2017 Academic Challenge

COMPUTER SCIENCE TEST – STATE

– This Test Consists of 30 Questions –

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GENERAL DIRECTIONS

Please read the following instructions carefully. This is a timed test; any instructions from the test supervisor should be followed promptly.

The test supervisor will give instructions for filling in any necessary information on the answer sheet. Most Academic Challenge sites will ask you to indicate your answer to each question by marking an oval that corresponds to the correct answer for that question. One oval should be marked to answer each question. Multiple ovals will automatically be graded as an incorrect answer.

Be sure ovals are marked as ⬤ , not ⊙ , ◖ , ◗ , etc.

If you wish to change an answer, erase your first mark completely before marking your new choice.

You are advised to use your time effectively and to work as rapidly as you can without losing accuracy. Do not waste your time on questions that seem too difficult for you. Go on to the other questions, and then come back to the difficult ones later if time remains.

*** **Time: 40 Minutes** ***

DO NOT OPEN TEST BOOKLET UNTIL YOU ARE TOLD TO DO SO!

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Use the following code for Questions 1, 2, 3, & 4.

```
1    class Rectangle {
2      public:
3        Rectangle(float=1, float=1);
4        float getLength()    const  { return length;          }
5        float getWidth ()    const  { return width;           }
6        float getPerimeter() const  { return 2*width+2*length; }
7        float getArea()      const  { return width*length;     }
8        void  setLength(float l)    { length = (l > 0) ? l : 5; }
9        void  setWidth (float w)    { width  = (w > 0) ? w : 5; }
10     protected:
11       float length, width;
12     private:
13       string name;
14   };
15   Rectangle::Rectangle(float l, float w) {
16     setLength(l);
17     setWidth(w);
18   }  // end Rectangle constructor
19   // END Rectangle Class
20   class Square: public Rectangle {
21     public:
22       float getSide()    const  { return width;                  }
23       void  setSide(float s)    { width = length = (s > 0) ? s : 2; }
24       Square operator++();
25   };
26   Square Square::operator++ () {
27     width++;  length++;
28     return *this;
29   } // end overloaded pre-increment ++
30   // END Square Class
31
32   int main () {
33     Rectangle a(0,0), b(2,-1), c[5];
34     Square d;
35
```

1. How many times is the `Rectangle` constructor called in the code above?

   a. 1   b. 3   c. 7   d. 8   e. Cannot be determined.

2. Which line of code will result in a compiler error?

   a. `++a;`   b. `cout << c[4].getArea();`

   c. `a.setWidth(2);`   d. `d.getWidth();`

   e. Multiple lines above will cause errors.

3. Given the relationship with the `Square` and `Rectangle` classes, which of the following would be a more appropriate declaration of the given methods and classes?

   a. Make all of the public items in `Rectangle` protected.
   b. Make `width` and `length` private.
   c. Make `setWidth` and `setLength` protected as well.
   d. Have `Square` inherit `Rectangle` as protected, then override `getArea` and `getPerimeter` in the `Square` class.
   e. Make all methods in `Square` private.

4. Which of the following statements is not true for the class above?

   a. `Rectangle` is the base class for the `Square` class.
   b. The `++` operator in the `Square` class is an example of polymorphism.
   c. The `Square` class may directly access private items in the `Rectangle` class.
   d. If a programmer attempts to set a side of the `Square` to -1, the side will be set to 2.
   e. `Square` objects may directly access its `length` within the class.

5. Given the two stack operations below, what will the stack look like after the following operations assuming the stack was empty to start.
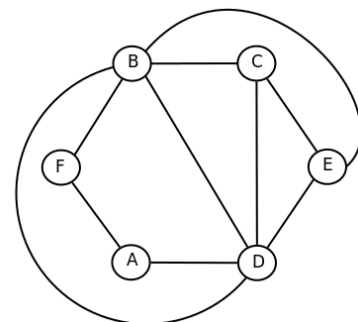
   > `PUSH` - put item on top of stack
   > `POP` - take an item off top of stack and return it

