

Technical Aptitude Questions

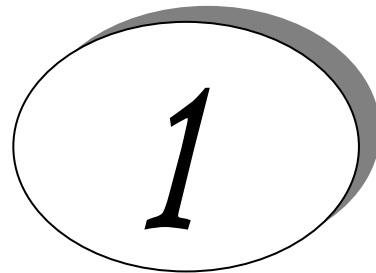
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Data Structures Aptitude



1. What is data structure?

A data structure is a way of organizing data that considers not only the items stored, but also their relationship to each other. Advance knowledge about the relationship between data items allows designing of efficient algorithms for the manipulation of data.

1. List out the areas in which data structures are applied extensively?

- Compiler Design,
- Operating System,
- Database Management System,
- Statistical analysis package,
- Numerical Analysis,
- Graphics,
- Artificial Intelligence,
- Simulation

2. What are the major data structures used in the following areas : RDBMS, Network data model & Hierarchical data model.

- RDBMS – Array (i.e. Array of structures)
- Network data model – Graph
- Hierarchical data model – Trees

3. If you are using C language to implement the heterogeneous linked list, what pointer type will you use?

The heterogeneous linked list contains different data types in its nodes and we need a link, pointer to connect them. It is not possible to use ordinary pointers for this. So we go for void pointer. Void pointer is capable of storing pointer to any type as it is a generic pointer type.

4. Minimum number of queues needed to implement the priority queue?

Two. One queue is used for actual storing of data and another for storing priorities.

5. What is the data structures used to perform recursion?

Stack. Because of its LIFO (Last In First Out) property it remembers its 'caller' so knows whom to return when the function has to return. Recursion makes use of system stack for storing the return addresses of the function calls.

Every recursive function has its equivalent iterative (non-recursive) function. Even when such equivalent iterative procedures are written, explicit stack is to be used.

6. What are the notations used in Evaluation of Arithmetic Expressions using prefix and postfix forms?

Polish and Reverse Polish notations.

7. Convert the expression $((A + B) * C - (D - E) ^ (F + G))$ to equivalent Prefix and Postfix notations.

Prefix Notation:

$$^{\wedge} - * + ABC - DE + FG$$
 Postfix Notation:

$$AB + C * DE - - FG + ^{\wedge}$$

8. Sorting is not possible by using which of the following methods?

- (a) Insertion
- (b) Selection
- (c) Exchange
- (d) Deletion

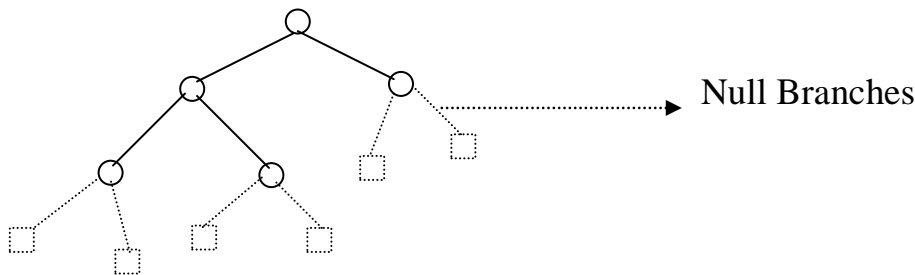
(d) Deletion.

Using insertion we can perform insertion sort, using selection we can perform selection sort, using exchange we can perform the bubble sort (and other similar sorting methods). But no sorting method can be done just using deletion.

9. A binary tree with 20 nodes has _____ null branches?

21

Let us take a tree with 5 nodes ($n=5$)



It will have only 6 (ie, $5+1$) null branches. In general,

A binary tree with **n** nodes has exactly **n+1** null nodes.

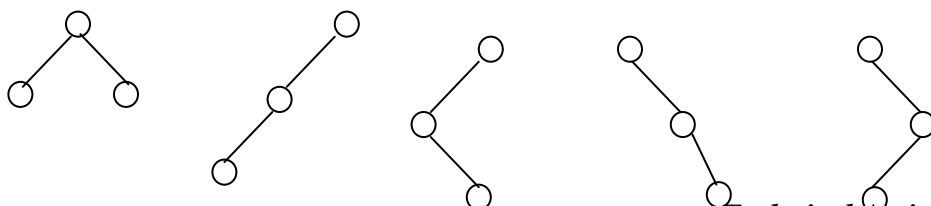
10. What are the methods available in storing sequential files ?

- Straight merging,
- Natural merging,
- Polyphase sort,
- Distribution of Initial runs.

11. How many different trees are possible with 10 nodes ?

1014

For example, consider a tree with 3 nodes ($n=3$), it will have the maximum combination of 5 different (ie, $2^3 - 3 = 5$) trees.



i

ii

iii

iv

v

In general:

If there are n nodes, there exist $2^n - n$ different trees.

12. List out few of the Application of tree data-structure?

- The manipulation of Arithmetic expression,
- Symbol Table construction,
- Syntax analysis.

13. List out few of the applications that make use of Multilinked Structures?

- Sparse matrix,
- Index generation.

14. In tree construction which is the suitable efficient data structure?

- (a) Array (b) Linked list (c) Stack (d) Queue (e) none

(b) Linked list

15. What is the type of the algorithm used in solving the 8 Queens problem?

Backtracking

16. In an AVL tree, at what condition the balancing is to be done?

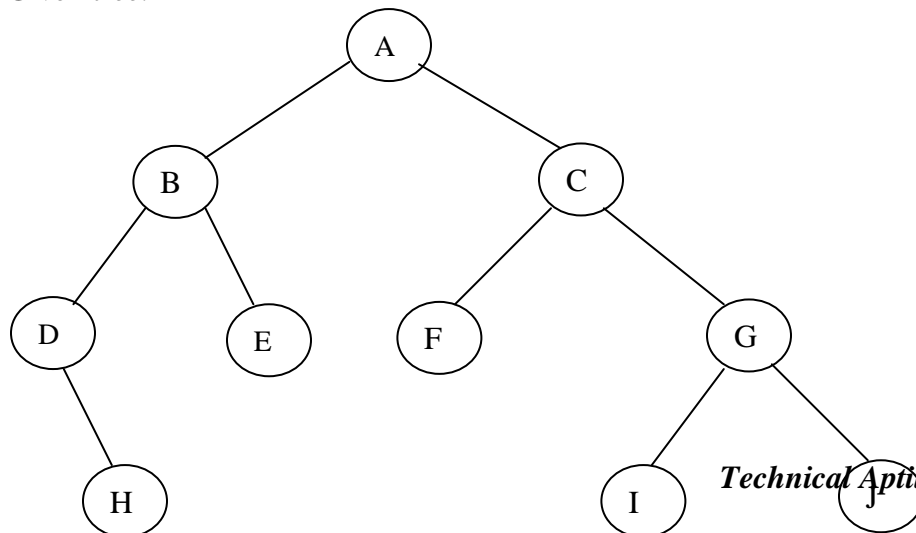
If the 'pivotal value' (or the 'Height factor') is greater than 1 or less than -1.

17. What is the bucket size, when the overlapping and collision occur at same time?

One. If there is only one entry possible in the bucket, when the collision occurs, there is no way to accommodate the colliding value. This results in the overlapping of values.

18. Traverse the given tree using Inorder, Preorder and Postorder traversals.

Given tree:



- Inorder : D H B E A F C I G J
- Preorder: A B D H E C F G I J
- Postorder: H D E B F I J G C A

19. There are 8, 15, 13, 14 nodes were there in 4 different trees. Which of them could have formed a full binary tree?

15.

In general:

There are $2^n - 1$ nodes in a full binary tree.

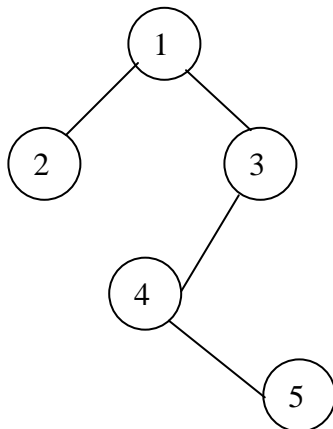
By the method of elimination:

Full binary trees contain odd number of nodes. So there cannot be full binary trees with 8 or 14 nodes, so rejected. With 13 nodes you can form a complete binary tree but not a full binary tree. So the correct answer is 15.

Note:

Full and Complete binary trees are different. All full binary trees are complete binary trees but not vice versa.

20. In the given binary tree, using array you can store the node 4 at which location?



At location 6

1	2	3	-	-	4	-	-	5
---	---	---	---	---	---	---	---	---

Root LC1 RC1 LC2 RC2 LC3 RC3 LC4 RC4

where LCn means Left Child of node n and RCn means Right Child of node n

21. Sort the given values using Quick Sort?

65 70 75 80 85 60 55 50 45

Sorting takes place from the pivot value, which is the first value of the given elements, this is marked bold. The values at the left pointer and right pointer are indicated using ^L and ^R respectively.

65 70^L 75 80 85 60 55 50 45^R

Since pivot is not yet changed the same process is continued after interchanging the values at L and R positions

65 45 75^L 80 85 60 55 50^R 70

65 45 50 80^L 85 60 55^R 75 70

65 45 50 55 85^L 60^R 80 75 70

65 45 50 55 60^R 85^L 80 75 70

When the L and R pointers cross each other the pivot value is interchanged with the value at right pointer. If the pivot is changed it means that the pivot has occupied its original position in the sorted order (shown in bold italics) and hence two different arrays are formed, one from start of the original array to the pivot position-1 and the other from pivot position+1 to end.

60^L 45 50 55^R **65** **85^L** 80 75 70^R

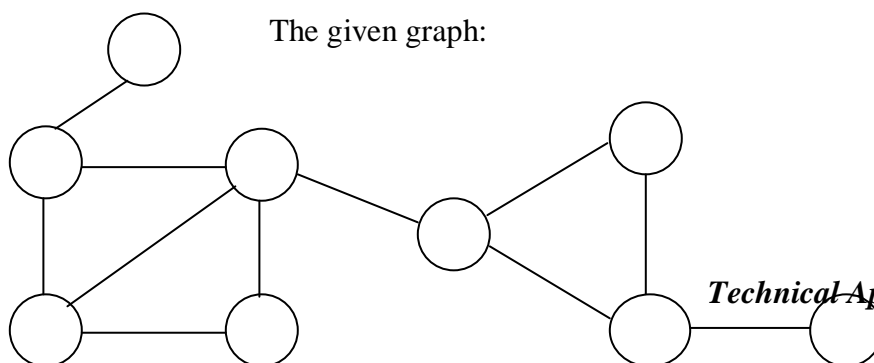
55^L 45 **50^R** **60** **65** **70^R** 80^L 75 **85**

50^L 45^R 55 60 65 70 80^L 75^R 85

In the next pass we get the sorted form of the array.

45 50 55 60 65 70 75 80 85

22. For the given graph, draw the DFS and BFS?



➤ BFS: A X G H P E M Y J

➤ DFS: A X H P E Y M J G

24. Classify the Hashing Functions based on the various methods by which the key value is found.

- Direct method,
- Subtraction method,
- Modulo-Division method,
- Digit-Extraction method,
- Mid-Square method,
- Folding method,
- Pseudo-random method.

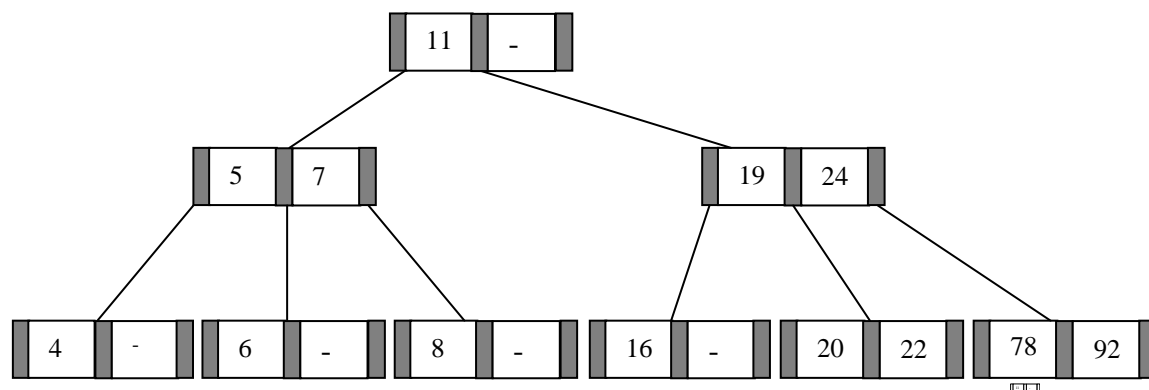
25. What are the types of Collision Resolution Techniques and the methods used in each of the type?

- Open addressing (closed hashing),
 The methods used include:
 Overflow block,
- Closed addressing (open hashing)
 The methods used include:
 Linked list,
 Binary tree...

26. In RDBMS, what is the efficient data structure used in the internal storage representation?

B+ tree. Because in B+ tree, all the data is stored only in leaf nodes, that makes searching easier. This corresponds to the records that shall be stored in leaf nodes.

27. Draw the B-tree of order 3 created by inserting the following data arriving in sequence – 92
24 6 7 11 8 22 4 5 16 19 20 78



28. Of the following tree structure, which is, efficient considering space and time complexities?

- (a) Incomplete Binary Tree
- (b) Complete Binary Tree
- (c) Full Binary Tree

(b) Complete Binary Tree.

By the method of elimination:

Full binary tree loses its nature when operations of insertions and deletions are done. For incomplete binary trees, extra storage is required and overhead of NULL node checking takes place. So complete binary tree is the better one since the property of complete binary tree is maintained even after operations like additions and deletions are done on it.

29. What is a spanning Tree?

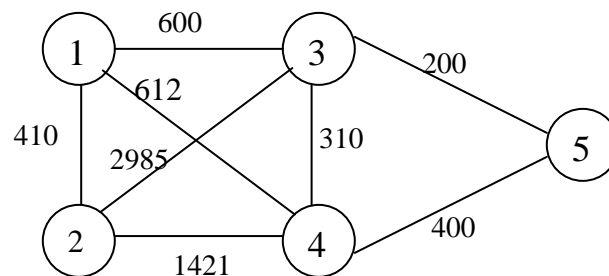
A spanning tree is a tree associated with a network. All the nodes of the graph appear on the tree once. A minimum spanning tree is a spanning tree organized so that the total edge weight between nodes is minimized.

30. Does the minimum spanning tree of a graph give the shortest distance between any 2 specified nodes?

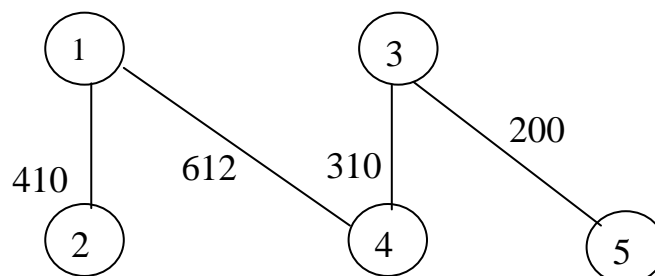
No.

Minimal spanning tree assures that the total weight of the tree is kept at its minimum. But it doesn't mean that the distance between any two nodes involved in the minimum-spanning tree is minimum.

31. Convert the given graph with weighted edges to minimal spanning tree.



the equivalent minimal spanning tree is:



32. Which is the simplest file structure?

- (a) Sequential
- (b) Indexed
- (c) Random

(a) Sequential

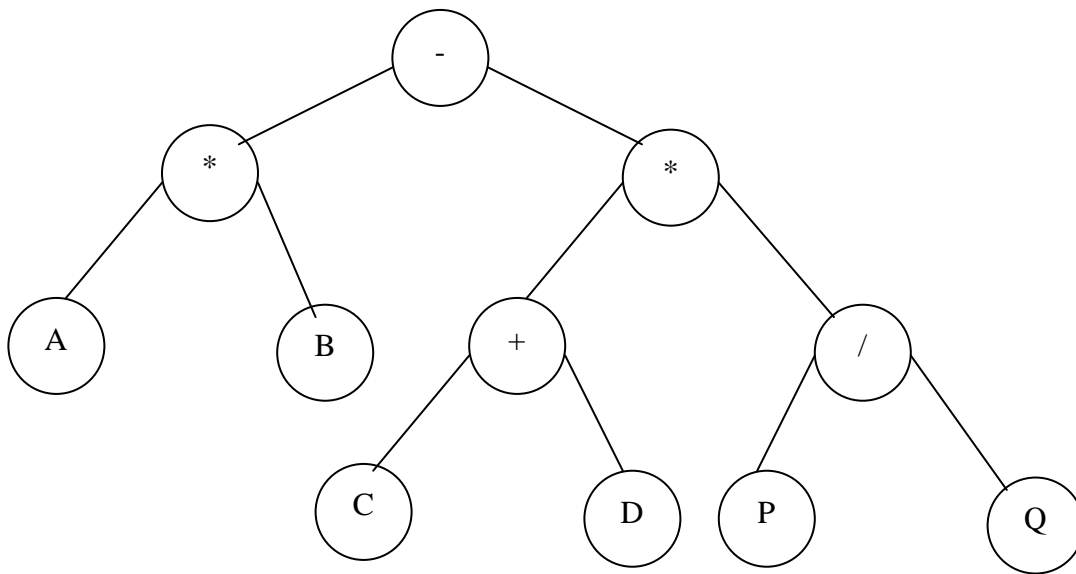
33. Whether Linked List is linear or Non-linear data structure?

