Part 1: Multiple Choice (114 points - 3 points per question)

(C) 1. Which statement is false?
   (A) Comments begin with /* and end with */.  (B) Lines beginning with a # are processed at preprocessor time.
   (C) Lengthy comments cause poor execution-time performance.  (D) none of the above

(B) 2. How is cc used to compile aloha.c into aloha?
   (A) cc aloha.c aloha  (B) cc aloha.c -o aloha  (C) cc aloha aloha.c  (D) none of the above

(C) 3. a, b, c, and d are 4 integers and and a = 1, b = 6, c = -8. What is the value of d after running
   \[ d = \text{\texttt{++a * b}} \% \text{\texttt{c + ++b}} \% \text{\texttt{c--}}; \]
   (A) -3  (B) 6  (C) 11  (D) none of the above

(A) 4. Which statement is true?
   (A) % has the lower precedence than ++.  (B) = is an equality operator.
   (C) ?: associates from left to right.  (D) none of the above

(A) 5. Which of the following is false?
   (A) The assignment operators associate left to right.  (B) & is an address operator.
   (C) _day is a valid identifier.  (D) none of the above

(D) 6. Which of the following is not a repetition structure?  (A) for (B) do \cdots while (C) while (D) switch

(D) 7. If \( x = -6 \) and \( y = 8 \), what is the value of \( y \) for \( y += x - y \text{ ? ++x : y--} \)?
   (A) -40  (B) 24  (C) 64  (D) none of the above

(B) 8. How many times will the following program print Aloha!?
   \[ \text{for (i = 1000; i > 0; i /= 2) printf("Aloha!");} \]
   (A) 9 (B) 10 (C) 11 (D) none of the above

(C) 9. Which statement is true?
   (A) The expression \( (a + 1)++ \) adds 2 to a.  (B) The expression \( **a \) multiplies a by a.
   (C) The expression \( ++(a * 2) \) causes a syntax error.  (D) none of the above

(D) 10. Which is an example of a unary operator?  (A)  (B) < (C) ?: (D) none of the above

(C) 11. Assume \( a = 8 \) and \( b = 3 \), which of the following is true?
   (A) \( a > 3 \&\& b > 12 \)  (B) \( b * b > a + b \&\& a/b > a \% b \)  (C) \( a - b > a \% b \)  (D) none of the above

(B) 12. Which can replace the expression \( \text{if (n != 7)} \)?
   (A) \( \text{if (n < 7 \&\& n < 7)} \)  (B) \( \text{if (!(n - 7)} \)  (C) \( \text{if !(n = 7)} \)  (D) none of the above

(D) 13. Which is an illegal statement in C?  (A) for (; ;)  (B) for (;i++;)  (C) for \( i = 0; ; i += 2, j++ \)  (D) none of the above

(B) 14. Which can be used to convert a lower case letter \( \text{ch} \) to a upper case?
   (A) \( \text{ch} += 'A' - 'a' \)  (B) \( \text{ch} -= 'a' - 'A' \)  (C) \( \text{ch} += 'z' - 'Z' \)  (D) none of the above

(B) 15. Consider the declarations:
   \[
   \begin{align*}
   \text{char } c &= '\text{xd}'; \\
   \text{int } i &= 6;
   \end{align*}
   \]
   Give the value and the data type of the expression \( c * i \).
   (A) \( \text{\texttt{\textbackslash 132}} \), char (B) 88, int (C) \( \text{\texttt{\textbackslash x56}} \), char (D) none of the above

(D) 16. Which can be used to determine the size of an array \( a[][] \)?
   (A) sizeof(\( a[][] \)) (B) sizeof(\( a[0][0] \)) (C) sizeof(\( a[] \)) sizeof(\( a[] \)) (D) sizeof(\( a \)) sizeof(\( a[0] \))

(D) 17. Given the following definitions, what is the value of \( b[2][1] \)?
   \[
   \text{int } b[3][4] = \{\{1, 2\}, \{3, 4\}, \{5, 6, 7\}\};
   \]
   (A) 5 (B) 6 (C) 7 (D) none of the above

(B) 18. Given \( \text{int } a[6] = 1, 6, 4, 8, 3, -4, i = 2 \). What is the value of \( \text{a[i * i]} - \text{a[i]} \)?
   (A) -4  (B) 4  (C) 8  (D) none of the above

