1. What is a constructor? Name and explain the different types of constructor with example program.(10M)

- A constructor initializes an object immediately upon creation.
- It has the same name as the class in which it resides and is syntactically similar to a method.
- Once defined, the constructor is automatically called when the object is created, before the new operator completes.
- Constructors no return type, not even void. This is because the implicit return type of a class' constructor is the class type itself.
- It is the constructor's job to initialize the internal state of an object so that the code creating an instance will have a fully initialized, usable object immediately.

Types of Constructors
1.*Default Constructor*
2.*Parameterised constructor*

Default Constructor : When the constructor is not define explicitly for a class, then Java creates a default constructor for the class.

- The default constructor automatically initializes all instance variables to their default values, which are zero, null, and false, for numeric types, reference types, and boolean, respectively.

.*Parameterised constructor:* Constructor with arguments(or you can say parameters) is known as Parameterized constructor

Example

```
class Box {
double width;
double height;
double depth;

Box() { // This is Default constructor for Box.

System.out.println("Constructing Box");
width = 10;
height = 10;
depth = 10;
}
Box(double w, double h, double d) { // This is parameter constructor for Box.
width = w;
height = h;
depth = d;
}
// compute and return volume
double volume() {
return width * height * depth;
}
}
class BoxDemo7 {
public static void main(String args[]) {
// declare, allocate, and initialize Box objects
Box mybox1 = new Box()
Box mybox2 = new Box(10, 20, 15);
```

```
double vol;
// get volume of first box
vol = mybox1.volume();
System.out.println("Volume is " + vol);
// get volume of second box
vol = mybox2.volume();
System.out.println("Volume is " + vol);
}
}
```

Output

```
Constructing Box
Volume is 1000.0
Volume is 3000.0
```

2. List and explain the uses of the keyword 'super' with Java programs. (10M)

- Whenever a subclass needs to refer to its immediate superclass, it can do so by use of the keyword super.
- super has two general forms.
  - The first calls the superclass' constructor.
  - The second is used to access a member of the superclass that has been hidden by a member of a subclass.

Using super to Call Superclass Constructors

A subclass can call a constructor defined by its superclass by use of the following form of super:

super(arg-list);

- Here, arg-list specifies any arguments needed by the constructor in the superclass.
- super( ) must always be the first statement executed inside a subclass' constructor.

Example

```
class Box {
private double width;
private double height;
private double depth;
// construct clone of an object
Box(Box ob) { // pass object to constructor
width = ob.width;
height = ob.height;
depth = ob.depth;
```

```
}
// constructor used when all dimensions specified
Box(double w, double h, double d) {
width = w;
height = h;
depth = d;
}
// constructor used when no dimensions specified
Box() {
width = -1; // use -1 to indicate
height = -1; // an uninitialized
depth = -1; // box
}
// compute and return volume
double volume() {
return width * height * depth;
}
}
// BoxWeight now fully implements all constructors.
class BoxWeight extends Box {
double weight; // weight of box
// constructor when all parameters are specified
BoxWeight(double w, double h, double d, double m) {
    super(w, h, d); // call superclass constructor
    weight = m;
    }
    // default constructor
    BoxWeight() {
    super();
    weight = -1;
    }
    }
    class DemoSuper {
```

```
public static void main(String args[]) {
BoxWeight mybox1 = new BoxWeight(10, 20, 15, 34.3);
BoxWeight mybox3 = new BoxWeight(); // default
double vol;
vol = mybox1.volume();
System.out.println("Volume of mybox1 is " + vol);
System.out.println("Weight of mybox1 is " + mybox1.weight);
System.out.println();
vol = mybox3.volume();
System.out.println("Volume of mybox3 is " + vol);
System.out.println("Weight of mybox3 is " + mybox3.weight);
System.out.println();
}
}
```

Second use of super to access a member of the superclass:

- The second form of super always refers to the superclass of the subclass in which it is used.

The general form is
super.member

- Here, member can be either a method or an instance variable. The second form of super is most

applicable to situations in which member names of a subclass hide members by the same name in the superclass.
Example:

```
/ Using super to overcome name hiding.
class A {
int i;
}
// Create a subclass by extending class A.
class B extends A {
int i; // this i hides the i in A
B(int a, int b) {
super.i = a; // i in A
i = b; // i in B
}
void show() {
System.out.println("i in superclass: " + super.i);
System.out.println("i in subclass: " + i);
}
}
class UseSuper {
public static void main(String args[]) {
B subOb = new B(1, 2);
subOb.show();
}
```

```
}
```
This program displays the following:
i in superclass: 1
i in subclass: 2

