For the next three questions, consider the class declaration:

```cpp
class CreditCard {
public:
    CreditCard(double Amount)      { Bal = Amount; }
    void   Pay( double Amount )    { Bal -= Amount; }
    void   Charge( double Amount ) { Bal += Amount; }
    double Balance() const         { return Bal; }
private:
    double Bal;
};
```

1. Which member function provides an observer/reporter operation?

1) Pay  
2) Charge  
3) Balance  
4) 1 and 2 only  
5) 1, 2, and 3  
6) None of these

2. Which member function provides a mutator operation?

1) Pay  
2) Charge  
3) Balance  
4) 1 and 2 only  
5) 1, 2, and 3  
6) None of these

3. Consider the following statements, assuming the class declaration for CreditCard is in scope:

```cpp
CreditCard WesternUnion(1000.0);
CreditCard BankAmerica(0.0);
WesternUnion.Pay(400.0);           // line 1
cout << WesternUnion.Bal;          //      2
BankAmerica = WesternUnion;        //      3
CreditCard.Charge(120.0);          //      4
```

Which statements would not cause compilation errors?

1) 1 only  
2) 2 only  
3) 3 only  
4) 4 only  
5) 1 and 3 only  
6) 1 and 4 only  
7) 2 and 3 only  
8) 2 and 4 only  
9) 2, 3 and 4 only  
10) None of these

4. Which of the following statements about C++ classes is false?

1) Classes can have private member functions.  
4) A class may have no data members.  
2) Classes can have both public and private data members.  
5) Aggregate assignment (shallow) is automatically supported for classes.  
3) By default, members of classes are private.  
6) None of these, (all are true).
5. Which of the following C++ built-in operations are not automatically defined for class objects?

1) = 4) None are auto-defined. 7) 1 and 3 only
2) == 5) All are auto-defined. 8) 2 and 3 only
3) << 6) 1 and 2 only

6. A class A has a public member function G that takes one int parameter for input, returns a bool value, and does not modify any of the class data members. Which of the following would be the best correct function prototype for G in the class declaration?

1) bool G(int& x); 4) bool G(int& x) const;
2) bool G(int x) const; 5) const bool G(int& x);
3) const bool G(int x); 6) None of these

7. Suppose that the declaration of the class A includes the following function prototype.

bool LessThan(const A& RHS);

Which of the following tests in the client code correctly compares two A objects named Alpha and Beta?

1) if (Alpha < Beta) 4) if (Alpha.LessThan.Beta)
2) if (LessThan(Alpha, Beta)) 5) if (LessThan(Alpha).Beta)
3) if (Alpha.LessThan(Beta)) 6) None of these

8. If the designer of a C++ class wishes to allow clients to inspect and modify a data member, what is the best approach?

1) Make the data member private and provide a public observer function as a class member.
2) Make the data member private and provide a public mutator function as a class member.
3) Declare the data to be public, not private.
4) Provide a public constructor that takes a value for that data member as a parameter.
5) Make the data member private and provide a public mutator function and a public observer function as class members.
6) Do nothing because it is not acceptable to let clients modify data members.
7) None of these

Consider the following class:

```cpp
class B {
private:
    int S;
public:
    B() {}
    B(int initS) { S = initS; }
};
```

9. Assuming everything necessary is in scope, consider the declaration: B Foo;

What is the value of Foo.S?

1) 0 3) The declaration isn't allowed.
2) Unknown 4) None of these
10. Assuming everything necessary is in scope, what is the value of Bar.S after executing the code fragment:

```cpp
B Foo(17), Bar(32);
Bar = Foo;
```

1) 17  
2) 32  
3) Unknown  
4) The assignment isn't allowed.  
5) None of these

For the next six questions, consider the class declaration:

```cpp
class Farey {
private:
    int Top, Bottom;
public:
    Farey();
    Farey(int T, int B);  
    Farey operator+(const Farey& RHS) const; 
    Farey operator-(const Farey& RHS) const; 
    bool operator===(const Farey& RHS) const; 
    void Display(ostream& Out) const;
};
```

Farey::Farey() {
    Top = Bottom = 0;
}
Farey::Farey(int T, int B) {
    Top = T;  
    Bottom = B;
}
Farey Farey::operator+(const Farey& RHS) const {
    return Farey(Top + RHS.Top, Bottom + RHS.Bottom);
}
Farey Farey::operator-(const Farey& RHS) const {
    return Farey(Top - RHS.Top, Bottom - RHS.Bottom);
}
bool Farey::operator===(const Farey& RHS) const {
    return (Top == RHS.Top) && (Bottom == RHS.Bottom);
}
void Farey::Display(ostream& Out) const {
    Out << Top << '/' << Bottom;
}

The addition operation here is sometimes called "Football player addition".
It does have a legitimate application.
Again, assuming everything necessary is in scope, consider the following code fragment:

```cpp
Farey A(3, 5), B(1, 4), C(2, 4), D(0, 5), E;
E = A + B; // line 1
A.Display(cout); // 2
E = A + B - C; // 3
E = 2*A; // 4
```

