



**University Interscholastic League
Computer Science Competition**

Number 147 (Region - 2014)

General Directions:

- 1) DO NOT OPEN EXAM UNTIL TOLD TO DO SO.**
- 2) NO CALCULATOR OF ANY KIND MAY BE USED.**
- 3) There are 40 questions on this contest exam. You have 45 minutes to complete this contest. If you are in the process of actually writing an answer when the signal to stop is given, you may finish writing that answer.
- 4) Papers may not be turned in until 45 minutes have elapsed. If you finish the test before the end of the allotted time, remain at your seat and retain your paper until told to do otherwise. Use this time to check your answers.
- 5) All answers must be written on the answer sheet/Scantron card provided. Indicate your answers in the appropriate blanks provided on the answer sheet or on the Scantron card. Clean erasures are necessary for accurate Scantron grading.
- 6) You may place as many notations as you desire anywhere on the test paper, but not on the answer sheet or Scantron card, which are reserved for answers only.
- 7) You may use additional scratch paper provided by the contest director.
- 8) All questions have ONE and only ONE correct (BEST) answer. There is a penalty for all incorrect answers.
- 9) A reference to commonly used Java classes is provided at the end of the test, and you may use this reference sheet during the contest. You may detach the reference sheets from the test booklet, but DO NOT DO SO UNTIL THE CONTEST BEGINS.

Scoring:

- 1) All questions will receive 6 points if answered correctly; no points will be given or subtracted if unanswered; 2 points will be deducted for an incorrect answer.

Note: Correct responses are based on Java, **J2sdk v 1.7.25**, from Sun Microsystems, Inc. All provided code segments are intended to be syntactically correct, unless otherwise stated (i. e. `error` is an answer choice) and any necessary Java 2 Standard Packages have been imported. Ignore any typographical errors and assume any undefined variables are defined as used. **For all output statements, assume that the System class has been statically imported... `import static java.lang.System.*;`**

QUESTION 1

Which of these is NOT equivalent to $111011110_2 - F2_{16}$?

- A. 234_{10} B. 354_8 C. EC_{16} D. 11101100_2 E. All are equivalent

QUESTION 2

What is output by the code to the right?

- A. 0.2 B. 0.6 C. 6.2
D. 7 E. 7.8

```
out.println(16 % 9 - 4 * 0.2);
```

QUESTION 3

What is output by the code to the right?

- A. Hello
Goodbye
4_
true
B. HelloGoodbye
4_true
C. Hello Goodbye 4_true
D. There is no output due to a compile error.
E. There is no output due to a runtime error.

```
out.print("Hello");  
out.println("Goodbye");  
out.printf("%s_%s\n",4,true);
```

QUESTION 4

What is output by the code to the right?

- A. balloonBomb B. balloonbomb
C. Balloonbomb D. BalloonBomb
E. There is no output due to a compile error.

```
String s = "BalloonBomb";  
s.toLowerCase();  
out.println(s);
```

QUESTION 5

For which initial values of p and q will the code on the right output false?

- A. p=true, q=true; B. p=false, q=true;
C. p=true, q=false; D. p=false, q=false;
E. None of these

```
boolean p=<value1>, q=<value2>;  
out.println(p|!p&q);
```

QUESTION 6

Which of the following would most accurately replace <datatype> in the following expression?

- A. float B. double
C. char D. int E. long

```
<datatype> num = Math.round(3.4);
```

QUESTION 7

What is output by the code to the right?

