Started on	Wednesday, 25 October 2023, 11:30 AM
State	Finished
Completed on	Wednesday, 25 October 2023, 1:30 PM
Time taken	1 hour 59 mins
Grade	**56.45** out of 100.00

Question 1

Incorrect

Mark 0.00 out of 7.00

Order the following three functions of n in increasing order of growth rate:

$F(n) = \frac{7\log n + 4n^{4.3}}{5\sqrt{n}(3+8n\log n)}$, $G(n) = \frac{5n^3\sqrt{n}(1+2\log n)}{4n+9logn}$, $H(n) = \frac{2n^5+7}{n^{4.3}\log n+6} + 5\sqrt{n}\,(16)^{(\log n)/5}$.

a. None of the other choices. ✖

b. $H(n) \ll G(n) \ll F(n)$

c. $F(n) \ll G(n) \ll H(n)$

d. $G(n) \ll H(n) \ll F(n)$

e. $F(n) \ll H(n) \ll G(n)$

f. $G(n) \ll F(n) \ll H(n)$

Your answer is incorrect.

See sample midterm test MT1(Q1e).
Also, use the formula $x^{\log y} = y^{\log x}$.
$F(n) = \Theta(n^{2.8}/\log n)$, $G(n) = \Theta(n^{2.5}\log n)$, $H(n) = \Theta(n^{1.3})$

The correct answer is:
$H(n) \ll G(n) \ll F(n)$

Question 2

Correct

Mark 7.00 out of 7.00

Fill in the underlined blank for the following code.

```
public static  int   f( double x , int  n) {
    // Pre-Condition:    x is a non-zero real number and n is a natural number.
    // Post-Condition:   returns  x^n
    double r = 1 ;
    while ( n > 0 ) {
          // Loop Invariant: _____________________   // fill in this line
          if (n % 2 != 0)  r *= x ;
          x *= x  ;
          n /= 2 ;
     }
     return  r ;
}
```

a. More than one of the other choices are correct.

b. None of the other choices are correct.

c. r will eventually become x^n

d. the loop repeatedly multiplies r by $x^{(n \mod 2)}$, cuts n in half, and squares x

e. the return value stated in the post-condition equals the current value of $r * x^n$ ✔

f. the purpose of the loop is to compute x^n

The correct answer is: the return value stated in the post-condition equals the current value of $r * x^n$

Question 3

Correct

Mark 6.00 out of 6.00

What will be the output of the following program?

```
public class Diet {
    static class Food { public Food() {  System.out.print ( "<My Favorite>" );  }  }
    static class Meet extends Food { public Meet() {  System.out.print ( "<Calorie Source>" );  }  }
    static class Poultry extends Meet { public Poultry() {  System.out.print ( "<Less Purine>" );  }  }
    public static void main( String[] args ) {  Poultry dinner = new Poultry();  }
}
```

a. <My Favorite>

b. <Less Purine>

c. None of the other choices.

d. <Less Purine><Calorie Source><My Favorite>

e. <Calorie Source>

f. <My Favorite><Calorie Source><Less Purine> ✔

Your answer is correct.

See sample Midterm MT1(Q1c). Implicit call to super-class constructor first.

The correct answer is:
<My Favorite><Calorie Source><Less Purine>

Question 4

Partially correct

Mark 2.10 out of 7.00

Fill in the underlined blank line in the following code for a correct and efficient algorithm.

```
public static  double f ( double x, int n) {
  // Pre-Condition: x is a non-zero real number and n is a natural number.
  // Post-Condition: returns x^n .
     if  (n == 0)  return 1 ;
     _____________________________   // blank line to be filled in
     return (n % 2 == 0) ?  z  :  z *x ;
}
```

a. double z = f(x*x*x, n/3) ;

b. double z = f(x, n/2) ; z *= z ;

c. double z = f(x*x, n) ; z /= 2 ; ✔

d. More than one of the other choices.

e. double z = f(x, n/2) * f(x, n/2) ;

The correct answer is: double z = f(x, n/2) ; z *= z ;

Question 5

Correct

Mark 6.00 out of 6.00

What does the following print?

System.out.println(5 + 3 + 7 + "26" + 4 + 9);

a. 5372649

b. 152649 ✔

c. None of the other choices.

d. 152613

Your answer is correct.

