Family Name:..... **First Name:**.....

Student ID:..... **Signature**.....

NWEN241: Systems Programming

Mid-term Test

19 April 2024 ** WITH SOLUTIONS **

Instructions

- Time allowed: **50 minutes**
- Attempt **all** the questions. There are **45** marks in total.
- Write your answers in this test paper and hand in all sheets.
- If you think a question is unclear, ask for clarification.
- This test contributes **15%** of your final grade.
- You may write notes and working on this paper, but make sure your answers are clear.
- Only silent non-programmable calculators or silent programmable calculators with their memories cleared are permitted in this examination.
- No electronic dictionaries are allowed.
- Paper foreign to English language dictionaries are allowed.

Sections	**Marks**	
1. True or False	[10]	
2. Multiple Choice Questions	[20]	
3. Short Answer Questions	[15]	
	TOTAL:	

SECTION A True (T) or False(F)

Write the letter of the correct answer in the box provided. Each correct answer will earn 1 mark.

1. During the preprocessing stage, the preprocessor converts C source code into an assembly file containing an assembly language program. **[1 mark]**

False

2. `_my_auto_var_2` is a valid identfier in C. **[1 mark]**

True

3. The rule: `sizeof(int) >= sizeof(short)` is always guarenteed in different implementations of C. **[1 mark]**

True

4. `'A'` is a valid string literal. **[1 mark]**

False

5. When executed, the following C program will complete without any issues: **[1 mark]**

```
#include <stdio.h>
void main()
{
    char *p = "NWEN241 C-Test";
    p[0] = 'n';
    p[1] = 'w';
    printf("%s", p);
}
```

False

6. In C, memory leaks are automatically managed through garbage collection, freeing up leaked memory. **[1 mark]**

False

7. `9.022e-4` is a valid floating point literal. **[1 mark]**

True

8. Consider the following code snippet. Assuming the allocation is successful, the size (in bytes) of the memory block pointed to by `cp` will be 40 bytes. **[1 mark]**

```
char *cp;
cp = (char)*malloc(20*sizeof(char));
```

False

9. In the following declaration: **[1 mark]**

```
register int i;
```

The value of variable `i` is guaranteed to be stored in a CPU register.

False

10. Consider the following code snippet. **[1 mark]**

```
char *ptr = (char *)malloc(8*sizeof(char));
realloc(ptr, 12*sizeof(char));
```

After the call to `realloc()` on the second line, `ptr` still points to the previously allocated memory on the the first line.

True

SECTION B Multiple Choice Questions

Write the letter corresponding to your answer in the box provided. Each question is accompanied by its respective mark allocation.

11. A C program contains the following declarations: **[1 mark]**

```
int i, j;
long ix ;
short s;
float x;
char c;
```

What is the resulting data type of the following expression?

```
3 * i + (long) (ix / s) - x * c / j
```

a) `int`
b) `double`
c) `long`
d) `float`

d

12. With every use of a memory allocation function, what function should be used to release allocated memory which is no longer needed? **[1 mark]**

a) `dealloc()`
b) `release()`
c) `free()`
d) `unalloc()`

c

13. What will be the data type returned for the following C function? **[1 mark]**

```
int func()
{
    return (float)(char)5.0;
}
```

a) `int`
b) `float`
c) `char`
d) No output, the program will generate a compile time error

a

14. Consider the following structure definition. **[1 mark]**

```
struct node {
    int i;
    float j;
 };
```

What does the following C statement declare?

```
struct node *s[10];
```

a) An array of size 10, each element of which is pointer to a structure of type `node`
b) A structure of 2 fields, each field being a pointer to an array of 10 elements
c) An array of size 10, each element of which is a structure of type node
d) None of these

a

15. Which of the following data type will throw an error on modulus operation(%)? **[1 mark]**

a) `int`
b) `short`
c) `long`
d) `float`

d

16. What will be the output of the following C code? **[1 mark]**

```
#include<stdio.h>

enum random { a, b = 99, c, d = -1};

main()
{
    printf("%d %d %d %d\n",a,b,c,d);
}
```

a) 1 99 100 -1
b) 0 99 100 -1
c) 1 2 3 4
d) 0 99 1 -1

b

17. What will be the output of the following C program? **[2 marks]**

```
void count(int n)
{
    static int d = 1;

    printf("%d", n);
    printf("%d", d);
    d++;
    if(n>1)
      count(n-1);
    printf("\n");
}

void main()
{
    count(3);
}
```

a) 3 1 2 2 1 3
b) 3 1 2 1 1 1
c) 3 1 2 2 1 3
d) 3 1 2 1 1 1

a

18. What will be the output of the following C program? **[2 marks]**

```
#include<stdio.h>

int main()
{
    char c[] = "STRINGS!!!";
    char *p = c;
    printf("%s\n", p + p[1] - p[4]);
}
```

