CyberChallenge.IT 2018 - Test
Commented solutions

Contents

1 Question 1

1.1 Question

Consider the following incomplete C code snippet:

```c
int c = 0;
int x = 41;
if (... || 2 && ++x) x++;
```

What would you put in place of ... to have x equal 43?

1.2 Answers

(A) !c

(B) c

(C) x can never become 43

(D) x will always be 43

1.3 Proposed solution

The correct answer is (B) c.

The logical AND has the precedence on the logical OR, thus if the expression that we are going to put in place of the dots is true, than the entire condition of the if is verified. Therefore, the compiler will evaluate that expression first, and the evaluation of the second one is performed only if necessary[1].

The consequence is that, if the expression that we are going to write is true, then `x` is incremented just one time (the `x++` instruction), otherwise the increments will be two (both `++x` and `x++`).

We want to have a condition that evaluates to false, which is, in this case, `c`.

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[1]See `https://c-faq.com/expr/shortcircuit.html`.

2 Question 2

2.1 Question

What does `j` contain after executing the following C code fragment?

```c
int i = 3;
int j = ++i + i--;
```

2.2 Answers

(A) It depends on the compiler

(B) 8

(C) 7

(D) 6

2.3 Proposed solution

The correct answer is `(A) it depends on the compiler`.

The result of these instructions is determined by the order of the execution between `++i` and `i--`, with different outcomes. Since the two expressions can be evaluated in any order, depending on the compiler[2], the value for `j` is not uniquely determined.

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[2]See the first sentence of this section `https://en.wikipedia.org/wiki/Sequence_point#Examples_of_ambiguity`.

3 Question 3

3.1 Question

The following function is equivalent to (the standard) function...:

```c
char *f(char *d, const char *s) {
    char *p = d;
    while (*p++ = *s++);
    return d;
}
```

3.2 Answers

(A) strcat

(B) strcpy

(C) memcpy

(D) memset

3.3 Proposed solution

The correct answer is (B) strcpy.

The function f is overwriting the memory pointed by d with the bytes pointed by s, up to the first null byte. This is the behaviour of the standard function strcpy.

4 Question 4

4.1 Question

Consider the following data structure.

```
int table[][4] = {{1,2,3,4},{2,3,4,5},{3,4,5,6}};
```

What is the value of `*(*(table+2)+1)`?

4.2 Answers

(A) 2

(B) 3

(C) 4

(D) 5

4.3 Proposed solution

The correct answer is `(C)` 4.

Given a pointer `p`, the expressions `p[n]` and `*(p+n)` are equivalent. Therefore `*(*(table+2)+1)` is the same as `table[2][1]`, which is 4.

5 Question 5

5.1 Question

What about the C statement `int *p = malloc(sizeof(unsigned int));`?

5.2 Answers

(A) type mismatch error

(B) no issue with the statement

(C) throws runtime error

(D) memory allocated correctly, but errors when storing `int` values in memory

5.3 Proposed solution

The correct answer is (B) `no issue with the statement`.

The statement is legitimate: it is correctly allocating the memory for one unsigned integer, whose size is the same as a signed one, and assigning its address to the pointer `p`. A possible error would be, for example, to access `p` as an array with size larger than 1, but it does not relate with the correctness of the proposed line of code.

6 Question 6

6.1 Question

Function `min` is supposed to return the minimum integer, from the (non-empty) sequence delimited by `p` (included) and `q` (excluded):

```
int min(int* p, int* q) {
    int result = ...;
    for (; p < q; ++p)
        if (*p < result)
            result = *p;
    return result;
}
```

What would you put in place of . . . ?

6.2 Answers

(A) *p++

(B) 0

(C) (*p)++

(D) -1

6.3 Proposed solution

The correct answer is (A) *p++.

The two main ways to address the problem of finding the minimum value inside an array are the following:

- set the minimum to the max possible value and then iterate over the entire array;
- set the minimum to the first element of the array and iterate starting from the second element.

None of the answers mimics the first method, while the usage of *p++ follows the second one.

7 Question 7

7.1 Question

We are interested in the sum of five numbers. We only know that, if we leave out any one number, the average of the remaining four numbers is 15, 70, 85, 100 or 130. What is the sum of all five numbers?

7.2 Answers

(A) 315

(B) 370

(C) 385

(D) 400

(E) 430

7.3 Proposed solution

The correct answer is (D) 400.

Let us denote the five numbers by x_1, x_2, x_3, x_4, x_5. Then, the five given averages are

$$\frac{x_1 + x_2 + x_3 + x_4}{4} = 15,$$

$$\frac{x_1 + x_2 + x_3 + x_5}{4} = 70,$$

and so on.

