OPTIMAL:

```
#include <stdio.h>

int findOptimalPage(int frames[], int frameCount, int pages[], int n, int currentIndex) {
    int farthest = -1, replaceIndex = -1;
    for (int i = 0; i < frameCount; i++) {
        int j;
        for (j = currentIndex; j < n; j++) {
            if (frames[i] == pages[j]) {
                if (j > farthest) {
                    farthest = j;
                    replaceIndex = i;
                }
                break;
            }
        }
        if (j == n) return i; // If page is not found in future, replace it
    }
    return replaceIndex;
}

void optimalPageReplacement(int pages[], int n, int frameCount) {
    int frames[frameCount], pageFaults = 0;

    // Initialize frames to -1 (empty)
    for (int i = 0; i < frameCount; i++) frames[i] = -1;

    for (int i = 0; i < n; i++) {
        int page = pages[i], pageFound = 0;

        // Check if page is already in memory
        for (int j = 0; j < frameCount; j++) {
            if (frames[j] == page) {
                pageFound = 1;
                break;
            }
        }

        // If the page is not in memory, replace one of the pages
        if (!pageFound) {
            int replaceIndex = findOptimalPage(frames, frameCount, pages, n, i + 1);
            frames[replaceIndex] = page;
            pageFaults++;
        }
```

```
        // Display frame status after each page reference
        printf("Page %d:\t", page);
        for (int j = 0; j < frameCount; j++)
            printf("%d\t", frames[j] == -1 ? '-' : frames[j]);
        printf("\n");
    }
    printf("\nTotal page faults: %d\n", pageFaults);
}

int main() {
    int n, frameCount;
    printf("Enter the number of frames: ");
    scanf("%d", &frameCount);
    printf("Enter the number of pages: ");
    scanf("%d", &n);

    int pages[n];
    printf("Enter the page reference string: ");
    for (int i = 0; i < n; i++) scanf("%d", &pages[i]);

    optimalPageReplacement(pages, n, frameCount);
    return 0;
}
```

```
Enter the number of frames: 4
Enter the number of pages: 2
Enter the page reference string: 3
1
Page 3: 3   45  45  45
Page 1: 1   45  45  45

Total page faults: 2
```