

# Subject Name Solutions

4341602 – Winter 2024

Semester 1 Study Material

*Detailed Solutions and Explanations*

## Question 1(a) [3 marks]

Write down the difference between oop and pop.

Solution		
Aspect	OOP	POP
Approach	Bottom-up approach	Top-down approach
Focus	Objects and classes	Functions and procedures
Data Security	Data hiding through encapsulation	No data hiding
Problem Solving	Divide problem into objects	Divide problem into functions

Mnemonic
“Objects Bottom, Procedures Top”

## Question 1(b) [4 marks]

What is byte code? Explain JVM in detail.

Solution
<p><b>Byte Code:</b> Platform-independent intermediate code generated by Java compiler from source code.</p> <p style="text-align: center;"><b>Mermaid Diagram (Code)</b></p> <pre>{Shaded} {Highlighting}[] graph LR     A[Java Source Code] --&gt; B[Java Compiler javac]     B --&gt; C[Byte Code .class]     C --&gt; D[JVM]     D --&gt; E[Machine Code] {Highlighting} {Shaded}</pre> <p><b>JVM Components:</b></p> <ul style="list-style-type: none"><li>• <b>Class Loader:</b> Loads .class files into memory</li><li>• <b>Memory Area:</b> Heap, stack, method area storage</li><li>• <b>Execution Engine:</b> Interprets and executes bytecode</li><li>• <b>Garbage Collector:</b> Automatic memory management</li></ul>

Mnemonic
“Byte Code Runs Everywhere”

## Question 1(c) [7 marks]

Write a program in Java to sort the elements of an array in ascending order

### Solution

```
import java.util.Arrays;

public class ArraySort \{
    public static void main(String[] args) \{
        int[] arr = \{64, 34, 25, 12, 22, 11, 90\};

        // Bubble Sort
        for(int i = 0; i < arr.length-1; i++) \{
            for(int j = 0; j < arr.length-i-1; j++) \{
                if(arr[j] > arr[j+1]) \{
                    int temp = arr[j];
                    arr[j] = arr[j+1];
                    arr[j+1] = temp;
                \}
            \}
        \}

        System.out.println("Sorted array: " + Arrays.toString(arr));
    \}
\}
```

#### Key Points:

- **Bubble Sort:** Compares adjacent elements
- **Time Complexity:**  $O(n^2)$
- **Space Complexity:**  $O(1)$

### Mnemonic

“Bubble Up The Smallest”

### Question 1(c OR) [7 marks]

Write a program in java to find out maximum from any ten numbers using command line argument.

### Solution

```
public class FindMaximum \{
    public static void main(String[] args) \{
        if(args.length != 10) \{
            System.out.println("Please enter exactly 10 numbers");
            return;
        \}

        int max = Integer.parseInt(args[0]);

        for(int i = 1; i < args.length; i++) \{
            int num = Integer.parseInt(args[i]);
            if(num > max) \{
                max = num;
            \}
        \}

        System.out.println("Maximum number: " + max);
    \}
\}
```

#### Key Points:

- **Command Line:** args[] array stores arguments
- **parseInt():** Converts string to integer
- **Validation:** Check array length

### Mnemonic

“Arguments Maximum Search”

## Question 2(a) [3 marks]

What is wrapper class? Explain with example.

### Solution

**Wrapper Class:** Converts primitive data types into objects.

Primitive	Wrapper Class
int	Integer
char	Character
boolean	Boolean
double	Double

```
// Boxing
Integer obj = Integer.valueOf(10);
// Unboxing
int value = obj.intValue();
```

### Mnemonic

“Wrap Primitives Into Objects”

## Question 2(b) [4 marks]

List out different features of java. Explain any two.

### Solution

**Java Features:**

- **Simple:** Easy syntax, no pointers
- **Platform Independent:** Write once, run anywhere
- **Object Oriented:** Based on objects and classes
- **Secure:** No explicit pointers, bytecode verification

**Detailed Explanation:**

- **Platform Independence:** Java bytecode runs on any platform with JVM
- **Object Oriented:** Supports inheritance, encapsulation, polymorphism, abstraction

### Mnemonic

“Simple Platform Object Security”

## Question 2(c) [7 marks]

What is method overriding? Explain with example.

