Last name (printed): 

First name (printed): 

Directions: 

a) DO NOT OPEN YOUR EXAM BOOKLET UNTIL YOU HAVE BEEN TOLD TO BEGIN. 

b) You have 80 minutes to complete the exam (10:20-11:40) 

c) This exam booklet contains 30 multiple choice questions, each weighted equally (5 points). **5, double-sided, pages total** 

d) You may use one 8.5” x 11” note sheet during the exam. No other reference materials or calculating devices may be used during the examination. 

e) Questions will not be interpreted during the examination. 

f) You should choose the single best alternative for each question, even if you believe that a question is ambiguous or contains a typographic error. 

h) Use a #2 pencil to encode any information on the OMR form. 

i) Please encode the following on the OMR form: 

- Last name and first initial 
- MSU PID 
- Exam form (see the title of this page) 

j) Please sign the OMR form. 

k) Only answers recorded on your OMR form will be counted for credit. 

l) Completely erase any responses on the OMR form that you wish to delete. 

m) You must turn in this exam booklet and the OMR form when you have completed the exam. When leaving, please be courteous to those still taking the exam. 

Good luck. 

**Timing tip.** A rate of 2.5 minutes per multiple choice problem leaves 5 minutes to go over any parts of the exam you might have skipped.
1) What output is produced by Line 1 in Figure 1?
   a) 5
   b) 6
   c) 7
   d) 8
   e) None of the above.

2) What output is produced by Line 2 in Figure 1?
   a) 98b9c7b7
   b) 98977
   c) bcb
   d) 98b9
   e) None of the above.

3) What output is produced by Line 3 in Figure 1?
   a) abc
   b) cba
   c) abc123
   d) 321cba
   e) None of the above.
4) What output is produced by Line 4 in Figure 1?
   a) 11111
   b) 12345
   c) 54321
   d) 00000
   e) None of the above.

5) What output is produced by Line 5 in Figure 1?
   a) true
   b) false
   c) 1
   d) 0
   e) None of the above

6) Which of the following is correct about a method?
   a) method is part of a class
   b) is called in the context of an object using a dot call
   c) has the this pointer assigned by the compiler
   d) All of the above
   e) None of the above

7) What is the significance of the variable string::npos?
   a) number of characters in a string
   b) what is returned by a failed find on a string
   c) the maximum number of characters a string can hold
   d) the position of the "largest" character in the string.
   e) None of the above

8) What is the meaning of the :: operator?
   a) another form of assignment
   b) member access operator
   c) pointer dereference operator
   d) scope resolution operator
   e) None of the above.

9) What is the meaning of cin.clear()?
   a) removes all characters from the input stream.
   b) undo the last input operation
   c) clears any errors, resets cin to be "good"
   d) closes the cin stream
   e) None of the above

10) What is the difference between capacity and size in a vector?
    a) You need to know the type of the vector to answer
    b) size is how many elements are in the vector, capacity is how many it could hold before growing
    c) capacity is how many elements are in the vector, size is how many it could hold before growing
    d) size is how many elements are in the vector, capacity is maximum it could ever hold.
    e) None of the above
11) The C++ container map is ordered. Which of the following are true about map
   a) Order is applied to the key
   b) key must respond to the < operator
   c) key is const
   d) All of the above
   e) None of the above

