CS11001 Programming and Data Structures, Autumn 2014–2015

Class Test 1

Date: 28–August–2014   Time: 7:00–8:00pm   Maximum Marks: 20

Roll no: _____   **Name:** _____

> *Write your answers in the question paper itself. Be neat and tidy.*
> *Answer all questions. Not all blanks carry equal marks.*

1. Supply single-line answers to the following parts.   **(2 × 4)**

(a) Let `n`, `i` and `sum` be `int` variables. The user enters a positive value of `n`. Which of the following program segments prints the largest value of `sum`?

(i) `sum = 0; i = 1; while (++i < n) sum += i; printf("%d", sum);`

(ii) `sum = 0; i = 1; while (i++ < n) sum += i; printf("%d", sum);`

(iii) `for (sum = 0, i = 1; i < n; i++) sum += i; printf("%d", sum);`

(iv) `for (sum = 0, i = 1; i <= n; ++i) sum += i; printf("%d", sum);`

<div align="center">(iv)</div>

(b) What is printed by the following program?

```
main ()
{
   int x = 0, y = 10, z = 20;
   while (1) {
      x++;
      if (y > z) break;
      y += 4*x; z += 2*x;
   }
   printf("x = %d, y = %d, z = %d", x, y, z);
}
```

<div align="center">x = 4, y = 34, z = 32</div>

(c) What is printed by the following program?

```
main() {
   int x = 1, y = 0, z = 1, t;
   for (t = 0; t < 10; ++t) {
      y += (x) ? z : -z;
      z++; x = !x;
   }
   printf("y = %d", y);
}
```

<div align="center">y = -5</div>

(d) What is printed by the following program?

```
main ()
{
   int x = 0;
   if (x = 0) printf("Case (a): %d", x);
   else if (x -= 7) printf("Case (b): %d", x);
   else printf("Case (c): %d", x);
}
```

<div align="center">Case (b): -7</div>

2. A positive integer is called square-free if it is not divisible by the square of any prime number. For example, $98 = 2 \times 7^2, 99 = 3^2 \times 11, 100 = 2^2 \times 5^2$ are *not* square-free, whereas 101 (a prime) and $102 = 2 \times 3 \times 17$ *are* square-free. Your task is to find the divisor m of a positive integer n supplied by the user, such that m is square-free and as large as possible. Indeed, m is the product of all the distinct prime factors of n, each taken only once. For example, for $n = 98, 99, 100, 101, 102$, the values of m will be $14 = 2 \times 7, 33 = 3 \times 11, 10 = 2 \times 5, 101, 102 = 2 \times 3 \times 17$, respectively. Complete the following program to solve this problem. **(5)**

```
main ()
{
   int n, m, d;

   scanf("%d", &n); /* Assume that a positive integer is entered as n */
   d = 2; m = 1; /* Initialize d (potential divisors of n) and m (the output) */

   while ( _____n > 1_____ ) { /* Supply a condition on n */

      if ( _____n % d == 0_____ ) { /* if n is divisible by d */
         /* If the above condition is true, then d is prime (see the note below) */

            m = _____m * d_____ ; /* Record this prime factor of n in m */
            /* Write a loop to remove all factors of the prime d from n */

                        _____while (n % d == 0) n = n / d;_____
      }
      d++; /* Check the next potential divisor in the next iteration */
   }
   printf("The desired square-free divisor is %d\n", m);
}
```

Notice that in this program, the condition of `if` can be true only when d is prime. This is because if d is composite, then we have taken out all the prime factors of d from n before the division by d is made. For example, we remove all factors of 2 and 3 from n before we divide n by $6, 9, 12, \ldots$. There is no necessity to explicitly check the condition whether d is prime.

3. In this exercise, your task is to evaluate a polynomial $a_0 + a_1 x + a_2 x^2 + \cdots + a_d x^d$ with floating-point coefficients a_i at a floating-point value of x. The user supplies the degree d, the value of x, and then the coefficients $a_0, a_1, \ldots, a_d$. In the following program, the variable `sum` accumulates the desired output value, and the variable `xpower` stores the value of x^i in the i-th iteration. Complete the program. **(7)**

```
main ()
{
   int i, d;
   float x, a, sum, xpower;

   scanf( _____"%d%f", &d, &x_____ ); /* Read both d and x from the user */

   xpower = _____1_____ ; sum = _____0_____ ; /* Initialize */
   /* Loop for reading the coefficients and updating sum and xpower */

   for ( _____i = 0_____ ; _____i <= d_____ ; _____++i_____ ) {

      scanf( _____"%f", &a_____ ); /* Read a_i to a */

               _____sum += a * xpower;_____     /* Update sum */

                  _____xpower *= x;_____     /* Update xpower for next iteration */
   }
   printf("The polynomial evaluates to %f\n", sum);
}
```