



2024 Academic Challenge COMPUTER SCIENCE TEST – STATE

Computer Science Test Production Team

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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 Number of Questions: 30

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

Academic Challenge
Computer Science Test (State) – 2024

1. In an assembly language program, an immediate operand refers to
 - A. an operand in a CPU data register.
 - B. an operand in cache memory.
 - C. an operand as part of the instruction in the instruction register.
 - D. an operand in a main memory location.
 - E. an operand resident on disk.

2. The byte 10111010 has 3 0s and 5 1s. How many different bytes have exactly 5 0s and 3 1s?
 - A. 8
 - B. 24
 - C. 28
 - D. 56
 - E. 84

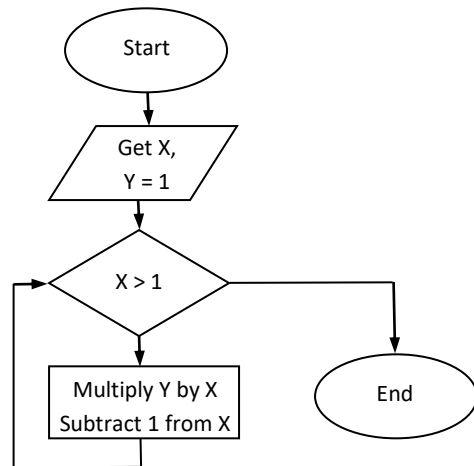
3. The 8-bit two's complement binary number 10010001 represents which decimal number?
 - A. -145
 - B. -111
 - C. -17
 - D. -17
 - E. -145

4. 1000BASE-T (also known as 802.3ab) is a standard for Gigabit Ethernet over twisted-pair wiring. Which organization has written and published this and other ethernet standards?
 - A. ANSI
 - B. FCC
 - C. FAAr
 - D. IEEE
 - E. NEMA

5. Which of the following eight-bit binary numbers has odd parity?
 - A. 11011101
 - B. 11011000
 - C. 11101110
 - D. 11110100
 - E. 11000000

6. What is the resulting value of Y for the program designed to implement the given flowchart?

- A. The sum of all integers less than X.
- B. The factorial of X.
- C. X to the power of X.
- D. X
- E. None of the above.



7. The ASCII code for the characters 'A', 'E', 'a' are 01000001, 01000101, and 01100001, respectively. What is the ASCII code for the character 'e'?

- A. 01000101
- B. 01000110
- C. 01100101
- D. 01010101
- E. None of the above

8. Which type of data structure is associated with first-in-first-out (FIFO) access?

- A. Queue
- B. Stack
- C. Linked list
- D. Indexed Array
- E. Associative Array

9. What is the Boolean expression that matches the given truth table?

J	K	L	output
F	F	F	F
F	F	T	T
F	T	F	T
F	T	T	F
T	F	F	T
T	F	T	F
T	T	F	F
T	T	T	T

- A. $JK'L' + J'KL' + J'K'L$
- B. $JKL + K'L' + J'L' + J'K'$
- C. $(J+K+L)(J+K+L')(J'+K+L')(J'+K'+L)$
- D. $(JKL)(JK'L')(J'KL')(J'K'L)$
- E. $JKL + JK'L' + J'KL' + J'K'L$.

10. What is an IDE?

- A. Instructional Data Expression
- B. Independent Data Exception
- C. Interrupt Driven Event
- D. Inheritance Derived Encryption
- E. Integrated Development Environment

11. What is the binary representation of the hexadecimal number FACE?

- A. 1111101011001110
- B. 1111101011101110
- C. 1111101111011110
- D. 1111101011011110
- E. 1111111011011110

12. What is the decimal representation of the hexadecimal number in problem 11?

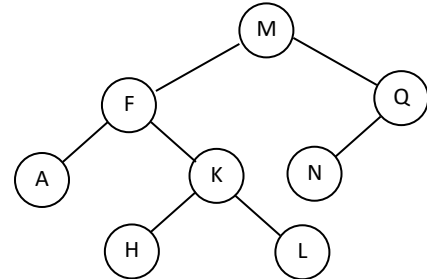
- A. 61896
- B. 62032
- C. 62224
- D. 63720
- E. 64026

13. Which of the following is equivalent to the Boolean expression $A \text{ XOR } B$?

- A. $(A \text{ OR } B) \text{ AND } ((\text{NOT } A) \text{ OR } (\text{NOT } B))$
- B. $(\text{NOT } (A \text{ OR } B)) \text{ AND } ((\text{NOT } A) \text{ AND } (\text{NOT } B))$
- C. $(\text{NOT } (A \text{ AND } B)) \text{ AND } ((\text{NOT } A) \text{ OR } (\text{NOT } B))$
- D. All of the above
- E. None of the above

14. An in-order traversal of the tree below will visit the elements of the tree in which order?

- A. A F H K L M N Q
- B. A H L K F M N Q
- C. M F A K H L Q N
- D. M F A K H L N Q
- E. None of the above.



15. Use the following Karnaugh map to determine the minimal sum of products logical function that corresponds to the table.

- A. A' or D
- B. $(A'C')$ or (ABC)
- C. $(A'B'C')$ or D
- D. $(A'C'D)$ or $(A'C'D)$ or (ABC)
- E. $(A'C')$ or $(A'B)$

	$A'B'$	$A'B$	AB	AB'
$C'D'$	T	T	F	F
$C'D$	T	T	F	F
CD	F	F	T	F
CD'	F	F	T	F

16. Associative arrays use hashing functions to:

- A. encrypt the data being stored.
- B. decrypt the data being stored.
- C. locate the data in a list based upon the data being stored.
- D. locate the first item in the list.
- E. insure that all items are stored sequentially.

