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Make sure the version number is marked on your scantron sheet.
This is Version 1

McGill University
COMP 208 -- Computers in Engineering
Mid-Term Examination
Tuesday, October 22, 2013
6:30 –8:30 P. M.

Faculty standard calculators allowed.

Grading:

Question	Points/Question	Total
1-25	3	75 marks
26	15	15 marks
27	15	15 marks
Total		105

(The extra 5 marks can be viewed as bonus marks.)

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Question 1
The memory of a computer is used to store programs as well as data in a Von Neuman machine.

a) True
b) False

See slide on Von Neumann (Computer Structure and Brief Look at C p3)

Question 2
Which of the following is not a benefit of using functions?

a) Avoiding code repetition
b) Being able to apply divide and conquer techniques
c) Making a program execute more efficiently
d) Designing reusable software
e) All of the above are benefits of the use of functions.

Question 3
The statement used to transfer control back from a function to its calling program is

a) return
b) break
c) continue
d) exit

Question 4
Which of the following is **not** a logical operator in C?

a) &
b) !
c) ||
d) &&

The & symbol alone is used to get the address of a variable.

Question 5
If malloc() successfully allocates memory, it returns the number of bytes allocated.

a) True
b) False

Malloc Returns the a pointer to the address in memory of the newly allocated space

Question 6
The following C statement outputs the value 7.

```
printf (“%d\n”, 7/9*9);
```

a) true
b) false

The output is 0 followed by a new line. In C math is done from left to right so 7/9 is 0 and 0*9 is still 0

Question 7
Consider the following declaration:

```
float A[12];
```

Which of the following statements is **false**?

a) It initializes the variable A to 12.
b) It assigns the name A to one or more memory cells.
c) It specifies that the memory cell or cells allocated can only hold real values.
d) It instructs the compiler to allocate space for 12 variables.
e) All of the statements are true

Question 8
If you pass an array as an argument to a function in C, what value is passed to the function?

a) The address of the first element of the array
b) The value of the first element of the array
c) All the values in the array
d) The address of the last element of the array
e) The name and size of the array

Question 9
Which of the following statements (a – d) about function prototypes in C is false?

a) The prototype must include the type of the value returned.
b) The prototype must include the name of the function.
c) The prototype must include the name of each parameter.
d) The prototype must include the type of each parameter.
e) All of the statements are true.

Question 10
Consider the C declaration:

```
   float *x;
```

Which of the following statements is false?

a) x is a memory cell containing a real value.
b) x is a memory cell containing the address of another memory cell.
c) x can be a pointer to an array of real values.
d) The compiler allocates a memory cell for the value of x.
e) The value of x is not defined after executing the declaration.

Question 11
Which of the following statements prints “A” if grade is greater than 84 and “Not A” otherwise?

```
   a) grade>84 ? printf(“A\n”):printf(“Not A\n”);
   b) grade>84 ? printf(“A\n”),printf(“Not A\n”);
   c) printf(“%s\n” grade>84 ? “A” ? “Not A”);
   d) printf(“%s\n” grade>84 : “A” ? “Not A”);
```

```
The Correct syntax is:

Condition ? If true do this : if false do this
```

Question 12
How many times will the following loop print “Hello”?

```
      for (i=1; i<=1000; i*=2) printf(“Hello\n”);
```

a) 1
b) 9
c) 10
d) 500
e) 1000

Question 13
What is the value of x after executing the following code segment?

```
int x = 8;
float y = 6;
float z = 5;
y = x / z;
x = 3.45 * y;
```

a) 3
b) 3.45
c) 5
d) 5.52
e) 20

The expression x/z gets cast to a floating point value so y=1.6. The expression 3.45*y is equal to 5.52 but then gets cast to an int because x is of type int.

Question 14
What is the binary representation of the decimal number 95?

a) 1 1 1 1 1 0 1
b) 1 1 1 1 0 1 1
c) 1 1 1 0 1 1 1
d) 1 1 0 1 1 1 1
e) 1 0 1 1 1 1 1

The trick to do this question quickly is to realize that 1111111_2 is 127_{10} and that 1011111_2 is $1111111_2 – 0100000_2 = 127_{10} - 32_{10} = 95_{10}$.

Question 15
How many times will the following program output “Good Luck”?

```
#include<stdio.h>
void main() {
    int x;
    for(x=0; x<=10; x++) {
        if(x < 5)
            continue;
        else
            break;

        printf("Good Luck");
    }
```

a) 0
b) 5

```
c) 6
d) 10
e) 11
```

Question 16

An eager COMP208 student wrote the following program to create an array of odd numbers and compute their average.

```
#include <stdio.h>

void main(){
     int a[10], sum, i;
     float ave;

     for (i=0; i<10; i++) a[i]=2*(i+1)+1;
     for (i=0; i<10; i++) sum += a[i];

     ave = sum/10;
     printf ("Average = %f\n", ave);
}
```

The student expected to get the output:

```
Average = 12.000000
```

but the actual output was:

```
Average = 214730352.000000
```

Why?

a) sum/10 was computed as an integer value and could not be assigned to a real variable

b) the value of sum was not initialized before entering the second do loop

c) the values of the array a were not computed properly in the first do loop because you cannot use i as an array index and also as as a control variable

d) the value of i after exiting the first loop is 10 and the second loop attempts to access a[10]

