



2024 Academic Challenge

COMPUTER SCIENCE TEST – REGIONAL

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!

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Academic Challenge
Computer Science Test (Regional) – 2024

1. $A = 11010011$ and $B = 10110101$. What is $A \text{ XOR } B$?
a. 00001000 b. 10011001 c. 11110111 d. 01100110 e. 10011001

2. Convert the hexadecimal represented number 3FE to decimal representation.
a. 398 b. 422 c. 684 d. 966 e. 1022

3. Which expression is equivalent to $A + (\bar{B} \cdot C)$?
a. $\overline{A + (\bar{B} \cdot C)}$ b. $\overline{\bar{A} \cdot (B + \bar{C})}$ c. $\bar{A} \cdot (B + \bar{C})$ d. $A + (\bar{B} \cdot C)$ e. $\overline{\bar{A} + (B \cdot \bar{C})}$

4. In a ten-bit two's complement integer representation, what is the range of decimal integer numbers that can be represented?
a. -10 to 9 b. -1024 to 1023 c. 0 to 255 d. 0 to 1024 e. -512 to 511

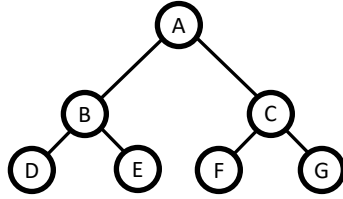
5. What is the 8-bit two's complement representation of decimal -83?
a. 11000101 b. 10101101 c. 10111011 d. 10001010 e. 10001010

6. What is the value of the expression $36 / 4 + 2 * 3 - 1$?
a. 1 b. 14 c. 17 d. 32 e. 36

7. Array A is defined by

$$\text{int } A[3][4]$$
and it holds the values 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 in order.
What is the value of $A[2][3]$?
a. 2 b. 3 c. 2, 3 d. 6 e. 12

8. A postorder traversal of the binary tree below would result in what sequence?



- a. ABCDEFG b. ACBGFED c. ABDECFG d. DEBFGCA e. GCFAEBD

9. How many Boolean functions are there of five Boolean variables?

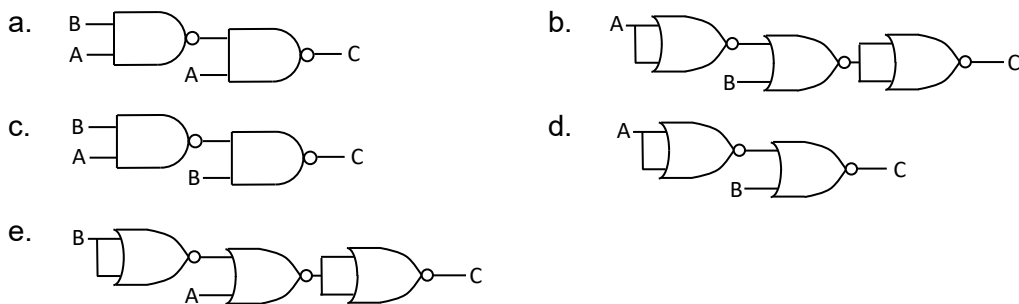
- a. 5 b. 32 c. 65,536 d. 16,777,216 e. 4,294,967,296

10. Which is a correct sum of products expression for the following logic function?

input A	input B	output C
0	0	1
0	1	1
1	0	0
1	1	1

- a. $\bar{A} \cdot \bar{B} + \bar{A} \cdot B + A \cdot B$ b. $\bar{A} \cdot B$ c. $\bar{A} + \bar{B} \cdot A + \bar{B} \cdot A + B$
 d. $(\bar{A} + \bar{B}) \cdot (A + \bar{B}) \cdot (A + B)$ e. $\bar{A} \cdot \bar{B} + A \cdot \bar{B} + A \cdot B$

11. If restricted to NOR gates, which of the following is a gate structure to implement the function in problem #10?



12. The maximum number of bits required for the product of two n -bit unsigned integers is

- a. n b. $n + 1$ c. $2n$ d. $2n + 1$ e. n^2

13. What does BIOS stand for?

- a. Boot Instructions On Startup
- b. Bit Insertion Operation Security
- c. Byte Instruction Offset Synchronization
- d. Basic Input Output System
- e. None of the above

14. Convert the decimal number 823 to a hexadecimal representation.

- a. 11100100011 b. 2A7 c. 2FE d. 337 e. 4ED

15. A computer architecture with shared program and data memory space with a single memory access bus is called _____ Architecture

- a. Von Neumann
- b. Harvard
- c. Divergent
- d. IBM
- e. Intel

16. What are the two parts to an *instruction*?

- a. the op code and the operands
- b. the program counter and the operation
- c. the program counter and the status flags
- d. the stack pointer and the program counter
- e. the clock cycle count and the return value

17. What is the console output for the following code?

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

int main()
{
    int i;
    int j = 1;
    for (i = 0; i < 4; ++i)
    {
        j = j * j + i;
        cout << j;
    }
}
```

- a. 11510 b. 12639 c. 12888 d. 126391525 e. 128888096

18. For the code in problem 17, what is the last value of the variable i before the execution is complete?

- a. 1 b. 2 c. 3 d. 4 e. 5

19. What is the console output for the following code?