According to Access strategies Linked list is a linear one.

According to Storage Linked List is a Non-linear one.

34. Draw a binary Tree for the expression :

$$A * B - (C + D) * (P / Q)$$



35. For the following COBOL code, draw the Binary tree?

01 STUDENT_REC.

02 NAME.

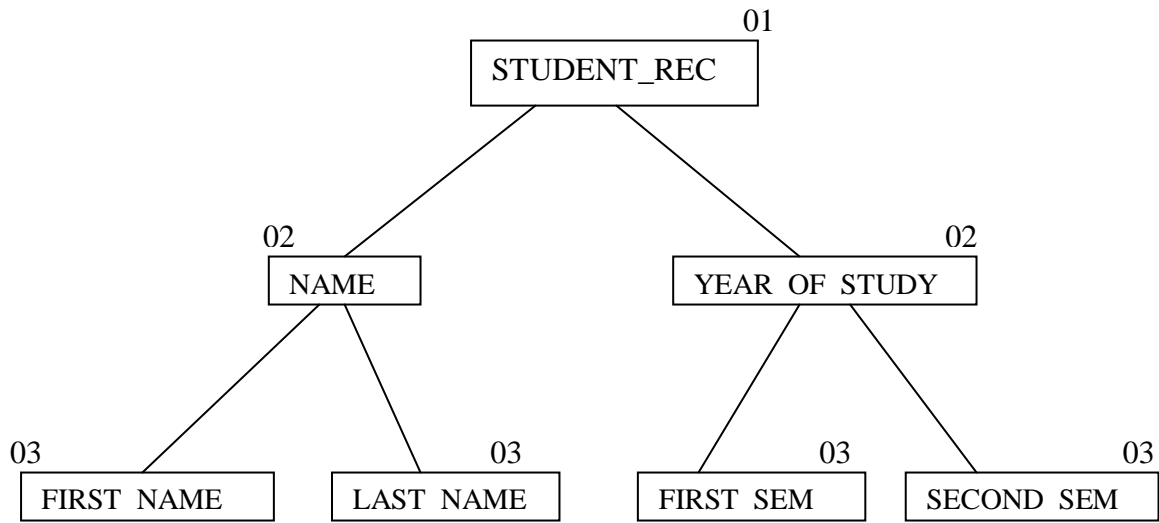
03 FIRST_NAME PIC X(10).

03 LAST_NAME PIC X(10).

02 YEAR_OF_STUDY.

03 FIRST_SEM PIC XX.

03 SECOND_SEM PIC XX.



Note : All the programs are tested under Turbo C/C++ compilers.

It is assumed that,

- Programs run under DOS environment,
- The underlying machine is an x86 system,
- Program is compiled using Turbo C/C++ compiler.

The program output may depend on the information based on this assumptions (for example `sizeof(int) == 2` may be assumed).

Predict the output or error(s) for the following:

```
1. void main()
{
    int const *p=5;
    printf("%d",++(*p));
}
```

Answer:

Compiler error: Cannot modify a constant value.

Explanation:

`p` is a pointer to a "constant integer". But we tried to change the value of the "constant integer".

```
2. main()
{
    char s[ ]="man";
    int i;
    for(i=0;s[ i ];i++)
        printf("\n%c%c%c%c",s[ i ],*(s+i),*(i+s),i[s]);
}
```

Answer:

mmmm
aaaa
nnnn

Explanation:

`s[i]`, `*(i+s)`, `*(s+i)`, `i[s]` are all different ways of expressing the same idea. Generally array name is the base address for that array. Here `s` is the base address. `i` is the index

number/displacement from the base address. So, indirecting it with * is same as s[i]. i[s] may be surprising. But in the case of C it is same as s[i].

```
3. main()
{
    float me = 1.1;
    double you = 1.1;
    if(me==you)
        printf("I love U");
    else
        printf("I hate U");
}
```

Answer:

I hate U

Explanation:

For floating point numbers (float, double, long double) the values cannot be predicted exactly. Depending on the number of bytes, the precision with of the value represented varies. Float takes 4 bytes and long double takes 10 bytes. So float stores 0.9 with less precision than long double.

Rule of Thumb:

Never compare or at-least be cautious when using floating point numbers with relational operators (== , >, <, <=, >=, !=) .

```
4. main()
{
    static int var = 5;
    printf("%d ",var--);
    if(var)
        main();
}
```

Answer:

5 4 3 2 1

Explanation:

When static storage class is given, it is initialized once. The change in the value of a static variable is retained even between the function calls. Main is also treated like any other ordinary function, which can be called recursively.

```
5. main()
{
    int c[ ]={2.8,3.4,4,6.7,5};
    int j,*p=c,*q=c;
    for(j=0;j<5;j++) {
        printf(" %d ",*c);
        ++q;    }
    for(j=0;j<5;j++){
        printf(" %d ",*p);
    }
```

```

        ++p;    }
    }

```

Answer:

2 2 2 2 2 3 4 6 5

Explanation:

Initially pointer **c** is assigned to both **p** and **q**. In the first loop, since only **q** is incremented and not **c**, the value 2 will be printed 5 times. In second loop **p** itself is incremented. So the values 2 3 4 6 5 will be printed.

```

6. main()
{
    extern int i;
    i=20;
    printf("%d",i);
}

```

Answer:

Linker Error : Undefined symbol '_i'

Explanation:

extern storage class in the following declaration,

extern int i;

specifies to the compiler that the memory for **i** is allocated in some other program and that address will be given to the current program at the time of linking. But linker finds that no other variable of name **i** is available in any other program with memory space allocated for it. Hence a linker error has occurred .

```

7. main()
{
    int i=-1,j=-1,k=0,l=2,m;
    m=i++&& j++&& k++|| l++;
    printf("%d %d %d %d %d",i,j,k,l,m);
}

```

Answer:

0 0 1 3 1

Explanation :

Logical operations always give a result of **1 or 0** . And also the logical AND (&&) operator has higher priority over the logical OR (||) operator. So the expression '**i++ && j++ && k++**' is executed first. The result of this expression is 0 (-1 && -1 && 0 = 0). Now the expression is 0 || 2 which evaluates to 1 (because OR operator always gives 1 except for '0 || 0' combination- for which it gives 0). So the value of **m** is 1. The values of other variables are also incremented by 1.

```

8. main()
{
    char *p;

```

```

    printf("%d %d ",sizeof(*p),sizeof(p));
}

```

Answer:

1 2

Explanation:

The sizeof() operator gives the number of bytes taken by its operand. P is a character pointer, which needs one byte for storing its value (a character). Hence sizeof(*p) gives a value of 1. Since it needs two bytes to store the address of the character pointer sizeof(p) gives 2.

9. main()

```

{
    int i=3;
    switch(i)
    {
        default:printf("zero");
        case 1: printf("one");
            break;
        case 2:printf("two");
            break;
        case 3: printf("three");
            break;
    }
}

```

Answer :

three

Explanation :

The default case can be placed anywhere inside the loop. It is executed only when all other cases doesn't match.

10. main()

```

{
    printf("%x",-1<<4);
}

```

Answer:

fff0

Explanation :

-1 is internally represented as all 1's. When left shifted four times the least significant 4 bits are filled with 0's. The %x format specifier specifies that the integer value be printed as a hexadecimal value.

11. main()

```

{
    char string[]="Hello World";
    display(string);
}

```

```

}
void display(char *string)
{
    printf("%s",string);
}

```

Answer:

Compiler Error : Type mismatch in redeclaration of function display

Explanation :

In third line, when the function **display** is encountered, the compiler doesn't know anything about the function display. It assumes the arguments and return types to be integers, (which is the default type). When it sees the actual function **display**, the arguments and type contradicts with what it has assumed previously. Hence a compile time error occurs.

12. main()

```

{
    int c=- -2;
    printf("c=%d",c);
}

```

Answer:

c=2;

Explanation:

Here unary minus (or negation) operator is used twice. Same maths rules applies, ie. minus * minus= plus.

Note:

However you cannot give like --2. Because -- operator can only be applied to variables as a **decrement** operator (eg., i--). 2 is a constant and not a variable.

13. #define int char

```

main()
{
    int i=65;
    printf("sizeof(i)=%d",sizeof(i));
}

```

Answer:

sizeof(i)=1

Explanation:

Since the #define replaces the string **int** by the macro **char**

14. main()

```

{
    int i=10;
    i=!i>14;
    printf("i=%d",i);
}

```

Answer:

i=0

Explanation:

In the expression **!i>14** , NOT (!) operator has more precedence than ' > ' symbol. ! is a unary logical operator. !i (!10) is 0 (not of true is false). 0>14 is false (zero).

```
15. #include<stdio.h>
main()
{
    char s[]={'a','b','c','\n','c','\0'};
    char *p,*str,*str1;
    p=&s[3];
    str=p;
    str1=s;
    printf("%d",++*p + ++*str1-32);
}
```

Answer:

77

Explanation:

p is pointing to character '\n'. str1 is pointing to character 'a' ++*p. "p is pointing to '\n' and that is incremented by one." the ASCII value of '\n' is 10, which is then incremented to 11. The value of ++*p is 11. ++*str1, str1 is pointing to 'a' that is incremented by 1 and it becomes 'b'. ASCII value of 'b' is 98.

Now performing (11 + 98 – 32), we get 77("M");

So we get the output 77 :: "M" (Ascii is 77).

```
16. #include<stdio.h>
main()
{
    int a[2][2][2] = { { 10,2,3,4}, { 5,6,7,8} };
    int *p,*q;
    p=&a[2][2][2];
    *q=***a;
    printf("%d----%d",*p,*q);
}
```

Answer:

SomeGarbageValue---1

Explanation:

p=&a[2][2][2] you declare only two 2D arrays, but you are trying to access the third 2D(which you are not declared) it will print garbage values. *q=***a starting address of a is assigned integer pointer. Now q is pointing to starting address of a. If you print *q, it will print first element of 3D array.

```
17. #include<stdio.h>
main()
{
```

```

struct xx
{
    int x=3;
    char name[]="hello";
};
struct xx *s;
printf("%d",s->x);
printf("%s",s->name);
}

```

Answer:

Compiler Error

Explanation:

You should not initialize variables in declaration

18. #include<stdio.h>

```

main()
{
    struct xx
    {
        int x;
        struct yy
        {
            char s;
            struct xx *p;
        };
        struct yy *q;
    };
}

```

Answer:

Compiler Error

Explanation:

The structure yy is nested within structure xx. Hence, the elements are of yy are to be accessed through the instance of structure xx, which needs an instance of yy to be known. If the instance is created after defining the structure the compiler will not know about the instance relative to xx. Hence for nested structure yy you have to declare member.

19. main()

```

{
    printf("\nab");
    printf("\bsi");
    printf("\rha");
}

```

Answer:

hai

Explanation:

\n - newline

\b - backspace
\r - linefeed

```
20. main()
{
    int i=5;
    printf("%d%d%d%d%d",i++,i--,++i,--i,i);
}
```

Answer:

45545

Explanation:

The arguments in a function call are pushed into the stack from left to right. The evaluation is by popping out from the stack. and the evaluation is from right to left, hence the result.

```
21. #define square(x) x*x
main()
{
    int i;
    i = 64/square(4);
    printf("%d",i);
}
```

Answer:

64

Explanation:

the macro call square(4) will substituted by 4*4 so the expression becomes i = 64/4*4 . Since / and * has equal priority the expression will be evaluated as (64/4)*4 i.e. 16*4 = 64

```
22. main()
{
    char *p="hai friends",*p1;
    p1=p;
    while(*p!='\0') ++*p++;
    printf("%s %s",p,p1);
}
```

Answer:

ibj!gsjfoet

Explanation:

++*p++ will be parse in the given order

- *p that is value at the location currently pointed by p will be taken
 - ++*p the retrieved value will be incremented
 - when ; is encountered the location will be incremented that is p++ will be executed
- Hence, in the while loop initial value pointed by p is 'h', which is changed to 'i' by executing ++*p and pointer moves to point, 'a' which is similarly changed to 'b' and so on. Similarly blank

space is converted to '!'. Thus, we obtain value in p becomes "ibj!gsjfoet" and since p reaches '\0' and p1 points to p thus p1 does not print anything.

```
23. #include <stdio.h>
    #define a 10
    main()
    {
        #define a 50
        printf("%d",a);
    }
```

Answer:

50

Explanation:

The preprocessor directives can be redefined anywhere in the program. So the most recently assigned value will be taken.

```
24. #define clrscr() 100
    main()
    {
        clrscr();
        printf("%d\n",clrscr());
    }
```

Answer:

100

Explanation:

Preprocessor executes as a separate pass before the execution of the compiler. So textual replacement of clrscr() to 100 occurs. The input program to compiler looks like this :

```
main()
{
    100;
    printf("%d\n",100);
}
```

Note:

100; is an executable statement but with no action. So it doesn't give any problem

```
25. main()
    {
        printf("%p",main);
    }
```

Answer:

Some address will be printed.

Explanation:

Function names are just addresses (just like array names are addresses). main() is also a function. So the address of function main will be printed. %p in printf specifies that the argument is an address. They are printed as hexadecimal numbers.

27) `main()`
`{`
`clrscr();`
`}`
`clrscr();`

Answer:

No output/error

Explanation:

The first `clrscr()` occurs inside a function. So it becomes a function call. In the second `clrscr();` is a function declaration (because it is not inside any function).

28) `enum colors {BLACK,BLUE,GREEN}`
`main()`
`{`

`printf("%d..%d..%d",BLACK,BLUE,GREEN);`

`return(1);`
`}`

Answer:

0..1..2

Explanation:

enum assigns numbers starting from 0, if not explicitly defined.

29) `void main()`
`{`
`char far *farther,*farthest;`

`printf("%d..%d",sizeof(farther),sizeof(farthest));`

`}`

Answer:

4..2

Explanation:

the second pointer is of char type and not a far pointer

30) `main()`
`{`
`int i=400,j=300;`
`printf("%d..%d");`
`}`

Answer:

400..300

Explanation:

printf takes the values of the first two assignments of the program. Any number of printf's may be given. All of them take only the first two values. If more number of assignments given in the program, then printf will take garbage values.

```
31)  main()
      {
      char *p;
      p="Hello";
      printf("%c\n",&*p);
      }
```

Answer:

H

Explanation:

* is a dereference operator & is a reference operator. They can be applied any number of times provided it is meaningful. Here p points to the first character in the string "Hello". *p dereferences it and so its value is H. Again & references it to an address and * dereferences it to the value H.

```
32)  main()
      {
      int i=1;
      while (i<=5)
      {
      printf("%d",i);
      if (i>2)
      goto here;
      i++;
      }
      }
      fun()
      {
      here:
      printf("PP");
      }
      }
```

Answer:

Compiler error: Undefined label 'here' in function main

Explanation:

Labels have functions scope, in other words The scope of the labels is limited to functions. The label 'here' is available in function fun() Hence it is not visible in function main.

```
33)  main()
      {
      static char names[5][20]={ "pascal","ada","cobol","fortran","perl"};
      int i;
      char *t;
```

```

t=names[3];
names[3]=names[4];
names[4]=t;
for (i=0;i<=4;i++)
    printf("%s",names[i]);
}

```

Answer:

Compiler error: Lvalue required in function main

Explanation:

Array names are pointer constants. So it cannot be modified.

