Question 1 [2 marks] (no partial marks)

https://hello.iitk.ac.in/manage/esc101a2122/node/13204?quizid=13203

In which of the following modes can you write to a file, assuming that it exists? An option is correct if you can both read and write. Remember that mode here refers to the second argument passed to fopen().

The question may have multiple correct choices.

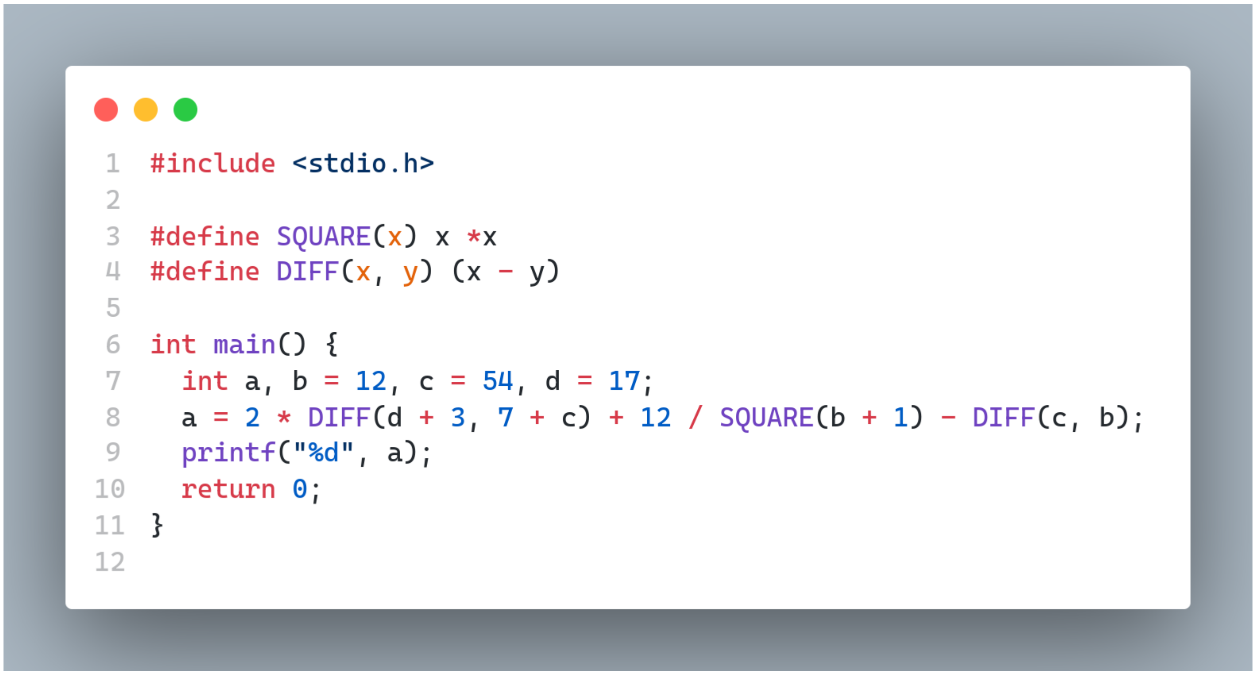
A) r
B) r+
C) a
D) a+

Answer: B, C, D.

Question 2 [3 marks]

https://hello.iitk.ac.in/manage/esc101a2122/node/13205?quizid=13203

What is the output of the following C program?

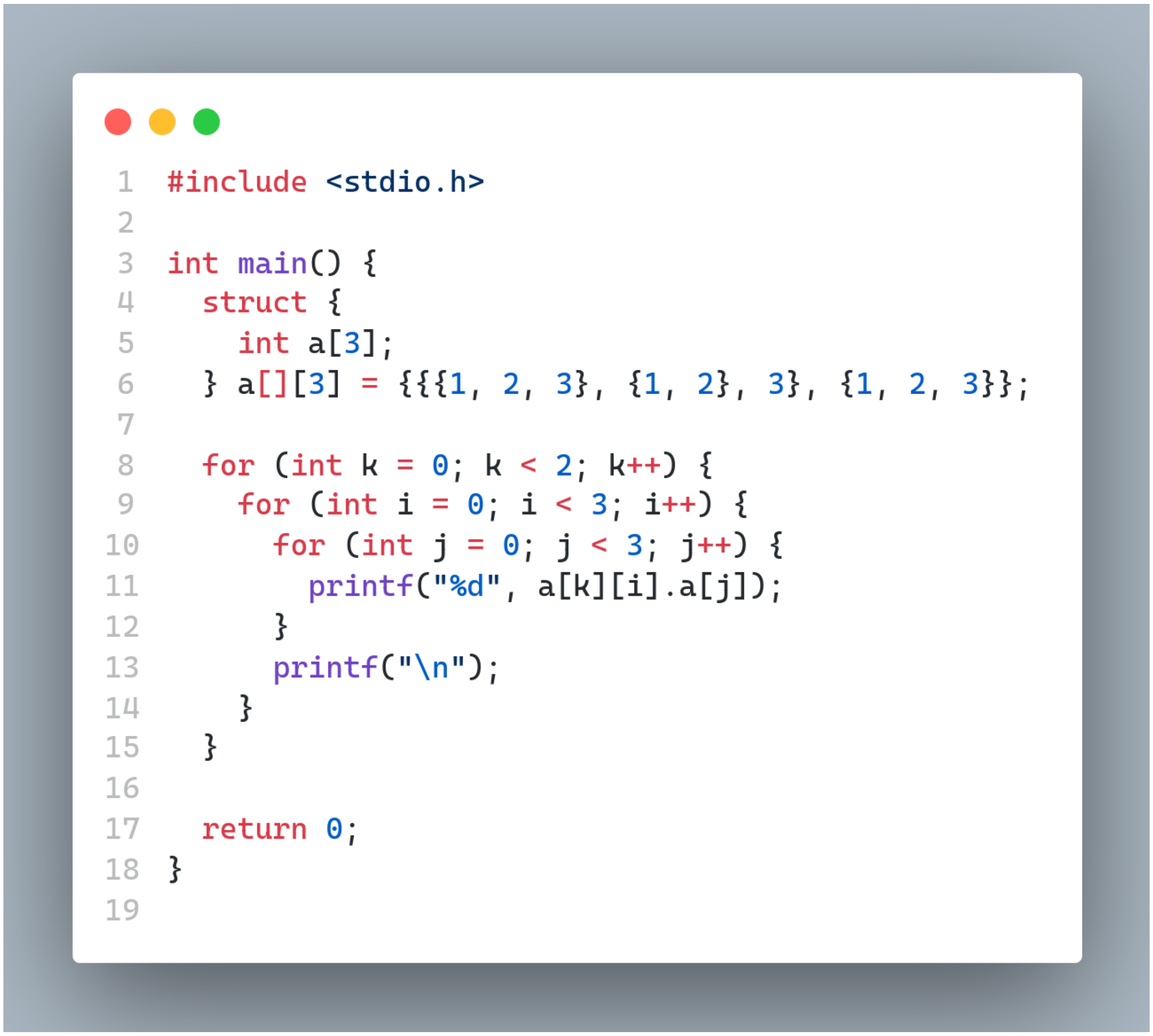


```c
#include <stdio.h>

#define SQUARE(x) x *x
#define DIFF(x, y) (x - y)

int main() {
  int a, b = 12, c = 54, d = 17;
  a = 2 * DIFF(d + 3, 7 + c) + 12 / SQUARE(b + 1) - DIFF(c, b);
  printf("%d", a);
  return 0;
}