### Solution

**Method Overriding:** Child class provides specific implementation of parent class method.

```
class Animal \{
    public void sound() \{
        System.out.println("Animal makes sound");
    \}
\}
```

```

class Dog extends Animal \{
    @Override
    public void sound() \{
        System.out.println("Dog barks");
    \}
\}

public class Test \{
    public static void main(String[] args) \{
        Animal a = new Dog();
        a.sound(); // Output: Dog barks
    \}
\}

```

#### Key Points:

- **Runtime Polymorphism:** Method called based on object type
- **@Override:** Annotation for method overriding
- **Dynamic Binding:** Method resolution at runtime

#### Mnemonic

“Child Changes Parent Method”

### Question 2(a OR) [3 marks]

Explain Garbage collection in java.

#### Solution

**Garbage Collection:** Automatic memory management that removes unused objects.

#### Mermaid Diagram (Code)

```

{Shaded}
{Highlighting}[]
graph LR
    A[Object Created] --> B[Object Used]
    B --> C[Object Unreferenced]
    C --> D[Garbage Collector]
    D --> E[Memory Freed]
{Highlighting}
{Shaded}

```

#### Key Points:

- **Automatic:** No manual memory deallocation
- **Mark and Sweep:** Identifies and removes unused objects
- **Heap Memory:** Works on heap memory area

#### Mnemonic

“Auto Clean Unused Objects”

### Question 2(b OR) [4 marks]

Explain static keyword with example.

#### Solution

**Static Keyword:** Belongs to class rather than instance.

```

class Student \{
    static String college = "GTU"; // Static variable

```

```
String name;

static void showCollege() \{    // Static method
    System.out.println("College: " + college);
\}

\}
```

#### Static Features:

- **Memory:** Loaded at class loading time
- **Access:** Can be accessed without object
- **Sharing:** Shared among all instances

#### Mnemonic

“Class Level Memory Sharing”

### Question 2(c OR) [7 marks]

What is constructor? Explain copy constructor with example.

#### Solution

**Constructor:** Special method to initialize objects.

```
class Person \{
    String name;
    int age;

    // Default constructor
    Person() \{
        name = "Unknown";
        age = 0;
    \}

    // Parameterized constructor
    Person(String n, int a) \{
        name = n;
        age = a;
    \}

    // Copy constructor
    Person(Person p) \{
        name = p.name;
        age = p.age;
    \}
\}
```

#### Constructor Types:

- **Default:** No parameters
- **Parameterized:** Takes parameters
- **Copy:** Creates object from existing object

#### Mnemonic

“Default Parameter Copy”

### Question 3(a) [3 marks]

Explain super keyword with example.

### Solution

**Super Keyword:** References parent class members.

```
class Vehicle \{
    String brand = "Generic";
\}

class Car extends Vehicle \{
    String brand = "Toyota";

    void display() \{
        System.out.println("Child: " + brand);
        System.out.println("Parent: " + super.brand);
    \}
\}
```

**Super Uses:**

- **Variables:** Access parent class variables
- **Methods:** Call parent class methods
- **Constructor:** Call parent class constructor

### Mnemonic

“Super Calls Parent”

## Question 3(b) [4 marks]

List out different types of inheritance. Explain multilevel inheritance.

### Solution

**Inheritance Types:**

Type	Description
Single	One parent, one child
Multilevel	Chain of inheritance
Hierarchical	One parent, multiple children
Multiple	Multiple parents (via interfaces)

**Multilevel Inheritance:**

```
class Animal \{
    void eat() \{ System.out.println("Eating"); \}
\}

class Mammal extends Animal \{
    void breathe() \{ System.out.println("Breathing"); \}
\}

class Dog extends Mammal \{
    void bark() \{ System.out.println("Barking"); \}
\}
```

### Mnemonic

“Single Multi Hierarchical Multiple”

### Question 3(c) [7 marks]

What is interface? Explain multiple inheritance with example.

#### Solution

**Interface:** Contract that defines what class must do, not how.

```
interface Flyable \{
    void fly();
\}

interface Swimmable \{
    void swim();
\}

class Duck implements Flyable, Swimmable \{
    public void fly() \{
        System.out.println("Duck is flying");
    \}

    public void swim() \{
        System.out.println("Duck is swimming");
    \}
\}
```

**Interface Features:**

- **Multiple Inheritance:** Class can implement multiple interfaces
- **Abstract Methods:** All methods are abstract by default
- **Constants:** All variables are public, static, final

#### Mnemonic

“Multiple Abstract Constants”

### Question 3(a OR) [3 marks]

Explain final keyword with example.