(D) 19. Which is true?
   (A) An array can contain data items of different data type.  (B) An array size can change after declaration.
   (C) The subscript for the last element of an array is the array size.  (D) none of the above

(D) 20. Which is a benefit of functions?
   (A) Reduce programming errors.  (B) Make a program more efficient.  (C) Avoid code reuse.  (D) none of the above

(C) 21. Which method will return 8.0?  (A) floor(7.4)  (B) round(7.4)  (C) ceil(7.4)  (D) none of the above

(D) 22. Which is an invalid function prototype?  (A) \text{int } f(\text{int } *)  (B) \text{int } f(\text{int, int})  (C) \text{int } f(\text{void})  (D) none of the above

(C) 23. A recursive function is a function that
   (A) returns another function (B) is inside of another function (C) calls itself (D) takes a function as an argument

(B) 24. What value does function mystery return when called with a value of 5?
   \[
   \text{int mystery (int } n \{ \\
   \quad \text{if (} n \leq 1 \text{) return 1; else return mystery(n - 1) + 2 * n;}
   \}
   \]
   (A) 24 (B) 29 (C) 34 (D) none of the above

(C) 25. Which function is used to get a string from the standard input?  (A) getc (B) getch (C) gets (D) none of the above

(C) 26. Which function does not read data from standard input?  (A) scanf (B) gets (C) fread (D) getchar
27. Which function is used to calculate remainder of two floating-point numbers?
(A) frem (B) fmod (C) floor (D) none of the above

28. Which is true?
(A) All variables defined inside a function are local variables. (B) Parameters are required for any function. (C) A function must have a return type. (D) none of the above

29. Which statement is true?
(A) An integer can be multiplied with a pointer (B) Arrays cannot contain pointers. (C) The size of an array of strings is the size of of the character array. (D) none of the above

30. How can a random number between -a and a be generated?
(A) a - rand() % (2 * a + 1) (B) a + rand() % a + 1 (C) a + rand() % (a + 1) (D) none of the above

31. Which function is used to append a string to another? (A) strapp (B) strcat (C) strcpy (D) strlen

32. Which statement is invalid if i = 100, *p = &i;
(A) --*p++ + *p; (B) *p++ - *p; (C) *p * ++*p; (D) none of the above

33. Which is true?
(A) A pointer can be assigned to an integer. (B) automatic is an identifier’s storage class. (C) The subscript for the last element of an array is the array size (D) none of the above

34. Which of the following can have a pointer as an operand? (A) % (B) *= (C) / (D) none of the above

35. Consider the following code:
```c
int add(int a, int b) return a + b;
int (*op)(int, int);
Which is a valid statement? (A) (*op)(3, 4) (B) *op = add (C) *op(3, 4) (D) none of the above
```

36. Which character handling library function returns a true value if its argument is a letter and 0 otherwise?
(A) isalphanumeric (B) isalphanumeric (C) isletter (D) isalpha

37. Which is used to convert a string to a double? (A) atof (B) atod (C) atoi (D) none of the above

38. Which function is used to tokenize a string? (A) strtok (B) strtokenize (C) tokenize (D) none of the above

Part 2: Questions and Answers (72 points)

1. (8 points) Consider the following code of a guessing number game. Find the errors and correct them.

```c
void guess ()
{    
    if (n < g) return 1;
    else if (n == g) return 0;
    else return -1;
}

main() {
    int n, g;
    srand(getpid());
    n = rand() % 10 + 1;
    do {
        printf("Guess the number between 1 and 10: ");
        scanf("%d", &g);
        if (guess(n, g) > 0) print("Too high!
")
            else print("Too low!
");
    } while (guess(n, g) != 0);
    print("The number is %f.
", n);
}

int guess (int n, int g) {
    if (n < g) return 1;
    else if (n == g) return 0;
    else return -1;
}

main() {
    int n, g;
    srand(getpid());
    n = rand() % 10 + 1;
    do {
        printf("Guess the number between 1 and 10: ");
        scanf("%d", &g);
        if (guess(n, g) > 0) print("Too high!
")
            else print("Too low!
");
    } while (guess(n, g) != 0);
```
printf("The number is %d.\n", n);
}