11. After the execution of line 1, what are the values of $E.\text{Top}$ and $E.\text{Bottom}$, respectively?

1) 0 and 0  
2) 3 and 5  
3) 4 and 9  
4) 9 and 4  
5) Unknown  
6) None of these

12. What is written to the stream `cout` when line 2 is executed?

1) "3/5"  
2) Nothing  
3) None of these

13. After the execution of line 3, what are the values of $E.\text{Top}$ and $E.\text{Bottom}$, respectively?

1) 0 and 0  
2) 2 and 5  
3) 4 and 9  
4) The statement isn't allowed.  
5) Unknown  
6) None of these

14. After the execution of line 4, what are the values of $E.\text{Top}$ and $E.\text{Bottom}$, respectively?

1) 6 and 10  
2) 6 and 5  
3) 3 and 10  
4) The statement isn't allowed.  
5) Unknown  
6) None of these

Consider the following code fragment:

```cpp
Farey X(1, 2), Y(2, 4);
if ( X == Y ) // line 5
    cout << "X == Y" << endl;
else
    cout << "X != Y" << endl;
if ( X + X == Y ) // line 6
    cout << "X + X == Y" << endl;
else
    cout << "X + X != Y" << endl;
```

15. When the `if` statement beginning in line 5 is executed, what is written to `cout`?

1) "X == Y"  
2) "X != Y"

16. When the `if` statement beginning in line 6 is executed, what is written to `cout`?

1) "X + X == Y"  
2) "X + X != Y"
For the next five questions, consider the following class:

```cpp
class Quadratic {
  private:
    double Coefficient[3];
  public:
    Quadratic(double a = 0.0, double b = 0.0, double c = 0.0);  
    double Evaluate(double x) const;
};
Quadratic::Quadratic(double a, double b, double c) {
  Coefficient[0] = a;
  Coefficient[1] = b;
  Coefficient[2] = c;
}
double Quadratic::Evaluate(double x) const {
  return (Coefficient[2]*x + Coefficient[1])*x + Coefficient[0];
}
```

17. Given the declaration: `Quadratic F(3, 2, 1);`

What value is output by the statement: `cout << F.Evaluate(2);`

1) 6  
2) 11  
3) 17  
4) None of these

18. Given the declaration: `Quadratic G(1);`

What value is output by the statement: `cout << G.Evaluate(2);`

1) 1  
2) 4  
3) Not allowed.  
4) None of these

A designer wants to add an addition operation to the class `Quadratic`. Consider the partial implementation:

```cpp
class Quadratic {
  private:
    double Coefficient[3];
  public:
    Quadratic(double a = 0.0, double b = 0.0, double c = 0.0);  
    double Evaluate(double x) const;
};
Quadratic::Quadratic(double a, double b, double c) {
  Coefficient[0] = a;
  Coefficient[1] = b;
  Coefficient[2] = c;
}
double Quadratic::Evaluate(double x) const {
  return (Coefficient[2]*x + Coefficient[1])*x + Coefficient[0];
}
```

19. How should the blank in line 1 be filled?

1) void  
2) Quadratic  
3) Quadratic&  
4) 2 or 3 only  
5) It should be left blank.  
6) None of these

20. How should the blank in line 2 be filled?

1) Quadratic(c, b, a)  
2) RHS  
3) *this  
4) Quadratic(a, b, c)  
5) It should be left blank.  
6) None of these
21. The algebraic expression in the member function `Evaluate()` could have been written as:

\[ \text{Coefficient}[2] \times x \times x + \text{Coefficient}[1] \times x + \text{Coefficient}[0] \]

Why was the approach shown above not used?

1) It isn't the right algebraic expression.
2) The original version required typing fewer characters.
3) The original version requires fewer operations to evaluate.
4) All of these
5) 1 and 2 only
6) 1 and 3 only
7) 2 and 3 only
8) None of these

For the next six questions, consider the following class declaration:

```cpp
ten Response {PRODUCT, CHECKPRICE, OUTOFSTOCK};
class Vendor {
private:
  unsigned int Stock;       // number of units available
  unsigned int Balance;     // total payments received
  unsigned int Price;       // unit price for product
  std::string passCode;     // security passcode
  unsigned int Capacity;    // max units vendor can hold
public:
  Vendor();
  Vendor(unsigned int Stk, unsigned int P, string Code);
  Response MakePurchase(unsigned int Payment);
  void addProduct(unsigned int Quantity, string Code);
  unsigned int removeMoney(string Code);
  bool changePrice(unsigned int P, string Code);
  ~Vendor();
};
```

For the next three questions, consider implementing the member function `MakePurchase()`.

```cpp
Response Vendor::MakePurchase(unsigned int Payment) {
  if (___________________________) return CHECKPRICE; // correct amount?
  if (___________________________) return OUTOFSTOCK; // stock available?
  Stock--;                                    // update stock
  Balance += Payment;                         // record payment
  return ____________________________;        // return product
}
```

22. The purpose of the first if statement is to make sure that the correct amount of money has been offered. A `Vendor` does not support making change. How should the blank in that line be filled?