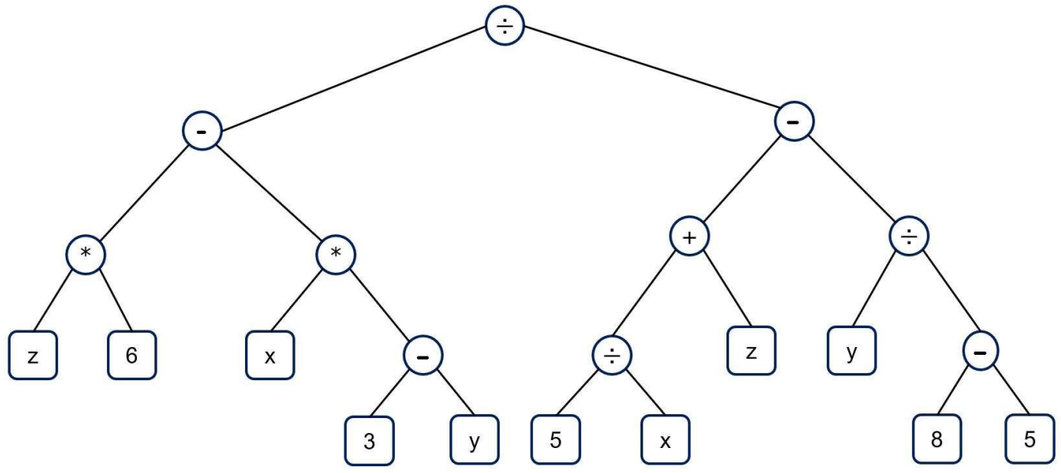
See Sample Midterm MT1(Q1b): Left-to-right associativity and overloaded operator. LS1, p.37

The correct answer is:
152649

Question 6

Correct

Mark 6.00 out of 6.00



The above arithmetic expression tree represents (i.e., is the parse tree of)

a. None of the other choices are correct.

b. the un-parenthesized prefix expression **÷ - ÷ - 5 8 y + z ÷ x 5 - * - y 3 x * 6 z**

c. More than one of the other choices are correct.

d. the fully parenthesized infix expression **(((z * 6) - (x * (3 - y))) ÷ ((z + (y ÷ x)) - (y ÷ (8 - 5))))**

e. the un-parenthesized postfix expression **z 6 * x 3 y - * - 5 x ÷ z + y 8 5 - ÷ - ÷** ✔

f. the un-parenthesized infix expression **z * 6 - x * 3 - y ÷ y ÷ x + z * y ÷ 3**

Your answer is correct.

The answer must be the exact expression as represented by the given parse tree. It should not be a partially evaluated expression, nor one with some subexpressions misplaced in wrong order.

The correct answer is:
the un-parenthesized postfix expression **z 6 * x 3 y - * - 5 x ÷ z + y 8 5 - ÷ - ÷**

Question 7

Correct

Mark 7.00 out of 7.00

What is the output of the following code?

```
public class Pattern {
    public static void pattern(int n, int m) {
        if (n <= 0 && m <= 0) return;
        if (n > 0 && n % 2 == 0)  System.out.print(n + " ");
        pattern(n - 1, m - 1);
        if (m > 0 && m % 2 == 1) System.out.print(m + " ");
    }

    public static void main(String[] args) {
        pattern(15, 7);
    }
}
```

a. 14 7 12 5 10 3 8 1 6 4 2

b. 14 13 12 11 10 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7

c. 14 12 10 8 6 4 2 1 3 5 7 ✔

d. None of the other choices

e. 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 1 2 3 4 5 6 7

Your answer is correct.

prints positive even integers at most n in decreasing order followed by positive odd integers at most m in increasing order.

The correct answer is:
14 12 10 8 6 4 2 1 3 5 7

Question 8

Correct

Mark 7.00 out of 7.00

What integer value does mystery(n) return for arbitrary n?

```
public static int mystery( int n ) {
    if (n > 56) return n - 3;
    return mystery( mystery(n + 4) + 1 );
}
```

a. $\max\{n-3, 55-(n \mod 2)\}$ ✔

b. That is in general undefined, since the recursion may not terminate.

c. $\max\{n-3, 55\}$

d. $\max\{n-3, 53+(n \mod 2)\}$

e. The returned value is a function of n and cannot be written in a closed form formula.

f. $\max\{n-3, 54\}$

Your answer is correct.

See a similar question in the sample midterm test MT3 (Q2c). The proof is by induction on the recursion depth.

The correct answer is:

$\max\{n-3, 55-(n \mod 2)\}$

Question 9

Partially correct

Mark 1.40 out of 7.00

$\left(\frac{n\sqrt{n}+n\log n}{\sqrt{n+\sqrt{n}}}+\frac{n^2\log n+n^{2.4}}{n\sqrt{n+\log n}}\right)\left(\frac{n+\sqrt{n}}{\log(n^2+3n+4)}+\sqrt{n}\log n\right)=\Theta\ (\ \_\_\_\_\_\ ).$

a. $n^{1.9}/\log n$

b. $n^2/\log n$

c. $n^{1.5}/\log n$ ☑

d. None of the other choices.

e. $n^{1.5}\log n$

The correct answer is: $n^2/\log n$

Question 10

Partially correct

Mark 0.35 out of 7.00

What is the asymptotic running time of the method below as a function of n?

```
public void doubleLoop ( int n ) {
   for ( int k = n*n; k > 0; k /=3 )
      for ( int m = 1; m < k; m *=2  )
          System.out.println( (3*k*m + 6) / (k + m) );
}
```

- a. $\Theta(n^2)$
- b. $\Omega(n^2 \log n)$ ✔
- c. $O(\log n)$
- d. $\Theta(n \log n)$
- e. $\Theta(\log^2 n)$
- f. None of the other choices.