#### Solution

**Final Keyword:** Restricts modification, inheritance, or overriding.

```
final class Math \{           // Cannot be inherited
    final int PI = 3.14;      // Cannot be modified

    final void calculate() \{ // Cannot be overridden
        System.out.println("Calculating");
    \}
\}
```

**Final Uses:**

- **Class:** Cannot be extended
- **Method:** Cannot be overridden
- **Variable:** Cannot be reassigned

#### Mnemonic

“Final Stops Changes”

### Question 3(b OR) [4 marks]

Explain different access controls in Java.

### Solution

#### Access Modifiers:

Modifier	Same Class	Same Package	Subclass	Different Package
public				
protected				
default				
private				

### Mnemonic

“Public Protected Default Private”

### Question 3(c OR) [7 marks]

What is package? Write steps to create a package and give example of it.

### Solution

**Package:** Group of related classes and interfaces.

#### Steps to Create Package:

1. **Declare:** Use package statement at top
2. **Compile:** `javac -d . ClassName.java`
3. **Run:** `java packagename.ClassName`

```
// File: mypack/Calculator.java
package mypack;
```

```
public class Calculator \{
    public int add(int a, int b) \{
        return a + b;
    }
}
```

```
// File: Test.java
import mypack.Calculator;
```

```
public class Test \{
    public static void main(String[] args) \{
        Calculator calc = new Calculator();
        System.out.println(calc.add(5, 3));
    }
}
```

#### Package Benefits:

- **Organization:** Groups related classes
- **Access Control:** Package-level protection
- **Namespace:** Avoids naming conflicts

### Mnemonic

“Declare Compile Run”

### Question 4(a) [3 marks]

Explain thread priorities with suitable example.



### Solution

**Thread Priority:** Determines thread execution order (1-10 scale).

```
class MyThread extends Thread \{
    public void run() \{
        System.out.println(getName() + " Priority: " + getPriority());
    }
}

public class ThreadPriorityExample \{
    public static void main(String[] args) \{
        MyThread t1 = new MyThread();
        MyThread t2 = new MyThread();

        t1.setPriority(Thread.MIN_PRIORITY); // 1
        t2.setPriority(Thread.MAX_PRIORITY); // 10

        t1.start();
        t2.start();
    }
}
```

**Priority Constants:**

- **MIN\_PRIORITY:** 1
- **NORM\_PRIORITY:** 5
- **MAX\_PRIORITY:** 10

### Mnemonic

“Min Normal Max”

## Question 4(b) [4 marks]

What is Thread? Explain Thread life cycle.

### Solution

**Thread:** Lightweight process for concurrent execution.

```
stateDiagram{-v2}
    direction LR
    [*] --> New
    New --> Runnable: start()
    Runnable --> Running: CPU allocation
    Running --> Blocked: wait(), sleep()
    Blocked --> Runnable: notify(), timeout
    Running --> Dead: complete
```

**Thread States:**

- **New:** Thread created but not started
- **Runnable:** Ready to run
- **Running:** Currently executing
- **Blocked:** Waiting for resource
- **Dead:** Execution completed

### Mnemonic

“New Runnable Running Blocked Dead”

### Question 4(c) [7 marks]

Write a program in java that create the multiple threads by implementing the Runnable interface.

#### Solution

```
class MyRunnable implements Runnable \{
    private String threadName;

    MyRunnable(String name) \{
        threadName = name;
    \}

    public void run() \{
for(int
i = 1; i {=} 5; i++) \{

        System.out.println(threadName + " {- Count: " + i);
        try \{
            Thread.sleep(1000);
        \} catch(InterruptedException e) \{
            e.printStackTrace();
        \}
    \}
\}

public class MultipleThreads \{
    public static void main(String[] args) \{
        Thread t1 = new Thread(new MyRunnable("Thread{-1"}));
        Thread t2 = new Thread(new MyRunnable("Thread{-2"}));
        Thread t3 = new Thread(new MyRunnable("Thread{-3"}));

        t1.start();
        t2.start();
        t3.start();
    \}
\}
```

#### Key Points:

- **Runnable Interface:** Better than extending Thread class
- **Thread.sleep():** Pauses thread execution
- **Multiple Threads:** Run concurrently

#### Mnemonic

“Implement Runnable Start Multiple”

### Question 4(a OR) [3 marks]

List four different inbuilt exceptions. Explain any one inbuilt exception.