3.Distinguish between method overloading and method overriding. Write Java programs to demonstrate the use of method overloading and method overriding. (10M)

Having more than one method with a same name is called as **method overloading**. To implement this concept, the constraints are:

- The number of arguments should be different, and/or
- Type of the arguments must be different.

```
class Overload
{
void test() //method without any arguments
{
System.out.println("No parameters");
}
void test(int a) //method with one integer argument
{
System.out.println("Integer a: " + a);
}
void test(int a, int b) //two arguments
{
System.out.println("With two arguments : " + a + " " + b);
}
void test(double a) //one argument of double type
{
System.out.println("double a: " + a);
}
}
class OverloadDemo
{
public static void main(String args[])
{
Overload ob = new Overload();
ob.test();
ob.test(10);
ob.test(10, 20);
ob.test(123.25);
}
}
```

- In a class hierarchy, when a method in a subclass has the same name and type signature as a method in its super class, then the method in the subclass is said to ***override*** the method in the super class.
- When an overridden method is called from within a subclass, it will always refer to the version of that method defined by the subclass. The version of the method defined by the super class will be hidden.

```
class A
{
int i, j;
A(int a, int b)
{
i = a;
j = b;
}
void show() //suppressed
{
System.out.println("i and j: " + i + " " + j);
}
}
class B extends A
{
int k;
B(int a, int b, int c)
{
super(a, b);
k = c;
}
void show() //Overridden method
{
System.out.println("k: " + k);
}
}
class Override
{
public static void main(String args[])
{
B subOb = new B(1, 2, 3);
subOb.show();
}
}
```

3. What is inheritance? Explain inheritance with the help of a Java program.

- Inheritance is one of the building blocks of object oriented programming languages. It allows creation of classes with hierarchical relationship among them.
- Using inheritance, one can create a general class that defines traits common to a set of related items. This class can then be inherited by other, more specific classes, each adding those things that are unique to it.
- A class that is inherited is called a ***superclass***. The class that does the inheriting is called a ***subclass***.
- The general form of a **class** declaration that inherits a superclass:
  class *subclass-name* **extends** *superclass-name* {
  // body of class
  }

Example

```
class A
{
int i, j;
void showij()
{
System.out.println("i and j: " + i + " " + j);
}
}
```
class B extends A
```
{
int k;
void showk()
{
System.out.println("k: " + k);
}
void sum()
{
System.out.println("i+j+k: " + (i+j+k));
}
}

class SimpleInheritance
{
public static void main(String args[])
{
A superOb = new A();
B subOb = new B();
superOb.i = 10;
superOb.j = 20;
System.out.println("Contents of superOb: ");
superOb.showij();
subOb.i = 7;
subOb.j = 8;
subOb.k = 9;
System.out.println("Contents of subOb: ");
subOb.showij();
subOb.showk();
System.out.println("Sum of i, j and k in subOb:");
subOb.sum();
}
}
```
5.What is an abstract class? Explain abstract class with the help of a Java program(4M)

A class containing at least one abstract method is called as ***abstract class.*** Abstract classes cannot be instantiated, that is one cannot create an object of abstract class. Whereas, a reference can be created for an abstract class.

- To declare an abstract method, use this general form:

abstract *type name(parameter-list);*

No method body is present.

```
abstract class A
{
abstract void callme();
void callmetoo()
{
System.out.println("This is a concrete method.");
}
}

class B extends A
{
void callme() //overriding abstract method
{
System.out.println("B's implementation of callme.");
}
}
class AbstractDemo
{
public static void main(String args[])
{
B = new B(); //subclass object
b.callme(); //calling abstract method
b.callmetoo(); //calling concrete method
}
}
```

6.With an example explain finalize() method in java 6(M)

- Java provides a mechanism called finalization to handle situations where specific actions are required before an object is reclaimed by the garbage collector.

- Objects may hold non-Java resources like file handles or character fonts.
- It is essential to free these resources before an object is destroyed.
- To add a finalizer to a class, define the `finalize()` method.
- The Java runtime automatically calls this method when it is about to recycle an object of that class.
- • Inside the `finalize()` method, specify actions that must be performed before an object is destroyed.
- This method is called by the garbage collector just before reclaiming the object

- The garbage collector runs periodically to identify and reclaim objects that are no longer referenced.
- Objects without any live references are candidates for garbage collection.
- Just before an object is freed, the Java runtime invokes the `finalize()` method on that object.
- This provides an opportunity to release resources or perform other necessary cleanup tasks.
- The garbage collector identifies and marks objects that are eligible for finalization.
- Finalization ensures proper resource management and cleanup before the object is deallocated.