```

Answer: 106

Question 3 [4 marks]

https://hello.iitk.ac.in/manage/esc101a2122/node/13206?quizid=13203



```c
#include <stdio.h>

int main() {
  struct {
    int a[3];
  } a[][3] = {{{1, 2, 3}, {1, 2}, 3}, {1, 2, 3}};

  for (int k = 0; k < 2; k++) {
    for (int i = 0; i < 3; i++) {
      for (int j = 0; j < 3; j++) {
        printf("%d", a[k][i].a[j]);
      }
      printf("\n");
    }
  }

  return 0;
}
```

1. Is the struct initialization in the above program a valid statement? (1 mark)

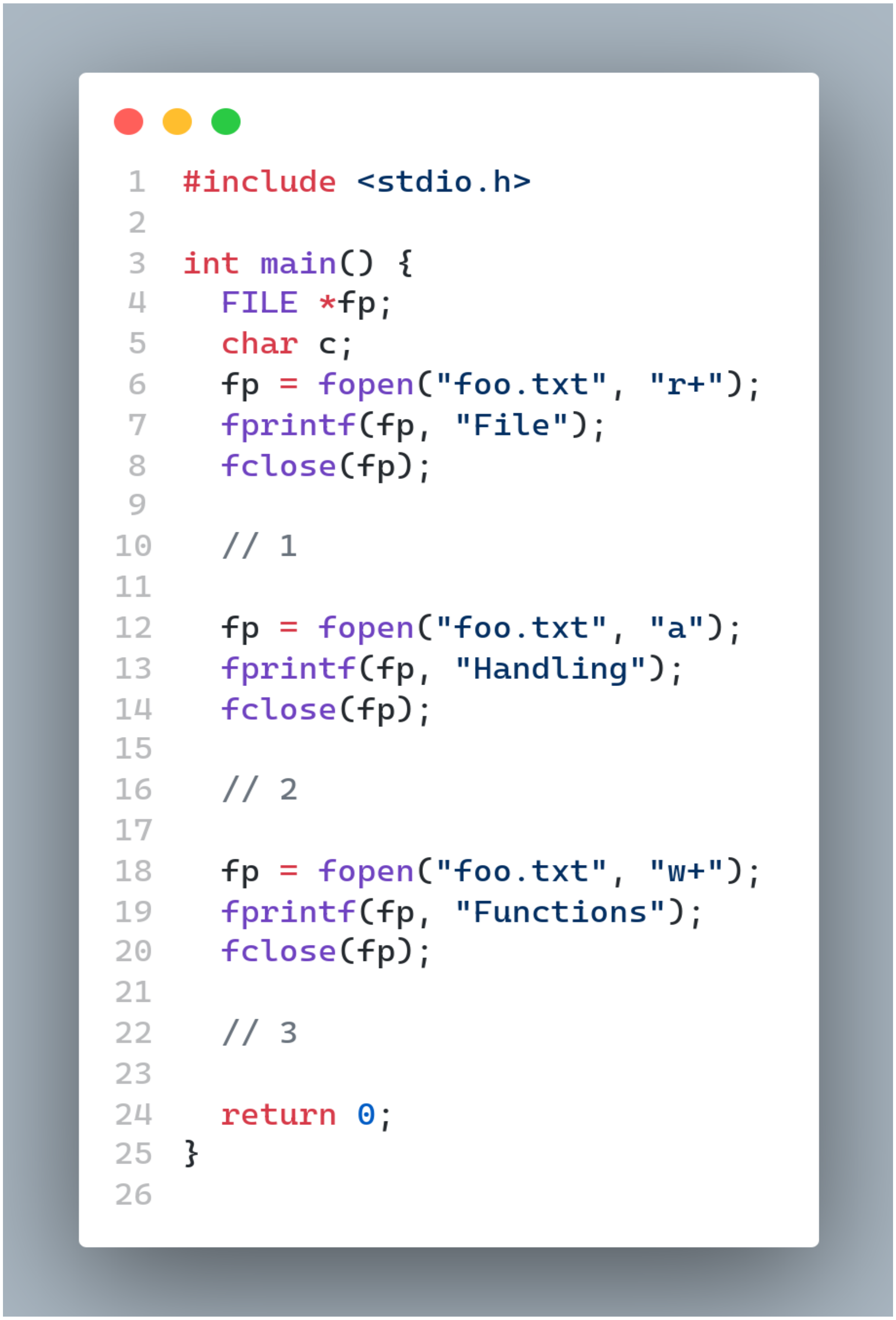
   If yes, write the output for the snippet. Else, provide an explanation as to why the initialization is invalid. (3 marks)

   Answer :

1. Yes, it is valid. Output is as follows.
2. 123
   120
   300
   123
   000
   000

Question 4 [6 marks]

Study the file-handling program and answer the questions that follow.



```c
#include <stdio.h>

int main() {
  FILE *fp;
  char c;
  fp = fopen("foo.txt", "r+");
  fprintf(fp, "File");
  fclose(fp);

  // 1

  fp = fopen("foo.txt", "a");
  fprintf(fp, "Handling");
  fclose(fp);

  // 2

  fp = fopen("foo.txt", "w+");
  fprintf(fp, "Functions");
  fclose(fp);

  // 3

  return 0;
}

```

The initial content of the foo.txt file is as follows. It contains exactly 6 characters and there are no whitespaces.

ESC101

Write the content of foo.txt at program points 1, 2 and 3.