- A. 25.0 B. 25.1
C. 28.0 D. 28.2
E. There is no output due to a compile error.

```
int a = 70;  
double b = 5.2;  
b += a /= 3;  
out.println(b);
```

QUESTION 8 <p>What is output by the code to the right?</p> <p>A. $B==b$ B. $B!=b$ C. There is no error, but there is no output. D. There is no output due to a compile error. E. There is no output due to a runtime error.</p>	<pre>char a = 'B'; char b = 'b'; if(a==b) out.println(a+"=="+b); else out.println(a+"!=" +b);</pre>
QUESTION 9 <p>If c stands for column in the code to the right, what column would contain water when first detected?</p> <p>A. column 3 B. column 5 C. column 15 D. column 14 E. It is not possible to determine this.</p>	<pre>int c = 0; boolean isWaterAhead = false; while(!isWaterAhead) { if((c+1)%5==0 && (c+1)%3==0) isWaterAhead=true; c++; }</pre>
QUESTION 10 <p>What is output by the code to the right?</p> <p>A. 65 B. 57 C. 129 D. 115 E. 147</p>	<pre>char[]list = new char[4]; list[1]=65; list[3]=50; int sum=list[1]+list[2]+list[3]; out.println(sum);</pre>
QUESTION 11 <p>Which of these Java classes can be used in the input process, either from keyboard or from file?</p> <hr/> <p>I. File II. FileWriter III. Scanner IV. PrintWriter</p> <hr/> <p>A. I only B. I and II only C. I and III only D. III only E. All of these can be used for input</p>	
QUESTION 12 <p>What is output by the code to the right?</p> <p>A. 4 4.8 B. 6 115.20 C. 13 9.6 D. 32 19.2 E. 70 38.4</p>	<pre>int a = 0; double b = 2.4; while (a+b<25) { b*=2;a+=b; } out.println(a+" "+b);</pre>
QUESTION 13 <p>What is output by the code to the right?</p> <p>A. 40 B. 21 C. 15 D. 11 E. 10</p>	<pre>int f = 5; int g = f<<2+1; out.println(g);</pre>
QUESTION 14 <p>What is output by the code to the right?</p> <p>A. 4 B. 8 C. 16 D. 32 E. 64</p>	<pre>out.println(Float.SIZE);</pre>
QUESTION 15 <p>What is output by the code to the right?</p> <p>A. [4, 1] B. [4, 1, 2] C. [4, 1, 3] D. [4, 3, 2] E. There is no output due to a compile error</p>	<pre>ArrayList<Integer> list = new ArrayList<Integer>(); list.add(4); list.add(1); list.add(3); list.add(2); list.remove(2); out.println(list);</pre>

<p>QUESTION 16</p> <p>Which of the following logical statements is represented by the digital electronics diagram on the right?</p> <p>A. $A \wedge !(B \wedge C) \wedge !D$ B. $A \wedge (B \wedge C) \wedge D$ C. $A \wedge !(B \wedge C) \wedge D$ D. $A \wedge !(B \wedge C) \wedge !D$</p>	<p>A B C D</p>
<p>QUESTION 17</p> <p>How many times will the word red be output by the code to the right?</p> <p>A. 36 B. 35 C. 26 D. 25 E. 24</p>	<pre>for(int a=45; a<=80; a++) out.print((a>50? a<75? "red": "green": "blue"));</pre>
<p>QUESTION 18</p> <p>What is output by the code to the right?</p> <p>A. falsefalse B. falsetrue C. truefalse D. truetrue E. There is no output due to a compile error</p>	<pre>String s = "UILRegion2014"; boolean p,q; p = s.matches(".[^WIN]+.*"); q = s.matches("....."); out.println(""+p+q);</pre>
<p>QUESTION 19</p> <p>What is output by statement 1 in the code to the right?</p> <p>A. The dog is a: dachshund B. The animal is a: dachshund C. The dog is a: mammal D. The animal is a: mammal E. There is no output.</p>	<pre>class Animal { public String type = "mammal"; public void show() { out.println("The animal is a: " + + type); } }</pre>
<p>QUESTION 20</p> <p>What is output by statement 2 in the code to the right?</p> <p>A. The dog is a: dachshund B. The dog is a: mammal C. The type is: dachshund D. The type is: mammal E. There is no output.</p>	<pre>class Dog extends Animal { public String type; public Dog(String type) { this.type = type; } public void show() { out.println("The dog is a: " + + type); } }</pre>
<p>QUESTION 21</p> <p>Which of the statements below is most accurate?</p> <p>A. In an inheritance situation as shown in the code to the right, early (static) binding occurs at run time, while late (dynamic) binding occurs at compile time. B. In the client code to the right, the show() method that is called is the one that belongs to the Animal class. C. In the client code to the right, the type instance variable that is used is the one that belongs to the Animal class. D. All of the above statements are true. E. None of these statements are true.</p>	<pre>//client code Animal doggie = new Dog("dachshund"); //statement 1 doggie.show(); //statement 2 out.println("The type is: " + + doggie.type);</pre>

QUESTION 22

What is output by the code to the right?