a) `STRINGS!!!`
b) `S!!!`
c) `TRINGS`
d) `!!!`

b

19. What will be the output of the following C program? **[2 marks]**

```
#include<stdio.h>

void f(int *p, int *q)
{
    p = q;
    *p = 2;
}

int i = 0, j = 1;

int main()
{
    f(&i, &j);
    printf("%d %d \n", i, j);
    return 0;
}
```

a) 2 2
b) 2 1
c) 0 1
d) 0 2

d

20. What will be the output of the following C program? **[2 marks]**

```
#include<stdio.h>
#include<string.h>

void main()
{
    char p[20];
    char *s = "string";
    int length = strlen(s);
    int i;
    for (i = 0; i < length; i++)
    p[i] = s[length - i];
    printf("%s",p);
}
```

a) gnirts
b) gnirt
c) string
d) no output is printed

d

21. What will be the output of the following C code segment? **[2 marks]**

```
void f1(int a, int b)
{
    int c;
    c = a;
    a = b;
    b = c;
}
void f2(int *a, int *b)
{
    int c;
    c = *a;
    *a = *b;
    *b = c;
}
int main(){
    int a = 7, b = 4, c = 9;
    f1(a,b);
    f2(&b, &c);
    printf(\%d\n",c-a-b);
}
```

a) -6
b) -2
c) -12
d) 2

c

22. Consider the following C declaration. **[2 marks]**

```
struct {
 short s[5];
 union {
   float y;
   long z;
  }u;
}t;
```

Assume that objects of the type `short`, `float` and `long` occupy 2 bytes, 4 bytes and 8 bytes, respectively. The memory requirement for variable `t` is:

a) 22
b) 18
c) 10
d) 14

b

23. What will be the output of the following C code? **[2 marks]**

```
#include <stdio.h>

#define foo(x, y) x / y + x

int main()
{
    int i = -6, j = 3;
    printf("%d\n",foo(i + j, 3));
    return 0;
}
```

a) -4
b) -8
c) 2
d) 4

b

SECTION C Short answer questions

Write your answer in the space provided. Each question is accompanied by its respective mark allocation.

24. Describe the difference between `char s1[]="cat";` and `char s2[]={'c','a','t'};` **[2 marks]**

s1 is a string. It contains 4 chars, the last being '\0' which is automatically added. s2 is an array of chars. It contains 3 chars, as given in the initialization.

25. Consider the following C function. Rewrite it as a function like macro named PRODUCT. **[2 marks]**

```
int product(int a, int b)
{
    return a*b;
}
```

```
#define PRODUCT(A, B) ((A)*(B))
```

26. Using only one C statement, declare an array which can hold 10 integers with initial values 1, 2, 3 and 4 for the first four elements, and 0 for the remaining elements. Name this array iarray. **[2 marks]**

```
int iarray[100] ={1, 2, 3, 4};
```

27. What will be the output of the following code? **[2 marks]**

```
#include <stdio.h>

int main()
{
    int ary[4] = {1, 2, 3, 4};
    int *p = ary + 2;
    printf("%d %d\n", p[-2], ary[*p]);
}
```

1 4

28. What will be the output of the following code segment? **[2 marks]**

```
#include <stdio.h>

struct point{
    int x;
    int y;
    int z;
};

void foo(struct point*);

int main()
{
    struct point p1[]  =  {1, 2, 3, 4, 5, 6};
    foo(p1);
}

void foo(struct point p[])
{
    printf("%d\n", p->y++);
}
```

2

29. Consider the following C program. **[3 marks]**

```
#include <stdio.h>
int a;
int main()
{
    int b;
    {
        int c;
     }
}
```

(a) **[1 mark]** What will be the sequence of allocation and deletion of variables in the above code?

Allocation a b c; Deletion c b a

(b) **[1 mark]** What is storage class of variable `c`?

auto

(c) **[1 mark]** What is lifetime of variable `a`?

static

30. Given the following variable declarations: **[2 marks]**

```
int a[] = {2,4,6,8,10};
int *ip = a;
int **pp = &ip;
```

Suppose that an `int` occupies 4 bytes in memory. The array `a` is at memory address 100, while `ip` is at memory address 200 and `pp` is at address 300(all addresses are in decimal).

(a) **[1 mark]** What is the numeric value of the expression *pp+1?

100+1*4=104

(b) **[1 mark]** What is the numeric value of the expression **pp+1?

3

* * * * * * * * * * * * * * *

SPARE PAGE FOR EXTRA ANSWERS

Cross out rough working that you do not want marked.
Specify the question number for work that you do want marked.