

S&T2024 Basic C Programming Language Mock Test (Second Checkpoint)

Time allowed: 1 hour and 30 minutes

INSTRUCTIONS TO S&T SCHOLARS

1. This is a **CLOSED BOOK** examination.
2. This examination paper contains **4 questions** and 4 printed pages. Answer **all** questions.
3. The full score for each question is as follows:
Question 1: 30 Question 2: 30 Question 3: 30 Question 4: 10
4. Answers to the questions are to be written in the answer booklet provided to you.
5. Students are **NOT** allowed to bring any programmable calculator, machine translator, or dictionary with them. If you have any of these items, you are to surrender them before the test starts. **Violation of this regulation will be severely dealt with and may result in an expulsion from the bridging course.**
6. Students are also **NOT** allowed to bring any paper to the Examination Hall.

Question 1.

Short division method is used to convert a number in base 10 to another base. For example, the base-2 equivalent of $43_{(10)}$ is obtained by repeatedly dividing it by 2 until it is equal to 0. The remainders are accumulated during the division process and the accumulation is subsequently read in reversed order.

$$43_{(10)} = \underline{101011}_{(2)}$$

2	43	
2	21	rem 1 ← Least significant digit
2	10	rem 1
2	5	rem 0
2	2	rem 1
2	1	rem 0
	0	rem 1 ← Most significant digit

Other examples are $30_{(10)} = 132_{(4)}$, $65_{(10)} = 122_{(7)}$, $-13_{(10)} = -31_{(4)}$ etc.

Write a full program in C language to read two positive integers from the keyboard where the first integer is the number in base 10, and the second number is the base to be converted to. You have to program the above method. For the ease of this exercise, the

base to be converted to is not greater than 8. Six sessions of the program execution are as follows:

```
C:\ C:\WINDOWS\system32\cmd.exe
```

```
Enter the base-10 number to be converted: 43
Enter the base to be converted to: 2
43(base 10) = 101011(base 2)
Press any key to continue . . .
```

```
C:\ C:\WINDOWS\system32\cmd.exe
```

```
Enter the base-10 number to be converted: 30
Enter the base to be converted to: 4
30(base 10) = 132(base 4)
Press any key to continue . . .
```

```
C:\ C:\WINDOWS\system32\cmd.exe
```

```
Enter the base-10 number to be converted: 65
Enter the base to be converted to: 7
65(base 10) = 122(base 7)
Press any key to continue . . .
```

```
C:\ C:\WINDOWS\system32\cmd.exe
```

```
Enter the base-10 number to be converted: -13
Enter the base to be converted to: 4
-13(base 10) = -31(base 4)
Press any key to continue . . .
```

```
C:\ C:\WINDOWS\system32\cmd.exe
```

```
Enter the base-10 number to be converted: 73
Enter the base to be converted to: 9
Base should be less than 9 and greater than 1!
Press any key to continue . . . _
```

```
C:\ C:\WINDOWS\system32\cmd.exe
```

```
Enter the base-10 number to be converted: 26
Enter the base to be converted to: -2
Base should be less than 9 and greater than 1!
Press any key to continue . . . _
```

(30 marks)

Question 2.

In the modulus-10 system, the successor function (s) and its arithmetic are defined as follows:

i	0	1	2	3	4	5	6	7	8	9
$s(i)$	1	2	3	4	5	6	7	8	9	0

$s^k(i) = s^{k-1}(s(i))$ for $k > 1$, and, $s^1(i) = s(i)$ and the answer is retrieved from the table.

For example: $s^3(8) = s^2(s(8)) = s^2(9) = s(s(9)) = s(0) = 1$.

An encoding system transforms the integer in the form of $x_1x_2x_3x_4x_5x_6$ to the result in the form of $y_1y_2y_3y_4y_5y_6$, where

$$y_1 = s(x_1), \quad y_2 = s^2(x_2), \quad y_3 = s^3(x_3), \quad y_4 = s^4(x_4), \\ y_5 = s^5(x_5), \quad \text{and } y_6 = s^6(x_6).$$

For example, 567890 will be encoded as 680246. In other words, 680246 will be decoded as 567890.

The number of bombs possessed by countries A to L has been encoded and stored in a text file named as **bombs.inf** with the contents shown on the right. Write a complete C program to decode it. You can assume that **bombs.inf** contains the information for 12 countries. If your program runs correctly to decode the data file, the screen display will be as follows:

```
A 234567
B 246802
C 890123
D 680246
E 367545
F 678901
G 459870
H 765478
I 965456
J 887656
K 563907
L 789012
```

bombs.inf

Actual Bombs Possession	
Country Code	Number
=====	=====
A	111111
B	123456
C	777777
D	567890
E	244199
F	555555
G	336424
H	642022
I	842000
J	764200
K	440551
L	666666
Press any key to continue:	

Screen Display

(30 marks)

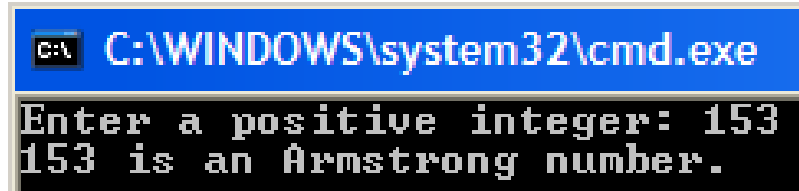
Question 3.

A positive integer is called an Armstrong number if the sum of cubes of the individual digit is equal to that number. For examples:

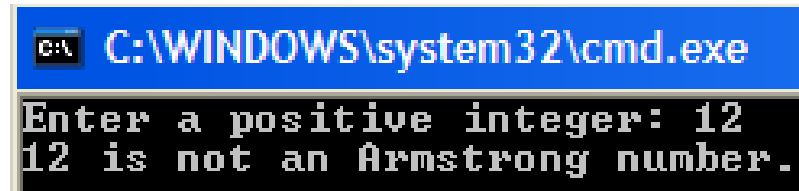
$153 = 1^3 + 5^3 + 3^3 = 153$. So 153 is an Armstrong number.

12 is not equal to $1^3 + 2^3$. So 12 is not an Armstrong number.

Write a complete C program to read a positive integer from the keyboard, and check whether the number is an Armstrong number. Two sessions of the program execution are as follows:



```
C:\WINDOWS\system32\cmd.exe
Enter a positive integer: 153
153 is an Armstrong number.
```



```
C:\WINDOWS\system32\cmd.exe
Enter a positive integer: 12
12 is not an Armstrong number.
```

(30 marks)

Question 4.

The contents of a linear array $a[10]$ is as follows:

5 3 8 9 1 7 0 2 6 4

where $a[0] = 5$, $a[1] = 3$, ..., and $a[9] = 4$. Assume that the array is to be sorted in non-decreasing order, i.e., $a[0] \leq a[1] \leq a[2] \leq a[3] \leq \dots \leq a[9]$. Write down the contents of the array after the second iteration of bubble sort algorithm has been executed.

(10 marks)

- End -

Please remain seated and keep quiet. Thank you.

Study hard for your actual test!!