Use the following code for questions 17 through 19:

```
#include <iostream >
using namespace std;

int main () {
    int a[10];
    for (int i = 0; i < 10; i++)
        a[i] = i*i;
    for (int j = 7; j >= 0; j -= j%3 + 1) {
        cout << a[j] << " " ;}
}
```

17. What does this code print out when it runs?

- A. 49 25 4
- B. 49 25 4 1
- C. 49 25 4 0
- D. 49 36 25 9 4 1
- E. 49 36 25 9 4 1.0

18. How many times does the second loop iterate?

- A. 8
- B. 7
- C. 6
- D. 4
- E. 3

19. In the final second loop evaluation, what is the value of j ?

- A. 2
- B. 1
- C. 0
- D. -1
- E. -2

Use the following code for questions 20 and 21:

```
#include <iostream >
using namespace std;

int funA(int a, int& b) {
    static int c = 1;
    b = ++c;
    return (a + b);
}

int main () {
    int a = 2, b = 3;
    cout << funA(a, b) << " ";
    cout << funA(b, a) << endl;
}
```

20. What is printed by the `cout` statements?

- A. 3 5
- B. 3 4
- C. 3 3
- D. 2 3
- E. 4 5

21. What are the values of `b` just before the function return for each of the two function calls?

- A. 1 1
- B. 1 2
- C. 2 2
- D. 2 3
- E. 3 3

22. The following items are added (PUSH) or removed (POP) from a stack data structure:

PUSH(M)
PUSH(B)
POP()
PUSH(Z)
PUSH(Q)
POP()
PUSH(P)
POP()

What is the state of the stack after the given operations?

- A. PQ
- B. PQZBM
- C. PQZ
- D. ZM
- E. PB

23. What is the Big O form of the algorithm that takes $3n^2 - 4n^3 + 1000$?

- a) n^2
- b) n^3
- c) 1000
- d) $3n^2$
- e) None of the above.

24. Assuming a list of N items, Algorithm 1 takes $3N^2 + 100N + 1000$ steps to process the list and Algorithm 2 takes $N^2 + 40N + 3000$ steps. For what size list do both of the Algorithms take the same number of steps?

- a) 1
- b) 12
- c) 20
- d) 50
- e) They are never equal.

Use the following code for questions 25 through 27:

```
struct {  
int a[10];  
int b;  
char c;  
} s;  
  
// First loop  
for (int i = 0; i <= 5; i++)  
    s.a[i] = i*i;  
    s.b = s.a[5];  
  
// Second loop  
for (int j = 5; j < 10; j++)  
    s.a[j] = s.a[j-5] * s.b;
```

25. At the end of the first loop, how many elements of `s.a` have been allocated?

- A. 5
- B. 6
- C. 9
- D. 10
- E. None have been allocated.

26. What is the sum of elements `s.a[5]` through `s.a[10]` at the end of the second loop?

- A. 750
- B. 775
- C. 805
- D. 830
- E. None of the above.

27. How many times is the `++` operator actually executed in completing both loops?

- A. 5
- B. 16
- C. 15
- D. 10
- E. 11

Use the following code for questions 28 through 30

```
1> /*** Code used with questions 28, 29 & 30. ***/
2> class Die {
3> private:
4> int num_sides, die_value;
5> static int num_dice;
6> public:
7> Die();
8> int RollDie();
9> void SetDieValue(int);
10> int GetDieValue() const {return die_value;}
11> void SetNumSides(int);
12> int GetNumSides() const {return num_sides;}
13> int GetNumDice() const {return num_dice;}
14> ~Die() {num_dice--;}
15> };
16> int Die::num_dice = 0;
17> Die::Die() {
18> SetNumSides(6);
19> die_value = 1;
20> num_dice++;
21> }
22> void Die::SetDieValue(int input) {
23> die_value = (input>0 && input<=num_sides) ? input : 1;
24> }
25> void Die::SetNumSides(int input) {num_sides = (input<2) ? 6 : input; }
26> int Die::RollDie() {
27> /*** rand() returns random number between 0 & max int inclusive ***/
28> die_value = (rand()%num_sides)+1;
29> return die_value;
30> }
```

28. It is desired to add code to the class that will allow the `>` to compare two instances of the `Die` class. If the first instance has a `die_value` greater than the second, then `TRUE` will be returned, otherwise `FALSE` will be returned. Which of the following code segments accomplishes this?

- A.

```
bool Die::operator>( const Die &d) {  
    return this.die_value > d.die_value;  
}
```
- B.

```
bool Die::operator>( const Die &d) {  
    return die_value > d->die_value;  
}
```
- C.

```
bool Die::operator>( const Die &d) {  
    return this.GetDieValue() > d.GetDieValue();  
}
```
- D.

```
bool Die::operator>( const Die &d) {  
    return this->die_value > d.die_value;  
}
```
- E. None of the above.

29. What concept from Object Oriented Programming best applies to the code from the last question?

- A. Inheritance
- B. Operator overloading
- C. Instantiation
- D. Friend function
- E. None of the above.

30. Setting the methods `GetDieValue`, `GetNumSides`, and `GetNumDice` as `const` allows for which of the following?

- A. Classes can be developed for which `Die` will be a parent.
- B. Those functions can then be overloaded.
- C. This encapsulates the data.
- D. Declaring them as `const` serves no purpose.
- E. These methods can be used with `const` instances of the `Die` class.

SCRATCH PAPER