The **finalize( ) method has this general form:**

protected void finalize( ) {

// finalization code here

}

7. Write a note on use of 'this' keyword(4M)

- Sometimes a method will need to refer to the object that invoked it.
- **this** can be used inside any method to refer to the *current object. That is,* **this** is always a reference to the object on which the method was invoked. You can use **this** anywhere a reference to an object of the current class ' type is permitted.

Example

// A redundant use of this

Box(double w, double h, double d) {

this.width = w;

this.height = h;

this.depth = d;

}

8.Design a Java class called Stack with the following instance variables
(i) private int stck[] (ii) private int tos
and methods
(i) void push(int)
(ii) int pop()

Write a Java program to create Stack object with stack size 5. Call the method push() to push 5 elements on to stack and display the output of the pop() operation

// This class defines an integer stack that can hold 5values

```
class Stack
{
   private int stck[];
   private int tos;
   // allocate and initialize stack
   Stack(int size)
   {
        stck = new int[size];
```

```
        tos = -1;
    }

    // Push an item onto the stack
    void push(int item)
    {
        if(tos==stck.length-1) // use length member
          System.out.println("Stack is full.");
        else
          stck[++tos] = item;
    }

    // Pop an item from the stack
    int pop()
    {
        if(tos < 0)
        {
          System.out.println("Stack underflow.");
          return 0;
        }
        else
          return stck[tos--];
    }
}

class TestStack2
{
    public static void main(String args[])
    {
        Stack mystack = new Stack(5);

        // push some numbers onto the stack
        for(int i=0; i<5; i++)
          mystack.push(i);

        // pop those numbers off the stack
        System.out.println("Stack in mystack:");
        for(int i=0; i<5; i++)
          System.out.println(mystack.pop());

    }
}
```

Output:

```
Stack in mystack:
4
3
2
1
0
```

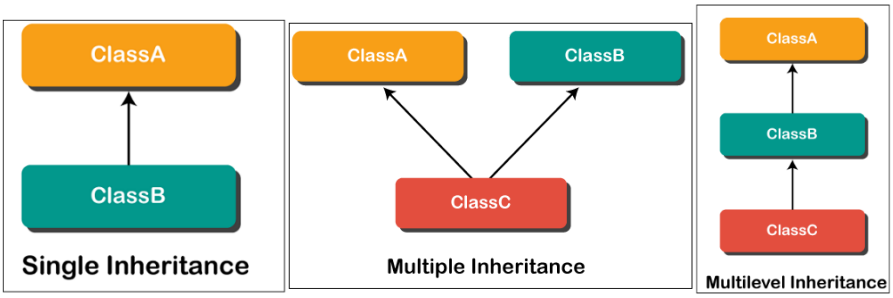
9.Explain different types of inheritance in JAVA with example and justify why multiple inheritance not supported in java with example.(10m)

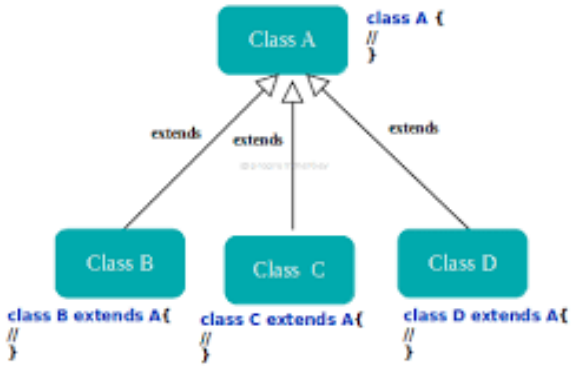
Types of inheritance in java

On the basis of class, there can be three types of inheritance in java:

- single,
- multilevel and
- hierarchical.

In java programming, multiple and hybrid inheritance is supported through interface only.





Hierarchial

When one class inherits multiple classes, it is known as multiple inheritance. Multiple inheritance is not supported in Java through class.