1) Payment < Price
2) Payment != Price
3) Payment != Vendor.Price
4) There is no correct way to do this.
5) None of these
23. The purpose of the second if statement is to make sure that there is an item in stock to dispense in return for payment. How should the blank in that line be filled?

1) Stock != 0
2) Stock <= Capacity
3) Vendor.Stock == 0
4) There is no correct way to do this.
5) None of these

24. What value should be returned in the final statement?

1) CHECKPRICE
2) OUTOFSTOCK
3) PRODUCT
4) There is no correct way to do this.
5) None of these

For the next question, consider an implementation the member function changePrice():

```cpp
bool Vendor::changePrice(unsigned int P, string Code) {
    if (Code == passCode) {  // authenticate caller
        Price = P;           // reset price
        return true;         // confirm reset
    }
    return false;           // deny reset
}
```

25. What design features of Vendor support restricting who can change the price of an item?

1) Making passCode private.
2) Not providing a mutator for passCode.
3) Providing changePrice() as public.
4) All of these
5) 1 and 2 only
6) 1 and 3 only
7) 2 and 3 only
8) None of these

26. Which of the following would be logically and syntactically valid declarations of Vendor objects?

```cpp
Vendor M0000;                       // 1
Vendor M0001(100, 50, "wowonfie"); // 2
Vendor M0002(300, 100, ",", 300);    // 3
```

1) 1 only
2) 2 only
3) 3 only
4) All of them
5) 1 and 2 only
6) 1 and 3 only
7) 2 and 3 only
8) None of these

27. Which of the following are possible consequences of the choice that the implementation of Vendor uses unsigned int instead of int for some data members?

1) It reduces the amount of memory a Vendor object requires.
2) It eliminates the possibility of logical errors if parameters with negative values were passed in calls to member functions.
3) It reduces the amount of code needed for member functions.
4) All of them are true.
5) All of them are false.
6) 1 and 2 only
7) 1 and 3 only
8) 2 and 3 only
9) None of these
For the next three questions, consider the following class that represents a todo list. Tasks are represented by string objects, and stored in an array of dimension 100. Tasks are always added at the tail of the list, and removed from the front. To make the use of the array efficient, it is used in a circular manner.

```cpp
const unsigned int SIZE = 100;

class todoList {
public:
    todoList();                           // set up empty task list
    bool addTask(const string& Task);     // add a task to the list
    string getNextTask() const;           // see what the next task is
    bool delTask();                       // remove the next task
    void Display(ostream& Out) const;     // see the whole list
    void Clear();                         // remove all the tasks
    ~todoList();

private:
    unsigned int putNext;                 // index where next task will go
    unsigned int doNext;                  // index of next task to do
    unsigned int nTasks;                  // number of tasks in the list
    string List[SIZE];                    // list of tasks
};
```

28. What, if anything, is wrong with the following implementation of the member function to add a new task to the list?

```cpp
bool todoList::addTask(const string& Task) {
    List[putNext] = Task;
    putNext = (putNext + 1) % SIZE;
    nTasks++;
    return true;
}
```

1) If the list is full, it will replace the first uncompleted task with a new one.  
2) It updates the index putNext incorrectly.  
3) It doesn’t need a return value, since it always returns the same thing.  
4) All of these  
5) 1 and 2 only  
6) 1 and 3 only  
7) 2 and 3 only  
8) Something not listed  
9) Nothing is wrong

29. What, if anything, is wrong with the following implementation of the member function to delete a task from the list?

```cpp
bool todoList::delTask() {
    if ( nTasks == 0 )
        return false;

    doNext = ( doNext + SIZE - 1 ) % SIZE;
    nTasks--;
    return true;
}
```

1) If the list is empty, it will cause a runtime error.  
2) It updates the index doNext incorrectly.  
3) It should be declared as a const member function.  
4) All of these  
5) 1 and 2 only  
6) 1 and 3 only  
7) 2 and 3 only  
8) Something not listed  
9) Nothing is wrong
30. What, if anything, is wrong with the following implementation of the member function to display the tasks in the list?

```cpp
void todoList::Display(ostream& Out) const {
    if ( nTasks == 0 )
        Out << "Todo list is empty." << endl;
    else {
        for (unsigned int Pos = 0; Pos < nTasks; Pos++) {
            Out << setw(3) << Pos << ": ";
            Out << List[Pos] << endl;
            Pos++;
        }
    }
}
```

1) It doesn't necessarily start with the next task to do.  
2) It doesn't necessarily stop with the last task to do.  
3) It doesn't necessarily print all of the tasks waiting to be done.  
4) All of these  
5) 1 and 2 only  
6) 1 and 3 only  
7) 2 and 3 only  
8) None of these