34)

```

void main()
{
    int i=5;
    printf("%d",i++ + ++i);
}

```

Answer:

Output Cannot be predicted exactly.

Explanation:

Side effects are involved in the evaluation of i

35)

```

void main()
{
    int i=5;
    printf("%d",i+++++i);
}

```

Answer:

Compiler Error

Explanation:

The expression i+++++i is parsed as i ++ ++ + i which is an illegal combination of operators.

36)

```

#include<stdio.h>
main()
{
    int i=1,j=2;
    switch(i)
    {
        case 1: printf("GOOD");
                break;
        case j: printf("BAD");
                break;
    }
}

```

Answer:

Compiler Error: Constant expression required in function main.

Explanation:

The case statement can have only constant expressions (this implies that we cannot use variable names directly so an error).

Note:

Enumerated types can be used in case statements.

```
37)  main()
      {
      int i;
      printf("%d",scanf("%d",&i)); // value 10 is given as input here
      }
```

Answer:

1

Explanation:

Scanf returns number of items successfully read and not 1/0. Here 10 is given as input which should have been scanned successfully. So number of items read is 1.

```
38)  #define f(g,g2) g##g2
      main()
      {
      int var12=100;
      printf("%d",f(var,12));
      }
```

Answer:

100

```
39)  main()
      {
      int i=0;

      for(;i++;printf("%d",i)) ;
          printf("%d",i);
      }
```

Answer:

1

Explanation:

before entering into the for loop the checking condition is "evaluated". Here it evaluates to 0 (false) and comes out of the loop, and i is incremented (note the semicolon after the for loop).

```
40)  #include<stdio.h>
      main()
      {
      char s[]={'a','b','c','\n','c','\0'};
      char *p,*str,*str1;
      p=&s[3];
```



```

str=p;
str1=s;
printf("%d",++*p + ++*str1-32);
}

```

Answer:

M

Explanation:

p is pointing to character '\n'.str1 is pointing to character 'a' ++*p meAnswer:"p is pointing to '\n' and that is incremented by one." the ASCII value of '\n' is 10. then it is incremented to 11. the value of ++*p is 11. ++*str1 meAnswer:"str1 is pointing to 'a' that is incremented by 1 and it becomes 'b'. ASCII value of 'b' is 98. both 11 and 98 is added and result is subtracted from 32.
i.e. (11+98-32)=77("M");

```

41) #include<stdio.h>
main()
{
    struct xx
    {
        int x=3;
        char name[]="hello";
    };
    struct xx *s=malloc(sizeof(struct xx));
    printf("%d",s->x);
    printf("%s",s->name);
}

```

Answer:

Compiler Error

Explanation:

Initialization should not be done for structure members inside the structure declaration

```

42) #include<stdio.h>
main()
{
    struct xx
    {
        int x;
        struct yy
        {
            char s;
            struct xx *p;
        };
        struct yy *q;
    };
}

```

Answer:

Compiler Error

Explanation:

in the end of nested structure yy a member have to be declared.

```
43)  main()
      {
      extern int i;
      i=20;
      printf("%d",sizeof(i));
      }
```

Answer:

Linker error: undefined symbol '_i'.

Explanation:

extern declaration specifies that the variable i is defined somewhere else. The compiler passes the external variable to be resolved by the linker. So compiler doesn't find an error. During linking the linker searches for the definition of i. Since it is not found the linker flags an error.

```
44)  main()
      {
      printf("%d", out);
      }
      int out=100;
```

Answer:

Compiler error: undefined symbol out in function main.

Explanation:

The rule is that a variable is available for use from the point of declaration. Even though a is a global variable, it is not available for main. Hence an error.

```
45)  main()
      {
      extern out;
      printf("%d", out);
      }
      int out=100;
```

Answer:

100

Explanation:

This is the correct way of writing the previous program.

```
46)  main()
      {
      show();
      }
      void show()
```

```
{
printf("I'm the greatest");
}
```

Answer:

Compiler error: Type mismatch in redeclaration of show.

Explanation:

When the compiler sees the function show it doesn't know anything about it. So the default return type (ie, int) is assumed. But when compiler sees the actual definition of show mismatch occurs since it is declared as void. Hence the error.

The solutions are as follows:

1. declare void show() in main() .
2. define show() before main().
3. declare extern void show() before the use of show().

47)

```
main( )
{
int a[2][3][2] = { {{2,4},{7,8},{3,4}}, {{2,2},{2,3},{3,4}}} };
printf(“%u %u %u %d \n”,a,*a,**a,***a);
printf(“%u %u %u %d \n”,a+1,*a+1,**a+1,***a+1);
}
```

Answer:

100, 100, 100, 2

114, 104, 102, 3

Explanation:

The given array is a 3-D one. It can also be viewed as a 1-D array.

2	4	7	8	3	4	2	2	2	3	3	4
100	102	104	106	108	110	112	114	116	118	120	122

thus, for the first printf statement a, *a, **a give address of first element . since the indirection ***a gives the value. Hence, the first line of the output.

for the second printf a+1 increases in the third dimension thus points to value at 114, *a+1 increments in second dimension thus points to 104, **a +1 increments the first dimension thus points to 102 and ***a+1 first gets the value at first location and then increments it by 1. Hence, the output.

48)

```
main( )
{
int a[ ] = {10,20,30,40,50},j,*p;
for(j=0; j<5; j++)
{
printf(“%d” ,*a);
a++;
}
p = a;
for(j=0; j<5; j++)
```

```

    {
        printf("%d ", *p);
        p++;
    }
}

```

Answer:

Compiler error: lvalue required.

Explanation:

Error is in line with statement `a++`. The operand must be an lvalue and may be of any of scalar type for the any operator, array name only when subscripted is an lvalue. Simply array name is a non-modifiable lvalue.

49) `main()`

```

{
    static int a[ ] = {0,1,2,3,4};
    int *p[ ] = {a,a+1,a+2,a+3,a+4};
    int **ptr = p;
    ptr++;
    printf("\n %d %d %d", ptr-p, *ptr-a, **ptr);
    *ptr++;
    printf("\n %d %d %d", ptr-p, *ptr-a, **ptr);
    *++ptr;
    printf("\n %d %d %d", ptr-p, *ptr-a, **ptr);
    ++*ptr;
    printf("\n %d %d %d", ptr-p, *ptr-a, **ptr);
}

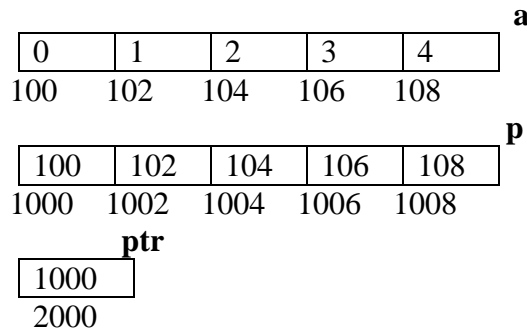
```

Answer:

111
222
333
344

Explanation:

Let us consider the array and the two pointers with some address



After execution of the instruction `ptr++` value in `ptr` becomes 1002, if scaling factor for integer is 2 bytes. Now `ptr - p` is value in `ptr` - starting location of array `p`, $(1002 - 1000) / (\text{scaling factor}) = 1$, `*ptr - a` = value at address pointed by `ptr` -

starting value of array a, 1002 has a value 102 so the value is $(102 - 100)/(\text{scaling factor}) = 1$, $**ptr$ is the value stored in the location pointed by the pointer of $ptr = \text{value pointed by value pointed by } 1002 = \text{value pointed by } 102 = 1$. Hence the output of the first printf is 1, 1, 1.

After execution of $*ptr++$ increments value of the value in ptr by scaling factor, so it becomes 1004. Hence, the outputs for the second printf are $ptr - p = 2$, $*ptr - a = 2$, $**ptr = 2$.

After execution of $++*ptr$ increments value of the value in ptr by scaling factor, so it becomes 1004. Hence, the outputs for the third printf are $ptr - p = 3$, $*ptr - a = 3$, $**ptr = 3$.

After execution of $++*ptr$ value in ptr remains the same, the value pointed by the value is incremented by the scaling factor. So the value in array p at location 1006 changes from 106 to 108. Hence, the outputs for the fourth printf are $ptr - p = 1006 - 1000 = 3$, $*ptr - a = 108 - 100 = 4$, $**ptr = 4$.

```
50) main( )
{
    char *q;
    int j;
    for (j=0; j<3; j++) scanf("%s", (q+j));
    for (j=0; j<3; j++) printf("%c", *(q+j));
    for (j=0; j<3; j++) printf("%s", (q+j));
}
```

Explanation:

Here we have only one pointer to type char and since we take input in the same pointer thus we keep writing over in the same location, each time shifting the pointer value by 1. Suppose the inputs are MOUSE, TRACK and VIRTUAL. Then for the first input suppose the pointer starts at location 100 then the input one is stored as

M	O	U	S	E	\0
---	---	---	---	---	----

When the second input is given the pointer is incremented as j value becomes 1, so the input is filled in memory starting from 101.

M	T	R	A	C	K	\0
---	---	---	---	---	---	----

The third input starts filling from the location 102

M	T	V	I	R	T	U	A	L	\0
---	---	---	---	---	---	---	---	---	----

This is the final value stored.

The first printf prints the values at the position q , $q+1$ and $q+2 = M T V$

The second printf prints three strings starting from locations q , $q+1$, $q+2$ i.e. MTVIRTUAL, TVIRTUAL and VIRTUAL.

```
51) main( )
{
    void *vp;
    char ch = 'g', *cp = "goofy";
    int j = 20;
    vp = &ch;
```

```
printf("%c", *(char *)vp);
vp = &j;
printf("%d", *(int *)vp);
vp = cp;
printf("%s", (char *)vp + 3);
}
```

Answer:

g20fy

Explanation:

Since a void pointer is used it can be type casted to any other type pointer. `vp = &ch` stores address of char `ch` and the next statement prints the value stored in `vp` after type casting it to the proper data type pointer. the output is 'g'. Similarly the output from second `printf` is '20'. The third `printf` statement type casts it to print the string from the 4th value hence the output is 'fy'.

52) `main ()`
`{`
`static char *s[] = {"black", "white", "yellow", "violet"};`
`char **ptr[] = {s+3, s+2, s+1, s}, ***p;`
`p = ptr;`
`**++p;`
`printf("%s", *--*++p + 3);`
`}`

Answer:

ck

Explanation:

In this problem we have an array of char pointers pointing to start of 4 strings. Then we have `ptr` which is a pointer to a pointer of type char and a variable `p` which is a pointer to a pointer to a pointer of type char. `p` hold the initial value of `ptr`, i.e. `p = s+3`. The next statement increment value in `p` by 1, thus now value of `p = s+2`. In the `printf` statement the expression is evaluated `*++p` causes gets value `s+1` then the pre decrement is executed and we get `s+1 - 1 = s`. the indirection operator now gets the value from the array of `s` and adds 3 to the starting address. The string is printed starting from this position. Thus, the output is 'ck'.

53) `main()`
`{`
`int i, n;`
`char *x = "girl";`
`n = strlen(x);`
`*x = x[n];`
`for(i=0; i<n; ++i)`
`{`
`printf("%s\n", x);`
`x++;`

```

    }
}

```

Answer:

```

(blank space)
irl
rl
l

```

Explanation:

Here a string (a pointer to char) is initialized with a value “girl”. The strlen function returns the length of the string, thus n has a value 4. The next statement assigns value at the nth location (‘\0’) to the first location. Now the string becomes “\0irl”. Now the printf statement prints the string after each iteration it increments its starting position. Loop starts from 0 to 4. The first time x[0] = ‘\0’ hence it prints nothing and pointer value is incremented. The second time it prints from x[1] i.e “irl” and the third time it prints “rl” and the last time it prints “l” and the loop terminates.

54)

```
int i,j;
for(i=0;i<=10;i++)
{
j+=5;
assert(i<5);
}
```

Answer:

Runtime error: Abnormal program termination.
assert failed (i<5), <file name>,<line number>

Explanation:

asserts are used during debugging to make sure that certain conditions are satisfied. If assertion fails, the program will terminate reporting the same. After debugging use,

```
#undef NDEBUG
```

and this will disable all the assertions from the source code. Assertion is a good debugging tool to make use of.

55)

```
main()
{
int i=-1;
+i;
printf("i = %d, +i = %d \n",i,+i);
}
```

Answer:

```
i = -1, +i = -1
```

Explanation:

Unary + is the only dummy operator in C. Where-ever it comes you can just ignore it just because it has no effect in the expressions (hence the name dummy operator).

56) What are the files which are automatically opened when a C file is executed?

Answer:

stdin, stdout, stderr (standard input, standard output, standard error).

57) what will be the position of the file marker?

a: fseek(ptr,0,SEEK_SET);

b: fseek(ptr,0,SEEK_CUR);

Answer :

a: The SEEK_SET sets the file position marker to the starting of the file.

b: The SEEK_CUR sets the file position marker to the current position of the file.

58)

```
main()
{
char name[10],s[12];
scanf(" %[^\"\\\"'",s);
}
```

How scanf will execute?

Answer:

First it checks for the leading white space and discards it. Then it matches with a quotation mark and then it reads all character upto another quotation mark.

59) What is the problem with the following code segment?

```
while ((fgets(receiving array,50,file_ptr)) != EOF)
;
```

Answer & Explanation:

fgets returns a pointer. So the correct end of file check is checking for != NULL.

60)

```
main()
{
main();
}
```

Answer:

Runtime error : Stack overflow.

Explanation:

main function calls itself again and again. Each time the function is called its return address is stored in the call stack. Since there is no condition to terminate the function call, the call stack overflows at runtime. So it terminates the program and results in an error.

61)

```
main()
{
char *cptr,c;
void *vptr,v;
```



```
c=10; v=0;
cptr=&c; vptr=&v;
printf("%c%v",c,v);
}
```

Answer:

Compiler error (at line number 4): size of v is Unknown.

Explanation:

You can create a variable of type void * but not of type void, since void is an empty type. In the second line you are creating variable vptr of type void * and v of type void hence an error.

62)

```
main()
{
char *str1="abcd";
char str2[]="abcd";
printf("%d %d %d",sizeof(str1),sizeof(str2),sizeof("abcd"));
}
```

Answer:

2 5 5

Explanation:

In first sizeof, str1 is a character pointer so it gives you the size of the pointer variable. In second sizeof the name str2 indicates the name of the array whose size is 5 (including the '\0' termination character). The third sizeof is similar to the second one.

63)

```
main()
{
char not;
not=!2;
printf("%d",not);
}
```

Answer:

0

Explanation:

! is a logical operator. In C the value 0 is considered to be the boolean value FALSE, and any non-zero value is considered to be the boolean value TRUE. Here 2 is a non-zero value so TRUE. !TRUE is FALSE (0) so it prints 0.

64)

```
#define FALSE -1
#define TRUE 1
#define NULL 0
main() {
if(NULL)
puts("NULL");
else if(FALSE)
puts("TRUE");
}
```

```

else
    puts("FALSE");
}

```

Answer:

TRUE

Explanation:

The input program to the compiler after processing by the preprocessor is,

```

main(){
    if(0)
        puts("NULL");
    else if(-1)
        puts("TRUE");
    else
        puts("FALSE");
}

```

Preprocessor doesn't replace the values given inside the double quotes. The check by if condition is boolean value false so it goes to else. In second if -1 is boolean value true hence "TRUE" is printed.

65)

```
main()
{
    int k=1;
    printf("%d==1 is ""%s",k,k==1?"TRUE":"FALSE");
}
```

Answer:

1==1 is TRUE

Explanation:

When two strings are placed together (or separated by white-space) they are concatenated (this is called as "stringization" operation). So the string is as if it is given as "%d==1 is %s". The conditional operator (?:) evaluates to "TRUE".

66)

```
main()
{
    int y;
    scanf("%d",&y); // input given is 2000
    if( (y%4==0 && y%100 != 0) || y%100 == 0 )
        printf("%d is a leap year");
    else
        printf("%d is not a leap year");
}
```

Answer:

2000 is a leap year

Explanation:

An ordinary program to check if leap year or not.

67)

```
#define max 5
```

```

#define int arr1[max]
main()
{
typedef char arr2[max];
arr1 list={0,1,2,3,4};
arr2 name="name";
printf("%d %s",list[0],name);
}

```

Answer:

Compiler error (in the line arr1 list = {0,1,2,3,4})

Explanation:

arr2 is declared of type array of size 5 of characters. So it can be used to declare the variable name of the type arr2. But it is not the case of arr1. Hence an error.

