9 Security I (MGK)

(a) Let $\text{Enc}_{K_E}$ be the encryption function of an encryption scheme that provides indistinguishability under chosen plaintext attack (CPA security). Let $\text{Mac}_{K_M}$ be a message-authentication-code function that provides existential unforgeability. Named below are three techniques for applying these two functions together to a message $M$. For each of them

- briefly explain how $\text{Enc}_{K_E}$ and $\text{Mac}_{K_M}$ are combined, and
- state whether the resulting construct is likely to provide indistinguishability under chosen ciphertext attack (CCA security):

1. encrypt-and-authenticate [2 marks]
2. authenticate-then-encrypt [2 marks]
3. encrypt-then-authenticate [2 marks]

(b) How can an attacker calling the C function `parse_text` below cause a buffer overflow? Explain how and why this works. [6 marks]

```c
#include <stdlib.h>
#include <string.h>
#define BUFLEN 4096
int check(int n) {
    if (n > BUFLEN) abort();
    return n;
}
void parse_text(char *text, size_t len) {
    char buf[BUFLEN];
    memcpy(buf, text, check(len));
    /* ... */
}
```

(c) Many Unix system administrators create a personal group for each of their users with this user as the sole member.

1. What is the purpose of such a group? [2 marks]

2. Such personal groups typically have the same name and integer identifier as the corresponding user identifier. Is this practice compatible with the Windows NT mechanism for identifying users and groups? [2 marks]

(d) Give two examples for resources where an operating system is expected to implement residual information protection and two alternative mechanisms for implementing it. What are their tradeoffs and threat assumptions? [4 marks]