1. What is object oriented programming (OOP)? How is it differs from the traditional programming?
2. What is a class? How a class is different from a structure?
3. The only technical difference between structures and classes in C++ is that ______.
4. What is the purpose of a class definition?
5. What is an object? What are the differences between a class and an object?
6. A ______ has the same relation to a(n) ______ that a basic data type has to a variable of that type.
7. In a class definition, data or functions designated private are accessible
   a. to any function in the program.
   b. only if you know the password.
   c. to member functions of that class.
   d. only to public members of the class.
8. True or false: Data items in a class must be private.
9. True or false: Member functions in a class must be public.
10. Members of a class have three types of access specifiers. What are these?
11. What are class members? What is the default access specifier for the class members?
12. Why is that all member data (variables) must be declared private and that typically most member functions (methods) be public?
13. The dot operator (or class member access operator) connects the following two entities (reading from left to right):
   a. A class member and a class object
   b. A class object and a class
   c. A class and a member of that class
   d. A class object and a member of that class
14. Member functions defined inside a class definition are ______ by default.
15. Carefully distinguish between the meaning and use of the dot operator and the scope resolution operator, ::
16. A constructor is executed automatically when an object is ______.
17. A constructor’s name is the same as ______.
18. True or false: In a class you can have more than one constructor with the same name.
19. A member function can always access the data
   a. in the object of which it is a member.
   b. in the class of which it is a member.
   c. in any object of the class of which it is a member.
   d. in the public part of its class.
20. If three objects of a class are defined, how many copies of that class’s data items are stored in memory? How many copies of its member functions?
21. Sending a message to an object is the same as ______.
22. Classes are useful because they
   a. are removed from memory when not in use.
   b. permit data to be hidden from other classes.
   c. bring together all aspects of an entity in one place.
   d. can closely model objects in the real world.
23. True or false: There is a simple but precise methodology for dividing a real-world programming problem into classes.

24. Suppose your program contains the following class definition,

```cpp
class Automobile
{
public:
    void setPrice(double newPrice);
    void setProfit(double newProfit);
    double getPrice();

private:
    double price;
    double profit;
    double getProfit();
};
```

and suppose the main function of your program contains the following declaration and that the program somehow sets the values of all the member variables to some values:

```
Automobile hyundai, jaguar;
```

a) Which of the following statements are then allowed in the main function of your program?

```cpp
hyundai.price = 4999.99;
jaguar.setPrice(30000.97);
double aPrice, aProfit;
aPrice = jaguar.getPrice();
aProfit = jaguar.getProfit();
aProfit = hyundai.getProfit();
hyundai = jaguar;
```

b) Suppose that in the definition of the class Automobile all member variables are public instead of private. How would this change your answer to the question in part a) above?

25. What meant by friend functions and friend class? Why it is become a controversial issue?

26. What is meant by inheritance? When a new class inherits from an existing class, what does it inherits?

27. Inheritance is a way to
   a. make general classes into more specific classes.
   b. pass arguments to objects of classes.
   c. add features to existing classes without rewriting them.
   d. improve data hiding and encapsulation.

28. A “child” class is said to be ________ from a base class.

29. Advantages of inheritance include
   a. providing class growth through natural selection.
   b. facilitating class libraries.
   c. avoiding the rewriting of code.
   d. providing a useful conceptual framework.

