COS126: General Computer Science	**Spring 1996**

First Midterm Exam

Date: Thursday, March 7, 1996

Instructions: *This exam is open-book. You may use your personal notes, any handouts and lecture notes from this course, the course reader, and "The C Programming Language" by Kernighan and Ritchie.* **No other materials are allowed.** *You have 90 minutes for this exam. There are three problems, some of which consist of more than one part. Write all your answers in an exam booklet. Be sure that your name and precept number are on the front of the booklet and printed legibly. Write and sign the honor code pledge.*

Problem 1, 33 points:

Part a (21 points):

Suppose the following program reads `-3` for the `scanf` statement. What does it print? Show all your work, so that we can give you partial credit in case your final answer is wrong.

```
#include <stdio.h>
float f(int i)
{
  float result, temp;
  i=2*i;
  temp = i;
  result = (temp -1)/2;
  printf("%f\n", temp);
  return result;
}
void main(void)
{
  int i;
  scanf("%d", &i);
  printf("%f\n", f(i));
  if (i <0)
    printf("%f\n", f((1-i)/2));
  else
    printf("%f\n", f((i+1)/2));
}
```

Part b (12 points): Find all the errors in the following C program. Copy the offending lines in your answer book and also describe briefly why they are erroneous.

```
#include <stdio.h>
int sum (int low, int high)
     {
        scanf(``%d'', low);
        return A[low] + A[high];
     }

void main(void)
   {
     int n,result;
     int A[n], B[n];
     for (j=1; j <= n; j = j+1)
         B[j]= sum(1,j);
     printf("%d\n", B);
   }
```

Problem 2, 33 points: Let n be a positive integer. Another number x is a *divisor* of n if there is a number y such that $x \times y = n$. Note that $n \times 1 = n$, so both 1 and n are divisors of n.

The number n is said to be *perfect* if the sum of all its divisors is equal to $2n$. Two examples of perfect numbers are 6 and 28. Note that the divisors of 6 are $1, 2, 3, 6$, and

$$1 + 2 + 3 + 6 = 12 = 2 \times 6.$$

The divisors of 28 are $1, 2, 4, 7, 14, 28$, and

$$1 + 2 + 4 + 14 + 28 = 56 = 2 \times 28.$$

By contrast, 4 is not perfect since its divisors are $1, 2, 4$, and

$$1 + 2 + 4 \neq 2 \times 4.$$

Write a program that takes a number n as input from the user and outputs all the perfect numbers from 2 to n.

Question 3, 34 points:

Part a (14 points): What are the contents of memory locations 40-44 after the following Toy program executes starting at PC=10? (There are comments on some of the lines, but others are intentionally left without comments.)

```
10:   B101                     R1 <- 1
11:   B340                     R3 <- 40
12:   B441                     R3 <- 41
13:   9630
14:   9740
15:   2067
16:   6036
17:   A730
18:   A640
19:   0000                     HALT

40:   0003               value 3
41:   0002               value 2
42:   0001               value 1
43:   0000               value 0
44:   0000               value 0
```

Part b (20 points): What are the contents of memory locations 40-44 after the following Toy program executes starting at PC=10? Describe in general terms what it does.

```
10:   B101                     R1 <- 1
11:   B203                     R2 <- 3
12:   B340                     R3 <- 40
13:   1431
14:   6219
15:   8530
16:   2221
17:   1331
18:   5013
19:   0000                     HALT

30:   9630
31:   9740
32:   2067
33:   6036
34:   A730
35:   A640
36:   7500

40:   0003               value 3
```

```
41:   0002                  value 2
42:   0001                  value 1
43:   0000                  value 0
44:   0000                  value 0
```