Last name (printed): ____________________________________________________________

First name (printed): __________________________________________________________

Directions:

a) DO NOT OPEN YOUR EXAM BOOKLET UNTIL YOU HAVE BEEN TOLD TO BEGIN.
b) You have 120 minutes to complete the exam (10am - noon)
c) This exam booklet contains 40 multiple choice questions, each weighted equally (5 points). 6 double-sided pages in 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.
g) Please fill in the requested information at the top of this exam booklet.
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 2.75 minutes per multiple choice problem leaves 10 minutes to go over any parts of the exam you might have skipped.
For the program in Figure 4, what output is produced on Line 1?

a) 2  
b) 4  
c) 6  
d) 8  
e) None of the above
2) For the program in Figure 4, what output is produced on Line 2?
   a) 2
   b) 4
   c) 6
   d) 8
   e) None of the above

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

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

5) For the program in Figure 4, what output is produced by Line 5?
   a) 0
   b) 1
   c) 2
   d) 3
   e) None of the above

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

7) For the program in Figure 4, what output is produced by Line 7?
   a) 1
   b) 2
   c) 3
   d) 4
   e) None of the above
For the program in Figure 5, what output is produced by Line 1?

a) -1  
b) 1  
c) 2  
d) 3  
e) None of the above
9) For the program in Figure 5, what output is produced by Line 2?
   a) -1
   b) 1
   c) 2
   d) 3
   e) None of the above

10) For the program in Figure 5, what output is produced by Line 3?
    a) jill
    b) jean
    c) janet
    d) empty string
    e) None of the above

11) For the program in Figure 5, what output is produced by Line 4?
    a) 1
    b) 2
    c) 3
    d) 4
    e) None of the above

12) For the program in Figure 5, what output is produced by Line 5?
    a) 1
    b) 2
    c) 3
    d) 4
    e) None of the above

13) For the program in Figure 5, what output is produced by Line 6?
    a) 1
    b) 2
    c) 3
    d) 4
    e) None of the above
Figure 1

14) For the program in Figure 1, what output is given by Line 1?
   a) 1
   b) 2
   c) 4
   d) some address
   e) None of the above.

15) For the program in Figure 1, what output is given by Line 2?
   a) 1
   b) 2
   c) 4
   d) some address
   e) None of the above.
16) For the program in Figure 1, what output is given by Line 3?
   a) 1
   b) 2
   c) 4
   d) some address
   e) None of the above.

17) For the program in Figure 1, what output is given by Line 4?
   a) true
   b) false
   c) 1
   d) 0
   e) None of the above.

18) For the program in Figure 1, what output is given by Line 5?
   a) 5
   b) 10
   c) 15
   d) some address
   e) None of the above.

19) For the program in Figure 1, what output is given by Line 6?
   a) 5
   b) 10
   c) 15
   d) some address
   e) None of the above.

20) For the program in Figure 1, what output is given by Line 7?
   a) 5
   b) 10
   c) 15
   d) some address
   e) None of the above.

21) For the program in Figure 1, what output is given by Line 8?
   a) true
   b) false
   c) 1
   d) 0
   e) None of the above.
22) Which of the following describes the term "memory leak"?
   a) An undeclared array.
   b) A pointer that points to the value `nullptr`
   c) Memory that was allocated by `new` but not deleted by `delete`
   d) Memory that is untyped.
   e) None of the above

23) What is the Big O rating for the algorithm to search for an element in a singly-linked list?
   a) O(1)
   b) O(n * log(n))
   c) O(n)
   d) O(n^2)
   e) None of the above

24) What is the return type of a class constructor?
   a) an instance of the class
   b) no return on a constructor
   c) an `int` (the size of the class in bytes)
   d) a `string` (the name of the class)
   e) None of the above

25) Which of the following represent differences between a C++ class and a struct?
   a) struct cannot have associated methods
   b) only a class can have private data members
   c) there are no constructors or destructors for a struct.
   d) All of the above
   e) None of the above.

26) Which of the following are true about the special variable `this`?
   a) It is a reference value
   b) You are allowed change what it points to in a method.
   c) It is bound to the calling instance of a method
   d) All of the above.
   e) None of the above

27) What is the size of a C++ pointer (how many bytes)?
   a) depends on the size of addressable memory of the operating system (32 bit, 64 bit, etc.)
   b) same size as the type it points to
   c) always 2 bytes
   d) always 4 bytes
   e) None of the above.

28) Which of the follow are true about basic C++ arrays?
   a) they are fixed size.
   b) they have associated function members/methods to manipulate the underlying data.
   c) they cannot be dynamically created during runtime.
   d) All of the above
   e) None of the above
29) For the program in Figure 2, what is the **full type name** for result on Line 1 given the call on Line 3?
   a) map<K,V>::iterator
   b) map<string,long>::iterator
   c) map<string,long>*
   d) string
   e) None of the above

30) For the program in Figure 2, what value is output on Line 2?
   a) 0
   b) 1
   c) 3
   d) 5
   e) None of the above
31) For the program in Figure 2, what is the **full type name** for result1 on Line 3?
   a) map<K,V>::iterator
   b) map<string,long>::iterator
   c) map<string,long>*
   d) string
   e) None of the above

32) For the program in Figure 2, what value is output on Line 4.
   a) 0
   b) 1
   c) 3
   d) 5
   e) None of the above

33) For the program in Figure 2, what value is output on Line 5?
   a) zero
   b) one
   c) three
   d) five
   e) None of the above

34) For the program in Figure 2, what value is output on Line 6?
   a) 0
   b) 1
   c) 3
   d) 5
   e) None of the above

35) For the program in Figure 2, what value is output on Line 7?
   a) 0
   b) 1
   c) 3
   d) 5
   e) None of the above
36) For the program in Figure 3, what type is `result` on Line 1?
   a) long
   b) vector<long>
   c) pair<long,long>
   d) string
   e) None of the above

37) For the program in Figure 3, what output is produced by Line 2?
   a) 1
   b) 2
   c) 3
   d) 4
   e) None of the above

Figure 3
38) For the program in Figure 3, what output is produced by Line 3?
   a) 1
   b) 2
   c) 3
   d) 4
   e) None of the above

39) For the program in Figure 3, what output is produced by Line 4?
   a) 1
   b) 2
   c) 3
   d) 4
   e) None of the above

40) For the program in Figure 3, what output is produced by Line 5?
   a) 1
   b) 2
   c) 3
   d) 4
   e) None of the above