Question 17*
What is the output of the following program?

```
int main ( ) {
     int x, y, z;
     float a, b;

     x = 3;  y = 5.3;  z = 2;
     a = 2.5; b = 3.14;
     x += y + a * z-b;
     printf ("%d\n", x);
     return 0;
}
```

a) 5
b) 9
c) 10.16
d) 10
e) 14

Question 18*
What is the output of the following program?

```
#include<stdio.h>

void fun(int*, int*);

int main(){
    int i=5, j=2;
    fun(&i, &j);
    printf("%d, %d", i, j);
    return 0;
}

void fun(int *i, int *j){
    *i = *i**i;
    *j = *j**j;
}
```

a) 25, 10
b) 25, 4
c) 10, 4
d) 5, 2
e) 2, 5

Question 19*

What is the output of the following program?

```
#include<stdio.h>

void main() {
    int a=0, b=1, c=3;
    *((a) ? &b : &a) = a ? b : c;
    printf("%d, %d, %d\n", a, b, c);
}
```

a) 3, 1, 3

b) 1, 2, 3

c) 0, 1, 3

d) 1, 3, 1

e) 0, 3, 3

Question 20*

What is the output of the following program?

```
#include <stdio.h>

int f(int y[], int n) {
    int i, num;

    num = 0;
    for (i=n-1;i>=0;i--)
        num = num*10 + y[i];
    return num;
}

void main() {
    int x[5]={1,2,3,4,5};

    printf ("%d\n",f(x,5));
}
```

a) 54321

b) 154321

c) 112345

d) 543211

e) 12345

Question 21

What is the output of the following C program?

```
#include<stdio.h>
int main() {
    char str[] = "midterm";
    char *s = str;
    printf("%s\n", ++s+1);
    return 0;
}
```

a) midterm
b) idterm
c) dterm
d) term
e) erm

Question 22*

What is the output of the following program?

```
#include<stdio.h>
int test (int);
int main()
{
    int a=12345, b=1234;
    a = test(a);
    b = test(a);
    printf("%d, %d\n", a, b);
    return 0;
}
int test(int n) {
    int s=0, d;
    while (n != 0) {
        d = n%10;
        n = n/10;
        s += d;
    }
    return s;
}
```

a) 12345, 1234
b) 15, 0
c) 15, 15
d) 15, 10
e) 15, 6

Question 23
What is the output of the following C program?

```
#include<stdio.h>

void main(){
    int i=3, *j;
    j = &i;
    printf("%d\n", *j*i*i+*j);
}
```

a) 3
b) 9
c) 27
d) 30
e) There is a syntax error in the printf statement.

Question 24*
The following code is intended to compute 5! = 120. The output, however is 24 instead of 120. What has to be changed to correct it?

```
#include <stdio.h>

 int main ( ) {
 int theNum, total;
        total = 1;
        theNum = 5;
        while (theNum > 1) {  /* line 1 */
              total *= --theNum; /* line 2 */
        }
        printf ("%d\n", total);
        return 0;
  }
```

```
Change
  a) line 1 to while (theNum >= 1) {
  b) line 2 to total *= theNum--;
  c) line 2 to total = total*--theNum;
  d) line 1 to while (theNum != 1) {
  e) line 2 to total *= theNum-1;
```

--theNum first decreases the value of theNum then gets evaluated. Change it to theNum-- in order to first evaluate the expression then decrease the value of theNum.

Question 25

What is the output of the following C program?

```
#include <stdio.h>

void f(int* x, int n){
     int i=0;
     while(i<n){
          *(x+i) += 1;
          i +=1;
     }
}
int main(){
     int a[5] = {1,2,3,4,5};
     int i;

     for(i=0; i<5; i++){
          f(a+i, 5-i);
     }

     for(i=0; i<5; i++){
          printf("%d,", a[i]);
     }
     printf("\n");
     return 0;
}
```

a) 2, 4, 6, 8, 10
b) 6, 6, 6, 6, 6
c) 1, 3, 5, 7, 9
d) 6, 7, 8, 9, 10
e) None of the above

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Answer the programming questions on the pages provided below.

Question 26 (Programming)
A perfect number is a positive integer that equals the sum of all of its divisors (other than the number itself). For example 6, 28 and 496 are perfect numbers because:

```
6 = 1 + 2 + 3
28 = 1 + 2 + 4 + 7 + 14
496 = 1 + 2 + 4 + 8 + 16 + 31 + 62 + 124 + 248
```

a) Write a C function definition that, given a number as argument, returns 1 if the number is perfect and 0 otherwise.

b) Write a C program that reads a positive integer N and counts the number of perfect numbers less than N. This program must use the function definition written in part (a)

Question 27 (Programming)
Define two sequences as follows:

```
    a(1) = 1
    b(1) = 1
    a(n+1) = a(n) + 3b(n)
    b(n+1) = a(n) + b(n)
```

It can be shown that the ratio, a(n)/b(n) converges to $\sqrt{3}$.

Write a C program that computes the values in this sequence. At each step, the program should compute the percentage error between the computed ratio and the value of $\sqrt{3}$ (that is the (difference/$\sqrt{3}$) *100). You can use the sqrt function to obtain a value for $\sqrt{3}$.
The program should stop when the magnitude of the error is smaller than 0.001%.
The output should look like the following. You do not have to output the column headings.

```
    a b a/b %error
    1 1 1.000000 -42.26497
    4 2 2.000000 15.47006
    .
    .
    .
```

Answer the programming questions on the following pages.

Answer to question 26

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Answer to question 27

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Additional page for your answers (if needed).