Answer:

1. File01
2. File01Handling
3. Functions

If “r+” in the first fopen() call in line 6 is replaced by “w”, what would be the content of foo.txt (with the same initial content - “ESC101”) at the three program points.

Answer:

1. File
2. FileHandling
3. Functions

Question 5 [2 marks] (no partial marking)

Choose the correct option(s). There may be more than one correct option.

1. Structuring large programs may involve separation of function prototypes and definitions.
2. Structuring large programs involves placing structure definitions, typedefs, and function prototypes in ".h" files.
3. You cannot rename elementary data-types (e.g., int, char, long, etc.) using the keyword typedef.
4. You can compile two ".c" files simultaneously using a single command.

Answer: 1, 2 and 4.

Question 6 [2 marks] (no partial marking)

Choose the correct option(s). There may be multiple correct choices.

1. For every loop, we can replace it with a recursive function having equivalent program flow.
2. For every recursive function, we can replace it with a loop with equivalent program flow.
3. A recursive function without a base condition will never stop executing on your personal laptop.
4. You cannot define a recursive function in standard C using macros and pre-processing directives.

Answer: 1 and 2.

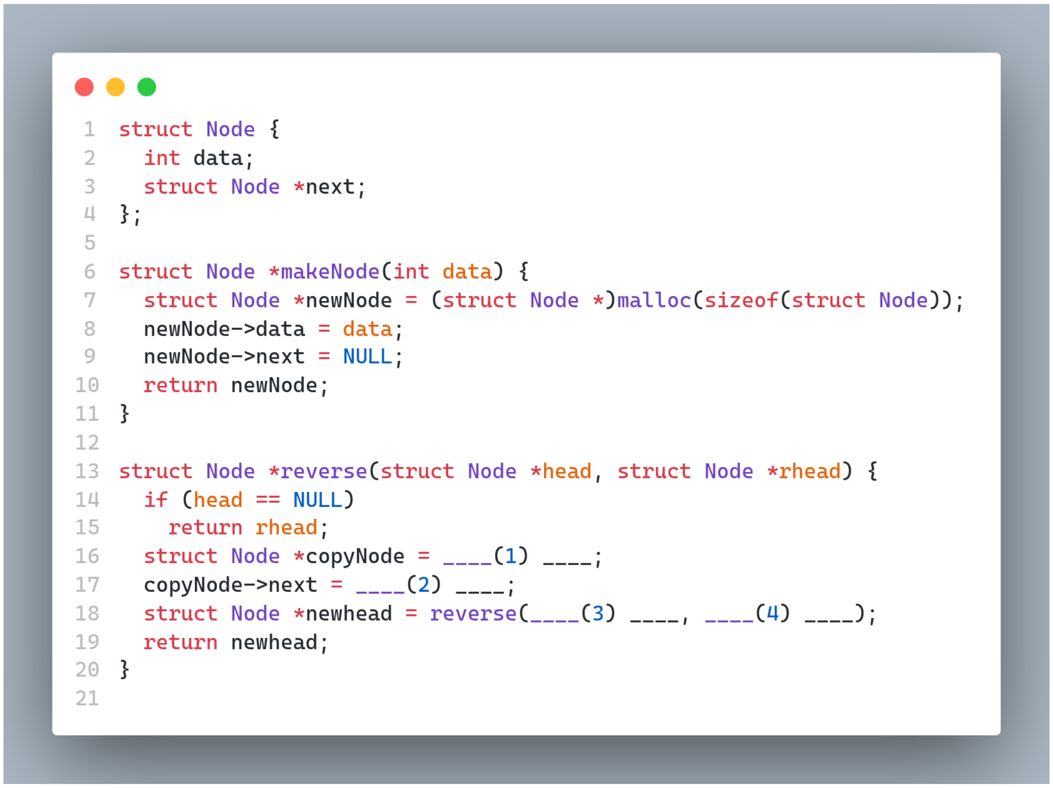
Question 7 [4 marks]

BONUS QUESTION: EVERYONE GETS 4 MARKS

Given the head of a linked list, the function reverse() creates a reversed linked list of the given list in a recursive way. The function reverse() returns the head of the new reversed copy.

The initial call to the function will be reverse(head, NULL). Complete the function reverse(). Note that the original list must NOT be altered.

The structure declaration and the supplementary makeNode() function are given. NOTE: rhead in the definition represents the moving head of a reversed list.



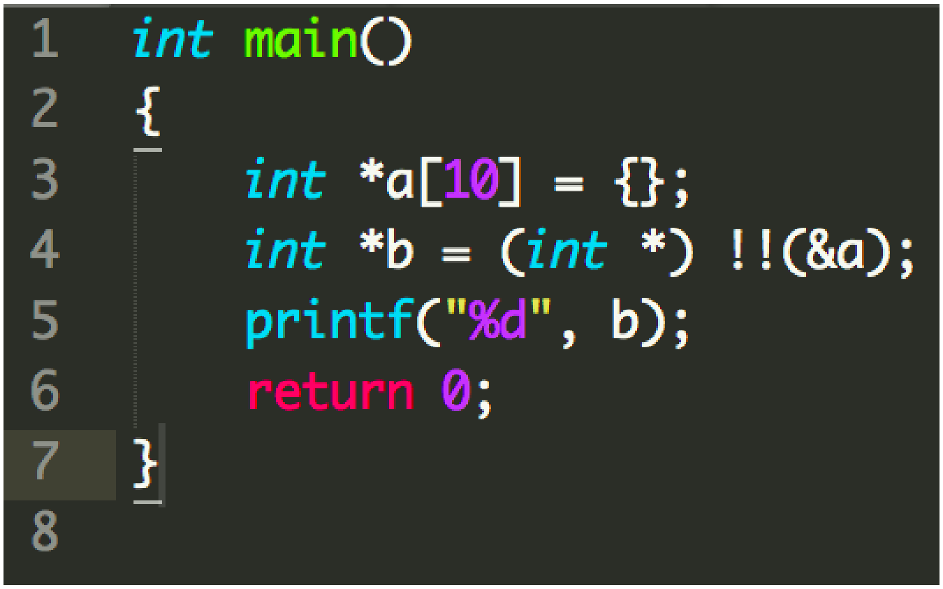
```c
struct Node {
  int data;
  struct Node *next;
};

struct Node *makeNode(int data) {
  struct Node *newNode = (struct Node *)malloc(sizeof(struct Node));
  newNode->data = data;
  newNode->next = NULL;
  return newNode;
}

struct Node *reverse(struct Node *head, struct Node *rhead) {
  if (head == NULL)
    return rhead;
  struct Node *copyNode = ____(1) ____;
  copyNode->next = ____(2) ____;
  struct Node *newhead = reverse(____(3) ____, ____(4) ____);
  return newhead;
}

```

Answer:

(1) makeNode(head->data)
(2) rhead
(3) head->next
(4) copyNode

Question 8 [2.5+2.5=5 marks]

Observe the following code.



```c
int main()
{
    int *a[10] = {};
    int *b = (int *) !!(&a);
    printf("%d", b);
    return 0;
}
```

Part 1
What is the final type of the following expression?

