Question #1 – pointers

Consider the following incomplete code fragment. It declares the type of the nodes of a linked list and defines a function del_key such that del_key(&l,k) removes all the nodes that contain key k from the list pointed to by l:

typedef struct node_t node_t;
struct node_t {
    int     key;
    node_t* next;
};

void del_key(node_t ** lp, int key) {
    while (*lp != NULL) {
        if ((*lp)->key == key) {
            node_t* dead = *lp;
            *lp = (*lp)->next;
            free(dead);
        } ???
    }
}

What would you put in place of ??? to make it work?
A. if (*lp == NULL) break;
B. else *lp = (*lp)->next;
C. else lp = &(*lp)->next;
D. *lp = (*lp)->next->next;

Question #2 – more pointers

A possible way to speed up a function that checks whether two arrays of char contain the same values is to unroll the loop and perform the comparisons by looking at the data as if they were of a wider primitive type, hence requiring fewer loop iterations. What would you put in place of ??? in the function below to achieve this goal?

typedef long T;
int test(char * a, char * b, unsigned n) {
    int i, step = sizeof(T)/sizeof(char);
    for (i=0; i+step-1 < n; i += step)
        if (???). return 0;
    for (; i<n; ++i)
        if (a[i] != b[i]) return 0;
    return 1;
}
A. (T)a[i] != (T)b[i]
B. ((T*)a)[i] != ((T*)b)[i]
C. (T)(a+i) != (T)(b+i)
D. *(T*)(a+i) != *(T*)(b+i)

Question #3 – reverse me

Consider the following C authentication fragment:

```c
unsigned password = ??, b = 35, res = password ^ (b & 0xF7);
if (res==0x3A) printf("access granted\n");
```

What value should ?? be so that the program prints “access granted”?
A. 8  
B. 13  
C. 25  
D. 61

Question #4 – deobfuscate me

Obfuscation is a common technique in computer security and software engineering to conceal the semantics of a program for protecting intellectual property or making the code less vulnerable to hacker attacks. The function below computes a function much simpler than it appears:

```c
char slp_fitbit(char x) {
    const static unsigned char _[2][2][2][2] = {
        { { 0xF, 0xE }, { 0xD, 0xC } },
        { { 0xB, 0xA }, { 0x9, 0x8 } } },
        { { 0x7, 0x6 }, { 0x5, 0x4 } },
        { { 0x3, 0x2 }, { 0x1, 0x0 } } }
    return _[(x & 8)][(x & 4)][(x & 2)][(x & 1)] | (x & 240);
}
```

What function is that?
A. slp_fitbit(x) = x  
B. slp_fitbit(x) = x % 128  
C. slp_fitbit(x) = ~x  
D. slp_fitbit(x) = x & 0xF0

Question #5 – catch the bug

You are given this simple dynamically-sized array implementation:

```c
#include <stdlib.h>
#include <assert.h>
#define INITIAL_CAPACITY (1<<3)
#define MAX_CAPACITY (1<<10)

typedef struct {
    int * data;
```
size_t used;
size_t capacity;
} darray;

darray * init() {
    darray * da = malloc(sizeof(darray));
    assert(da != NULL);
    da->capacity = INITIAL_CAPACITY;
    da->data = malloc(sizeof(int) * da->capacity);
    assert(da->data != NULL);
    da->used = 0;
    return da;
}

grow(darray * da) {
    da->capacity *= 2;
    if (da->capacity > MAX_CAPACITY)
        exit(EXIT_FAILURE);
    da->data = realloc(da->data, da->capacity);
    assert(da->data != NULL);
}

void add_element(darray * da, int x) {
    assert(da != NULL && da->data != NULL);
    if (da->used == da->capacity)
        grow(da);
    da->data[da->used] = x;
    da->used += 1;
}

int main() {
    darray * da = init();
    int k;
    for (k = 0; k < 512; k++)
        add_element(da, k * 2);
    free(da->data);
    free(da);
    return 0;
}

Unfortunately, there's a serious bug: in which function?

A. init()
B. grow()
C. add_element()
D. main()

Question #6 — ASCII galore

Consider the following code fragment:

unsigned BB[] = ???;
printf("%s\n", (char *) (BB + 1));
Assumptions:
- 32-bit little-endian platform
- sizeof(char) == 1
- sizeof(unsigned) == 4

How would you initialize (i.e., replace ??? above) BB so as to get the output “Say my name”?

A. {0xA5207961, 0x536E2079, 0x6D656D61, 0x0}
B. {0xA5, 0x53617920, 0x6D79206E, 0x616D6500}
C. {0xA5536179, 0x206D7920, 0x6E616D65, 0x0}
D. {0xA5, 0x20796153, 0x6E20796D, 0x656D61}

Just recall that the decimal ASCII code of the space is 32.

Question #7 – leaking around

In his last trip around Central Italy, Barry filled the gas tank to the top, a total of 40 liters. He traveled at 60 km/h across secondary roads and he knew that his car could make on average 10 km per liter. However, the moment he started, the gas tank developed a leak and 4 hours later the car stopped having run out of gas from the hole.

How many liters of gas had it lost through the leak?

A. 12
B. 14
C. 16
D. 18

Question #8 – playing cards

A deck of French playing cards includes thirteen ranks (A, 2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K) for each of the four French suits (clubs, diamonds, hearts, spades).

What is the minimum number of cards you must take to be sure to pick at least one four-of-a-kind (i.e., four cards of the same rank)?

A. 39
B. 40
C. 44
D. 49

Question #9 – eat healthy

You have 100 kg of watermelons, and 99 percent of their weight comes from water. You let them dehydrate until they are 98 percent made of water.

How many kilograms do they weigh now?

A. 50
B. 98.09
C. 98.9
D. 98.99

**Question #10 – stranded**

Oliver, Sara, Shado, and Slade are all trapped in Lian Yu, an island in the middle of a crocodile infested lake. They have one crocodile repelling stick that protects only up to two swimmers. To get to safety a maximum of two swimmers can be in the water at the same time, also they have to be together to benefit from the stick and they have to swim at the pace of the slower swimmer.

As the shore is too far, someone has to swim back with the stick until all four are safe on the shore. Oliver can swim the distance in 3 minutes, Sara in 7, Shado in 13, and Slade in 17.

What is the minimum time required for them to all get to safety?

A. 41
B. 43
C. 46
D. 47

**Question #11 – birthdays**

Four good friends visited Bruce at his manor last year for his birthday. His butler Alfred took notes on what time each of them arrived, but he forgot to write down whether it was before (AM) or after (PM) noon.

According to his notes:
- James arrived at 8:00
- Lee arrived at 9:00
- Selina arrived at 10:00
- Lucius arrived at 11:00

While Bruce recalls that:
- Selina did not visit him between Lee and Lucius
- At least one friend visited him between James and Lee
- James might have visited him before Selina or Lucius, but not before both

Which of the following options is compatible with the events as described above? *(hint: there is only one feasible assignment of the AM/PM suffix to the events).*

A. James 8:00 AM
B. Lee 9:00 PM
C. Selina 10:00 AM
D. Lucius 11:00 AM

**Question #12 – break the code**

Fobi govv, iye nsn bowowlob Tevsec Mkockb. Grkd sc dro cew yp kvv dro xewlobc pbyw yxo dy pybdi?
Hint: we used a substitution cipher that replaces each letter of the alphabet with another.

A. 780
B. 800
C. 820
D. 840