```
1    #include <iostream>
2    using namespace std;
3
4    int square(int i)
5    {
6        int k = 6;
7        j = i * i + 1;
8        return k;
9    }
10
11   int main()
12   {
13       int i = 1;
14       int j = 2;
15       int m;
16       m = square(j);
17       cout << m;
18   }
```

- a. 2 b. 3 c. 4 d. 5 e. 6

20. For the code in problem 19, which line could be deleted and the console output remain the same?

- a. 1 b. 6 c. 7 d. 15 e. 16

21. For the line of code below, what will be the value of k after execution of that line if $i = 3$ and $j = 2$?

`k = i * j + 12 / 3 - 4;`

- a. -6 b. 2 c. 3 d. 6 e. 14

22. Which column of the truth table is equivalent to the expression below? Note: your response is the column label in the first row of that column.

$\sim (\sim (p \ \&\& \ q) \ \&\& \ \sim \ r)$

p	q	r	a	b	c	d	e
0	0	0	1	0	0	1	0
0	0	1	0	1	1	0	1
0	1	0	1	1	0	0	0
0	1	1	0	1	1	1	1
1	0	0	1	0	0	1	1
1	0	1	0	1	1	1	0
1	1	0	0	0	1	1	0
1	1	1	0	1	1	0	0

23. What is the console output of the following code?

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

class sphere {
private:
    double radius;
public:
    sphere(double);
    double diameter(void) {
        return 4*3.14159*radius*radius;
    }
    double surface(void) {
        return 1.333333*3.14159*radius*radius*radius;
    }
};

sphere::sphere(double r) {
    radius = r;
}

int main()
{
    sphere A(2);
    cout << A.diameter();
}
```

- a. 2.00000 b. 4.00000 c. 12.5664 d. 50.2654 e. 62.8317

24. In the code in problem 23, what kind of function is the sphere function?

- a. recursive b. constructor c. polymorphic d. hybrid e. external

25. What is the console output for the following code?

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

int functionA(int k) {
    int i;
    i = k*k;
    return i;
}

int main()
{
    int i;
    int j;
    int k;
    int m;
    i = 2;
    j = 3;
    k = 1;
    m = functionA(j);
    cout << m;
    cout << i;
}
```

- a. 10 b. 12 c. 24 d. 22 e. 92

26. What is the console output for the following code?

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

int sum(int i) {
    if (i > 0) {
        return i + sum(i - 1);
    } else {
        return 0;
    }
}

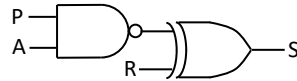
int main() {
    int total = sum(10);
    cout << total;
}
```

- a. 0 b. 10 c. 19 d. 55 e. 100

27. In the code of problem 26, the function sum has a line of code which calls the function sum. That is called

- a. internalization b. overload c. recursion d. reciprocity e. encapsulation

28. Which column in the function table has the correct value of S for all possible inputs of P, Q, and R?



P	Q	R	a	b	c	d	e
0	0	0	1	1	0	1	1
0	0	1	0	1	1	0	0
0	1	0	1	1	0	0	1
0	1	1	0	1	1	1	0
1	0	0	1	1	0	1	1
1	0	1	0	1	0	1	0
1	1	0	0	0	1	1	1
1	1	1	1	1	0	0	1

29. What is the console output for the following code?

```
1    #include <iostream>
2    using namespace std;
3
4    int function1(int) {
5        return 0;
6    };
7
8    int function1(float) {
9        return 1;
10   };
11
12   int function1(char) {
13       return 2;
14   };
15
16   int main()
17   {
18       cout << function1('1');
19   }
```

- a. 0 b. 1 c. 2 d. function1('1')
e. code will not compile because of the multiple definitions of function1.

30. The multiple definitions of function1 in the code in problem 29 is an example of

- a. function duplication b. function copying c. function overloading d. function reuse
e. illegal duplicate function naming

Scratch Paper