!!(&a)

A. int ***
B. int *
C. int
D. bool

Answer: C

Part 2

Assuming no errors and ignoring warnings in the above code. What will be printed?

A. 0

B. some garbage value

C. start address of array a

D. 1

Answer: D

Question 9 [2 marks]

Which of the following is (are) true?

A. A C program can't open its own compiled binary file

B. A C program can open its own source file

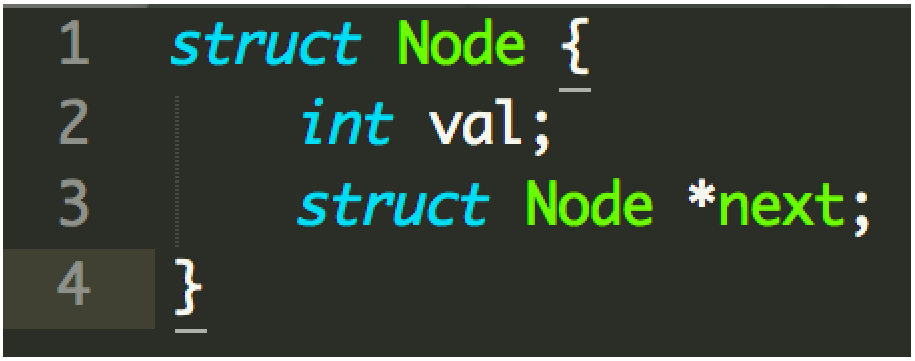
C. A C program can open its own compiled binary file, but can't modify it

D. A C program can open its own source file but can't modify it

Answers: B

Question 10 [3 marks]

Consider the following structure



```
struct Node {
	int val;
	struct Node *next;
}
```

You are given a singly linked list of the structure Node. The list has 4 nodes, and assume head points to the start of the list. Which of the following expression(s) will correctly give the value stored at the third node in the list?

A. head->next->next->val

B. (*(head->next)).next->val

C. (*(head->next->next)).val

D. (*(*(head->next)).next).val

ANSWER: A,B,C,D

Question 11 [3 marks]

Select the incorrect statements.

a) A function with return type int can have no return statements.

b) A function declaration must have the names and types of the formal parameters.

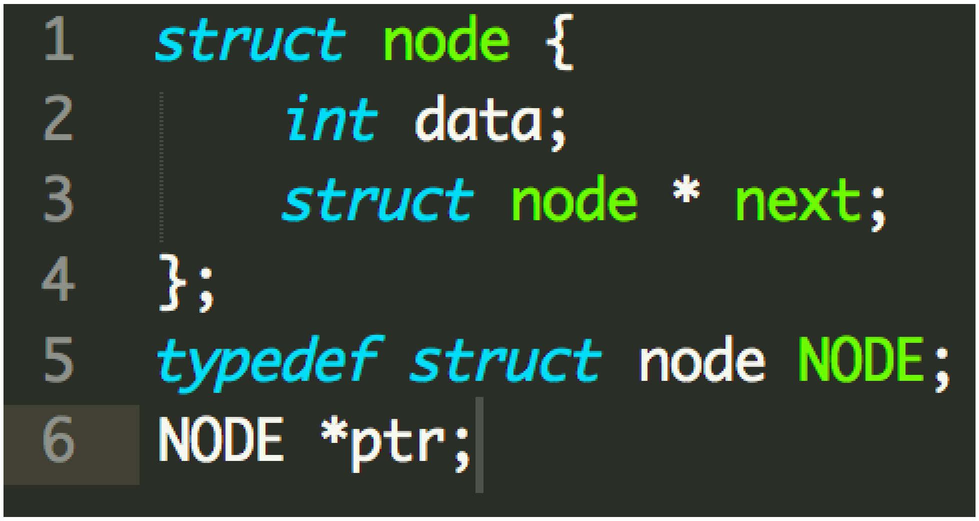
c) Return statements do not implicitly typecast variables to match function return types.

d) Dynamically allocated memory within a function is freed when the function returns.

Answer - b,c,d

Question 12 [2 marks]

Consider the following definition in the C programming language



```c
struct node {
    int data;
    struct node * next;
};
typedef struct node NODE;
NODE *ptr;
```

Which of the following code can be used to create a new node?

a) ptr=(NODE*)malloc(sizeof(NODE));

b) ptr=(NODE)malloc(sizeof(NODE*));