30. True or false: Adding a derived class to a base class requires fundamental changes to the base class.

31. To be accessed from a member function of the derived class, data or functions in the base class must be public or ________.
32. If a base class contains a member function basefunc( ), and a derived class does not contain a function with this name, can an object of the derived class access basefunc( )?
33. True or false: If no constructors are specified for a derived class, objects of the derived class will use the constructors in the base class.
34. If a base class and a derived class each include a member function with the same name, which member function will be called by an object of the derived class, assuming the scope-resolution operator is not used?
35. The scope-resolution operator usually
   a. limits the visibility of variables to a certain function.
   b. tells what base class a class is derived from.
   c. specifies a particular class.
   d. resolves ambiguities.
36. True or false: It is sometimes useful to specify a class from which no objects will ever be created.
37. True or false: A class D can be derived from a class C, which is derived from a class B, which is derived from a class A.
38. A class hierarchy
   a. shows the same relationships as an organization chart.
   b. describes “has a” relationships.
   c. describes “is a kind of” relationships.
   d. shows the same relationships as a family tree.
39. True or false: It is illegal to make objects of one class members of another class.
40. In the UML, inheritance is called ____________.
41. Aggregation is
   a. a stronger form of instantiation.
   b. a stronger form of generalization.
   c. a stronger form of composition.
   d. a “has a” relationship.
42. What is polymorphism? Why polymorphism is related to pointers?
43. What is a virtual function? How it is different from a pure virtual function?
44. What is the name given to a class that contains at least one pure virtual function?

**Programming Exercises**

1. Write a program that calculates the area and circumference of a circle for given the value of radius r. The value r is defined in class called `Radius`.
2. Write a program that stores the (x, y) value of a coordinate in a class structure called `Point`. Then calculate the distance between any two points where the points are supplied by the user.
3. Write a program that calculates the area and circumference of a triangle for given the values of its base b and height h. The values b and h are defined in a class called `Sides`. Include a constructor to set the values of b and h to 1.
4. Write a program that convert the measurement in inches into centimetres. The value in inches is supplied by the user and stored in a class structure. Include a constructor to set the values of inches to 0.
5. Create a fraction class. Member data is the fraction’s numerator and denominator. Member functions should accept input from the user in the form 3/5, and output the fraction’s value in the same format. Another member function should add two fraction values. Write a main() program that allows the user to repeatedly input two fractions and then displays their sum. After each operation, ask whether the user wants to continue or not.

6. Given the following class definition, write an appropriate definition for the member function set.
   
   ```
   class Temperature
   {
   public:
   void set(float newDegrees, char newScale);
   //Sets the member variables to the values given as arguments.
   double degrees;
   char scale;  //’F’ for Fahrenheit or ’C’ for Celsius. }
   ```

7. Write a program that calculates the area and circumference of a triangle for given the values of its base b and height h by using the concept of inheritance. The values b and h are defined in a class called Sides. Include a constructor to set the values of b and h to 1.

8. Write a program that calculates the voltage V and power P of a resistor for given the values of its current I and resistance R using the concept of inheritance. The values I and R are defined in a class called Data. Include a constructor to set the values of I and R to 0.1 and 1000 respectively.

PART A

1. The two common programming methods in practice today are _______ and _______.
2. _______ programming is centered around functions, whereas _______ programming is centered around objects.
3. An object is a software entity that combines both ____ and ____ in a single unit.
4. An object is a(n) _______ of a class.
5. Creating a class object is often called the _______ of a class.
6. Once a class is declared, how many objects can be created from it? _______
7. An object’s data items are stored in its _______.
8. The functions an object performs are called its _______.
9. An object’s member can be declared public or private. A public member can be accessed by _______. A private member can be accessed by _______.
10. Normally a class’s _____ are declared to be private, and its _____ are declared to be public.
11. A class constructor is a member function with the same name as the _______.
12. A constructor is automatically called when an object is _______.
13. Constructors cannot have a(n) _______ type.
14. A(n) _______ constructor is one that requires no arguments.
15. A class may have more than one constructor, as long as each has a different _______.
16. A derived class inherits the _____ of its base class.
17. Consider the declaration: \textit{class Pet:Public Dog} The name of the base class is ______ and the name of the derived class is ______. The access specification for the base class is ______.