Rule of Thumb:

#defines are used for textual replacement whereas typedefs are used for declaring new types.

```

68) int i=10;
main()
{
extern int i;
{
int i=20;
{
const volatile unsigned i=30;
printf("%d",i);
}
printf("%d",i);
}
printf("%d",i);
}

```

Answer:

30,20,10

Explanation:

'{' introduces new block and thus new scope. In the innermost block i is declared as,

const volatile unsigned

which is a valid declaration. i is assumed of type int. So printf prints 30. In the next block, i has value 20 and so printf prints 20. In the outermost block, i is declared as extern, so no storage space is allocated for it. After compilation is over the linker resolves it to global variable i (since it is the only variable visible there). So it prints i's value as 10.

```

69) main()
{
int *j;

```

```

{
    int i=10;
    j=&i;
}
printf("%d",*j);
}

```

Answer:

10

Explanation:

The variable i is a block level variable and the visibility is inside that block only. But the lifetime of i is lifetime of the function so it lives upto the exit of main function. Since the i is still allocated space, *j prints the value stored in i since j points i.

70)

```
main()
{
    int i=-1;
    -i;
    printf("i = %d, -i = %d \n",i,-i);
}
```

Answer:

i = -1, -i = 1

Explanation:

-i is executed and this execution doesn't affect the value of i. In printf first you just print the value of i. After that the value of the expression -i = -(-1) is printed.

71)

```
#include<stdio.h>
main()
{
    const int i=4;
    float j;
    j = ++i;
    printf("%d %f", i,++j);
}
```

Answer:

Compiler error

Explanation:

i is a constant. you cannot change the value of constant

72)

```
#include<stdio.h>
main()
{
    int a[2][2][2] = { { 10,2,3,4}, { 5,6,7,8} };
    int *p,*q;
    p=&a[2][2][2];
    *q=***a;
}
```

```
printf("%d..%d",*p,*q);
}
```

Answer:

garbagevalue..1

Explanation:

p=&a[2][2][2] you declare only two 2D arrays. but you are trying to access the third 2D(which you are not declared) it will print garbage values. *q=***a starting address of a is assigned integer pointer. now q is pointing to starting address of a.if you print *q meAnswer:it will print first element of 3D array.

```
73) #include<stdio.h>
main()
{
    register i=5;
    char j[] = "hello";
    printf("%s %d",j,i);
}
```

Answer:

hello 5

Explanation:

if you declare i as register compiler will treat it as ordinary integer and it will take integer value. i value may be stored either in register or in memory.

```
74) main()
{
    int i=5,j=6,z;
    printf("%d",i+++j);
}
```

Answer:

11

Explanation:

the expression i+++j is treated as (i++ + j)

```
76) struct aaa{
    struct aaa *prev;
    int i;
    struct aaa *next;
};

main()
{
    struct aaa abc,def,ghi,jkl;
    int x=100;
    abc.i=0;abc.prev=&jkl;
    abc.next=&def;
    def.i=1;def.prev=&abc;def.next=&ghi;
    ghi.i=2;ghi.prev=&def;
```

```

ghi.next=&jkl;
jkl.i=3;jkl.prev=&ghi;jkl.next=&abc;
x=abc.next->next->prev->next->i;
printf("%d",x);
}

```

Answer:

2

Explanation:

above all statements form a double circular linked list;

abc.next->next->prev->next->i

this one points to "ghi" node the value of at particular node is 2.

77) struct point
{
int x;
int y;
};
struct point origin,*pp;
main()
{
pp=&origin;
printf("origin is(%d%d)\n",(*pp).x,(*pp).y);
printf("origin is (%d%d)\n",pp->x,pp->y);
}

Answer:

origin is(0,0)

origin is(0,0)

Explanation:

pp is a pointer to structure. we can access the elements of the structure either with arrow mark or with indirection operator.

Note:

Since structure point is globally declared x & y are initialized as zeroes

78) main()
{
int i=_l_abc(10);
printf("%d\n",--i);
}
int _l_abc(int i)
{
return(i++);
}

Answer:

9

Explanation:

return(i++) it will first return i and then increments. i.e. 10 will be returned.

```
79) main()
{
    char *p;
    int *q;
    long *r;
    p=q=r=0;
    p++;
    q++;
    r++;
    printf("%p...%p...%p",p,q,r);
}
```

Answer:

0001...0002...0004

Explanation:

++ operator when applied to pointers increments address according to their corresponding data-types.

```
80) main()
{
    char c=' ',x,convert(z);
    getc(c);
    if((c>='a') && (c<='z'))
        x=convert(c);
    printf("%c",x);
}
convert(z)
{
    return z-32;
}
```

Answer:

Compiler error

Explanation:

declaration of convert and format of getc() are wrong.

```
81) main(int argc, char **argv)
{
    printf("enter the character");
    getchar();
    sum(argv[1],argv[2]);
}
sum(num1,num2)
int num1,num2;
{
    return num1+num2;
}
```

```
}
```

Answer:

Compiler error.

Explanation:

argv[1] & argv[2] are strings. They are passed to the function sum without converting it to integer values.

```
82) #include <stdio.h>
int one_d[]={1,2,3};
main()
{
    int *ptr;
    ptr=one_d;
    ptr+=3;
    printf("%d",*ptr);
}
```

Answer:

garbage value

Explanation:

ptr pointer is pointing to out of the array range of one_d.

```
83) #include<stdio.h>
aaa() {
    printf("hi");
}
bbb(){
    printf("hello");
}
ccc(){
    printf("bye");
}
main()
{
    int (*ptr[3])();
    ptr[0]=aaa;
    ptr[1]=bbb;
    ptr[2]=ccc;
    ptr[2]();
}
```

Answer:

bye

Explanation:

ptr is array of pointers to functions of return type int. ptr[0] is assigned to address of the function aaa. Similarly ptr[1] and ptr[2] for bbb and ccc respectively. ptr[2]() is in effect of writing ccc(), since ptr[2] points to ccc.

85) `#include<stdio.h>`
`main()`
`{`
`FILE *ptr;`
`char i;`
`ptr=fopen("zzz.c","r");`
`while((i=fgetc(ptr))!=EOF)`
`printf("%c",i);`
`}`

Answer:

contents of zzz.c followed by an infinite loop

Explanation:

The condition is checked against EOF, it should be checked against NULL.

86) `main()`
`{`
`int i =0;j=0;`
`if(i && j++)`
`printf("%d..%d",i++,j);`
`printf("%d..%d,i,j);`
`}`

Answer:

0..0

Explanation:

The value of i is 0. Since this information is enough to determine the truth value of the boolean expression. So the statement following the if statement is not executed. The values of i and j remain unchanged and get printed.

87) `main()`
`{`
`int i;`
`i = abc();`
`printf("%d",i);`
`}`
`abc()`
`{`
`_AX = 1000;`
`}`

Answer:

1000

Explanation:

Normally the return value from the function is through the information from the accumulator. Here _AH is the pseudo global variable denoting the accumulator. Hence, the value of the accumulator is set 1000 so the function returns value 1000.

88)

```
int i;
main(){
int t;
for ( t=4;scanf("%d",&i)-t;printf("%d\n",i))
    printf("%d--",t--);
}
```

// If the inputs are 0,1,2,3 find the o/p

Answer:

4--0

3--1

2--2

Explanation:

Let us assume some x= scanf("%d",&i)-t the values during execution will be,

t	i	x
4	0	-4
3	1	-2
2	2	0

89)

```
main(){
int a=0;int b=20;char x=1;char y=10;
if(a,b,x,y)
printf("hello");
}
```

Answer:

hello

Explanation:

The comma operator has associativity from left to right. Only the rightmost value is returned and the other values are evaluated and ignored. Thus the value of last variable y is returned to check in if. Since it is a non zero value if becomes true so, "hello" will be printed.

90)

```
main(){
unsigned int i;
for(i=1;i>-2;i--)
printf("c aptitude");
}
```

Explanation:

i is an unsigned integer. It is compared with a signed value. Since the both types doesn't match, signed is promoted to unsigned value. The unsigned equivalent of -2 is a huge value so condition becomes false and control comes out of the loop.

91) In the following pgm add a stmt in the function fun such that the address of 'a' gets stored in 'j'.

```
main(){
int *j;
```

```

void fun(int **);
fun(&j);
}
void fun(int **k) {
    int a =0;
    /* add a stmt here*/
}

```

Answer:

*k = &a

Explanation:

The argument of the function is a pointer to a pointer.

92) What are the following notations of defining functions known as?

i. `int abc(int a, float b)`

```

{
    /* some code */
}

```

ii. `int abc(a,b)`

```

int a; float b;
{
    /* some code*/
}

```

Answer:

i. ANSI C notation

ii. Kernighan & Ritchie notation

93) `main()`

```

{
    char *p;
    p="%d\n";
    p++;
    p++;
    printf(p-2,300);
}

```

Answer:

300

Explanation:

The pointer points to % since it is incremented twice and again decremented by 2, it points to '%d\n' and 300 is printed.

94) `main(){`

```

    char a[100];
    a[0]='a';a[1]='b';a[2]='c';a[4]='d';
    abc(a);
}
abc(char a[]){

```

```

a++;
printf("%c",*a);
a++;
printf("%c",*a);
}

```

Explanation:

The base address is modified only in function and as a result a points to 'b' then after incrementing to 'c' so bc will be printed.

```

95) func(a,b)
    int a,b;
    {
        return( a= (a==b) );
    }
main()
{
    int process(),func();
    printf("The value of process is %d !\n ",process(func,3,6));
}
process(pf,val1,val2)
int (*pf) ();
int val1,val2;
{
    return((*pf) (val1,val2));
}

```

Answer:

The value if process is 0 !

Explanation:

The function 'process' has 3 parameters - 1, a pointer to another function 2 and 3, integers. When this function is invoked from main, the following substitutions for formal parameters take place: func for pf, 3 for val1 and 6 for val2. This function returns the result of the operation performed by the function 'func'. The function func has two integer parameters. The formal parameters are substituted as 3 for a and 6 for b. since 3 is not equal to 6, a==b returns 0. therefore the function returns 0 which in turn is returned by the function 'process'.

```

96) void main()
    {
        static int i=5;
        if(--i){
            main();
            printf("%d ",i);
        }
    }

```

Answer:

0 0 0 0

Explanation:

The variable "I" is declared as static, hence memory for I will be allocated for only once, as it encounters the statement. The function main() will be called recursively unless I becomes equal to 0, and since main() is recursively called, so the value of static I ie., 0 will be printed every time the control is returned.

```
97) void main()
    {
        int k=ret(sizeof(float));
        printf("\n here value is %d",++k);
    }
int ret(int ret)
{
    ret += 2.5;
    return(ret);
}
```

Answer:

Here value is 7

Explanation:

The int ret(int ret), ie., the function name and the argument name can be the same.

Firstly, the function ret() is called in which the sizeof(float) ie., 4 is passed, after the first expression the value in ret will be 6, as ret is integer hence the value stored in ret will have implicit type conversion from float to int. The ret is returned in main() it is printed after and preincrement.

```
98) void main()
    {
        char a[]="12345\0";
        int i=strlen(a);
        printf("here in 3 %d\n",++i);
    }
```

Answer:

here in 3 6

Explanation:

The char array 'a' will hold the initialized string, whose length will be counted from 0 till the null character. Hence the 'i' will hold the value equal to 5, after the pre-increment in the printf statement, the 6 will be printed.

```
99) void main()
    {
        unsigned giveit=-1;
        int gotit;
        printf("%u ",++giveit);
        printf("%u \n",gotit=--giveit);
    }
```

Answer:

0 65535

Explanation:

```
100) void main()
{
    int i;
    char a[]="\0";
    if(printf("%s\n",a))
        printf("Ok here \n");
    else
        printf("Forget it\n");
}
```

Answer:

Ok here

Explanation:

Printf will return how many characters does it print. Hence printing a null character returns 1 which makes the if statement true, thus "Ok here" is printed.

```
101) void main()
{
    void *v;
    int integer=2;
    int *i=&integer;
    v=i;
    printf("%d", (int*)*v);
}
```

Answer:

Compiler Error. We cannot apply indirection on type void*.

Explanation:

Void pointer is a generic pointer type. No pointer arithmetic can be done on it. Void pointers are normally used for,

1. Passing generic pointers to functions and returning such pointers.
2. As a intermediate pointer type.
3. Used when the exact pointer type will be known at a later point of time.

```
102) void main()
{
    int i=i++,j=j++,k=k++;
    printf("%d%d%d",i,j,k);
}
```

Answer:

Garbage values.

Explanation:

An identifier is available to use in program code from the point of its declaration.

So expressions such as `i = i++` are valid statements. The `i`, `j` and `k` are automatic variables and so they contain some garbage value. Garbage in is garbage out (GIGO).

```
103) void main()
{
    static int i=i++, j=j++, k=k++;
    printf("i = %d j = %d k = %d", i, j, k);
}
```

Answer:

`i = 1 j = 1 k = 1`

Explanation:

Since static variables are initialized to zero by default.

```
104) void main()
{
    while(1){
        if(printf("%d",printf("%d")))
            break;
        else
            continue;
    }
}
```

Answer:

Garbage values

Explanation:

The inner `printf` executes first to print some garbage value. The `printf` returns no of characters printed and this value also cannot be predicted. Still the outer `printf` prints something and so returns a non-zero value. So it encounters the `break` statement and comes out of the `while` statement.

```
104) main()
{
    unsigned int i=10;
    while(i-->=0)
        printf("%u ",i);
}
```

Answer:

`10 9 8 7 6 5 4 3 2 1 0 65535 65534.....`

Explanation:

Since `i` is an unsigned integer it can never become negative. So the expression `i-->=0` will always be true, leading to an infinite loop.

```
105) #include<conio.h>
```

```
main()
{
    int x,y=2,z,a;
    if(x=y%2) z=2;
    a=2;
    printf("%d %d ",z,x);
}
```

Answer:

Garbage-value 0

Explanation:

The value of $y\%2$ is 0. This value is assigned to x . The condition reduces to $\text{if}(x)$ or in other words $\text{if}(0)$ and so z goes uninitialized.

Thumb Rule: Check all control paths to write bug free code.

106)

```
main()
{
    int a[10];
    printf("%d",*a+1-*a+3);
}
```

Answer:

4

Explanation:

$*a$ and $-*a$ cancels out. The result is as simple as $1 + 3 = 4$!

107)

```
#define prod(a,b) a*b
main()
{
    int x=3,y=4;
    printf("%d",prod(x+2,y-1));
}
```

Answer:

10

Explanation:

The macro expands and evaluates to as:

$x+2*y-1 \Rightarrow x+(2*y)-1 \Rightarrow 10$

108)

```
main()
{
    unsigned int i=65000;
    while(i++!=0);
    printf("%d",i);
}
```

Answer:

1

Explanation:

Note the semicolon after the while statement. When the value of i becomes 0 it comes out of while loop. Due to post-increment on i the value of i while printing is 1.

```
109)  main()
      {
          int i=0;
          while(++i!=0)
              i=i++;
          printf("%d",i);
      }
```

Answer:

-1

Explanation:

Unary + is the only dummy operator in C. So it has no effect on the expression and now the while loop is, while(i--!=0) which is false and so breaks out of while loop. The value -1 is printed due to the post-decrement operator.

```
113)  main()
      {
          float f=5,g=10;
          enum{ i=10,j=20,k=50 };
          printf("%d\n",++k);
          printf("%f\n",f<<2);
          printf("%lf\n",f%g);
          printf("%lf\n",fmod(f,g));
      }
```

Answer:

Line no 5: Error: Lvalue required
 Line no 6: Cannot apply leftshift to float
 Line no 7: Cannot apply mod to float

Explanation:

Enumeration constants cannot be modified, so you cannot apply ++.
 Bit-wise operators and % operators cannot be applied on float values.
 fmod() is to find the modulus values for floats as % operator is for ints.

```
110)  main()
      {
          int i=10;
          void pascal f(int,int,int);
          f(i++,i++,i++);
          printf(" %d",i);
      }
      void pascal f(integer :i,integer:j,integer :k)
      {
          write(i,j,k);
      }
```

```
}
```

Answer:

Compiler error: unknown type integer

Compiler error: undeclared function write

Explanation:

Pascal keyword doesn't mean that pascal code can be used. It means that the function follows Pascal argument passing mechanism in calling the functions.

```
111) void pascal f(int i,int j,int k)
{
    printf("%d %d %d",i, j, k);
}
void cdecl f(int i,int j,int k)
{
    printf("%d %d %d",i, j, k);
}
main()
{
    int i=10;
    f(i++,i++,i++);
    printf(" %d\n",i);
    i=10;
    f(i++,i++,i++);
    printf(" %d",i);
}
```

Answer:

10 11 12 13

12 11 10 13

Explanation:

Pascal argument passing mechanism forces the arguments to be called from left to right. cdecl is the normal C argument passing mechanism where the arguments are passed from right to left.