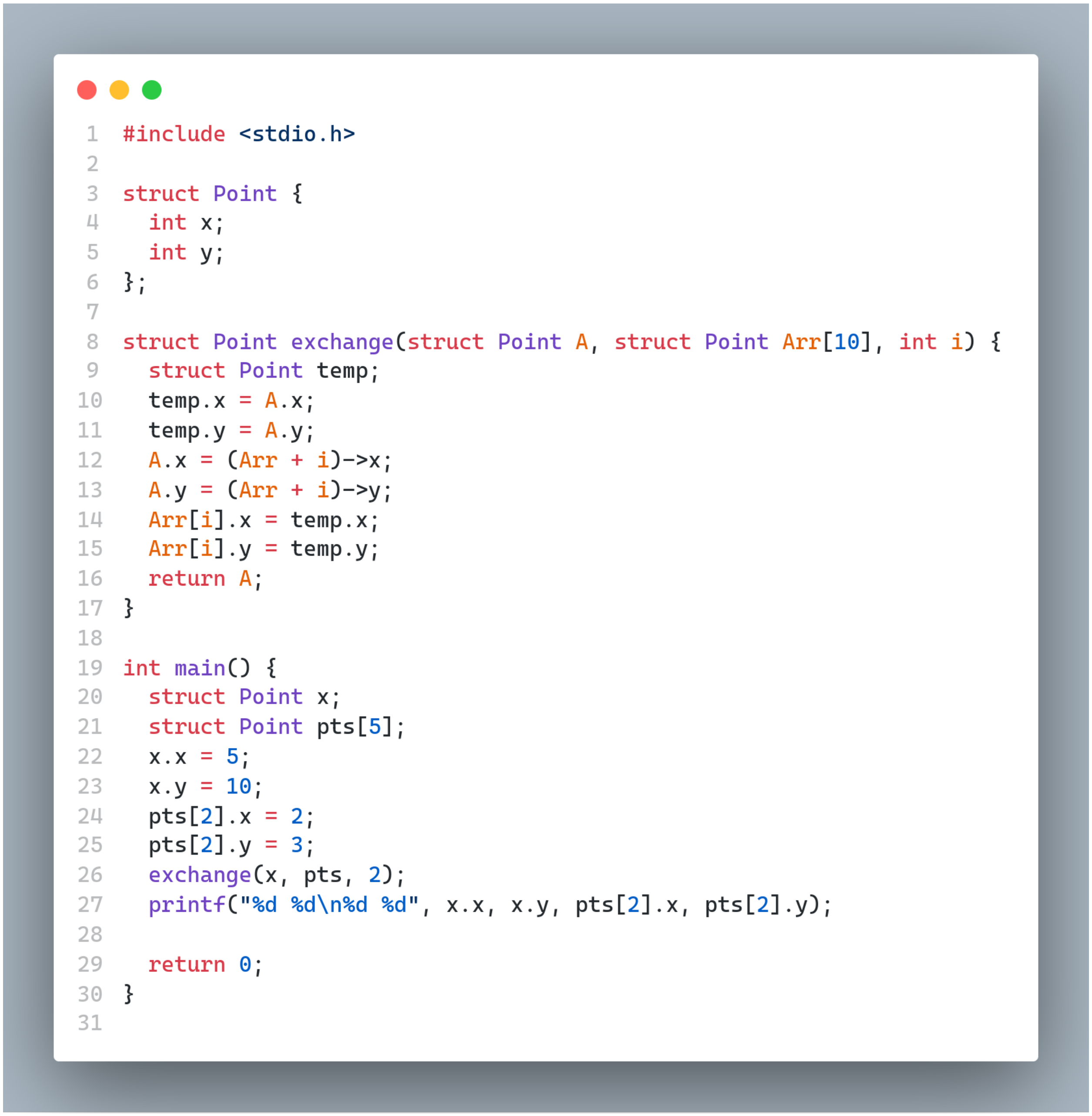
c) ptr=(NODE*)malloc(sizeof(NODE*));

d) ptr=(NODE)malloc(sizeof(NODE));

Answer - a

Question 13 [4 marks]

Write the output of the following code. In case of an error, write "ERROR" and give a brief explanation highlighting the erroneous part of the code.



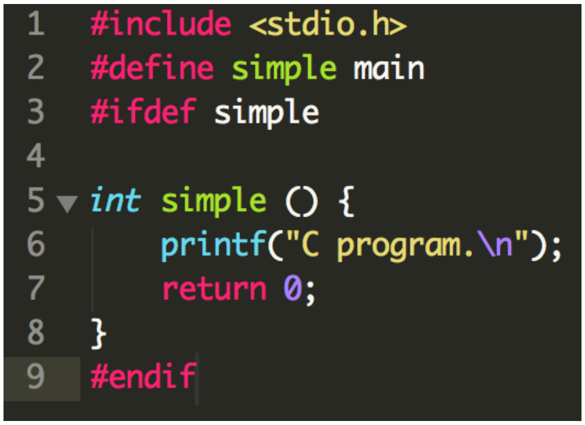
```c
#include <stdio.h>

struct Point {
  int x;
  int y;
};

struct Point exchange(struct Point A, struct Point Arr[10], int i) {
  struct Point temp;
  temp.x = A.x;
  temp.y = A.y;
  A.x = (Arr + i)->x;
  A.y = (Arr + i)->y;
  Arr[i].x = temp.x;
  Arr[i].y = temp.y;
  return A;
}

int main() {
  struct Point x;
  struct Point pts[5];
  x.x = 5;
  x.y = 10;
  pts[2].x = 2;
  pts[2].y = 3;
  exchange(x, pts, 2);
  printf("%d %d\n%d %d", x.x, x.y, pts[2].x, pts[2].y);

  return 0;
}

```

Answer:

5 10
5 10

Question 14 [2 marks]

Find the output of the given code snippet



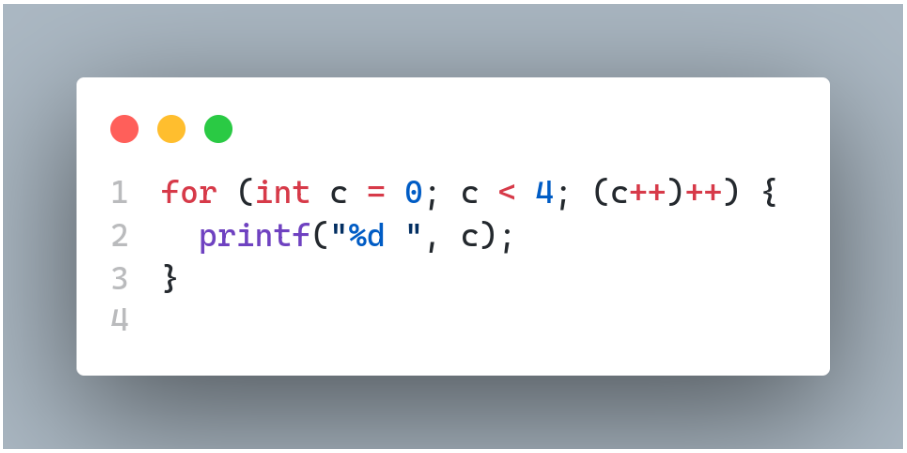
```c
#include <stdio.h>
#define simple main
#ifdef simple

int simple () {
    printf("C program.\n");
    return 0;
}
#endif
```

A: Compilation error
B: Run-time error
C: C program.
D: No output

Answer: C: C program.

Question 15 [2 marks]

Write the output of the following code snippet. In case of an error, write "ERROR" and give a brief explanation stating the erroneous part of the code.



```c
for (int c = 0; c < 4; (c++)++) {
  printf("%d ", c);
}

```

Answer: ERROR / COMPILATION ERROR. The post-increment operator can only be applied to a variable or an expression resulting in a variable (LVALUE), not just any expression.

Thus, (c++)++ is incorrect.