   `PUSH(Z); PUSH(X); PUSH(M); PUSH(Q); POP(); PUSH(POP()); PUSH(A); PUSH(B); POP();`

   a. ZXMA   b. BAQM   c. AQMX   d. BAQMXZ   e. ZXMBA

6. For the graph to the right, which of the following represents a depth first search (DFS) starting at node B?

   a. FADECB
   b. BCDFEA
   c. ABCDEF
   d. BDACEF
   e. BCDAFE

7. For the graph to the right, which statement is false?

   a. The minimal spanning tree will have edges 1, 2, 3, 4, 5.
   b. The lowest cost path from B to D is 12.
   c. The lowest cost path from A to C is 11.
   d. A spanning tree of this graph will have 5 edges.
   e. The degree of node B is 5.
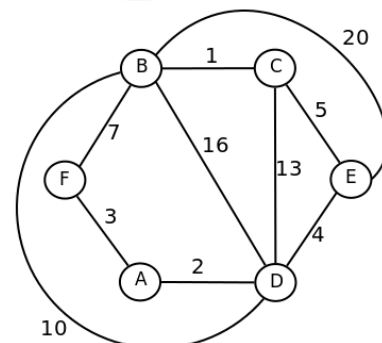
Use the following code for Questions 8 & 9.

```
1    struct node {
2       int data;
3       node* next, prev;
4    };
5
6    node *head, *n;
7    head = new node;
8    head->data = 2;
9    head->next = new node;
10   n = head->next;
11   n->data = 8;
12   n->next = NULL;
13   n->prev = new node;
14   n->prev->data = 4;
15   n->prev->prev = head;
16   n->prev->next = n
17   head->next = n->prev;
18   head->prev = n;
```

8. Determine the order and contents of the linked list.

a. 2 8 4   b. 2 4 8   c. 2 4   d. 8 4 2   e. Cannot be determined.

9. Using the `struct` above and assuming that the head node points to the first node in the list, which code will add up the sum of all the data elements in the list?

a.
```
int sum = 0;
for(node* n = head; n!=NULL; n=n->next)
    sum += n->data;
```
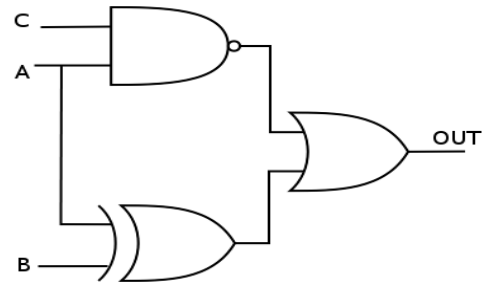
b.
```
int sum = 0;
n = head;
while (n!=NULL)
    sum += n->data;
    n=n->next;
```

c.
```
int sum = 0;
n = head;
do {
    sum += n->data;
    n = n->next;
} while (n->next!=NULL);
```

d. All of the sets of code will work correctly to add up the sum of data elements.
e. None of the sets of code will work correctly.

10. What is the logical output of the logic circuit to the right when A is TRUE and B is FALSE?

    a. C
    b. C'
    c. TRUE
    d. FALSE
    e. None of the above.

11. Determine the minimal sum of products expression for the Karnaugh map (Kmap) to the right.

    a. B'C' + C'D + BD
    b. B'C' + C'D + BCD
    c. C'D + A'B'C' + AB'C' + BCD
    d. B'C' + BD
    e. None of the answers above are correct.

	C'D' 00	C'D 01	CD 11	CD' 10
A'B' 00	1	1	0	0
A'B 01	0	1	1	0
AB 11	0	1	1	0
AB' 10	1	1	0	0

12. What is the result in base 10 of the following subtraction assuming that the 2 numbers are represented in 8-bit 2's complement format?

```
    10111011
  -11111011
```

    a. 64   b. 11000000   c. -64   d. -65   e. Overflow

13. Biased numbers are used to represent positive and negative integers. The number is first calculated as an unsigned integer, then the bias is subtracted from that value. The bias of an n-bit biased number is $2^{n-1} - 1$. So, for an 8-bit biased number, the bias is -127. The 8-bit biased number 11111100 would be $252 - 127$ which is 125.

Given this information, which of the following is not true regarding biased numbers.

    a. The lowest value for an 8-bit biased number is -127.
    b. The largest value for an 8-bit biased number is 128.
    c. The bias for a 6-bit biased number would be -31.
    d. -125 in decimal represented as an 8-bit biased number would be 00000010.
    e. The value for zero as an 8-bit biased number is 00000000.

14. What is SQL injection?

    a. A technique where malicious users can inject SQL commands into an SQL statement via web page input.
    b. A technique used to quickly load data into a relational database from a flat file.
    c. A type of denial of service attack where multiple compromised systems are used to target a single system.
    d. A SQL statement that will copy data from one table to another.
    e. Any SQL INSERT statement.

