

Beginning C Programming for Engineers

Final Exam

Name: _____

You should have received 7 pages, including this title page. You will have 45 minutes to complete this exam.

The exam is graded out of 100 points, with each problem marked as to how many points it is worth (the number in the box). You may use a a crib sheet, as described in the syllabus, throughout the entire test. However, you may not use a computer or calculator to help solve the problems.

You are highly encouraged to show your work and explain how you arrived at your answer, so that we can give as much partial credit as possible for any incorrect answers.

Be sure you write your name on each page. You must also sign the following declaration:

I understand that collaboration of any form is not permitted on this final exam. All work I present here is my own, and I agree not to divulge the contents of this exam until answers have been published.

Signature: _____

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Octal	Bits	Decimal
0	0 0 0	0
1	0 0 1	1
2	0 1 0	2
3	0 1 1	3
4	1 0 0	4
5	1 0 1	5
6	1 1 0	6
7	1 1 1	7

	1	1	0	1	0	1	1	0
0	3		2		6			
0x	d			6				

Hexadecimal	Bits	Decimal
0	0 0 0 0	0
1	0 0 0 1	1
2	0 0 1 0	2
3	0 0 1 1	3
4	0 1 0 0	4
5	0 1 0 1	5
6	0 1 1 0	6
7	0 1 1 1	7
8	1 0 0 0	8
9	1 0 0 1	9
A	1 0 1 0	10
B	1 0 1 1	11
C	1 1 0 0	12
D	1 1 0 1	13
E	1 1 1 0	14
F	1 1 1 1	15

Figure 1: Binary, octal, hexadecimal conversions

%i	integer (any base)
%d	integer (decimal)
%o	integer (octal)
%x, %X	integer (hexadecimal)
%f, %e, %g	float
%s	string

Figure 2: I/O formats

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- 7 1. A device is connected to a computer that can return various temperatures related to the weather. The `GetTemps` function returns the daily high temperature in bits 20–29, the daily low temperature in bits 10–19, and the current temperature in bits 0–9, all as 10-bit integers.

In the following program fragment, lines 8 and 9 are incomplete. They should store the high temperature in `highTemp` and the current temperature in `currTemp`, so that these temperatures can be printed in line 10. Please complete lines 8 and 9. Show your work.

```
1 #include <stdio.h>
2
3 int GetTemps(void);
4
5 int main() {
6     int w, highTemp, currTemp;
7     w = GetTemps();
8     highTemp =
9     currTemp =
10    printf("High: %d\nCurrent: %d\n", highTemp, currTemp);
11    return 0;
12 }
```

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2. In these questions, you will consider several fragments of C code, presumably from the bodies of deranged and nonsensical functions. Determine the effect of each code fragment to answer the questions. Be sure to show all work.

- 5 (a) After this code executes, what will be printed?

```
float a=100, b;  
b = pow(a, 2); /* From math.h */  
printf("a=%g\n", a);
```

- 5 (b) After this code executes, what will be printed?

```
int a = 0x20, b = 02;  
a >> b;  
printf("a=%d, b=%d\n", a, b);
```

- 8 (c) After this code executes, what will be printed?

```
int i = 0, sum=0;  
while (i <= 5) {  
    sum += i;  
    printf("sum[%d] = %d\n", i, sum);  
    i++;  
}
```

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- 20 3. When asked to create a program to find the volume of any cone, given its radius and height, a programmer created this program to implement the formula $V = \frac{1}{3}\pi r^2 h$. It compiles, and it runs, but it gives completely incorrect results.

A serious problem lies in the `ComputeVolume` function. Additionally, the programmer was confused about parameters and local variables. Make this function work correctly, and also improve its use of parameters, changing `main` as necessary. Note any other minor or stylistic errors you might find throughout the program. *You can simply note changes on the program listing.*

```
#include <stdio.h>

#define PIE 3.14

float ComputeVolume(float r, float h, float ans, float r2);

int main() {
    float radius, height, ans, r2;
    printf("Radius: ");
    scanf("%g", &radius);
    printf("Height: ");
    scanf("%g", &height);
    ans = ComputeVolume(radius, height, ans, r2);
    printf("Volume: %g\n", ans);
    return 0;
}

float ComputeVolume(float r, float h, float ans, float r2)
{
    r2 = r*r;
    ans = (1/3)*PIE*r2*h;
    return ans;
}
```

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4. The following set of questions are based on this program.

```
#include <stdio.h>

int Frazzle(int n); /* Frazzle prototype */

/* Main program to test "Frazzle" */
int main() {
    int n, end;
    printf("End of table? ");
    scanf("%d", &end);
    for (n = 1; n < end; ++n) {
        printf("%d, %d\n", n, Frazzle(n));
    }
    return 0;
}

/* Frazzle function */
int Frazzle(int z) {
    int y, da, db, dc, dd;
    y = da = db = dc = dd = 2;
    while (z > y) {
        da = db;
        y = y + 1;
        db = dc;
        dc = da * db;
        dd = da * db * dc;
    }
    return dc;
}
```

- 15 (a) Draw a flowchart for the `Frazzle` function.

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- 5 (b) The function `Frazzle` has a *control variable*. Which variable is the control variable? State why you believe this is the control variable.
- 5 (c) Another variable in `Frazzle` is completely useless. If you removed it, as well as the calculations involving it, `Frazzle` would return the same results. Which is the useless variable?
- 30 (d) Rewrite `Frazzle` so that it uses a `for` statement instead of a `while` statement (with the initialization, test, and step expressions all present). Remove the useless variable. Your rewritten `Frazzle` must return the same results as the original `Frazzle`.