Single Inheritance Example

When a class inherits another class, it is known as a single inheritance. In the example given below, Dog class inherits the Animal class, so there is the single inheritance.

```
class Animal
{
void eat()
{
System.out.println("eating...");
}
}
class Dog extends Animal
{
void bark()
{
System.out.println("barking...");
}
}
class TestInheritance
{
```

```
public static void main(String args[])
{
Dog d=new Dog();
d.bark();
d.eat();
}
}
```

Multilevel Inheritance Example

When there is a chain of inheritance, it is known as multilevel inheritance. As you can see in the example given below, BabyDog class inherits the Dog class which again inherits the Animal class, so there is a multilevel inheritance.

```
class Animal
{
void eat()
{
System.out.println("eating...");
}
}
class Dog extends Animal{
void bark(){
System.out.println("barking...");
}
}
class BabyDog extends Dog{
void weep(){
System.out.println("weeping...");
}
}
class TestInheritance2{
public static void main(String args[]){
BabyDog d=new BabyDog();
d.weep();
d.bark();
d.eat();
}
}
```

Hierarchical Inheritance Example

When two or more classes inherit a single class, it is known as hierarchical inheritance. In the example given below, Dog and Cat classes inherit the Animal class, so there is hierarchical inheritance.

```
class Animal{
void eat(){
System.out.println("eating...");
}
}
class Dog extends Animal{
void bark(){
System.out.println("barking...");
}
}
class Cat extends Animal{
void meow(){
System.out.println("meowing...");
}
}
```

```
class TestInheritance3{
public static void main(String args[]){
Cat c=new Cat();
c.meow();
c.eat();
Dog d = new Dog();
d.bark();
}
}
```

11.Explain the following keywords (i) this (ii)super (iii)final (iv) static with example(8m)

- this: Sometimes a method will need to refer to the object that invoked it.

  this can be used inside any method to refer to the *current object. That is,* **this** is always a reference to the object on which the method was invoked. You can use **this** anywhere a reference to an object of the current class ' type is permitted.

  Example

  // A redundant use of this

  Box(double w, double h, double d) {

  this.width = w;

  this.height = h;

  this.depth = d;

  }

super

- Whenever a subclass needs to refer to its immediate superclass, it can do so by use of the keyword super.
- super has two general forms.
  - The first calls the superclass' constructor.
  - The second is used to access a member of the superclass that has been hidden by a member of a subclass.

```
class Box
{
double w, h, b;
Box(double wd, double ht, double br)
{
```

```
w=wd; h=ht; b=br;
}
}
class ColourBox extends Box
{
int colour;
ColourBox(double wd, double ht, double br, int c)
{
w=wd; h=ht; b=br; //code redundancy
colour=c;
}
}
```

```
class A
{
int a;
}
class B extends A
{
int a; //duplicate variable a
B(int x, int y)
{
super.a=x; //accessing superclass a
a=y; //accessing own member a
}
void disp()
{
System.out.println("super class a: "+ super.a);
System.out.println("sub class a: "+ a);
}
}
class SuperDemo
{
public static void main(String args[])
{
B ob=new B(2,3);
ob.disp();
}
                    }
```

Static

- When a member is declared static, it can be accessed before any objects of its class are created, and without reference to any object. You can declare both methods and variables to be static.
- Instance variables declared as static are, essentially, global variables. When objects of its class are declared, no copy of a static variable is made.

Methods declared as static have several restrictions:

• They can only directly call other static methods.

• They can only directly access static data.

• They cannot refer to this or super in any way.

/ Demonstrate static variables, methods, and blocks.
class UseStatic {
static int a = 3;
static int b;
static void meth(int x) {
System.out.println("x = " + x);
System.out.println("a = " + a);
System.out.println("b = " + b);
}
static {
System.out.println("Static block initialized.");
b = a * 4;
}
public static void main(String args[]) {
meth(42);
}
}

12.What is the output of the following program with the proper reason(2m)

```
class A {
   int i=20;
   A() {
     i = 40;
   }
}
```

```
public class B {
   public static void main(String
args[]) {
       A a1= new A();
       System.out.println(a1.i);
   }}
```

Output : 40
Step1 : execution starts from class B main method, object A is created, then constructor get involked.
Step2: i is overrided to 40. Then controls backs to main method then it prints 40

9.Write a program to demonstrate the constructor overloading.(5M)
/* Here, Box defines three constructors to initialize
the dimensions of a box various ways.
*/
class Box {
double width;
double height;
double depth;
// constructor used when all dimensions specified
Box(double w, double h, double d) {
width = w;
height = h;
depth = d;
}
// constructor used when no dimensions specified
Box() {
width = -1; // use -1 to indicate
height = -1; // an uninitialized
depth = -1; // box
}
// constructor used when cube is created

```
Box(double len) {
width = height = depth = len;

}
// compute and return volume
double volume() {
return width * height * depth;
}
}
class OverloadCons {
public static void main(String args[]) {
// create boxes using the various constructors
Box mybox1 = new Box(10, 20, 15);
Box mybox2 = new Box();
Box mycube = new Box(7);
double vol;
// get volume of first box
vol = mybox1.volume();
System.out.println("Volume of mybox1 is " + vol);
// get volume of second box
vol = mybox2.volume();
System.out.println("Volume of mybox2 is " + vol);

// get volume of cube
vol = mycube.volume();
System.out.println("Volume of mycube is " + vol);
}
}
```