15. What type of software allows a single physical computer to operate as two or more separate and independent computers?

    a. Operating system   b. Anti-virus program
    c. Virtualization   d. Emulator
    e. RDBMS

16. What is decimal range for the first octet of a Class C IPv4 network address?

    a. 128 – 191   b. 192 – 223
    c. 1 – 126   d. 1 - 255
    e. 224 – 239

17. What are the three logic structures used in most programming languages?

    a. FIFO, LIFO, FILO
    b. IF, CASE, DO
    c. DO, FOR, CASE
    d. Sequence, selection, repetition
    e. None of the above.

Use the following code for Questions 18, 19, & 20.

```
1   int m = 4;
2   for (int i=2;i<4;i++)
3       m = m << i;
4   cout << m << endl;
```

18. What type of operator is the << operator used on line 3?

    a. conditional   b. bitwise   c. cast   d. modulus   e. output

19. What is the output of the code?

    a. 4   b. 16   c. 32   d. 64   e. 128

20. If line 2 was replaced with the following line of code, what would the output be?

```
for (int i=2;i<4;i+=2)
```

    a. 4   b. 16   c. 32   d. 64   e. 128

Use the following code for Questions 21, 22, & 23.

```
1      int my_func1(int a) {
2          return a*a;
3      }
4      int my_func2(int a) {
5          int b = 0;
6          return b = 2*a;
7      }
8      int main() {
9          int j = 0;
10         for (int i=0;i<4;i++)
11             if (i % 2)
12                 j += my_func1(i);
13             else
14                 j -= my_func2(i);
15         cout << j << endl;
16         return 0;
17     }
```

21. When will `my_func1()` be called?

   a. When `i` is greater than 5.
   b. When `i` is even.
   c. When `i` is odd.
   d. `my_func1()` will never be called.
   e. `my_func1()` will be called on every iteration of the for loop.

22. What is the value of `j` on line 15?

   a. -2   b. -3   c. 6   d. 1   e. 23

23. If the conditional expression in the `for` loop were changed to `i < 6`, what would the value of `j` be on line 15?

   a. -2   b. -3   c. 6   d. 1   e. 23

Use the following code for Questions 24, 25, 26, & 27.

```
1    int my_func(int n) {
2        switch (n%4) {
3            case 1:
4                n+=n;
5                break;
6            case 2:
7                n*=2;
8            case 3:
9                n*=n;
10               break;
11           default:
12               n=0;
13       }
14       return n;
15   }
16   int main() {
17       int tot = 0;
18       for (int i=0;i<6;i++)
19           tot += my_func(i);
20       cout << tot;
21       return 0;
22   }
23
```

24. When will line 9 be executed?

    a. When `n % 4` evaluates to 1.

    b. When `n % 4` evaluates to 2.

    c. When `n % 4` evaluates to 3.

    d. When `n % 4` evaluates to 1, 2, or 3.

    e. When `n % 4` evaluates to 2 or 3.

25. When will line 12 be executed?

    a. When `n % 4` evaluates to 0.

    b. When `n % 4` evaluates to 1.

    c. When `n % 4` evaluates to 2.

    d. When `n % 4` evaluates to 3.

    e. When `n % 4` evaluates to 1, 2, or 3.

26. What value will be output on line 20?

    a. 0   b. 2   c. 18   d. 27   e. 37

27. If line 11 were replaced with the following line of code, would the output then be on line 20?

```
case 0:
```

   a. There would be no output as the case labels would be out of numerical order and cause a syntax error.

   b. The output would be zero as control would always be transferred to the new case label.

   c. There would be no output as the case labels would be out of numerical order and cause a logic error.

   d. The output would not change.

   e. None of the above.

Use the following code for Questions 28, 29, & 30.

```
1   void my_func1 (int b[], int a) {
2       for (int n=0; n<a; n++)
3           cout << b[n] << " ";
4       cout << endl;
5   }
6   void my_func2 (int c[], int a, int b) {
7       c[a] = b;
8   }
9   int main() {
10      int a[] = {4, 8 ,12, 16};
11      my_func1 (a,4);
12      my_func2 (a,1,4);
13      my_func1 (a,3);
14      return 0;
15  }
16
```

28. What will be the output from `my_func1` when it is called on line 11?

   a. 4 8 16   b. 4 8 12 16

   c. 4 4 12   d. 4 8 12 16 20

   e. 4 4 20

29. What will be the output from `my_func1` when it is called on line 13?

   a. 4 8 16   b. 4 8 12 16

   c. 4 4 12   d. 4 8 12 16 20

   e. 4 4 20

30. What is the purpose of `endl` on line 4?

   a. It terminates the program.

   b. It inserts a newline character into the output sequence.

   c. It flushes the associated stream buffer.

   d. It inserts a newline character into the output sequence and flushes the associated stream buffer.

   e. None of the above.