If we sum up all these values, each one of the five numbers will appear 4 times and thus we have

$$x_1 + x_2 + x_3 + x_4 + x_5 =$$
$$\frac{4x_1 + 4x_2 + 4x_3 + 4x_4 + 4x_5}{4} =$$
$$15 + 70 + 85 + 100 + 130 = 400.$$

8 Question 8

8.1 Question

If I eat soup today, then I will eat pizza tomorrow. Which one of the following statements is equivalent?

8.2 Answers

(A) If I eat soup today, then I won't eat pizza tomorrow

(B) If I eat pizza tomorrow, then I won't eat soup today

(C) If I eat pizza today, then I will eat soup tomorrow

(D) If I don't eat pizza today, then I will eat soup tomorrow

(E) If I don't eat pizza tomorrow, then I won't eat soup today

8.3 Proposed solution

The correct answer is (E) If I don't eat pizza tomorrow, then I won't eat soup today.

Let us denote by p the proposition "I eat soup today" and by q the proposition "I will eat pizza tomorrow". Then, the statement in the question is represented by $p \Rightarrow q$ and, by the transposition rule[3], if $p \Rightarrow q$ is true, then also $\overline{q} \Rightarrow \overline{p}$ is true, which corresponds to the statement "If I don't eat pizza tomorrow, then I won't eat soup today".

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[3]See https://en.wikipedia.org/wiki/Transposition_(logic)

9 Question 9

9.1 Question

If FRIEND is coded as HUMJTK, how can CANDLE be written in that code?

9.2 Answers

(A) DEQJQM

(B) DCQHQK

(C) EDRIRL

(D) ESJFME

9.3 Proposed solution

The correct answer is (C) EDRIRL.

Let us compute the differences between the ASCII codes of the corresponding letters:

- 'H' - 'F' = 2

- 'U' - 'R' = 3

- 'M' - 'I' = 4

- ...

We can assume that the code is explointing this regularity, thus we compute the encoded version of the word "CANDLE" as:

- 'C' + 2 = 'E'

- 'A' + 3 = 'D'

- 'N' + 4 = 'R'

- 'D' + 5 = 'I'

- 'L' + 6 = 'R'

- 'E' + 7 = 'L'

10 Question 10

10.1 Question

Going from point A to B costs 3, from A to C costs 5. Going from B to C costs 5, from B to F costs 7. Going from C to F costs 3. Going from F to D costs 3 and from F to E costs 5. What is the minimum cost for going from A to E?
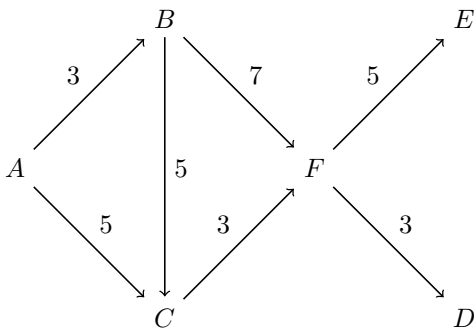
10.2 Answers

(A) 13

(B) 14

(C) 15

(D) 16

10.3 Proposed solution

The correct answer is (A) 13.

Let us visualize the situation.

From A the following nodes can be reached:

- B directly, with cost 3

- C directly, with cost 5

- F through C, with cost 8

- D through F with cost 11

- E through F with cost 13

The answer is 13.

11 Question 11

11.1 Question

There is a pole in a lake. Half of the pole is embedded in the mud at the bottom of the pond, another one third is covered by water, and 40cm stand out of the water. What is the total length of the pole?

11.2 Answers

(A) 1.2m

(B) 1.6m

(C) 2m

(D) 2.4m

11.3 Proposed solution

The correct answer is (D) 2.4m.

Let l be the lenght of the pole. The situation is resumed by the equation

$$\frac{l}{2} + \frac{l}{3} + 40 = l$$
$$\frac{l}{6} = 40$$
$$l = 240$$

So, l is 240cm long, which is 2.4m.

12 Question 12

12.1 Question

Bob has 20 Euro more than Alice; together they have 60 Euro. Which of the following sentences is true?

12.2 Answers

(A) Alice has 40 Euro

(B) Alice is richer than Bob

(C) Alice has 20 Euro

(D) Alice and Bob have the same amount of Euro

12.3 Proposed solution

The correct answer is (C) `Alice has 20 Euro`.

Let a, b be the amount that Alice and Bob have, respectively. We have:

$$\begin{cases} b = 20 + a \\ a + b = 60 \end{cases}$$

whose solution is

$$\begin{cases} a = 20 \\ b = 40 \end{cases}$$

so Alice has 20 Euro and the answer is (C).