18. Protected members of a base class are like ____ members, except they may be accessed by derived class.

\textbf{PART B}

1. Locate the errors.
   
   Class Circle: {
   \hspace{1cm} \text{private float X;}
   \hspace{1cm} float Y;
   \hspace{1cm} float radius;
   \hspace{1cm} \text{public setCenter(float, float);}
   \hspace{1cm} \text{setRadius(float);}  
   }

\textbf{SOLUTION TO QUESTION 3.}

Write a program that calculates the area and circumference of a triangle for given the values of its base \(b\) and height \(h\). The values \(b\) and \(h\) are defined in a class called \textit{Sides}.

\begin{itemize}
\item[-] a) Using the normal method (. operator)
   \begin{verbatim}
   #include <iostream>
   #include<cmath>
   using namespace std;
   class Sides
   {
   float b, h;
   public:
   Sides( ) {
   cout<<"Enter base: "; cin>>b;
   cout<<"Enter height: "; cin>>h;       }
   float area(){
   return b*h; }
   float circumference(){
return b+h+sqrt((b*b) + (h*h));  }
   };
   
   main()
   {
   Sides n;
   cout<<"The area is "<<n.area()<<endl;
   cout<<"The circumference is "<<n.circumference()<<endl;   }
   
   Sample output:-
   Enter base: 2.3
   Enter height: 5.1
   The area is 11.73
   The circumference is 12.9946
   
   b) Using a pointer (-> operator)
   
   #include <iostream>
   
   \end{verbatim}
\end{itemize}
```cpp
#include<cmath>
using namespace std;
class Sides
{   float b, h;
    public: Sides()
    {
        cout<<"Enter base: "; cin>>b;
        cout<<"Enter height: "; cin>>h;
    }
    float area()
    {
        return b*h;
    }
    float circumference()
    {
        return b+h+sqrt((b*b) + (h*h));
    }
};
main()
{ Sides n, *ptr;
    ptr=&n;
    cout<<"The area is "<<ptr->area()<<endl;
    cout<<"The circumference is "<<ptr->circumference()<<endl; }

Sample output:-
Enter base: 2.3
Enter height: 5.6
The area is 12.88
The circumference is 13.9539

c) Using the concept of inheritance. Breaking the class Sides into base class and creating a derived class Calc. The private access specifier for variables b and h now becomes protected.
Using the normal method (. operator), using object of derived class.
```
Sample output:-
Enter base: 5.1
Enter height: 3.2
The area is 16.32
The circumference is 14.3208

d) Using a pointer to the derived class
#include <iostream>
#include<cmath>
using namespace std;
class Sides
{   protected: float b,h;
    public:   Sides( )
                {   cout<<"Enter base: "; cin>>b;
                    cout<<"Enter height: "; cin>>h;  } 
};
class Calc: public Sides{
    public:    float area(){
                    return b*h; }
    float circumference(){
                    return b+h+sqrt((b*b) + (h*h));  } 
};

main()
{ Calc n, *ptr;
    ptr=&n;
    cout<<"The area is "<<ptr->area()<<endl;
    cout<<"The circumference is "<<ptr->circumference()<<endl;  }

Sample output:-
Enter base: 1.3
Enter height: 2.8
The area is 3.64
The circumference is 7.18707

e) Using a pointer to the base class. Since the pointer is of type base class, it cannot be used to run the functions in the derived class, even though the address of derived class object is stored in the pointer.

In order to run the function in the derived class using pointer to base class, create a function having the same name as the one in the derived class in the base class. But since this function in the base class is not to be executed, make it a virtual function.
#include <iostream>
#include<cmath>
using namespace std;
class Sides
{   protected: float b,h;
    public:   Sides( )

```cpp
{ cout<"Enter base: "; cin>>b;
cout<"Enter height: "; cin>>h;  }
virtual float area(){ }
virtual float circumference(){ }

class Calc: public Sides{
public:    float area()
              { return b*h; }
    float circumference()
              { return b+h+sqrt((b*b) + (h*h)); }    }

main()
{ Sides *ptr;
  Calc n;
  ptr=&n;
cout<"The area is "<<ptr->area()<<endl;
cout<"The circumference is "<<ptr->circumference()<<endl;  }

Sample output:-
Enter base: 4.1
Enter height: 2.3
The area is 9.43
The circumference is 11.1011
```