#### Solution

##### Inbuilt Exceptions:

- **NullPointerException:** Accessing null object
- **ArrayIndexOutOfBoundsException:** Invalid array index
- **ArithmeticException:** Division by zero
- **NumberFormatException:** Invalid number format

**ArithmeticException:** Thrown when arithmetic operation fails.

```
int result = 10 / 0; // Throws ArithmeticException
```

### Mnemonic

“Null Array Arithmetic Number”

### Question 4(b OR) [4 marks]

Explain Try and Catch with suitable example.

#### Solution

**Try-Catch:** Exception handling mechanism.

```
public class TryCatchExample \{
    public static void main(String[] args) \{
        try \{
            int[] arr = \{1, 2, 3\};
            System.out.println(arr[5]); // Index out of bounds
        \}
        catch(ArrayIndexOutOfBoundsException e) \{
            System.out.println("Array index error: " + e.getMessage());
        \}
        finally \{
            System.out.println("Always executed");
        \}
    \}
\}
```

**Exception Handling Flow:**

- **Try:** Code that may throw exception
- **Catch:** Handles specific exceptions
- **Finally:** Always executes

### Mnemonic

“Try Catch Finally”

### Question 4(c OR) [7 marks]

What is Exception? Write a program that show the use of Arithmetic Exception.

#### Solution

**Exception:** Runtime error that disrupts normal program flow.

```
public class ArithmeticExceptionExample \{
    public static void main(String[] args) \{
        Scanner sc = new Scanner(System.in);

        try \{
            System.out.print("Enter first number: ");
            int num1 = sc.nextInt();

            System.out.print("Enter second number: ");
            int num2 = sc.nextInt();

            int result = num1 / num2;
            System.out.println("Result: " + result);
        \}
        catch(ArithmeticException e) \{
            System.out.println("Error: Cannot divide by zero!");
        \}
    \}
\}
```

```

        catch(Exception e) \{
            System.out.println("General error: " + e.getMessage());
        \}
        finally \{
            sc.close();
        \}
    \}
\}

```

#### Exception Types:

- **Checked:** Compile-time exceptions
- **Unchecked:** Runtime exceptions
- **Error:** System-level problems

#### Mnemonic

“Runtime Error Disrupts Flow”

### Question 5(a) [3 marks]

Explain `ArrayIndexOutOfBoundsException` Exception in Java with example.

#### Solution

**ArrayIndexOutOfBoundsException:** Thrown when accessing invalid array index.

```

public class ArrayIndexExample \{
    public static void main(String[] args) \{
        int[] numbers = \{10, 20, 30\};

        try \{
            System.out.println(numbers[5]); // Invalid index
        \}
        catch(ArrayIndexOutOfBoundsException e) \{
            System.out.println("Invalid array index: " + e.getMessage());
        \}
    \}
\}

```

#### Key Points:

- **Valid Range:** 0 to array.length-1
- **Negative Index:** Also throws exception
- **Runtime Exception:** Unchecked exception

#### Mnemonic

“Array Index Range Check”

### Question 5(b) [4 marks]

Explain basics of stream classes.

#### Solution

**Stream Classes:** Handle input/output operations.

Stream Type	Classes
Byte Streams	InputStream, OutputStream
Character Streams	Reader, Writer
File Streams	FileInputStream, FileOutputStream

## Mermaid Diagram (Code)

```

{Shaded}
{Highlighting}[]
graph TD
    A[Stream Classes] --> B[Byte Streams]
    A --> C[Character Streams]
    B --> D[InputStream]
    B --> E[OutputStream]
    C --> F[Reader]
    C --> G[Writer]
{Highlighting}
{Shaded}

```

## Stream Features:

- **Sequential:** Data flows in sequence
- **One Direction:** Either input or output
- **Automatic:** Handles low-level details

## Mnemonic

“Byte Character File Buffered”

## Question 5(c) [7 marks]

Write a java program to create a text file and perform read operation on the text file.