112). What is the output of the program given below

```
main()
{
    signed char i=0;
    for(;i>=0;i++) ;
    printf("%d\n",i);
}
```

Answer

-128

Explanation

Notice the semicolon at the end of the for loop. The initial value of the i is set to 0. The inner loop executes to increment the value from 0 to 127 (the

positive range of char) and then it rotates to the negative value of -128. The condition in the for loop fails and so comes out of the for loop. It prints the current value of i that is -128.

```
113) main()
{
    unsigned char i=0;
    for(;i>=0;i++) ;
    printf("%d\n",i);
}
```

Answer

infinite loop

Explanation

The difference between the previous question and this one is that the char is declared to be unsigned. So the i++ can never yield negative value and i>=0 never becomes false so that it can come out of the for loop.

```
114) main()
{
    char i=0;
    for(;i>=0;i++) ;
    printf("%d\n",i);
}
```

Answer:

Behavior is implementation dependent.

Explanation:

The detail if the char is signed/unsigned by default is implementation dependent. If the implementation treats the char to be signed by default the program will print -128 and terminate. On the other hand if it considers char to be unsigned by default, it goes to infinite loop.

Rule:

You can write programs that have implementation dependent behavior. But don't write programs that depend on such behavior.

115) Is the following statement a declaration/definition. Find what does it mean?

```
int (*x)[10];
```

Answer

Definition.

x is a pointer to array of(size 10) integers.

Apply clock-wise rule to find the meaning of this definition.

116). What is the output for the program given below

```
typedef enum errorType{ warning, error, exception,}error;
main()
{
    error g1;
    g1=1;
    printf("%d",g1);
}
```

Answer

Compiler error: Multiple declaration for error

Explanation

The name error is used in the two meanings. One means that it is a enumerator constant with value 1. The another use is that it is a type name (due to typedef) for enum errorType. Given a situation the compiler cannot distinguish the meaning of error to know in what sense the error is used:

```
error g1;
g1=error;
// which error it refers in each case?
```

When the compiler can distinguish between usages then it will not issue error (in pure technical terms, names can only be overloaded in different namespaces).

Note: the extra comma in the declaration,
enum errorType{ warning, error, exception,}

is not an error. An extra comma is valid and is provided just for programmer's convenience.

117)

```
typedef struct error{int warning, error, exception;}error;
main()
{
    error g1;
    g1.error =1;
    printf("%d",g1.error);
}
```

Answer

1

Explanation

The three usages of name errors can be distinguishable by the compiler at any instance, so valid (they are in different namespaces).

Typedef struct error{int warning, error, exception;}error;

This error can be used only by preceding the error by struct keyword as in:

```
struct error someError;
typedef struct error{int warning, error, exception;}error;
```

This can be used only after . (dot) or -> (arrow) operator preceded by the variable name as in :

```
g1.error =1;
```

```
printf("%d",g1.error);
typedef struct error{int warning, error, exception;}error;
```

This can be used to define variables without using the preceding struct keyword as in:

```
error g1;
```

Since the compiler can perfectly distinguish between these three usages, it is perfectly legal and valid.

Note

This code is given here to just explain the concept behind. In real programming don't use such overloading of names. It reduces the readability of the code. Possible doesn't mean that we should use it!

```
118) #ifdef something
int some=0;
#endif

main()
{
    int thing = 0;
    printf("%d %d\n", some ,thing);
}
```

Answer:

Compiler error : undefined symbol some

Explanation:

This is a very simple example for conditional compilation. The name something is not already known to the compiler making the declaration `int some = 0;` effectively removed from the source code.

```
119) #if something == 0
int some=0;
#endif

main()
{
    int thing = 0;
    printf("%d %d\n", some ,thing);
}
```

Answer

0 0

Explanation

This code is to show that preprocessor expressions are not the same as the ordinary expressions. If a name is not known the preprocessor treats it to be equal to zero.

120). What is the output for the following program

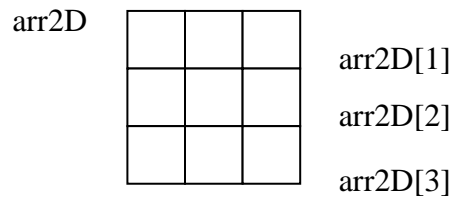
```
main()
{
    int arr2D[3][3];
    printf("%d\n", ((arr2D==* arr2D)&&(* arr2D == arr2D[0])) );
}
```

Answer

1

Explanation

This is due to the close relation between the arrays and pointers. N dimensional arrays are made up of (N-1) dimensional arrays. arr2D is made up of a 3 single arrays that contains 3 integers each .



The name arr2D refers to the beginning of all the 3 arrays. *arr2D refers to the start of the first 1D array (of 3 integers) that is the same address as arr2D. So the expression (arr2D == *arr2D) is true (1).

Similarly, *arr2D is nothing but *(arr2D + 0), adding a zero doesn't change the value/meaning. Again arr2D[0] is the another way of telling *(arr2D + 0). So the expression (*(arr2D + 0) == arr2D[0]) is true (1).

Since both parts of the expression evaluates to true the result is true(1) and the same is printed.

121) void main()

```
{
    if(~0 == (unsigned int)-1)
        printf("You can answer this if you know how values are represented in memory");
}
```

Answer

You can answer this if you know how values are represented in memory

Explanation

~ (tilde operator or bit-wise negation operator) operates on 0 to produce all ones to fill the space for an integer. -1 is represented in unsigned value as all 1's and so both are equal.

122) int swap(int *a,int *b)

```
{
    *a=*a+*b;*b=*a-*b;*a=*a-*b;
}
```

```

    }
    main()
    {
        int x=10,y=20;
        swap(&x,&y);
        printf("x= %d y = %d\n",x,y);
    }

```

Answer

x = 20 y = 10

Explanation

This is one way of swapping two values. Simple checking will help understand this.

123) main()
 {
 char *p = "ayqm";
 printf("%c",++*(p++));
 }

Answer:

b

124) main()
 {
 int i=5;
 printf("%d",++i++);
 }

Answer:

Compiler error: Lvalue required in function main

Explanation:

++i yields an rvalue. For postfix ++ to operate an lvalue is required.

125) main()
 {
 char *p = "ayqm";
 char c;
 c = ++*p++;
 printf("%c",c);
 }

Answer:

b

Explanation:

There is no difference between the expression ++*(p++) and ++*p++. Parenthesis just works as a visual clue for the reader to see which expression is first evaluated.

126)

```
int aaa() {printf("Hi");}
int bbb() {printf("hello");}
int ccc() {printf("bye");}
```

```
main()
{
    int (* ptr[3]) ();
    ptr[0] = aaa;
    ptr[1] = bbb;
    ptr[2] = ccc;
    ptr[2]();
}
```

Answer:

bye

Explanation:

int (* ptr[3])() says that ptr is an array of pointers to functions that takes no arguments and returns the type int. By the assignment ptr[0] = aaa; it means that the first function pointer in the array is initialized with the address of the function aaa. Similarly, the other two array elements also get initialized with the addresses of the functions bbb and ccc. Since ptr[2] contains the address of the function ccc, the call to the function ptr[2]() is same as calling ccc(). So it results in printing "bye".

127)

```
main()
{
    int i=5;
    printf("%d", i==++i ==6);
}
```

Answer:

1

Explanation:

The expression can be treated as i = (++i==6), because == is of higher precedence than = operator. In the inner expression, ++i is equal to 6 yielding true(1). Hence the result.

128)

```
main()
{
    char p[ ]="d\n";
    p[1] = 'c';
    printf(p,65);
}
```

Answer:

A

Explanation:

Due to the assignment `p[1] = 'c'` the string becomes, `"%c\n"`. Since this string becomes the format string for `printf` and ASCII value of 65 is 'A', the same gets printed.

129) `void (* abc(int, void (*def) ())) ();`

Answer::

`abc` is a ptr to a function which takes 2 parameters .(a). an integer variable.(b). a ptr to a function which returns void. the return type of the function is void.

Explanation:

Apply the clock-wise rule to find the result.

130) `main()`
`{`
`while (strcmp("some", "some\0"))`
`printf("Strings are not equal\n");`
`}`

Answer:

No output

Explanation:

Ending the string constant with `\0` explicitly makes no difference. So `"some"` and `"some\0"` are equivalent. So, `strcmp` returns 0 (false) hence breaking out of the while loop.

131) `main()`
`{`
`char str1[] = {'s','o','m','e'};`
`char str2[] = {'s','o','m','e','\0'};`
`while (strcmp(str1, str2))`
`printf("Strings are not equal\n");`
`}`

Answer:

`"Strings are not equal"`

`"Strings are not equal"`

....

Explanation:

If a string constant is initialized explicitly with characters, `'\0'` is not appended automatically to the string. Since `str1` doesn't have null termination, it treats whatever the values that are in the following positions as part of the string until it randomly reaches a `'\0'`. So `str1` and `str2` are not the same, hence the result.

132) `main()`
`{`
`int i = 3;`
`for (; i++=0;) printf("%d", i);`

```
}
```

Answer:

Compiler Error: Lvalue required.

Explanation:

As we know that increment operators return rvalues and hence it cannot appear on the left hand side of an assignment operation.

```
133) void main()
{
    int *mptr, *cptr;
    mptr = (int*)malloc(sizeof(int));
    printf("%d", *mptr);
    int *cptr = (int*)calloc(sizeof(int), 1);
    printf("%d", *cptr);
}
```

Answer:

garbage-value 0

Explanation:

The memory space allocated by malloc is uninitialized, whereas calloc returns the allocated memory space initialized to zeros.

```
134) void main()
{
    static int i;
    while(i<=10)
        (i>2)?i++:i--;
    printf("%d", i);
}
```

Answer:

32767

Explanation:

Since i is static it is initialized to 0. Inside the while loop the conditional operator evaluates to false, executing i--. This continues till the integer value rotates to positive value (32767). The while condition becomes false and hence, comes out of the while loop, printing the i value.

```
135) main()
{
    int i=10, j=20;
    j = i, j?(i,j)?i:j:j;
    printf("%d %d", i, j);
}
```

Answer:

10 10

Explanation:

The Ternary operator (? :) is equivalent for if-then-else statement. So the question can be written as:

```

if(i,j)
{
    if(i,j)
        j = i;
    else
        j = j;
}
else
    j = j;

```

- 136) 1. const char *a;
 2. char* const a;
 3. char const *a;
 -Differentiate the above declarations.

Answer:

- 'const' applies to char * rather than 'a' (pointer to a constant char)
 *a='F' : illegal
 a="Hi" : legal
- 'const' applies to 'a' rather than to the value of a (constant pointer to char)
 *a='F' : legal
 a="Hi" : illegal
- Same as 1.

137) main()
 {
 int i=5,j=10;
 i=i&=j&&10;
 printf("%d %d",i,j);
 }

Answer:

1 10

Explanation:

The expression can be written as i=(i&=(j&&10)); The inner expression (j&&10) evaluates to 1 because j==10. i is 5. i = 5&1 is 1. Hence the result.

138) main()
 {
 int i=4,j=7;

```

    j = j || i++ && printf("YOU CAN");
    printf("%d %d", i, j);
}

```

Answer:

4 1

Explanation:

The boolean expression needs to be evaluated only till the truth value of the expression is not known. j is not equal to zero itself means that the expression's truth value is 1. Because it is followed by \parallel and $\text{true} \parallel (\text{anything}) \Rightarrow \text{true}$ where (anything) will not be evaluated. So the remaining expression is not evaluated and so the value of i remains the same.

Similarly when $\&\&$ operator is involved in an expression, when any of the operands become false, the whole expression's truth value becomes false and hence the remaining expression will not be evaluated.

$\text{false} \&\& (\text{anything}) \Rightarrow \text{false}$ where (anything) will not be evaluated.

```

139) main()
{
    register int a=2;
    printf("Address of a = %d",&a);
    printf("Value of a = %d",a);
}

```

Answer:

Compiler Error: '&' on register variable

Rule to Remember:

& (address of) operator cannot be applied on register variables.

```

140) main()
{
    float i=1.5;
    switch(i)
    {
        case 1: printf("1");
        case 2: printf("2");
        default : printf("0");
    }
}

```

Answer:

Compiler Error: switch expression not integral

Explanation:

Switch statements can be applied only to integral types.

```

141) main()
{
    extern i;
}

```

```

printf("%d\n",i);
{
    int i=20;
    printf("%d\n",i);
}
}

```

Answer:

Linker Error : Unresolved external symbol i

Explanation:

The identifier i is available in the inner block and so using extern has no use in resolving it.

```

142) main()
{
    int a=2,*f1,*f2;
    f1=f2=&a;
    *f2+=*f2+=a+=2.5;
    printf("\n%d %d %d",a,*f1,*f2);
}

```

Answer:

16 16 16

Explanation:

f1 and f2 both refer to the same memory location a. So changes through f1 and f2 ultimately affects only the value of a.

```

143) main()
{
    char *p="GOOD";
    char a[ ]="GOOD";
    printf("\n sizeof(p) = %d, sizeof(*p) = %d, strlen(p) = %d", sizeof(p), sizeof(*p),
    strlen(p));
    printf("\n sizeof(a) = %d, strlen(a) = %d", sizeof(a), strlen(a));
}

```

Answer:

sizeof(p) = 2, sizeof(*p) = 1, strlen(p) = 4
 sizeof(a) = 5, strlen(a) = 4

Explanation:

sizeof(p) => sizeof(char*) => 2

sizeof(*p) => sizeof(char) => 1

Similarly,

sizeof(a) => size of the character array => 5

When sizeof operator is applied to an array it returns the sizeof the array and it is not the same as the sizeof the pointer variable. Here the sizeof(a) where a is the character array and the size of the array is 5 because the space necessary for the terminating NULL character should also be taken into account.

```

144) #define DIM( array, type) sizeof(array)/sizeof(type)
      main()
      {
          int arr[10];
          printf("The dimension of the array is %d", DIM(arr, int));
      }

```

Answer:

10

Explanation:

The size of integer array of 10 elements is 10 * sizeof(int). The macro expands to sizeof(arr)/sizeof(int) => 10 * sizeof(int) / sizeof(int) => 10.

```

145) int DIM(int array[])
      {
          return sizeof(array)/sizeof(int );
      }
      main()
      {
          int arr[10];
          printf("The dimension of the array is %d", DIM(arr));
      }

```

Answer:

1

Explanation:

Arrays cannot be passed to functions as arguments and only the pointers can be passed. So the argument is equivalent to int * array (this is one of the very few places where [] and * usage are equivalent). The return statement becomes, sizeof(int *) / sizeof(int) that happens to be equal in this case.

```

146) main()
      {
          static int a[3][3]={ 1,2,3,4,5,6,7,8,9};
          int i,j;
          static *p[]={ a,a+1,a+2 };
          for(i=0;i<3;i++)
          {
              for(j=0;j<3;j++)
              printf("%d\t%d\t%d\t%d\n",*(*(p+i)+j),
                  *(*j+p)+i,*(*(i+p)+j),*(*(p+j)+i));
          }
      }

```

Answer:

1	1	1	1
2	4	2	4
3	7	3	7
4	2	4	2

5	5	5	5
6	8	6	8
7	3	7	3
8	6	8	6
9	9	9	9

Explanation:

((p+i)+j) is equivalent to p[i][j].

```
147) main()
{
    void swap();
    int x=10,y=8;
    swap(&x,&y);
    printf("x=%d y=%d",x,y);
}
void swap(int *a, int *b)
{
    *a ^= *b, *b ^= *a, *a ^= *b;
}
```

Answer:

x=10 y=8

Explanation:

Using ^ like this is a way to swap two variables without using a temporary variable and that too in a single statement.

