from one location to another. Assume that the destination holds enough space to accommodate the source string.

```c
void copyString(char *source, char *destination) {
```
12. [10] In the code below, write a loop to read numbers from standard input (cin) until the number zero is read, at which time the loop should exit and print the value of the maximum number read. If a negative number is read the program print an error message and exit.

```cpp
#include <iostream>
using namespace std;

int main() {

    return 0;
}
```


```cpp
int swap(int& x, int& y) {
    int temp = x;
    x = y;
    y = temp;
}
```
14. [5] This is a question about the scope of variables. Consider the following program. Draw each scope in the program using a rectangle to indicate the scope.

```cpp
int x = 3;

int foo(int& x) {
    x = 23;
    return x;
}

int goo(int y) {
    y = 30;
    return y;
}

int main () {
    int x = 3;
    if (x > 1) {
        int x = 4;
        cout << x;
        for (int x = 1; x == 1; x++) {
            x = 1;
        }
        cout << x;
        int y = foo(x);
    }
    int y = goo(x);
    cout << x;
    cout << x;
    return 0;
}
```

15. [3] What is printed by this program?
16. [4] Consider the following program; each line of interest is numbered from 1 through 15 (the number is a comment). List the numbers of the commented lines in the order of their execution when the compiled program is run. I’ll start the list for you:

4, 5, ________________________________

#include <iostream>
using namespace std;

void sum(int x) {
    /* line 1 */ static int sum = 0;
    /* line 2 */ sum += x;
    /* line 3 */ cout << "sum is " << sum << endl;
}

int main () {
    /* line 4 */ int j = 3;
    /* line 5 */ while (j < 7 && j != 5) {
        /* line 6 */ if (j % 2 == 0) {
            /* line 7 */ sum(j);
        }
        else {
            /* line 8 */ cout << j << endl;
        }
    }
    /* line 9*/ return 0;
}

17. [4] In terms of line numbers in the execution of the program, what is the lifetime of each variable in the program given above?

j’s lifetime is ________________________________

x’s lifetime is ________________________________

sum’s lifetime is ________________________________
18. [4] Joe would like to open a file for input. The file name is “input.txt”. Write the code to open the file for input and read the file character-by-character. You may print each character that is read if you like.