## Solution

```

import java.io.*;

public class FileReadExample \{
    public static void main(String[] args) \{
        // Create and write to file
        try \{
            FileWriter writer = new FileWriter("sample.txt");
            writer.write("Hello World!\n");
            writer.write("Java File Handling\n");
            writer.write("GTU Exam 2024");
            writer.close();
            System.out.println("File created successfully");
        \}
        catch(IOException e) \{
            System.out.println("Error creating file: " + e.getMessage());
        \}

        // Read from file
        try \{
            BufferedReader reader = new BufferedReader(new FileReader("sample.txt"));
            String line;

            System.out.println("\nFile contents:");
            while((line = reader.readLine()) != null) \{
                System.out.println(line);
            \}
            reader.close();
        \}
        catch(IOException e) \{
            System.out.println("Error reading file: " + e.getMessage());
        \}
    \}
}

```

```

    \}
  \}
\}

```

**Key Points:**

- **FileWriter:** Creates and writes to file
- **BufferedReader:** Efficient reading
- **Exception Handling:** Handle IOException

**Mnemonic**

“Create Write Read Close”

### Question 5(a OR) [3 marks]

Explain Divide by Zero Exception in Java with example.

**Solution**

**ArithmeticException:** Thrown during divide by zero operation.

```

public class DivideByZeroExample \{
    public static void main(String[] args) \{
        try \{
            int a = 10;
            int b = 0;
            int result = a / b; // Throws ArithmeticException
            System.out.println("Result: " + result);
        \}
        catch(ArithmeticException e) \{
            System.out.println("Cannot divide by zero: " + e.getMessage());
        \}
    \}
\}

```

**Key Points:**

- **Integer Division:** Only integer division by zero throws exception
- **Floating Point:** Returns Infinity for floating point division
- **Runtime Exception:** Unchecked exception

**Mnemonic**

“Zero Division Arithmetic Error”

### Question 5(b OR) [4 marks]

Explain java I/O process.

**Solution**

**Java I/O Process:** Mechanism for reading and writing data.

**Mermaid Diagram (Code)**

```

{Shaded}
{Highlighting}[]
graph LR
    A[Data Source] --> B[Input Stream]
    B --> C[Java Program]
    C --> D[Output Stream]
    D --> E[Data Destination]
{Highlighting}

```

{Shaded}

#### I/O Components:

- **Stream:** Sequence of data
- **Buffer:** Temporary storage for efficiency
- **File:** Persistent storage
- **Network:** Remote data transfer

#### I/O Types:

- **Byte-oriented:** Raw data (images, videos)
- **Character-oriented:** Text data
- **Synchronous:** Blocking operations
- **Asynchronous:** Non-blocking operations

#### Mnemonic

“Stream Buffer File Network”

### Question 5(c OR) [7 marks]

Write a java program to create a text file and perform write operation on the text file.

#### Solution

```
import java.io.*;
import java.util.Scanner;

public class FileWriteExample \{
    public static void main(String[] args) \{
        Scanner sc = new Scanner(System.in);

        try \{
            // Create file with FileWriter
            FileWriter writer = new FileWriter("student.txt");

            System.out.println("Enter student details:");
            System.out.print("Name: ");
            String name = sc.nextLine();

            System.out.print("Roll Number: ");
            String rollNo = sc.nextLine();

            System.out.print("Branch: ");
            String branch = sc.nextLine();

            // Write data to file
            writer.write("Student Information{n}");
            writer.write("===== {n}");
            writer.write("Name: " + name + "{n}");
            writer.write("Roll Number: " + rollNo + "{n}");
            writer.write("Branch: " + branch + "{n}");
            writer.write("Date: " + new java.util.Date() + "{n}");

            writer.close();
            System.out.println("{n}Data written to file successfully!");

        }
        catch(IOException e) \{
            System.out.println("Error writing to file: " + e.getMessage());
        }
        finally \{
            sc.close();
        }
    }
}
```

```
    \}  
  \}  
\}
```

**Key Points:**

- **FileWriter:** Writes character data to file
- **BufferedWriter:** More efficient for large data
- **Auto-close:** Use try-with-resources for automatic closing

**Mnemonic**

“Create Write Close Handle”