1. (15 points) Rewrite the following program so that it uses a while loop in place of the for loop. (Note that a part of the new program is already shown at the bottom of this page; you are simply required to fill in the missing lines.)

```c
#include <stdio.h>

main()
{
    int i, n = 4;
    float x = 1.0;
    for (i = 1; i <= n; i++){
        x = 1 / x;
        x = x + 1;
        printf("%d %.4f\n", i, x);
    }
}
```

New Program:

```c
#include <stdio.h>

main()
{
    int i, n = 4;
    float x = 1.0;

    while ( ){
        x = 1 / x;
        x = x + 1;
    } /* end while loop */
}
2. (20 points) The following program was written by a student. The program executes correctly, though the indentation is a bit unusual. Show the output that is generated when the program is executed.

```c
#include <stdio.h>

main()
{
    float x = 3, y = 1;
    int i, n = 4;

    for (i = 1; i < n; i++)   {
        if ((x > 0) && (y != x))
            y = y / x;
        x = y - i;
        printf("%.2f  %.2f\n", x, y);
    }
}
```
3. (20 points) The following program will be used to position singers in a mixed chorus of sopranos, altos, tenors, and basses. The singers will each be placed in one of 8 sections, according to their voices and heights.

```c
#include <stdio.h>

main()
{
    char gender, voice;
    int ht, section = 8;

    printf("Enter the voice type (s/a/t/b): ");
    scanf("%c", &voice);
    printf("Enter the singer's height, in inches: ");
    scanf("%d", &ht);

    if ((voice == 't') || (voice == 'b'))
        gender = 'm';
    else
        gender = 'f';

    if (gender == 'm') {
        if (ht > 70) {
            if (voice == 'b')
                section = 1;
            else
                section = 2;
        } else {
            if (voice == 't')
                section = 6;
            else
                section = 5;
        }
    } else {
        if (ht > 67) {
            if (voice == 'a')
                section = 4;
            else
                section = 3;
        } else {
            if (voice == 's')
                section = 7;
        }
    }

    printf("This singer is located in section %d", section);
}
```
(a) Which of the following singers is positioned in section 5?

(1) A 5’11” (71 inch) Tenor
(2) A 5’6” (66 inch) Bass
(3) A 5’8” (68 inch) Alto
(4) A 5’8” (68 inch) Soprano
(5) A 5’6” (66 inch) Alto

(b) Which of these singers is positioned in section 3?

(c) In which section would a 5’5” (65 inch) Soprano be located?

(d) In which sections would the altos be located?
4. (15 points) Please refer to the flowchart (control flow diagram) shown on the next page. Three students have been studying the portion of the flowchart enclosed by the large brace and labeled (A). The first student says that the double for loop (a) corresponds to the logic shown in the flowchart. The second student says that the double do–while loop (b) is the appropriate construct, whereas the third student says that either loop will work. Which student is correct, and why?

(a) 
```
for (odd = 1; odd <= n; odd = odd + 2) 
    odd_sum = odd_sum + odd;

for (even = 2; even <= n; even = even + 2) 
    even_sum = even_sum + even;
```

(b) 
```
odd = 1;
do 
    { 
        odd_sum = odd_sum + odd;
        odd = odd + 2;
    } while (odd <= n);

even = 2;
do 
    { 
        even_sum = even_sum + even;
        even = even + 2;
    } while (even <= n);
```
5. (30 points) A student submitted the attached C program as a solution to homework assignment 3. Note that the lines are numbered for your convenience.

a) Why is the variable ans assigned an initial value in line 11?

b) What is the purpose of the while loop which begins in line 13 and extends to line 64?

c) Is the scanf statement in line 21 written correctly? If not, what changes are required?

d) What is the purpose of toupper in line 24?

e) Are the logical expressions in lines 24, 36 and 48 written correctly? If not, what changes are required?
(f) What does the variable \( i \) represent? (See lines 29, 41 and 55.)

g) What mathematical equation is used to determine A, given P, r and n?

h) Is the `printf` statement in line 57 written correctly? If not, what changes are required?

i) What is the purpose of `% .2f` in lines 34 and 46?

j) What is the purpose of the `printf` statement in line 60? Under what conditions will this statement be executed?
/* Programming Assignment 3 */

#include <stdio.h>
#include <math.h>
#include <ctype.h>

main()
{
    float a, p, i, r, v;
    int n;
    char choice, ans = 'Y';

    while (toupper(ans) == 'Y') {

        /* menu */
        printf("Program choices:
");
        printf("  A) Calculate A, given P, r and n\n");
        printf("  P) Calculate P, given A, r and n\n");
        printf("  n) Calculate n, Given A, P and r\n");
        printf("Please enter your choice (A, P or n) ");
        scanf(" %d", &choice);

        /* calculations */
        if (toupper(choice) == 'A') {
            printf("P = ");
            scanf("%f", &p);
            printf("r = ");
            scanf("%f", &r);
            i = 0.01 * r / 12;
            printf("n = ");
            scanf("%d", &n);
            v = pow((1 + i), n);
            a = i * p * v / (v - 1);
            printf("A = %.2f \n", a);
        } else if (toupper(choice) == 'P') {
            printf("A = ");
            scanf("%f", &a);
            printf("r = ");
            scanf("%f", &r);
            i = 0.01 * r / 12;
            printf("n = ");
            scanf("%d", &n);
            v = pow((1 + i), n);
            p = a * (v - 1) / (i * v);
            printf("P = %.2f\n", p);
        } else if (toupper(choice) == 'N') {
            printf("A = ");
            scanf("%f", &a);
            printf("P = ");
            scanf("%f", &p);
            printf("r = ");
            scanf("%f", &r);
            i = 0.01 * r / 12;
            n = (int) ((log(a) - log(a - p * i)) / log(1 + i));
            printf("n = %d \n", n);
        } else
            printf("ERROR - Please Try Again\n");

        printf("Again? (Y/N) ");
        scanf(" %c", &ans);
    }

    printf("Goodbye, Have a Nice Day!");
}