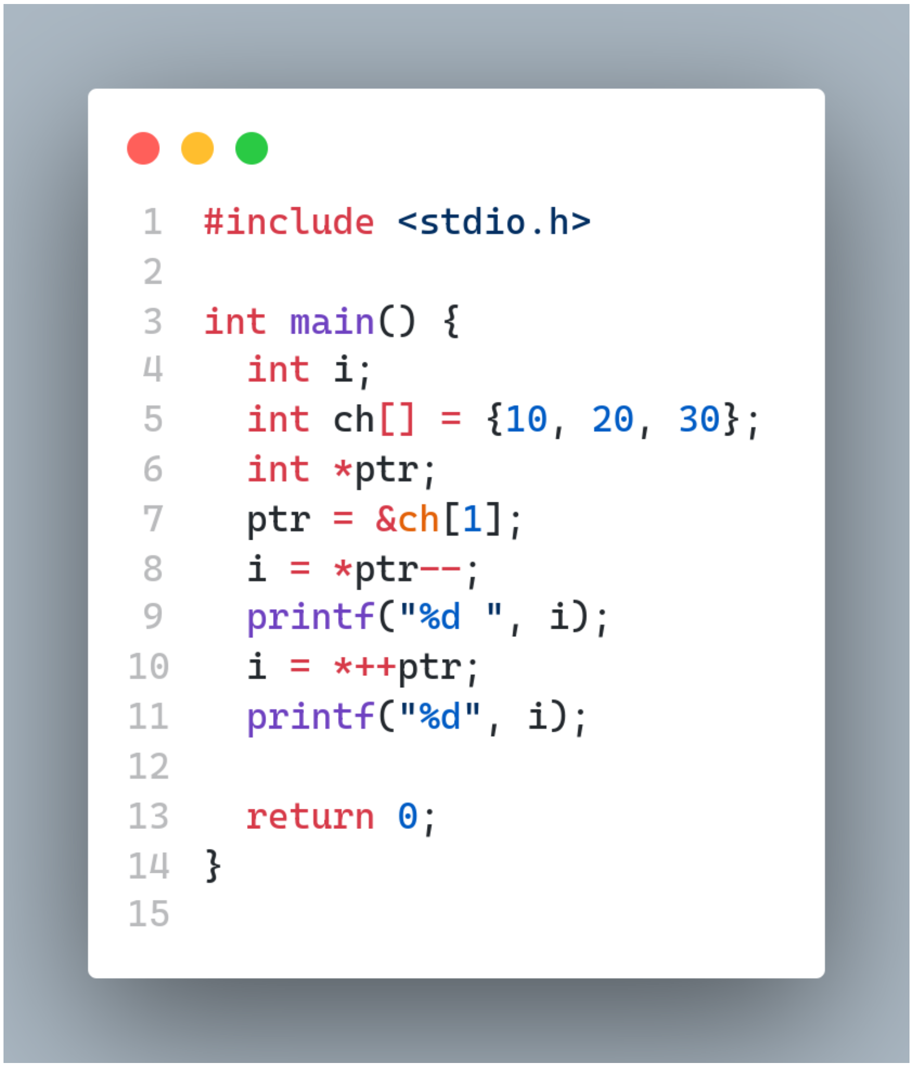
Question 16 [2*1 = 2 marks]

Write True or False.

1. Macros in C have a local scope. -> **False**
2. A function cannot be defined inside another function in C. -> **True**

Question 17 [4 marks]

Find the output of the below program.



```c
#include <stdio.h>

int main() {
  int i;
  int ch[] = {10, 20, 30};
  int *ptr;
  ptr = &ch[1];
  i = *ptr--;
  printf("%d ", i);
  i = *++ptr;
  printf("%d", i);

  return 0;
}

```

Ans:

20 20

Question 18 [1 mark] (T/F question)

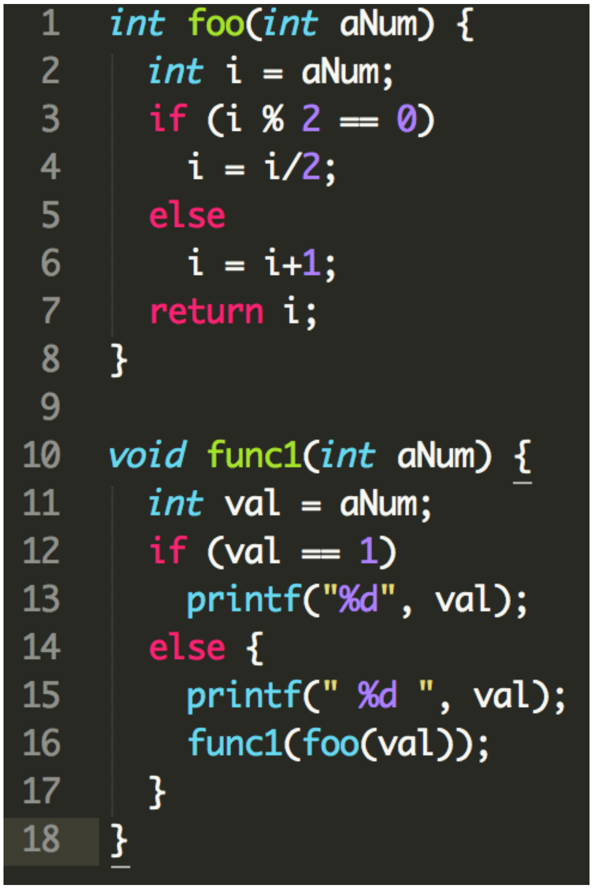
Let char str[10]; be a character array storing a string. Then str can contain only one null character.

- True
- False

Answer : False

Question 19 [3 marks]

Find the number of times printf statement is executed for given code snippet if func1 is called with an argument 17. Do not provide program output as answer.