- A. 7 2 4 3 8 1 -24130- 1 2 3 4 7 8
- B. 7 2 4 3 8 1 -24103- 1 2 3 4 7 8
- C. 7 2 4 3 8 1 -21034- 1 2 3 4 7 8
- D. 7 2 4 3 8 1 -21043- 1 2 3 4 7 8
- E. 7 2 4 3 8 1 -21403- 1 2 3 4 7 8

QUESTION 23

Which algorithm process listed below best describes the code to the right?

- A. Insertion sort
- B. Quick sort
- C. Merge sort
- D. Bubble sort
- E. Heap sort

QUESTION 24

What is the most restrictive bound on the runtime of this process, where N represents the number of items in list?

- A. O(1)
- B. O(N)
- C. O(log N)
- D. O(N log N)
- E. O(N^2)

```
class SomeSort {
    static int[] numbers;
    static int[] helper;
    public static void sort(int[] values)
    {
        numbers = values;
        int number = values.length;
        helper = new int[number];
        somesort(0, number - 1);
    }

    public static void somesort(int low,
                                int high)
    {
        if (low < high) {
            int middle=low+(high-low)/2;
            out.print (middle);
            somesort(low, middle);
            somesort(middle + 1, high);
            combine(low, middle, high);
        }
    }

    public static void combine(int low,
                               int middle, int high)
    {
        for (int i = low; i <= high; i++) {
            helper[i] = numbers[i];
        }
        int i = low;
        int j = middle + 1;
        int k = low;
        while (i <= middle && j <= high) {
            if (helper[i] <= helper[j]) {
                numbers[k] = helper[i];
                i++;
            } else {
                numbers[k] = helper[j];
                j++;
            }
            k++;
        }
        while (i <= middle) {
            numbers[k] = helper[i];
            k++;
            i++;
        }
    }

    //client code
    int [] list = {7,2,4,3,8,1};
    for(int x:list)
        out.print(x+" ");
    out.print("-");
    SomeSort.sort(list);
    out.print("- ");
    for(int x:list)
        out.print(x+" ");
}
```

QUESTION 25 What is output by the code to the right? A. 16 B. 24 C. 30 D. 36 E. There is no output due to a compile error	<pre>int [][] g = new int [5][]; for(int x=0;x<g.length;x++) g[x]=new int[(x+1)*2]; int d=0; for(int r=0;r<g.length;r++) for(int c=0;c<g[r].length;c++) d++; out.println(d);</pre>
QUESTION 26 What is output by the code to the right? A. 5 B. 10 C. 54 D. 135 E. 525	<pre>out.println(Integer.toString(75,7));</pre>
QUESTION 27 What is output by the code to the right? A. 12VLein B. 24LUino C. 24ILonU D. 2L4ino E. einVL21	<pre>String s = "Region UIL 2014"; char[]list = s.toCharArray(); PriorityQueue<Character> pq = new PriorityQueue<Character>(); for(int x = 0;x<list.length;x++) { pq.add(list[x]); if(x%2==0) pq.remove(); } for(char a:pq) out.print(a);</pre>
QUESTION 28 What is output by the code to the right? A. 3 B. 7 C. 9 D. 14 E. 15	<pre>int a=13,b=4,c=7,d=6; out.println(a^b&c d);</pre>
QUESTION 29 What is output by the code to the right? A. 001 010 101 110 B. 001 011 101 111 C. 000 010 100 110 D. 001 011 101 110 E. 000 010 101 110	<pre>for(int p = 0; p <= 1; p++) for(int q = 0;q <= 1; q++) { boolean P = p==1; boolean Q = q==1; boolean R = !(P Q) (P&!Q); int r = R?1:0; out.print(""+p+q+r+" "); }</pre>
QUESTION 30 What is output by the code to the right? A. 0 B. 100 C. -245 D. 172 E. -2940	<pre>int a = (int)Math.pow(14,2); int b = a>>4; int c = b%5; out.println(a-b*c);</pre>