Inside main(), void swap(); means that swap is a function that may take any number of arguments (not no arguments) and returns nothing. So this doesn't issue a compiler error by the call swap(&x,&y); that has two arguments.

This convention is historically due to pre-ANSI style (referred to as Kernighan and Ritchie style) style of function declaration. In that style, the swap function will be defined as follows,

```
void swap()
int *a, int *b
{
    *a ^= *b, *b ^= *a, *a ^= *b;
}
```

where the arguments follow the (). So naturally the declaration for swap will look like, void swap() which means the swap can take any number of arguments.

```
148) main()
{
    int i = 257;
    int *iPtr = &i;
    printf("%d %d", *((char*)iPtr), *((char*)iPtr+1) );
}
```

Answer:

1 1

Explanation:

The integer value 257 is stored in the memory as, 00000001 00000001, so the individual bytes are taken by casting it to char * and get printed.

```
149) main()
{
    int i = 258;
    int *iPtr = &i;
    printf("%d %d", *((char*)iPtr), *((char*)iPtr+1) );
}
```

Answer:

2 1

Explanation:

The integer value 257 can be represented in binary as, 00000001 00000001. Remember that the INTEL machines are 'small-endian' machines. Small-endian means that the lower order bytes are stored in the higher memory addresses and the higher order bytes are stored in lower addresses. The integer value 258 is stored in memory as: 00000001 00000010.

```
150) main()
{
    int i=300;
    char *ptr = &i;
    *++ptr=2;
    printf("%d",i);
}
```

Answer:

556

Explanation:

The integer value 300 in binary notation is: 00000001 00101100. It is stored in memory (small-endian) as: 00101100 00000001. Result of the expression *++ptr = 2 makes the memory representation as: 00101100 00000010. So the integer corresponding to it is 00000010 00101100 => 556.

```
151) #include <stdio.h>
main()
{
    char * str = "hello";
    char * ptr = str;
    char least = 127;
    while (*ptr++)
        least = (*ptr < least) ? *ptr : least;
    printf("%d", least);
}
```

Answer:

0

Explanation:

After 'ptr' reaches the end of the string the value pointed by 'str' is '\0'. So the value of 'str' is less than that of 'least'. So the value of 'least' finally is 0.

- 152) Declare an array of N pointers to functions returning pointers to functions returning pointers to characters?

Answer:

```
(char*(*)( )) (*ptr[N])( );
```

- 153) main()

```
{
    struct student
    {
        char name[30];
        struct date dob;
    }stud;
    struct date
    {
        int day,month,year;
    };
    scanf("%s%d%d%d", stud.rollno, &student.dob.day, &student.dob.month,
    &student.dob.year);
}
```

Answer:

Compiler Error: Undefined structure date

Explanation:

Inside the struct definition of 'student' the member of type struct date is given. The compiler doesn't have the definition of date structure (forward reference is not allowed in C in this case) so it issues an error.

- 154) main()

```
{
    struct date;
    struct student
    {
        char name[30];
        struct date dob;
    }stud;
    struct date
    {
        int day,month,year;
    };
    scanf("%s%d%d%d", stud.rollno, &student.dob.day, &student.dob.month,
    &student.dob.year);
}
```

Answer:

Compiler Error: Undefined structure date

Explanation:

Only declaration of struct date is available inside the structure definition of 'student' but to have a variable of type struct date the definition of the structure is required.

- 155) There were 10 records stored in "somefile.dat" but the following program printed 11 names. What went wrong?

```
void main()
{
    struct student
    {
        char name[30], rollno[6];
    }stud;
    FILE *fp = fopen("somefile.dat","r");
    while(!feof(fp))
    {
        fread(&stud, sizeof(stud), 1 , fp);
        puts(stud.name);
    }
}
```

Explanation:

fread reads 10 records and prints the names successfully. It will return EOF only when fread tries to read another record and fails reading EOF (and returning EOF). So it prints the last record again. After this only the condition feof(fp) becomes false, hence comes out of the while loop.

- 156) Is there any difference between the two declarations,

1. int foo(int *arr[]) and
2. int foo(int *arr[2])

Answer:

No

Explanation:

Functions can only pass pointers and not arrays. The numbers that are allowed inside the [] is just for more readability. So there is no difference between the two declarations.

- 157) What is the subtle error in the following code segment?

```
void fun(int n, int arr[])
{
    int *p=0;
    int i=0;
    while(i++<n)
        p = &arr[i];
    *p = 0;
```

```
}
```

Answer & Explanation:

If the body of the loop never executes p is assigned no address. So p remains NULL where *p =0 may result in problem (may rise to runtime error “NULL pointer assignment” and terminate the program).

158) What is wrong with the following code?

```
int *foo()
{
    int *s = malloc(sizeof(int)100);
    assert(s != NULL);
    return s;
}
```

Answer & Explanation:

assert macro should be used for debugging and finding out bugs. The check s != NULL is for error/exception handling and for that assert shouldn't be used. A plain if and the corresponding remedy statement has to be given.

159) What is the hidden bug with the following statement?

```
assert(val++ != 0);
```

Answer & Explanation:

Assert macro is used for debugging and removed in release version. In assert, the expression involves side-effects. So the behavior of the code becomes different in case of debug version and the release version thus leading to a subtle bug.

Rule to Remember:

Don't use expressions that have side-effects in assert statements.

160) void main()

```
{
int *i = 0x400; // i points to the address 400
*i = 0;         // set the value of memory location pointed by i;
}
```

Answer:

Undefined behavior

Explanation:

The second statement results in undefined behavior because it points to some location whose value may not be available for modification. This type of pointer in which the non-availability of the implementation of the referenced location is known as 'incomplete type'.

161) #define assert(cond) if(!(cond)) \
(fprintf(stderr, "assertion failed: %s, file %s, line %d \n",#cond,\
__FILE__,__LINE__), abort())

```
void main()
{
```

```
int i = 10;
if(i==0)
    assert(i < 100);
else
    printf("This statement becomes else for if in assert macro");
}
```

Answer:

No output

Explanation:

The else part in which the printf is there becomes the else for if in the assert macro. Hence nothing is printed.

The solution is to use conditional operator instead of if statement,

```
#define assert(cond) ((cond)?(0): (fprintf (stderr, "assertion failed: \ %s, file %s, line %d \n",#cond, __FILE__,__LINE__), abort()))
```

Note:

However this problem of “matching with nearest else” cannot be solved by the usual method of placing the if statement inside a block like this,

```
#define assert(cond) { \
if(!(cond)) \
    (fprintf(stderr, "assertion failed: %s, file %s, line %d \n",#cond,\
__FILE__,__LINE__), abort()) \
}
```

162) Is the following code legal?

```
struct a
{
    int x;
    struct a b;
}
```

Answer:

No

Explanation:

Is it not legal for a structure to contain a member that is of the same type as in this case. Because this will cause the structure declaration to be recursive without end.

163) Is the following code legal?

```
struct a
{
    int x;
    struct a *b;
}
```

Answer:

Yes.

Explanation:

*b is a pointer to type struct a and so is legal. The compiler knows, the size of the pointer to a structure even before the size of the structure is determined(as you know the pointer to any type is of same size). This type of structures is known as 'self-referencing' structure.

164) Is the following code legal?

```
typedef struct a
{
    int x;
    aType *b;
}aType
```

Answer:

No

Explanation:

The typename aType is not known at the point of declaring the structure (forward references are not made for typedefs).

165) Is the following code legal?

```
typedef struct a aType;
struct a
{
    int x;
    aType *b;
};
```

Answer:

Yes

Explanation:

The typename aType is known at the point of declaring the structure, because it is already typedefed.

166) Is the following code legal?

```
void main()
{
    typedef struct a aType;
    aType someVariable;
    struct a
    {
        int x;
        aType *b;
    };
}
```

Answer:

No

Explanation:

When the declaration, typedef struct a aType;

is encountered body of struct a is not known. This is known as ‘incomplete types’.

```
167) void main()
{
printf("sizeof (void *) = %d \n", sizeof( void *));
printf("sizeof (int *)  = %d \n", sizeof(int *));
printf("sizeof (double *) = %d \n", sizeof(double *));
printf("sizeof(struct unknown *) = %d \n", sizeof(struct unknown *));
}
```

Answer :

```
sizeof (void *) = 2
sizeof (int *)  = 2
sizeof (double *) = 2
sizeof(struct unknown *) = 2
```

Explanation:

The pointer to any type is of same size.

```
168) char inputString[100] = {0};
To get string input from the keyboard which one of the following is better?
1) gets(inputString)
2) fgets(inputString, sizeof(inputString), fp)
```

Answer & Explanation:

The second one is better because gets(inputString) doesn't know the size of the string passed and so, if a very big input (here, more than 100 chars) the characters will be written past the input string. When fgets is used with stdin performs the same operation as gets but is safe.

```
169) Which version do you prefer of the following two,
1) printf("%s",str); // or the more curt one
2) printf(str);
```

Answer & Explanation:

Prefer the first one. If the str contains any format characters like %d then it will result in a subtle bug.

```
170) void main()
{
    int i=10, j=2;
    int *ip= &i, *jp = &j;
    int k = *ip/*jp;
    printf("%d",k);
}
```

Answer:

Compiler Error: “Unexpected end of file in comment started in line 5”.

Explanation:

The programmer intended to divide two integers, but by the “maximum munch” rule, the compiler treats the operator sequence / and * as /* which

happens to be the starting of comment. To force what is intended by the programmer,

```
int k = *ip/ *jp;  
// give space explicitly separating / and *  
//or  
int k = *ip/(*jp);  
// put braces to force the intention
```

will solve the problem.

171)

```
void main()  
{  
char ch;  
for(ch=0;ch<=127;ch++)  
printf("%c %d \n", ch, ch);  
}
```

Answer:

Implementaion dependent

Explanation:

The char type may be signed or unsigned by default. If it is signed then ch++ is executed after ch reaches 127 and rotates back to -128. Thus ch is always smaller than 127.

172) Is this code legal?

```
int *ptr;  
ptr = (int *) 0x400;
```

Answer:

Yes

Explanation:

The pointer ptr will point at the integer in the memory location 0x400.

173)

```
main()  
{  
char a[4]="HELLO";  
printf("%s",a);  
}
```

Answer:

Compiler error: Too many initializers

Explanation:

The array a is of size 4 but the string constant requires 6 bytes to get stored.

174)

```
main()  
{  
char a[4]="HELL";  
printf("%s",a);  
}
```

Answer:

HELL% @!~@!@???@~~!

Explanation:

The character array has the memory just enough to hold the string “HELL” and doesn't have enough space to store the terminating null character. So it prints the HELL correctly and continues to print garbage values till it accidentally comes across a NULL character.

```
175) main()
{
    int a=10,*j;
    void *k;
    j=k=&a;
    j++;
    k++;
    printf("\n %u %u ",j,k);
}
```

Answer:

Compiler error: Cannot increment a void pointer

Explanation:

Void pointers are generic pointers and they can be used only when the type is not known and as an intermediate address storage type. No pointer arithmetic can be done on it and you cannot apply indirection operator (*) on void pointers.

```
176) main()
{
    extern int i;
    {
        int i=20;
        {
            const volatile unsigned i=30; printf("%d",i);
        }
        printf("%d",i);
    }
    printf("%d",i);
}
int i;
```

177) Printf can be implemented by using _____ list.

Answer:

Variable length argument lists

```
178) char *someFun()
{
    char *temp = "string constant";
    return temp;
}
int main()
{
```



```
puts(someFun());  
}
```

Answer:

string constant

Explanation:

The program suffers no problem and gives the output correctly because the character constants are stored in code/data area and not allocated in stack, so this doesn't lead to dangling pointers.

```
179) char *someFun1()  
    {  
    char temp[ ] = "string";  
    return temp;  
    }  
    char *someFun2()  
    {  
    char temp[ ] = {'s', 't', 'r', 'i', 'n', 'g'};  
    return temp;  
    }  
    int main()  
    {  
    puts(someFun1());  
    puts(someFun2());  
    }
```

Answer:

Garbage values.

Explanation:

Both the functions suffer from the problem of dangling pointers. In someFun1() temp is a character array and so the space for it is allocated in heap and is initialized with character string "string". This is created dynamically as the function is called, so is also deleted dynamically on exiting the function so the string data is not available in the calling function main() leading to print some garbage values. The function someFun2() also suffers from the same problem but the problem can be easily identified in this case.

C++ Aptitude and OOPS

3

Note : All the programs are tested under Turbo C++ 3.0, 4.5 and Microsoft VC++ 6.0 compilers.

It is assumed that,

- Programs run under Windows environment,
- The underlying machine is an x86 based system,
- Program is compiled using Turbo C/C++ compiler.

The program output may depend on the information based on this assumptions (for example `sizeof(int) == 2` may be assumed).

```
1) class Sample
{
public:
    int *ptr;
    Sample(int i)
    {
        ptr = new int(i);
    }
    ~Sample()
    {
        delete ptr;
    }
    void PrintVal()
    {
        cout << "The value is " << *ptr;
    }
};

void SomeFunc(Sample x)
{
    cout << "Say i am in someFunc " << endl;
}

int main()
{
    Sample s1= 10;
    SomeFunc(s1);
    s1.PrintVal();
}
```

Answer:

Say i am in someFunc

Null pointer assignment(Run-time error)

Explanation:

As the object is passed by value to SomeFunc the destructor of the object is called when the control returns from the function. So when PrintVal is called it meets up with ptr that has been freed. The solution is to pass the Sample object by reference to SomeFunc:

```
void SomeFunc(Sample &x)
{
    cout << "Say i am in someFunc " << endl;
}
```

because when we pass objects by reference that object is not destroyed. while returning from the function.

2) Which is the parameter that is added to every non-static member function when it is called?

Answer:

‘this’ pointer

3) class base

```
{
    public:
    int bval;
    base(){ bval=0;}
};
```

class deri:public base

```
{
    public:
    int dval;
    deri(){ dval=1;}
};
```

void SomeFunc(base *arr,int size)

```
{
    for(int i=0; i<size; i++,arr++)
        cout<<arr->bval;
    cout<<endl;
}
```

int main()

```
{
    base BaseArr[5];
    SomeFunc(BaseArr,5);
    deri DeriArr[5];
    SomeFunc(DeriArr,5);
}
```

Answer:

00000
01010

Explanation:

The function SomeFunc expects two arguments. The first one is a pointer to an array of base class objects and the second one is the sizeof the array. The first call of someFunc calls it with an array of base objects, so it works correctly and prints the bval of all the objects. When Somefunc is called the second time the argument passed is the pointer to an array of derived class objects and not the array of base class objects. But that is what the function expects to be sent. So the derived class pointer is promoted to base class pointer and the address is sent to the function. SomeFunc() knows nothing about this and just treats the pointer as an array of base class objects. So when arr++ is met, the size of base class object is taken into consideration and is incremented by sizeof(int) bytes for bval (the derived class objects have bval and dval as members and so is of size $\geq \text{sizeof(int)} + \text{sizeof(int)}$).

```
4) class base
{
    public:
        void baseFun(){ cout<<"from base"<<endl;}
};
class deri:public base
{
    public:
        void baseFun(){ cout<<"from derived"<<endl;}
};
void SomeFunc(base *baseObj)
{
    baseObj->baseFun();
}
int main()
{
    base baseObject;
    SomeFunc(&baseObject);
    deri deriObject;
    SomeFunc(&deriObject);
}
```

Answer:

from base
from base

Explanation:

As we have seen in the previous case, SomeFunc expects a pointer to a base class. Since a pointer to a derived class object is passed, it treats the argument only as a base class pointer and the corresponding base function is called.

```
5) class base
{
    public:
```

```

        virtual void baseFun(){ cout<<"from base"<<endl;}
    };
class deri:public base
{
    public:
        void baseFun(){ cout<< "from derived"<<endl;}
};
void SomeFunc(base *baseObj)
{
    baseObj->baseFun();
}
int main()
{
    base baseObject;
    SomeFunc(&baseObject);
    deri deriObject;
    SomeFunc(&deriObject);
}

```

Answer:

```

    from base
    from derived

```

Explanation:

Remember that baseFunc is a virtual function. That means that it supports run-time polymorphism. So the function corresponding to the derived class object is called.

```

void main()
{
    int a, *pa, &ra;
    pa = &a;
    ra = a;
    cout <<"a="<<a <<"*pa="<<*pa <<"ra"<<ra ;
}
/*

```

Answer :

Compiler Error: 'ra',reference must be initialized

Explanation :

Pointers are different from references. One of the main differences is that the pointers can be both initialized and assigned, whereas references can only be initialized. So this code issues an error.