Your answer is partially correct.

See sample midterm MT1(Q2b) and MT Practice Quiz.

The outer loop iterates $\Theta(\log n)$ times. The inner loop iterates $\Theta(\log k)$ times for iteration k of the outer loop.

The correct answer is:
$\Theta(\log^2 n)$

Question 11

Correct

Mark 7.00 out of 7.00

What is the output of the following code?

```
public class Mystery {
      public static void main(String[] args) {
            int[] a = new int[] { 9, 8, 7, 6, 5, 4, 3, 2, 1, 0 };
            for (int e : a) {  a[e] = e;   System.out.print(" " + e);    }
       }
}
```

- a. 5 6 7 8 9 9 8 7 6 5
- b. 9 8 7 6 5 4 3 2 1 0
- c. 0 1 2 3 4 5 6 7 8 9
- d. 0 1 2 3 4 4 3 2 1 0
- e. 9 8 7 6 5 5 6 7 8 9 ✔

Your answer is correct.

for-each loop LS1, pp: 54-55.

The correct answer is:

9 8 7 6 5 5 6 7 8 9

Question 12

Partially correct

Mark 0.60 out of 6.00

Suppose $f(n)$ is $O(n^5)$ and $g(n)$ is $\Omega(n^2 \log n)$. Then

- a. $f(n) * g(n)$ is $\Theta(n^7 \log n)$
- b. $f(n) + g(n)$ is $O(n^5)$ ☑
- c. $\frac{f(n)}{g(n)}$ is $O(\frac{n^3}{\log n})$
- d. $\frac{f(n)}{g(n)}$ is $\Omega(\frac{n^3}{\log n})$

The correct answer is: $\frac{f(n)}{g(n)}$ is $O(\frac{n^3}{\log n})$

Question 13

Correct

Mark 6.00 out of 6.00

What is the output of element-spans algorithm, that we studied in the course, on the input array $\{36, 73, 48, 39, 34, 42, 50, 14, 63, 71\}$?

a. $\{1, 9, 4, 2, 1, 1, 2, 1, 1, 1\}$

b. None of the other choices.

c. $\{1, 2, 1, 1, 1, 3, 5, 1, 7, 8\}$ ✔

d. $\{36, 109, 48, 39, 34, 115, 213, 14, 290, 361\}$

Your answer is correct.

See sample MT3(Q1h) and LS6, pp: 24-27.

The correct answer is:
$\{1, 2, 1, 1, 1, 3, 5, 1, 7, 8\}$

Question 14

Incorrect

Mark 0.00 out of 7.00

What is the **double** (i.e., real number) value of the postfix expression `8 9 14 - 4 * / 8 7 + *` ?

a. Some number between 20 and 40.

b. None of the other choices.

c. Some number between 5 and 15 .

d. Some number between -15 and -5 .

e. Some number between -40 and -20 . ✖

Your answer is incorrect.

Equivalent expressions:

parenthesized postfix: `( ( 8 ( ( 9 14 - ) 4 * ) / ) ( 8 7 + ) * )`

parenthesized infix:
```
( ( 8 / ( ( 9 - 14 ) * 4 ) ) * ( 8 + 7 ) )
    = ( ( 8 / ( -5 * 4 ) ) * 15 )
    = ( ( 8 / -20 ) * 15 )
    = ( ( -2/5 ) * 15 )
    = -6
```

The correct answer is:

Some number between -15 and -5 .

Question 15

Incorrect

Mark 0.00 out of 7.00

If L is an instance of LinkedList (as defined below) of unspecified size $n > 0$, what does L.mystery() return?

```
public class LinkedList<E> { // singly linked list with header, and generic element type E

        private static class Node<E> { // -------- nested node class ---------
                private E element;      // field
                private Node<E> next;   // field
                public Node(E e)        // constructor
                        { element = e;   next = null; }
        } // ------------------------------------ end of nested class -------

        Node<E> head; // field: head of linked list

        public E mystery() {
                Node<E> p = head;
                if (p == null) return null;
                Node<E> q = p;
                while (q != null && q.next != null) {
                        q = q.next.next;
                        p = p.next;
                }
                return p.element;
        }

        /* rest of LinkedList class definition is not shown here */
}
```

a. The element at list position $1 + \lfloor n/2 \rfloor$.

b. The element at list position $1 + \lfloor 2n/3 \rfloor$.

c. The element at list position n.

d. None of the other choices.

e. The element at list position $1 + \lfloor n/3 \rfloor$. ✖

f. null.

Your answer is incorrect.

Pointer q advances twice as fast as p. When q reaches the end of the list, p is at the last midpoint of the list.

The correct answer is:
The element at list position $1 + \lfloor n/2 \rfloor$.

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