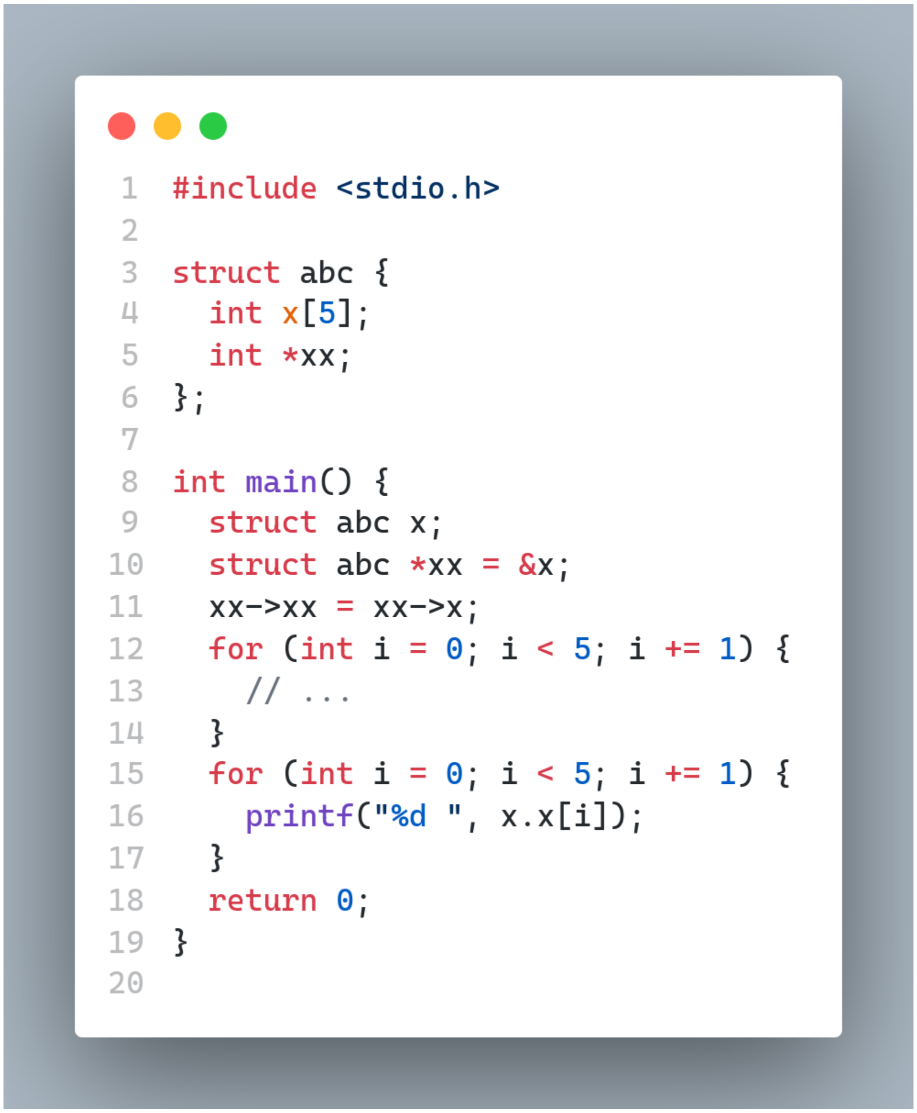


```c
int foo(int aNum) {
  int i = aNum;
  if (i % 2 == 0)
    i = i/2;
  else
    i = i+1;
  return i;
}

void func1(int aNum) {
  int val = aNum;
  if (val == 1)
    printf("%d", val);
  else {
    printf(" %d ", val);
    func1(foo(val));
  }
}
```

Answer: 10

Question 20 [4 marks] (no partial mark)

Consider the following code. Choose the correct options for the empty commented line so that the code outputs "0 1 2 3 4".



```c
#include <stdio.h>

struct abc {
  int x[5];
  int *xx;
};

int main() {
  struct abc x;
  struct abc *xx = &x;
  xx->xx = xx->x;
  for (int i = 0; i < 5; i += 1) {
    // ...
  }
  for (int i = 0; i < 5; i += 1) {
    printf("%d ", x.x[i]);
  }
  return 0;
}

```

1. *(x.xx + i) = i;
2. xx.xx[i] = i;
3. x.xx[i] = i;
4. (*xx).x[i] = i;

Ans: A, C, D

Question 21 [2 marks]

Consider the following struct xyz.

```
struct xyz {

        int val;

        char a[2];

};
```

I want to create an array of 1000 xyz elements. Choose the option(s) that will correctly create the required array.

1. struct xyz *xy = (struct xyz*)malloc(1000*sizeof(xyz));
2. struct xyz *xy = (struct xyz*)malloc(5000);
3. xyz xy[1000];
4. struct xyz *xy = (struct xyz*)(1000*malloc(sizeof(xyz)));

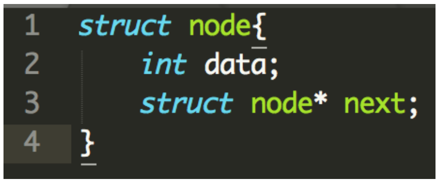
Answer : 1.

Question 22 [1*6=6 marks]

Complete the given function foo that prints all the elements at index multiple of k in a given linked list. Index of the node pointed by head is 1.

- *NULL denotes end of list*
- *head points to the first node of the list*

List node definition:



```
struct node{
    int data;
    struct node* next;
}
```

Example 1:

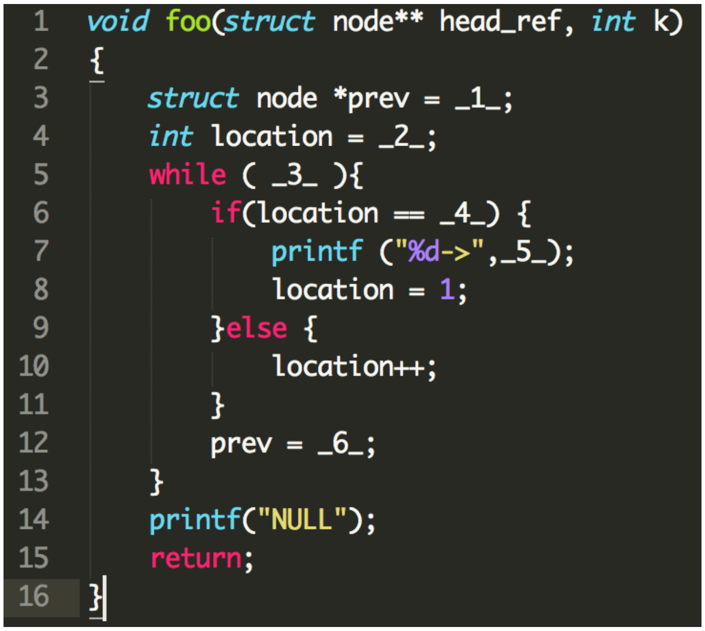
List: 10->11->12->13->14->15->16->17->NULL

Output for foo(&head,2): 11->13->15->17->NULL

Example 2:

List: 5->1->8->7->6->4->3->2->NULL

Output for foo(&head,3): 8->4->NULL

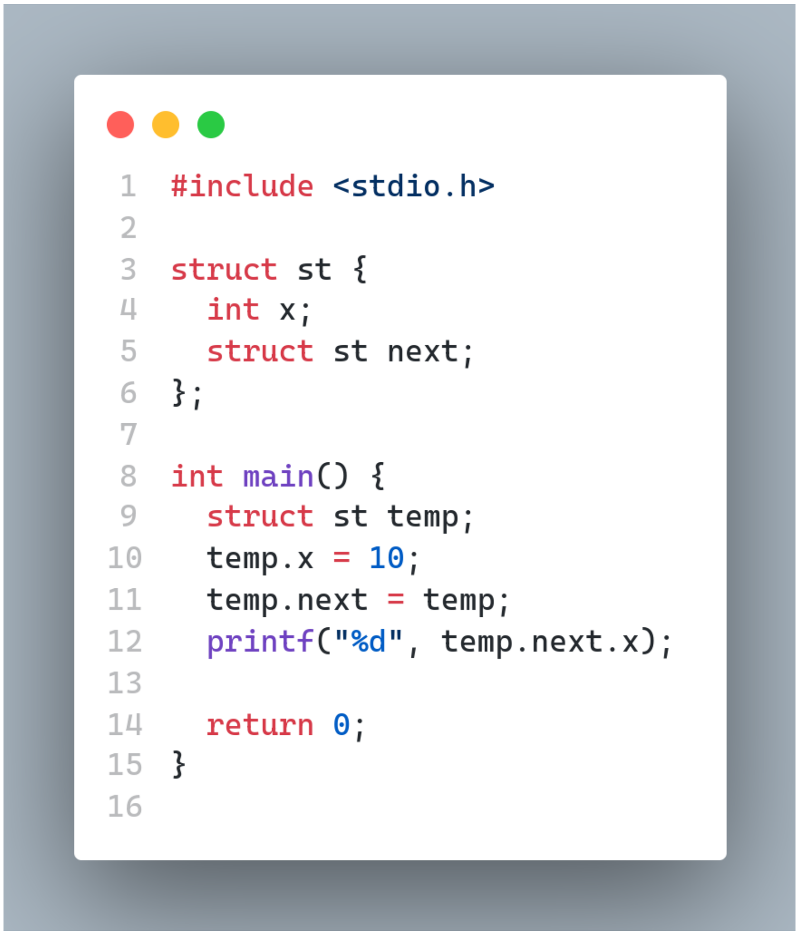


```
void foo(struct node** head_ref, int k)
{
    struct node *prev = _1_;
    int location = _2_;
    while ( _3_ ){
        if(location == _4_) {
            printf ("%d->",_5_);
            location = 1;
        }else {
            location++;
        }
        prev = _6_;
    }
    printf("NULL");
    return;
}
```

Answer: (1) *head_ref (2) 1 (3) prev != NULL (4) k (5) prev->data // any other member name is incorrect, struct definition provided (6) prev->next

Question 23 [2 marks]

What will be the output of the following snippet?



```c
#include <stdio.h>

struct st {
  int x;
  struct st next;
};

int main() {
  struct st temp;
  temp.x = 10;
  temp.next = temp;
  printf("%d", temp.next.x);

  return 0;
}
```

(a) 10

(b) Compilation Error

(c) Run Time Error

(d) 100

Ans: (b) . A structure cannot contain a member of its own type because if this is allowed then it becomes impossible for compiler to know size of such struct.

Question 24 [2 marks] (no partial marks)

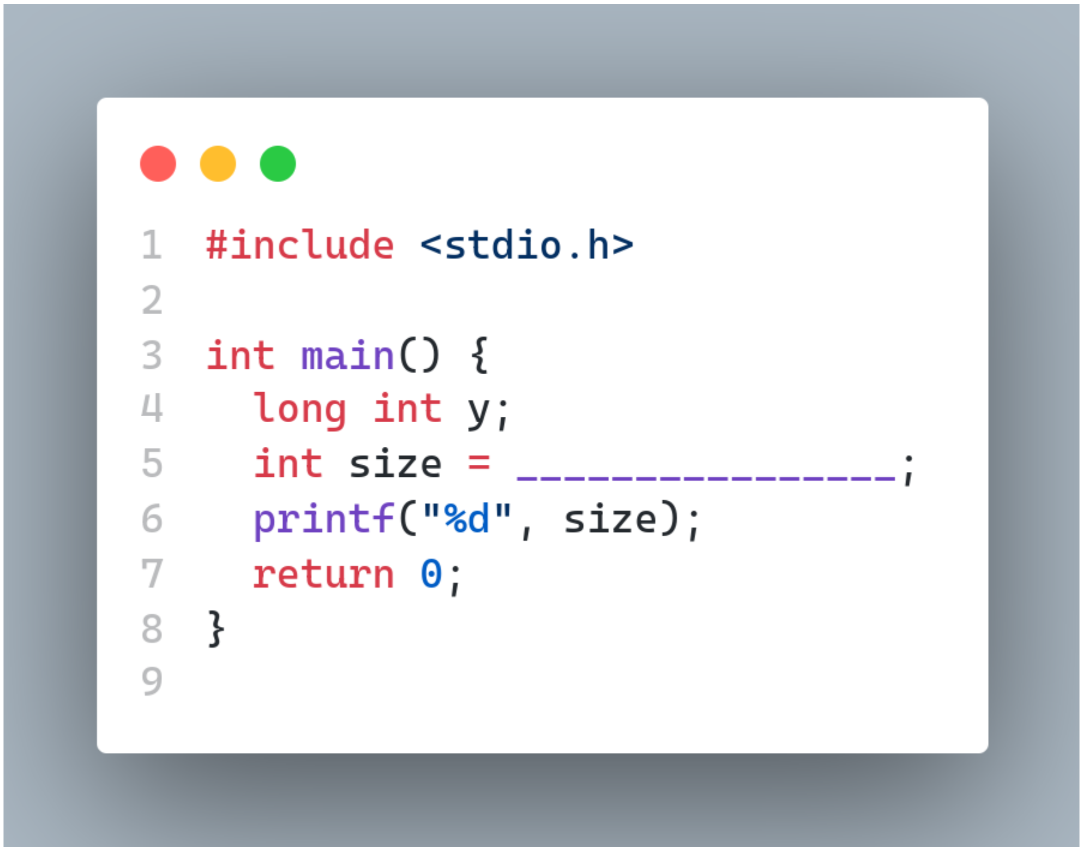
Which of the following data-types are valid as conditions for switch statements?

A) int
B) float
C) char
D) string

Ans: A, C

Question 25 [3 marks]

The following code measures the size of a variable. Please complete the following code without using the "sizeof()" operator.



```c
#include <stdio.h>

int main() {
  long int y;
  int size = _________________;
  printf("%d", size);
  return 0;
}

```

Ans: (char *)(&y+1) – (char *)&y