*/

```

const int size = 5;
void print(int *ptr)
{
    cout<<ptr[0];
}

```

```

}

void print(int ptr[size])
{
    cout<<ptr[0];
}

void main()
{
    int a[size] = {1,2,3,4,5};
    int *b = new int(size);
    print(a);
    print(b);
}
/*

```

Answer:

Compiler Error : function 'void print(int *)' already has a body

Explanation:

Arrays cannot be passed to functions, only pointers (for arrays, base addresses) can be passed. So the arguments `int *ptr` and `int prt[size]` have no difference as function arguments. In other words, both the functoins have the same signature and so cannot be overloaded.

*/

```

class some{
public:
    ~some()
    {
        cout<<"some's destructor"<<endl;
    }
};

```

```

void main()
{
    some s;
    s.~some();
}
/*

```

Answer:

some's destructor
some's destructor

Explanation:

Destructors can be called explicitly. Here '`s.~some()`' explicitly calls the destructor of '`s`'. When `main()` returns, destructor of `s` is called again, hence the result.

```

*/

#include <iostream.h>

class fig2d
{
    int dim1;
    int dim2;

public:
    fig2d() { dim1=5; dim2=6;}

    virtual void operator<<(ostream & rhs);
};

void fig2d::operator<<(ostream &rhs)
{
    rhs <<this->dim1<<" "<<this->dim2<<" ";
}

/*class fig3d : public fig2d
{
    int dim3;
public:
    fig3d() { dim3=7;}
    virtual void operator<<(ostream &rhs);
};

void fig3d::operator<<(ostream &rhs)
{
    fig2d::operator <<(rhs);
    rhs<<this->dim3;
}
*/

void main()
{
    fig2d obj1;
    // fig3d obj2;

    obj1 << cout;
    // obj2 << cout;
}
/*

```

Answer :

5 6

Explanation:

In this program, the << operator is overloaded with ostream as argument. This enables the 'cout' to be present at the right-hand-side. Normally, 'cout' is implemented as global function, but it doesn't mean that 'cout' is not possible to be overloaded as member function.

Overloading << as virtual member function becomes handy when the class in which it is overloaded is inherited, and this becomes available to be overridden. This is as opposed to global friend functions, where friend's are not inherited.
*/

```
class opOverload{
public:
    bool operator==(opOverload temp);
};

bool opOverload::operator==(opOverload temp){
    if(*this == temp ){
        cout<<"The both are same objects\n";
        return true;
    }
    else{
        cout<<"The both are different\n";
        return false;
    }
}

void main(){
    opOverload a1, a2;
    a1==a2;
}
```

Answer :

Runtime Error: Stack Overflow

Explanation :

Just like normal functions, operator functions can be called recursively. This program just illustrates that point, by calling the operator == function recursively, leading to an infinite loop.

```
class complex{
    double re;
    double im;
public:
    complex() : re(1),im(0.5) {}
    bool operator==(complex &rhs);
    operator int(){}
};
```



```

bool complex::operator==(complex &rhs){
    if((this->re == rhs.re) && (this->im == rhs.im))
        return true;
    else
        return false;
}

int main(){
    complex c1;
    cout<< c1;
}

```

Answer : Garbage value

Explanation:

The programmer wishes to print the complex object using output re-direction operator, which he has not defined for his class. But the compiler instead of giving an error sees the conversion function and converts the user defined object to standard object and prints some garbage value.

```

class complex{
    double re;
    double im;
public:
    complex() : re(0),im(0) {}
    complex(double n) { re=n,im=n;};
    complex(int m,int n) { re=m,im=n;}
    void print() { cout<<re; cout<<im;}
};

void main(){
    complex c3;
    double i=5;
    c3 = i;
    c3.print();
}

```

Answer:

5,5

Explanation:

Though no operator= function taking complex, double is defined, the double on the rhs is converted into a temporary object using the single argument constructor taking double and assigned to the lvalue.

```

void main()
{
    int a, *pa, &ra;
    pa = &a;
    ra = a;
    cout <<"a="<<a <<"*pa="<<*pa <<"ra"<<ra ;
}

```

Answer :

Compiler Error: 'ra',reference must be initialized

Explanation :

Pointers are different from references. One of the main differences is that the pointers can be both initialized and assigned, whereas references can only be initialized. So this code issues an error.

Try it Yourself

1) Determine the output of the 'C++' Codelet.

```

class base
{
public :
    out()
    {
        cout<<"base ";
    }
};
class deri{
public : out()
{
    cout<<"deri ";
}
};
void main()
{
    deri dp[3];
    base *bp = (base*)dp;
    for (int i=0; i<3;i++)
        (bp++)->out();
}

```

2) Justify the use of virtual constructors and destructors in C++.

3) Each C++ object possesses the 4 member fns,(which can be declared by the programmer explicitly or by the implementation if they are not available). What are those 4 functions?

4) What is wrong with this class declaration?

```

class something
{
    char *str;
public:
    something(){
        st = new char[10]; }
    ~something()
    {
        delete str;
    }
};

```

5) Inheritance is also known as ----- relationship. Containership as _____ relationship.

6) When is it necessary to use member-wise initialization list (also known as header initialization list) in C++?

7) Which is the only operator in C++ which can be overloaded but NOT inherited.

8) Is there anything wrong with this C++ class declaration?

```

class temp
{
    int value1;
    mutable int value2;
public :
    void fun(int val)
    const{
        ((temp*) this)->value1 = 10;
        value2 = 10;
    }
};

```

1. What is a modifier?

Answer:

A modifier, also called a modifying function is a member function that changes the value of at least one data member. In other words, an operation that modifies the state of an object. Modifiers are also known as 'mutators'.

2. What is an accessor?

Answer:

An accessor is a class operation that does not modify the state of an object. The accessor functions need to be declared as const operations

3. Differentiate between a template class and class template.

Answer:

Template class:

A generic definition or a parameterized class not instantiated until the client provides the needed information. It's jargon for plain templates.

Class template:

A class template specifies how individual classes can be constructed much like the way a class specifies how individual objects can be constructed. It's jargon for plain classes.

4. When does a name clash occur?

Answer:

A name clash occurs when a name is defined in more than one place. For example., two different class libraries could give two different classes the same name. If you try to use many class libraries at the same time, there is a fair chance that you will be unable to compile or link the program because of name clashes.

5. Define namespace.

Answer:

It is a feature in c++ to minimize name collisions in the global name space. This namespace keyword assigns a distinct name to a library that allows other libraries to use the same identifier names without creating any name collisions. Furthermore, the compiler uses the namespace signature for differentiating the definitions.

6. What is the use of 'using' declaration.

Answer:

A using declaration makes it possible to use a name from a namespace without the scope operator.

7. What is an Iterator class?

Answer:

A class that is used to traverse through the objects maintained by a container class. There are five categories of iterators:

- input iterators,
- output iterators,
- forward iterators,

- bidirectional iterators,
- random access.

An iterator is an entity that gives access to the contents of a container object without violating encapsulation constraints. Access to the contents is granted on a one-at-a-time basis in order. The order can be storage order (as in lists and queues) or some arbitrary order (as in array indices) or according to some ordering relation (as in an ordered binary tree). The iterator is a construct, which provides an interface that, when called, yields either the next element in the container, or some value denoting the fact that there are no more elements to examine. Iterators hide the details of access to and update of the elements of a container class.

The simplest and safest iterators are those that permit read-only access to the contents of a container class. The following code fragment shows how an iterator might appear in code:

```
cont_iter:=new cont_iterator();
x:=cont_iter.next();
while x/=none do
    ...
    s(x);
    ...
    x:=cont_iter.next();
end;
```

In this example, `cont_iter` is the name of the iterator. It is created on the first line by instantiation of `cont_iterator` class, an iterator class defined to iterate over some container class, `cont`. Successive elements from the container are carried to `x`. The loop terminates when `x` is bound to some empty value. (Here, `none`) In the middle of the loop, there is `s(x)` an operation on `x`, the current element from the container. The next element of the container is obtained at the bottom of the loop.

9. List out some of the OODBMS available.

Answer:

- GEMSTONE/OPAL of Gemstone systems.
- ONTOS of Ontos.
- Objectivity of Objectivity inc.
- Versant of Versant object technology.
- Object store of Object Design.
- ARDENT of ARDENT software.
- POET of POET software.

10. List out some of the object-oriented methodologies.

Answer:

- Object Oriented Development (OOD) (Booch 1991,1994).
- Object Oriented Analysis and Design (OOA/D) (Coad and Yourdon 1991).
- Object Modelling Techniques (OMT) (Rumbaugh 1991).
- Object Oriented Software Engineering (Objectory) (Jacobson 1992).
- Object Oriented Analysis (OOA) (Shlaer and Mellor 1992).
- The Fusion Method (Coleman 1991).

11. What is an incomplete type?

Answer:

Incomplete types refers to pointers in which there is non availability of the implementation of the referenced location or it points to some location whose value is not available for modification.

Example:

```
int *i=0x400 // i points to address 400
*i=0;        //set the value of memory location pointed by i.
```

Incomplete types are otherwise called uninitialized pointers.

12. What is a dangling pointer?

Answer:

A dangling pointer arises when you use the address of an object after its lifetime is over. This may occur in situations like returning addresses of the automatic variables from a function or using the address of the memory block after it is freed.

13. Differentiate between the message and method.

Answer:

Message	Method
Objects communicate by sending messages to each other.	Provides response to a message.
A message is sent to invoke a method.	It is an implementation of an operation.

14. What is an adaptor class or Wrapper class?

Answer:

A class that has no functionality of its own. Its member functions hide the use of a third party software component or an object with the non-compatible interface or a non- object-oriented implementation.

15. What is a Null object?

Answer:

It is an object of some class whose purpose is to indicate that a real object of that class does not exist. One common use for a null object is a return value from a member function that is supposed to return an object with some specified properties but cannot find such an object.

16. What is class invariant?

Answer:

A class invariant is a condition that defines all valid states for an object. It is a logical condition to ensure the correct working of a class. Class invariants must hold when an object is created, and they must be preserved under all operations of the class. In particular all class invariants are both preconditions and post-conditions for all operations or member functions of the class.

17. What do you mean by Stack unwinding?

Answer:

It is a process during exception handling when the destructor is called for all local objects between the place where the exception was thrown and where it is caught.

18. Define precondition and post-condition to a member function.

Answer:

Precondition:

A precondition is a condition that must be true on entry to a member function. A class is used correctly if preconditions are never false. An operation is not responsible for doing anything sensible if its precondition fails to hold.

For example, the interface invariants of stack class say nothing about pushing yet another element on a stack that is already full. We say that `isful()` is a precondition of the push operation.

Post-condition:

A post-condition is a condition that must be true on exit from a member function if the precondition was valid on entry to that function. A class is implemented correctly if post-conditions are never false.

For example, after pushing an element on the stack, we know that `isempty()` must necessarily hold. This is a post-condition of the push operation.

19. What are the conditions that have to be met for a condition to be an invariant of the class?

Answer:

- The condition should hold at the end of every constructor.
- The condition should hold at the end of every mutator(non-const) operation.

20. What are proxy objects?

Answer:

Objects that stand for other objects are called proxy objects or surrogates.

Example:

```
template<class T>
class Array2D
{
    public:
        class Array1D
        {
            public:
                T& operator[] (int index);
                const T& operator[] (int index) const;
                ...
        };
        Array1D operator[] (int index);
        const Array1D operator[] (int index) const;
        ...
};
```

The following then becomes legal:

```
Array2D<float>data(10,20);
.....
cout<<data[3][6];    // fine
```

Here data[3] yields an Array1D object and the operator [] invocation on that object yields the float in position(3,6) of the original two dimensional array. Clients of the Array2D class need not be aware of the presence of the Array1D class. Objects of this latter class stand for one-dimensional array objects that, conceptually, do not exist for clients of Array2D. Such clients program as if they were using real, live, two-dimensional arrays. Each Array1D object stands for a one-dimensional array that is absent from a conceptual model used by the clients of Array2D. In the above example, Array1D is a proxy class. Its instances stand for one-dimensional arrays that, conceptually, do not exist.

21. Name some pure object oriented languages.

Answer:

- Smalltalk,
- Java,
- Eiffel,
- Sather.

22. Name the operators that cannot be overloaded.

Answer:

sizeof . .* .-> :: ?:

23. What is a node class?

Answer:

A node class is a class that,

- relies on the base class for services and implementation,
- provides a wider interface to the users than its base class,
- relies primarily on virtual functions in its public interface
- depends on all its direct and indirect base class
- can be understood only in the context of the base class
- can be used as base for further derivation
- can be used to create objects.

A node class is a class that has added new services or functionality beyond the services inherited from its base class.

24. What is an orthogonal base class?

Answer:

If two base classes have no overlapping methods or data they are said to be independent of, or orthogonal to each other. Orthogonal in the sense means that two classes operate in different dimensions and do not interfere with each other in any way. The same derived class may inherit such classes with no difficulty.

25. What is a container class? What are the types of container classes?

Answer:

A container class is a class that is used to hold objects in memory or external storage. A container class acts as a generic holder. A container class has a predefined behavior and a well-known interface. A container class is a supporting class whose purpose is to hide the topology

used for maintaining the list of objects in memory. When a container class contains a group of mixed objects, the container is called a heterogeneous container; when the container is holding a group of objects that are all the same, the container is called a homogeneous container.

26. What is a protocol class?

Answer:

An abstract class is a protocol class if:

- it neither contains nor inherits from classes that contain member data, non-virtual functions, or private (or protected) members of any kind.
- it has a non-inline virtual destructor defined with an empty implementation,
- all member functions other than the destructor including inherited functions, are declared pure virtual functions and left undefined.

27. What is a mixin class?

Answer:

A class that provides some but not all of the implementation for a virtual base class is often called mixin. Derivation done just for the purpose of redefining the virtual functions in the base classes is often called mixin inheritance. Mixin classes typically don't share common bases.

28. What is a concrete class?

Answer:

A concrete class is used to define a useful object that can be instantiated as an automatic variable on the program stack. The implementation of a concrete class is defined. The concrete class is not intended to be a base class and no attempt to minimize dependency on other classes in the implementation or behavior of the class.

29. What is the handle class?

Answer:

A handle is a class that maintains a pointer to an object that is programmatically accessible through the public interface of the handle class.

Explanation:

In case of abstract classes, unless one manipulates the objects of these classes through pointers and references, the benefits of the virtual functions are lost. User code may become dependent on details of implementation classes because an abstract type cannot be allocated statically or on the stack without its size being known. Using pointers or references implies that the burden of memory management falls on the user. Another limitation of abstract class object is of fixed size. Classes however are used to represent concepts that require varying amounts of storage to implement them.

A popular technique for dealing with these issues is to separate what is used as a single object in two parts: a handle providing the user interface and a representation holding all or most of the object's state. The connection between the handle and the representation is typically a pointer in the handle. Often, handles have a bit more data than the simple representation pointer, but not much more. Hence the layout of the handle is typically stable, even when the representation changes and also that handles are small enough to move around relatively freely so that the user needn't use the pointers and the references.

30. What is an action class?

Answer:

The simplest and most obvious way to specify an action in C++ is to write a function. However, if the action has to be delayed, has to be transmitted 'elsewhere' before being performed, requires its own data, has to be combined with other actions, etc then it often becomes attractive to provide the action in the form of a class that can execute the desired action and provide other services as well. Manipulators used with iostreams is an obvious example.

Explanation:

A common form of action class is a simple class containing just one virtual function.

```
class Action
{
    public:
        virtual int do_it( int )=0;
        virtual ~Action( );
}
```

Given this, we can write code say a member that can store actions for later execution without using pointers to functions, without knowing anything about the objects involved, and without even knowing the name of the operation it invokes. For example:

class write_file : public Action

```
{
    File& f;
    public:
        int do_it(int)
        {
            return f.write( ).succeed( );
        }
};
```

class error_message: public Action

```
{
    response_box db(message.cstr( ), "Continue", "Cancel", "Retry");
    switch (db.getresponse( ))
    {
        case 0: return 0;
        case 1: abort();
        case 2: current_operation.redo( );return 1;
    }
};
```

A user of the Action class will be completely isolated from any knowledge of derived classes such as write_file and error_message.

