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*(Knowledge for Development)*

**KIBABII UNIVERSITY**

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**UNIVERSITY EXAMINATIONS  
2020/2021 ACADEMIC YEAR**

**SPECIAL/SUPPLEMENTARY EXAMINATIONS  
YEAR ONE SEMESTER TWO EXAMINATIONS**

**FOR BACHELORS OF SCIENCE IN**

**(COMPUTER SCIENCE & INFORMATION  
TECHNOLOGY)**

**COURSE CODE: BIT 122/CSC 120**

**COURSE TITLE: OBJECT ORIENTED PROGRAMMING I**

**DATE: 30/09/2021**

**TIME: 11.00 A.M- 1.00 P.M**

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**INSTRUCTIONS TO CANDIDATES**

**ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS**

## QUESTION ONE (COMPULSORY)

[30 MARKS]

- a. Explain the implication and the use of the following concepts
- i. **extends** keyword and **implements** keyword [2 marks]
  - ii. **static** keyword and **final** keyword [2 marks]
- b. How does method overloading differ from method overriding? [2 marks]
- c. Explain features of object-oriented paradigms that help in handling the complexity attached to the real-world objects? [3 marks]
- d. Differentiate between encapsulation and data abstraction as used in java programming. [2 marks]
- e. Consider the class definition below:

```
class TwoDArray {
public static void main(String args[])
{
int twoD[][]= new int[4][5];
int i, j, k = 0;
for(i=0; i<4; i++)
for(j=0; j<5; j++)
{
twoD[i][j] = k;
k++;
}
for(i=0; i<4; i++)
{
for(j=0; j<5; j++)
System.out.print (twoD[i][j] + " ");
System.out.println();
}
}
}
```

Simulate the output that this program.

[2 marks]

- f. Consider the figure 1 below.

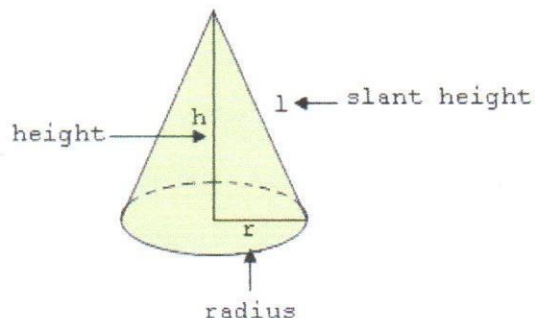


Figure 1: Cone

Define a class Called Cone and include the following:

- i. instance variables radius and height of type double. [1 mark]
- ii. a parameterized constructor that will used to set the radius and height to new values [2 marks]
- iii. methods to set and return the values of radius and height as necessary. [2 marks]
- iv. a method `getSurfaceArea` that compute and return the surface area of the Cones use the Math class for PI and `pow( )` functions/ methods. [3 marks]

Use the formula, the total surface area of a cone  $= \pi r^2 + \pi r l = \pi r(r+l)$

The relationship between radius (r) , height (h) and slant height (l) is given by

$$l = \sqrt{r^2 + h^2}$$

- g. Given the following incomplete Java method with the name `Login` complete it by providing the return type and the body so that it returns either success or fail based on the values.

[2 marks]

```
public _____ Login ()
{
    _____;
}
```

- h. Explain the effect of the keyword **static** when applied on a variable and method and keyword **final** when applied on a class [3 marks]
- i. Consider the definition of the class C shown below.

```
1 public class A
2 {
3     _____ int m;
4     _____ int n;
5     public C(int mIn, int nIn)
6     {
7         m = mIn;
8         n = nIn;
9     }
10    public int m1()
11    {
12        return m+n;
13    }
14 }
```

Define a subclass of A named B that overrides method `m1()` so that it returns the difference between `m` and `n` instead of their sum. Provide the appropriate access modifier for the instance variables `m` (on line 3) and `n` (on line 4). [4 marks]

### QUESTION TWO

[20 MARKS]

a. *Shape* is an abstract class defined as shown below.

```
1 public abstract class Shape
2     {
3         private String name;
4         public void setName(String name)
5     {
6         this.name = name
7     }
8         public String getName()
9         {
10            return name;
11        }
12        public abstract getArea();
13        public abstract getPerimeter();
14    }
```

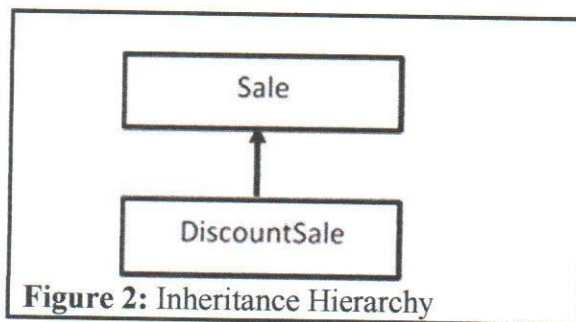
- i. *Rectangle* is a *Shape* with attributes *length* and *width* in addition to the attributes of *Shape*. Write the class definition for *Rectangle*. [5 marks]
  - ii. *Triangle* is a *Shape* with attributes *base* and *height* in addition to the attributes of *Shape*. Write the class definition for *Triangle*. [5 marks]
  - iii. Write a driver class *ShapeTest* to test your class in (a) and (b) above. Create one rectangle and one triangle objects and initialize all its attributes with values from the user. [5 marks]
- b. Using relevant java signatures, explain how you will differentiate inheritance and polymorphism, explain conditions in which each concept is handy [5 marks]