12) Which of the following are true about generic algorithms:
   a) use iterators to work with a container
   b) must be templated to work with the container type
   c) are often not very efficient, but they are convenient.
   d) All of the above
   e) None of the above

```cpp
#include<iostream>
#include<sstream>
#include<vector>
#include<string>
using std::cout; using std::endl;
using std::stringstream;
using std::vector;
using std::string;

void fn2(vector<int> &v){
    for(auto &element : v) // Line 1
        if (element%2)
            element = 0;
}

string fn1(const vector<int> &v){
    stringstream oss;
    for (auto element : v) // Line 2
        oss << element << ",";
    string result = oss.str();
    result = result.substr(0,result.size()-1);
    return result;
}

int main (){  // Line 3
    vector<int> v{5,3,6,4,8,1};
    cout << v[v.size()-1]<<endl;
    cout << fn1(v)<<endl; // Line 4
    fn2(v);
    cout << v[v.size()-1]<<endl; // Line 5
}
13) For the program in Figure 2, give the output of Line 3.
   a) 1
   b) 8
   c) 4
   d) 6
   e) None of the above

14) For the program in Figure 2, give the output of Line 4.
   a) 5, 3, 6, 4, 8, 1
   b) 5, 3, 6, 4, 8, 1,
   c) 5, 3, 6, 4, 8,
   d) empty string
   e) None of the above

15) For the program in Figure 2, give the output of Line 5.
   a) 1
   b) 8
   c) 4
   d) 6
   e) None of the above

16) For the program in Figure 2, what does the & represent in Line 1.
   a) element is a pointer
   b) take the address of element
   c) nothing special, it is part of the way to declare an auto.
   d) element is a reference
   e) None of the above

17) For the program in Figure 2, what type is element in Line 2.
   a) vector
   b) vector<int>
   c) int
   d) string
   e) None of the above
18) For the program shown in Figure 3, what output is produced by Line 2?
   a) 10
   b) 20
   c) 0
   d) 100
   e) None of the above

19) For the program shown in Figure 3, what output is produced by Line 3?
   a) 10
   b) 20
   c) 0
   d) 100
   e) None of the above
20) For the program shown in Figure 3, what output is produced by Line 4?
   a) 10
   b) 20
   c) 0
   d) 100
   e) None of the above
21) For the program shown in Figure 3, what output is produced by Line 5?
   a) 1
   b) 2
   c) 3
   d) 4
   e) None of the above
22) In Figure 3, which of the following would be a good substitute for Line 1?
   a) `result = get_second();`
   b) `result = (*itr).second;`
   c) `result = itr &second;`
   d) All of the above
   e) None of the above
Figure 4

23) For the program in Figure 4, what value is printed by Line 1?
   a) 0
   b) 1
   c) 2
   d) 3
   e) None of the above

24) For the program in Figure 4, what value is printed by Line 2?
   a) 0
   b) 1
   c) 2
   d) No Output occurs
   e) None of the above
25) For the program in Figure 4, what value is printed by Line 3?
   a) 2
   b) 4
   c) 6
   d) 8
   e) None of the above

26) For the program in Figure 4, what value is printed by Line 4?
   a) 2
   b) 4
   c) 6
   d) 8
   e) None of the above

27) For the program in Figure 4, what value is printed by Line 5?
   a) 2
   b) 4
   c) 6
   d) 8
   e) None of the above

```cpp
#include<iostream>
#include<string>
using std::cout; using std::endl;
using std::string; using std::to_string;

class MyClass{
private:
    int x_;  
    double y_;  
public:
    MyClass() : x_(1), y_(1.1) {};
    MyClass(int, double);
    string fn1();
    MyClass fn2(const MyClass &);
};

MyClass::MyClass(int x, double y){
    x_ = x;
    y_ = y;
}

string MyClass::fn1(){
    return "x:" + to_string(x_) +", y:" + to_string(y_);
}

MyClass MyClass::fn2(const MyClass &c2){
    return MyClass(x_+c2.x_, y_+c2.y_);
}

int main (){  
    MyClass c1;
    MyClass c2(2,2.2);
    cout << c1.fn1() << endl;   // Line 1
    auto result = c1.fn2(c2);  // Line 2
    cout << result.fn1() << endl;  // Line 3
}
```

Figure 5
28) For the program in Figure 5, what output is produced by Line 1?
   a) 1, 1.1
   b) x:1, y:1.1
   c) 0,0
   d) x:0, y:0.0
   e) None of the above

29) For the program in Figure 5, what type is result on Line 2?
   a) int
   b) double
   c) string
   d) MyClass
   e) None of the above

30) For the program in Figure 5, what output is produced by Line 3?
   a) 1, 1.1
   b) x:1, y:1.1
   c) 0,0
   d) x:0, y:0.0
   e) None of the above