31. When can you tell that a memory leak will occur?

Answer:

A memory leak occurs when a program loses the ability to free a block of dynamically allocated memory.

32. What is a parameterized type?

Answer:

A template is a parameterized construct or type containing generic code that can use or manipulate any type. It is called parameterized because an actual type is a parameter of the code body. Polymorphism may be achieved through parameterized types. This type of polymorphism is called parameteric polymorphism. Parameteric polymorphism is the mechanism by which the same code is used on different types passed as parameters.

33. Differentiate between a deep copy and a shallow copy?

Answer:

Deep copy involves using the contents of one object to create another instance of the same class. In a deep copy, the two objects may contain the same information but the target object will have its own buffers and resources. The destruction of either object will not affect the remaining object. The overloaded assignment operator would create a deep copy of objects.

Shallow copy involves copying the contents of one object into another instance of the same class thus creating a mirror image. Owing to straight copying of references and pointers, the two objects will share the same externally contained contents of the other object to be unpredictable.

Explanation:

Using a copy constructor we simply copy the data values member by member. This method of copying is called shallow copy. If the object is a simple class, comprised of built in types and no pointers this would be acceptable. This function would use the values and the objects and its behavior would not be altered with a shallow copy, only the addresses of pointers that are members are copied and not the value the address is pointing to. The data values of the object would then be inadvertently altered by the function. When the function goes out of scope, the copy of the object with all its data is popped off the stack.

If the object has any pointers a deep copy needs to be executed. With the deep copy of an object, memory is allocated for the object in free store and the elements pointed to are copied. A deep copy is used for objects that are returned from a function.

34. What is an opaque pointer?

Answer:

A pointer is said to be opaque if the definition of the type to which it points to is not included in the current translation unit. A translation unit is the result of merging an implementation file with all its headers and header files.

35. What is a smart pointer?

Answer:

A smart pointer is an object that acts, looks and feels like a normal pointer but offers more functionality. In C++, smart pointers are implemented as template classes that encapsulate a pointer and override standard pointer operators. They have a number of advantages over regular pointers. They are guaranteed to be initialized as either null pointers or pointers to a heap object. Indirection through a null pointer is checked. No delete is ever necessary. Objects are automatically freed when the last pointer to them has gone away. One significant problem with these smart pointers is that unlike regular pointers, they don't respect inheritance. Smart pointers

are unattractive for polymorphic code. Given below is an example for the implementation of smart pointers.

Example:

```
template <class X>
class smart_pointer
{
    public:
        smart_pointer();           // makes a null pointer
        smart_pointer(const X& x)   // makes pointer to copy of x

        X& operator *( );
        const X& operator*( ) const;
        X* operator->() const;

        smart_pointer(const smart_pointer <X> &);
        const smart_pointer <X> & operator =(const smart_pointer<X>&);
        ~smart_pointer();
    private:
        //...
};
```

This class implement a smart pointer to an object of type X. The object itself is located on the heap. Here is how to use it:

```
smart_pointer <employee> p= employee("Harris",1333);
Like other overloaded operators, p will behave like a regular pointer,
cout<<*p;
p->raise_salary(0.5);
```

36. What is reflexive association?

Answer:

The 'is-a' is called a reflexive association because the reflexive association permits classes to bear the is-a association not only with their super-classes but also with themselves. It differs from a 'specializes-from' as 'specializes-from' is usually used to describe the association between a super-class and a sub-class. For example:

Printer is-a printer.

37. What is slicing?

Answer:

Slicing means that the data added by a subclass are discarded when an object of the subclass is passed or returned by value or from a function expecting a base class object.

Explanation:

Consider the following class declaration:

```
class base
{
    ...
    base& operator =(const base&);
    base (const base&);
```

```

    }
    void fun( )
    {
        base e=m;
        e=m;
    }

```

As base copy functions don't know anything about the derived only the base part of the derived is copied. This is commonly referred to as slicing. One reason to pass objects of classes in a hierarchy is to avoid slicing. Other reasons are to preserve polymorphic behavior and to gain efficiency.

38. What is name mangling?

Answer:

Name mangling is the process through which your c++ compilers give each function in your program a unique name. In C++, all programs have at-least a few functions with the same name. Name mangling is a concession to the fact that linker always insists on all function names being unique.

Example:

In general, member names are made unique by concatenating the name of the member with that of the class e.g. given the declaration:

```

class Bar
{
    public:
        int ival;
    ...
};

```

ival becomes something like:

```

// a possible member name mangling
ival__3Bar

```

Consider this derivation:

```

class Foo : public Bar
{
    public:
        int ival;
    ...
}

```

The internal representation of a Foo object is the concatenation of its base and derived class members.

```

// Pseudo C++ code
// Internal representation of Foo
class Foo
{
    public:
        int ival__3Bar;
        int ival__3Foo;
    ...
}

```

};

Unambiguous access of either ival members is achieved through name mangling. Member functions, because they can be overloaded, require an extensive mangling to provide each with a unique name. Here the compiler generates the same name for the two overloaded instances(Their argument lists make their instances unique).

39. What are proxy objects?

Answer:

Objects that points to other objects are called proxy objects or surrogates. Its an object that provides the same interface as its server object but does not have any functionality. During a method invocation, it routes data to the true server object and sends back the return value to the object.

40. Differentiate between declaration and definition in C++.

Answer:

A declaration introduces a name into the program; a definition provides a unique description of an entity (e.g. type, instance, and function). Declarations can be repeated in a given scope, it introduces a name in a given scope. There must be exactly one definition of every object, function or class used in a C++ program.

A declaration is a definition unless:

- it declares a function without specifying its body,
- it contains an extern specifier and no initializer or function body,
- it is the declaration of a static class data member without a class definition,
- it is a class name definition,
- it is a typedef declaration.

A definition is a declaration unless:

- it defines a static class data member,
- it defines a non-inline member function.

41. What is cloning?

Answer:

An object can carry out copying in two ways i.e. it can set itself to be a copy of another object, or it can return a copy of itself. The latter process is called cloning.

42. Describe the main characteristics of static functions.

Answer:

The main characteristics of static functions include,

- It is without the a this pointer,
- It can't directly access the non-static members of its class
- It can't be declared const, volatile or virtual.
- It doesn't need to be invoked through an object of its class, although for convenience, it may.

43. Will the inline function be compiled as the inline function always? Justify.

Answer:

An inline function is a request and not a command. Hence it won't be compiled as an inline function always.

Explanation:

Inline-expansion could fail if the inline function contains loops, the address of an inline function is used, or an inline function is called in a complex expression. The rules for inlining are compiler dependent.

44. Define a way other than using the keyword inline to make a function inline.

Answer:

The function must be defined inside the class.

45. How can a '::' operator be used as unary operator?

Answer:

The scope operator can be used to refer to members of the global namespace. Because the global namespace doesn't have a name, the notation :: member-name refers to a member of the global namespace. This can be useful for referring to members of global namespace whose names have been hidden by names declared in nested local scope. Unless we specify to the compiler in which namespace to search for a declaration, the compiler simply searches the current scope, and any scopes in which the current scope is nested, to find the declaration for the name.

46. What is placement new?

Answer:

When you want to call a constructor directly, you use the placement new. Sometimes you have some raw memory that's already been allocated, and you need to construct an object in the memory you have. Operator new's special version placement new allows you to do it.

```
class Widget
{
    public :
        Widget(int widgetsized);
        ...
        Widget* Construct_widget_int_buffer(void *buffer,int widgetsized)
        {
            return new(buffer) Widget(widgetsized);
        }
};
```

This function returns a pointer to a Widget object that's constructed within the buffer passed to the function. Such a function might be useful for applications using shared memory or memory-mapped I/O, because objects in such applications must be placed at specific addresses or in memory allocated by special routines.

OOAD

1. What do you mean by analysis and design?

Analysis:

Basically, it is the process of determining what needs to be done before how it should be done. In order to accomplish this, the developer refers the existing systems and

documents. So, simply it is an art of discovery.

Design:

It is the process of adopting/choosing the one among the many, which best accomplishes the users needs. So, simply, it is compromising mechanism.

2. What are the steps involved in designing?

Before getting into the design the designer should go through the SRS prepared by the System Analyst.

The main tasks of design are Architectural Design and Detailed Design.

In Architectural Design we find what are the main modules in the problem domain.

In Detailed Design we find what should be done within each module.

3. What are the main underlying concepts of object orientation?

Objects, messages, class, inheritance and polymorphism are the main concepts of object orientation.

4. What do u meant by "SBI" of an object?

SBI stands for State, Behavior and Identity. Since every object has the above three.

➤ State:

It is just a value to the attribute of an object at a particular time.

➤ Behaviour:

It describes the actions and their reactions of that object.

➤ Identity:

An object has an identity that characterizes its own existence. The identity makes it possible to distinguish any object in an unambiguous way, and independently from its state.

5. Differentiate persistent & non-persistent objects?

Persistent refers to an object's ability to transcend time or space. A persistent object stores/saves its state in a permanent storage system with out losing the information represented by the object.

A non-persistent object is said to be transient or ephemeral. By default objects are considered as non-persistent.

6. What do you meant by active and passive objects?

Active objects are one which instigate an interaction which owns a thread and they are responsible for handling control to other objects. In simple words it can be referred as client.

Passive objects are one, which passively waits for the message to be processed. It waits for another object that requires its services. In simple words it can be referred as server.

Diagram:

client server
(Active) (Passive)

7. What is meant by software development method?

Software development method describes how to model and build software systems in a reliable and reproducible way. To put it simple, methods that are used to represent ones' thinking

using graphical notations.

8. What are models and meta models?

Model:

It is a complete description of something (i.e. system).

Meta model:

It describes the model elements, syntax and semantics of the notation that allows their manipulation.

9. What do you mean by static and dynamic modeling?

Static modeling is used to specify structure of the objects that exist in the problem domain. These are expressed using class, object and USECASE diagrams.

But Dynamic modeling refers representing the object interactions during runtime. It is represented by sequence, activity, collaboration and statechart diagrams.

10. How to represent the interaction between the modeling elements?

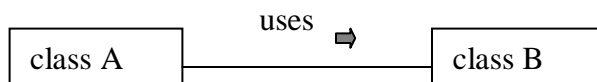
Model element is just a notation to represent (Graphically) the entities that exist in the problem domain. e.g. for modeling element is class notation, object notation etc.

Relationships are used to represent the interaction between the modeling elements.

The following are the Relationships.

➤ Association: It's just a semantic connection two classes.

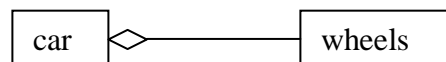
e.g.:



➤ Aggregation: It's the relationship between two classes which are related in the fashion that master and slave. The master takes full rights than the slave. Since the slave works under the master. It is represented as line with diamond in the master area.

ex:

car contains wheels, etc.



➤ Containment: This relationship is applied when the part contained within the whole part, dies when the whole part dies.

It is represented as darkened diamond at the whole part.

example:

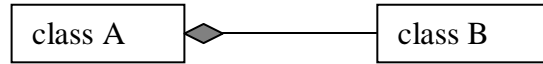
```
class A{
//some code
};
```

```
class B
{
```

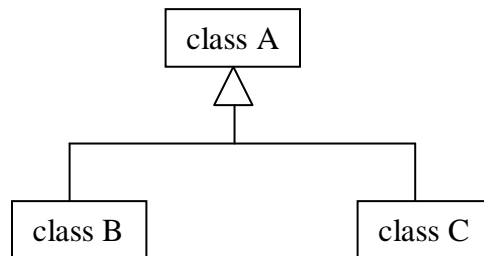
```
    A aa; // an object of class A;
    // some code for class B;
```

};

In the above example we see that an object of class A is instantiated within the class B. so the object class A dies when the object class B dies. we can represent it in diagram like this.



- Generalization: This relationship is used when we want to represent a class, which captures the common states of objects of different classes. It is represented as an arrow line pointed at the class, which has captured the common states.



- Dependency: It is the relationship between dependent and independent classes. Any change in the independent class will affect the states of the dependent class.

DIAGRAM:

class A class B

11. Why generalization is very strong?

Even though Generalization satisfies Structural, Interface, Behaviour properties. It is mathematically very strong, as it is Antisymmetric and Transitive.

Antisymmetric: employee is a person, but not all persons are employees. Mathematically all As' are B, but all Bs' not A.

Transitive: $A \Rightarrow B$, $B \Rightarrow C$ then $A \Rightarrow C$.

A. Salesman.

B. Employee.

C. Person.

Note: All the other relationships satisfy all the properties like Structural properties, Interface properties, Behaviour properties.

12. Differentiate Aggregation and containment?

Aggregation is the relationship between the whole and a part. We can add/subtract some properties in the part (slave) side. It won't affect the whole part.

Best example is Car, which contains the wheels and some extra parts. Even though the parts are not there we can call it as car.

But, in the case of containment the whole part is affected when the part within that got affected. The human body is an apt example for this relationship. When the whole body dies the parts (heart etc) are died.

13. Can link and Association applied interchangeably?

No, You cannot apply the link and Association interchangeably. Since link is used represent the relationship between the two objects.

But Association is used represent the relationship between the two classes.

link :: student:Abhilash course:MCA

Association:: student course

14. what is meant by "method-wars"?

Before 1994 there were different methodologies like Rumbaugh, Booch, Jacobson, Meyer etc who followed their own notations to model the systems. The developers were in a dilemma to choose the method which best accomplishes their needs. This particular span was called as "method-wars"

15. Whether unified method and unified modeling language are same or different?

Unified method is convergence of the Rumbaugh and Booch.

Unified modeling lang. is the fusion of Rumbaugh, Booch and Jacobson as well as Betrand Meyer (whose contribution is "sequence diagram"). Its' the superset of all the methodologies.

16. Who were the three famous amigos and what was their contribution to the object community?

The Three amigos namely,

- James Rumbaugh (OMT): A veteran in analysis who came up with an idea about the objects and their Relationships (in particular Associations).
- Grady Booch: A veteran in design who came up with an idea about partitioning of systems into subsystems.
- Ivar Jacobson (Objectory): The father of USECASES, who described about the user and system interaction.

17. Differentiate the class representation of Booch, Rumbaugh and UML?

If you look at the class representaiton of Rumbaugh and UML, It is some what similar and both are very easy to draw.

Representation: OMT

UML.

Diagram:

Booch: In this method classes are represented as "Clouds" which are not very easy to draw as for as the developer's view is concern.

Diagram:

18. What is an USECASE? Why it is needed?

A Use Case is a description of a set of sequence of actions that a system performs that yields an observable result of value to a particular action.

In SSAD process <=> In OOAD USECASE. It is represented elliptically.

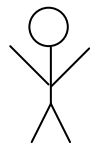
Representation:

19. Who is an Actor?

An Actor is someone or something that must interact with the system. In addition to that an Actor initiates the process (that is USECASE).

It is represented as a stickman like this.

Diagram:



20. What is guard condition?

Guard condition is one, which acts as a firewall. The access from a particular object can be made only when the particular condition is met.

For Example,

customer check customer number ATM.

Here the object on the customer accesses the ATM facility only when the guard condition is met.

21. Differentiate the following notations?

I: :obj1 :obj2

II: :obj1 :obj2

In the above representation I, obj1 sends message to obj2. But in the case of II the data is transferred from obj1 to obj2.

22. USECASE is an implementation independent notation. How will the designer give the implementation details of a particular USECASE to the programmer?

This can be accomplished by specifying the relationship called "refinement" which talks about the two different abstraction of the same thing.

Or example,

calculate pay

calculate

class1 class2 class3

23. Suppose a class acts an Actor in the problem domain, how to represent it in the static model?

In this scenario you can use “stereotype”. Since stereotype is just a string that gives extra semantic to the particular entity/model element. It is given with in the << >>.

```
class A
<< Actor>>
attributes

methods.
```

24. Why does the function arguments are called as "signatures"?

The arguments distinguish functions with the same name (functional polymorphism). The name alone does not necessarily identify a unique function. However, the name and its arguments (signatures) will uniquely identify a function.

In real life we see suppose, in class there are two guys with same name, but they can be easily identified by their signatures. The same concept is applied here.

ex:

```
class person
{
    public:
        char getsex();
        void setsex(char);
        void setsex(int);
};
```

In the above example we see that there is a function setsex() with same name but with different signature.