The output produced by this program is shown here:

```
Volume of mybox1 is 3000.0
Volume of mybox2 is -1.0
Volume of mycube is 343.0
```

10.Write a Java program to create a class called Shape with a method called getArea(). Create a subclass called Rectangle that overrides the getArea() method to calculate the area of a rectangle.(5)

```
// Shape class
class Shape {
    // Method to get the area (to be overridden by subclasses)
    public double getArea() {
        return 0; // Default implementation (to be overridden)
    }
}

// Rectangle class (subclass of Shape)
class Rectangle extends Shape {
    // Fields
    private double length;
    private double width;

    // Constructor
    public Rectangle(double length, double width) {
        this.length = length;
        this.width = width;
    }
```

```
    // Override the getArea() method to calculate the area of a rectangle
    @Override
    public double getArea() {
        return length * width;
    }
}

// Main class to test the program
public class Main {
    public static void main(String[] args) {
        // Create an instance of Rectangle
        Rectangle myRectangle = new Rectangle(5.0, 3.0);

        // Call the getArea() method of the Rectangle class
        double area = myRectangle.getArea();

        // Display the calculated area
        System.out.println("Area of the rectangle: " + area);
    }
}
```

11.Write a JAVA program demonstrating Method overriding.(6)

```
class B extends A {
int k;
B(int a, int b, int c) {
super(a, b);
k = c;
}
// display k – this overrides show() in A
void show() {
System.out.println("k: " + k);
}
}
class Override {
public static void main(String args[]) {
B subOb = new B(1, 2, 3);
subOb.show(); // this calls show() in B
}
}
```

The output produced by this program is shown here:

```
k: 3
```

12.What is the output of the following program with the proper reason(4)

```
public class C extends A
{
    private C()
    {
        s += "how are you";
    }
    public static void
main(String[] args)
    {
        new C();
        System.out.println(s);
    } }
```

```
class A
{
   static String s = "hi ";
    protected A()
    {
        s += "hello ";
    } }
class B extends A
{
    private B()
    {
        s += "How do you do";
    } }
```

Output : hi hello how are you

Step1 : Execution starts from main method.
Step 2: object is created , Constructor is getting invoked of class c that private c().
Step3: Inside construction , implicitly super() method is getting invoked, then controls go to immediate superclass Constructor that is protected A(), it takes s+= hello which is concatenation of string takes place so, s = *hi hello*.
Step 4: After concatenation controls goes back to constructor private c(), then again one more concatenation of string takes places, that is s= *hi hello how are you*, then control comes back to main method it will print *hi hello how are you*

13.Explain the different Access Specifiers support in Java with example.(6)
The access specifiers in JAVA are
1. private
2. public
3. protected
The three access specifiers, private, public, and protected, provide a variety of ways to produce the many levels of access required by these categories.
Public: Anything declared public can be accessed from anywhere.
Private: Anything declared private cannot be seen outside of its class.
Default: When a member does not have an explicit access specification, it is visible to subclasses as well as to other classes in the same package. This is the default access.
Protected: If you want to allow an element to be seen outside your current package, but only to classes that subclass your class directly, then declare that element protected.

```
class Test {
int a; // default access
public int b; // public access
private int c; // private access
// methods to access c
void setc(int i) { // set c's value
c = i;
}
int getc() { // get c's value
return c;
}
}
class AccessTest {
```

```
public static void main(String args[]) {
Test ob = new Test();
// These are OK, a and b may be accessed directly
ob.a = 10;
ob.b = 20;
// This is not OK and will cause an error
// ob.c = 100; // Error!
// You must access c through its methods
ob.setc(100); // OK
System.out.println("a, b, and c: " + ob.a + " " +
ob.b + " " + ob.getc());
}
}
```

14.Differentiate between static and final keyword.(4)

BASIS FOR COMPARISON	STATIC	FINAL
Applicable	Static keyword is applicable to nested static class, variables, methods and block.	Final keyword is applicable to class, methods and variables.
Initialization	It is not compulsory to initialize the static variable at the time of its declaration.	It is compulsory to initialize the final variable at the time of its declaration.
Modification	The static variable can be reinitialized.	The final variable can not be reinitialized.
Methods	Static methods can only access the static members of the class, and can only be called by other static methods.	Final methods can not be inherited.
Class	Static class's object can not be created, and it only contains static members only.	A final class can not be inherited by any class.
Block	Static block is used to initialize the static variables.	Final keyword supports no such block.