Question #1 – pointers

Consider the following incomplete code fragment. It declares the type of the nodes of a linked list and defines a function `dup_key` such that `dup_key(&l,k)` duplicates the first occurrence of key `k` in the list pointed to by `l` so that the old and the new copy of `k` appear consecutively in the list:

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

void dup_key(node_t ** lp, int key) {
    while (*lp != NULL)
        if ((*lp)->key == key) {
            node_t* n = malloc(sizeof(node_t));
            assert(n != NULL);
            n->next = ???
            n->key = key;
            *lp = n;
            break;
        } else lp = &(*lp)->next;
}
```

What would you put in place of `??` to make it work?

A. = (*lp)->next;
B. = *lp;
C. ->next = (*lp)->next;
D. = NULL

Question #2 – bits of secrets

A simple way of concealing data is to scramble their representation. Assuming that `sizeof(short)==2` and `sizeof(unsigned)==4`, functions below pack/unpack two 16-bit signed integers into/from one 32-bit word.

Unfortunately, there is a missing part:

```c
unsigned encode(short a, short b){
    return (a & 0xFF00) << 16 | (a & 0x00FF) << 8 |
        (b & 0x00FF) >> 8 | (b & 0x00FF) << 16;
}

void decode(unsigned i, short * a, short * b){
    *a = (i & 0xFF000000) >> 16 | (i & 0x0000FF00) >> 8;
    *b = ???
}
```
What would you put in place of ??? to make it work?

A. (i & 0x00FF0000) >> 16 | (i & 0x000000FF) << 8;
B. (i & 0x00FF0000) >> 8 | (i & 0x000000FF) >> 8;
C. (i & 0x00FF0000) << 8 | (i & 0x00FF0000) >> 8;
D. (i & 0x00FF0000) >> 8 | (i & 0x000000FF) << 16;

**Question #3 – reverse me**

Consider the following C authentication fragment:

```c
unsigned password = ??, b = 35, res = password ^ (b | 0xF7);
if (res==0x3B) printf("access granted\n");
```

What value should ?? be so that the program prints “access granted”?

A. 0xAB
B. 0x03
C. 0xFE
D. 0xCC

**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_f1tb1t(char x) {
    const static unsigned char _[2][2][2][2] = {
        { { { 0x00, 0x10 }, { 0x20, 0x30 } },
            { { 0x40, 0x50 }, { 0x60, 0x70 } } },
        { { { 0x80, 0x90 }, { 0xA0, 0xB0 } },
            { { 0xC0, 0xD0 }, { 0xE0, 0xF0 } } }
    };
    return _[!!(x&0x80)][!!(x&0x40)][!!(x&0x20)][!!(x&0x10)] | (x&15);
}
```

What function is that?

A. __slp_f1tb1t(x) = ~x
B. __slp_f1tb1t(x) = (x % 128) + 127
C. __slp_f1tb1t(x) = x
D. __slp_f1tb1t(x) = ~x | 0xF

**Question #5 – catch the bug**

You are given this simple dynamically-sized array implementation:

```c
#include <stdlib.h>
#include <assert.h>
```
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:

```c
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 “Red Ross!”?

A. {0xA5, 0x52656420, 0x526F7373, 0x2100}
B. {0xA5, 0x20646552, 0x73736F52, 0x21}
C. {0xA5206465, 0x5273736F, 0x5221}
D. {0xA5656420, 0x6F737352, 0x215200}

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

**Question #7 – leaking around**

In his last trip around Central Italy, Eobard filled the gas tank to the top, a total of 12 gallons. He traveled at 50 mph across divided highways and he knew that his car could make on average 25 miles per gallon. 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 gallons of gas had it lost through the leak?

A. 3
B. 3.5
C. 4
D. 4.5

**Question #8 – playing cards**

A deck of Neapolitan playing cards includes ten ranks (1, 2, 3, 4, 5, 6, 7, 8, 9, 10) for each of the four Spanish suits (clubs, golden coins, cups, swords).

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. 27
B. 30
C. 31
D. 33

**Question #9 – eat healthy**

You have 100 kg of cantaloupes, and 90 percent of their weight comes from water. You let them dehydrate until they are 80 percent made of water.

How many kilograms do they weigh now?

A. 50
B. 78.88
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 1 minute, Sara in 2, Shado in 5, and Slade in 10.

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

A. 17
B. 19
C. 20
D. 22

Question #11 – birthdays

Four good friends visited Prof. Stein at the office for his birthday, as he had to spent the entire day working. His wife and assistant Clarissa took notes on what time each of them arrived, but she didn’t write down whether it was before (AM) or after (PM) noon.

According to her notes:
- Sara arrived at 7:00
- Jax arrived at 8:00
- Leonard arrived at 9:00
- Ray arrived at 10:00

While Prof. Stein recalls that:
- Leonard did not visit him between Jax and Ray
- At least one friend visited him between Sara and Jax
- Sara might have visited him before Leonard or Ray, 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. Sara 7:00 AM
B. Jax 8:00 PM
C. Leonard 9:00 AM
D. Ray 10:00 AM

Question #12 – break the code

AEETFNFTHRWHAUROOPHELMOFYIASLBMICRTUTEOFYAIMHRNTBTSESEY?
Hint: we used a transposition cipher, so you might start by dividing the text into blocks of equal length (just ignore the question mark at the end of the text).

A. 1225
B. 1250
C. 1275
D. 1300