2. (6 points) Consider the following C code. The program is compiled into an executable code called Hello. Write the result after running it in the command line as follows:
Hello Lady Gaga Taylor Swift Lily Allen

message (int i, int argc, char *args[]) {
    i % 3 ? printf("Hello!") : printf("Aloha!");
    printf("%s", i % 2 ? args[i] : args[i % 2 + 1]);
    printf("%s\n", i % 3 ? args[i + 1] : args[i % 3 + 2]);
}

main (int argc, char *args[]) {
    int i;
    for (i = argc - 1; i > 0; i--) message(++i, argc, args);
}

Aloha! Lady Gaga
Hello! Lady Lily
Hello! Lady Taylor

3. (8 points) Write the result after executing the following program.

int func (int a, int b) {
    a += 2;
    printf("a = %d, b = %d.\n", a, b);
    return ++a * b--;
}

int sub (int *a, int *b) {
    *b *= 3;
    printf("a = %d, b = %d.\n", *a, *b);
    return --*a + ***b;
}

main() {
    int x = 3, y = 2;
    x = func(x, y);
    printf("x = %d, y = %d.\n", x, y);
    y = sub(&x, &x);
    printf("x = %d, y = %d.\n", x, y);
}

a = 5, b = 2.
x = 12, y = 2.
a = 36, b = 36.
x = 36, y = 72.

4. (a) (5 points) Consider the following recursive function. Rewrite it using iterative (nonrecursive) approach.

int sum(int n) {
    if (n < 1) return 1;
    return n * sum(n - 1) + n;
}

(b) (5 points) Consider the following function sum. Rewrite it as a recursive function.

int sum (int n) {
    int i, sum = 1;
    for (i = 1; i <= n; i++) sum += i * i - i;
    return sum;
}

(a) int suma (int n) {
    int i, sum = 1;
    for (i = 1; i <= n; i++) sum = sum * i + i;
    return sum;
}
(b) int sum(int n) {
    if (n < 1) return 1;
    return sum(n - 1) + n * n - n;
}

5. (8 points) Write the result after executing the following program.

main() {
    int i[] = {10, 20, 30, 40, 50};
    int *pa[] = {i+2, i+4, i, i+3, i+1};
    int **pi = pa;
    printf("****pi = %d\n", ****pi);
    printf("*****pi = %d\n", *****pi);
    printf("******pi = %d\n", ******pi);
    printf("*******pi = %d\n", *******pi);
    ****pi = 31
    *****pi = 50
    ******pi = 49
    *******pi = 49
}

6. (a) (5 points) Write a function that passes a double array and its size and returns the square summation of the array \(a_1^2 + a_2^2 + \ldots + a_n^2\).

(b) (5 points) Write a function that passes a double array and its size and reverse the array elements.

(a) double sqrt_sum(double a[], int size) {
    double sum = 0;
    int i;
    for (i = 0; i < size; i++) sum += a[i] * a[i];
    return sum;
}

(b) void reverse(double a[], int size) {
    int i;
    double b[size];
    for (i = 0; i < size; i++) b[i] = a[size - 1 - i];
    for (i = 0; i < size; i++) a[i] = b[i];
}

7. (a) (9 points) Write a function that passes x and n and returns the value of the following function.
\[ f(n) = x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \frac{x^9}{9} - \ldots + \frac{x^n}{n} \] if n is an odd number.

(b) (3 points) Write the main function that uses the above function.

double f(double x, int n) {
    double t = x, sum = 0;
    int i, sign = 1;
    for (i = 1; i <= n; i++, t *= x, sign = -sign) sum += sign * t/(i * i);
    return sum;
}

main() {
    double x;
    int n;
    printf("Enter x, n: ");
    scanf("%lf%d", &x, &n);
    printf("f(%f, %d) = %f\n", x, n, f(x, n));
}

8. (10 points) Write a program to read n to generate a board of n by n as follows. A possible run may look like:

```
Enter n: 2
+---+---+
|   |   |
+---+---+
|   |   |
+---+---+```
main() {
    int n, i, j;
    printf("Enter n: ");
    scanf("%d", &n);
    for (i = 0; i < n; i++) printf("+-");
    printf("+
");
    for (i = 0; i < n; i++) {
        for (j = 0; j < n; j++) printf("| ");
        printf("|
");
        for (j = 0; j < n; j++) printf("+-");
        printf("+
");
    }
}