### QUESTION THREE

[20 MARKS]

- a. Suppose you have an Object `A`, with public methods `a()`, `b()`, and private method `c()`. And suppose you have a subclass of `A` named `B` with methods named `b()`, `c()` and `d()`.
  - i. Draw the inheritance hierarchy showing the relationship between these two classes. [2 marks]
  - ii. Identify those methods which would be considered polymorphic. [2 marks]

- b. Consider the inheritance hierarchy in **Figure 2** in which a sale object contains the name of the item for sale and the price of the item. A discount sale object is a sale for which the percentage discount has been specified (e.g. 12% discount will be specified as 0.12)



Define a class called Sale to represent a sale. Include in your class the following:

- i. a default constructor that sets the name to “No name yet” and price to 0.0 [1 mark]
  - ii. constructor with two parameters [1 mark]
  - iii. a method called bill that returns the price of the item [2 marks]
  - iv. a method called greaterThan that receives a Sale object as a parameter and returns true if the received sale is greater than the current sale, returns false otherwise. [2 marks]
- c. You are required to create a class to represent a Sphere. Your class should contain instance variables for the radius, a default constructor, a parameterized constructor, set and get methods for the radius, as well as member method to calculate the Volume of the Sphere. Include in your class the method **toString** that returns the string “Sphere object” when called.
- i. Draw a class diagram for the Sphere class [3 marks]
  - ii. Give the definition of the Sphere class in java [4 marks]
  - iii. Write down a driver class with two objects that will be used to demonstrate the capabilities of the class in (ii) above use dummy values for radius. [3 marks]

#### **QUESTION FOUR**

**[20 MARKS]**

- a. Why do we require packages and import statements in java? [2 marks]
- b. For a programmer to inputs from the keyboard, Scanner class is required. Import statement is used to import java.util. Scanner at the start of program file.
  - i. Write a java statement that will be used in the main method to create and initialize a Scanner object. [2 marks]

ii. Write a java code that will be used to capture an integer, a double and a String input value from the keyboard. [3 marks]

c. Consider the following class definition that represents a thermostatically controlled water heater.

```
1 public class ThermostatHeatingSystem
2 {
3     public int temperatureLimit; // from 0 to 30 (celsius)
4     public boolean currentHeaterState; // true or false (for on/off)
5     public void evaluateState(); // switch on/off as required
6     public int getCurrentTemp(); // obtain temperature from sensor
7 }
```

- a. Provide a redesigned **ThermostatHeatingSystem** class that uses more appropriate access modifiers. [2 marks]
- b. Provide accessor and mutator method that will enable the **temperatureLimit** instance variable to be retrieved and modified. [2 marks]
- c. Provide a constructor for the **Thermostat** class that will initialize the instance variables to suitable (valid) start values. [2 marks]
- d. Write a body for the **evaluateState()** method that enables it to switch on and off the heater (by changing the **currentHeaterState** instance variable) by comparing the current value of **temperatureLimit** with the current temperature, as returned by **getCurrentTemp()** method. [3 marks]
- e. Write a short driver program that instantiates the **ThermostatHeatingSystem** class and demonstrates that the methods you designed above behave correctly by using a set of appropriate test values. [4 marks]

#### QUESTION FIVE

[20 MARKS]

a. Explain the differences in meaning of `int x [5]`; and the meaning of `x [5]`; as used in arrays.

[2 marks]

b. Consider the program below:

```
1 import java.io.*;
2 import java.util.Arrays;
3 public class SortingArrayElements {
4     static int sortRowWise(int marks[][]) {
5         for (int i = 0; i < marks.length; i++) {
6             Arrays.sort(marks[i]);
7         }
8     }
```

```

9      for (int i = 0; i < marks.length; i++) {
10     for (int j = 0; j < marks[i].length; j++) {
11     System.out.print(marks[i][j] + " ");
12     }
13     System.out.println();
14     }
15     return 0;
16     }
17     public static void main(String args[]) {
18     int marks[ ][ ] = {{45, 78, 72, 71, 57, 70, 58, 80},
19     {34, 56, 76, 24, 54, 75, 49, 64},
20     {60, 64, 65, 42, 63, 73, 80, 67}
21     };
22     sortRowWise(marks);
23     }
24     }

```

Simulate the output of this program.

**[3 marks]**

- c. Write java program that reads an integer between 0 – 999 and adds all the digits in the integer. For example, if an integer is 932, the sum of all its digit is 14. Hint: Use the % operator to extract digits and use the / operator to remove the extracted digit. For instance,  $932 \% 10 = 2$  and  $932 / 10 = 93$ . **[5 marks]**
- d. In a gymnastics or diving competition, each contestant's score is calculated by dropping the lowest and highest scores and then adding the remaining scores. Write a java program that allows the user to enter eight judges' scores and then outputs the point received by the contestant. A judge awards point between 1 and 10, with 1 being the lowest and 10 being the highest. For example, if the scores are: 9.2, 9.3, 9.0, 9.9, 9.5, 9.5, 9.6 and 9.8, then the contestant receives a total of 56.9 points. (Note: Use arrays Sparingly). **[6 marks]**
- e. Write a method called computeIncentive that takes one argument salesAmount compute and returns the annual incentives based on sales classification in table 1 below. **[4 marks]**

**Table 1:** Incentive Table

Class	Sales	Incentives
1	0 to 10000	10% of sales amount
2	10001 to 20000	20% of sales amount
3	20001 to 30000	25% of sales amount.