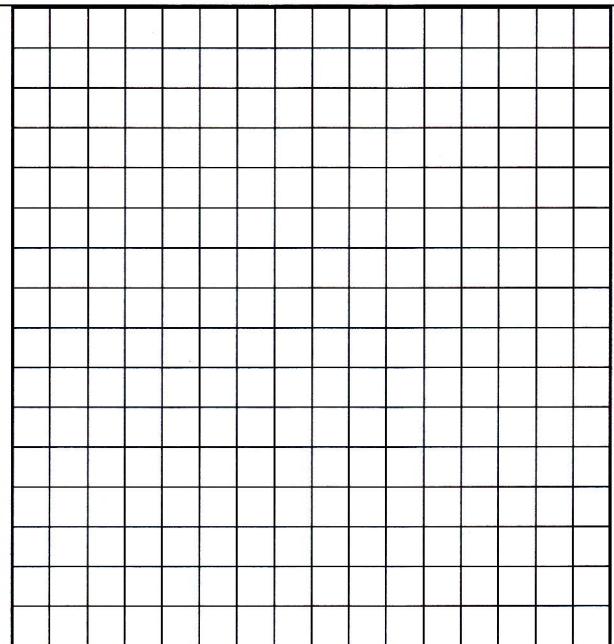
QUESTION 31

Consider the following recursive algorithm for painting a square:

1. Given a square with side length 16 feet
2. If the length of a side is equal to 1, stop the process for that square, otherwise continue.
3. Divide the square into 4 equal size squares.
4. Paint one of the these 4 smaller squares.
5. Return step 2 for each of the remaining 3 squares.

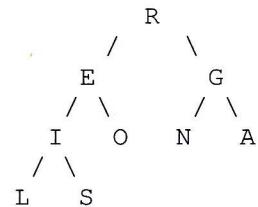
How many square feet of this square will be painted?

- A. 256 B. 148 C. 175
 D. 81 E. 64

**QUESTION 32**

Which of the following is the preorder traversal of the tree shown to the right?

- A. REILSONGA B. REILSOGNA
 C. AEGILNORS D. LISEORNGA
 E. LSIOENAGR

**QUESTION 33**

What is output by the code to the right?

- A. [5, 1, 3, 6, 7]
 B. [1, 3, 4, 5, 6, 7]
 C. [4, 1, 3, 5, 6, 7]
 D. [4, 5, 1, 3, 5, 6, 7]
 E. [4, 5, 1, 3, 6, 7]

```
LinkedList<Integer>a = new
    LinkedList<Integer>();
a.offerFirst(4);
a.addLast(5);
a.element();
int [] list = {5,3,6,7,1};
Set<Integer> set = new
    TreeSet<Integer>();
for(int x:list)
    set.add(x);
a.addAll(set);
a.removeLastOccurrence(5);
out.println(a);
```

QUESTION 34

In the methods of the Queue interface, three pairs of methods are similar, with **add()** and **offer()** both inserting an element into the queue, **peek()** and **element()** both returning the head value of the queue without removing it, and **poll()** and **remove()** both returning and removing the head value. So what, if any, is the difference between each pair of methods? Select the statement below that accurately describes this situation.

- A. **add()** throws an exception if the queue is full; **offer()** returns false without throwing an exception
 B. **peek()** returns **null** if the queue is empty; **element()** throws an exception
 C. **poll()** returns **null** if the queue is empty; **remove()** throws an exception
 D. All of these statements are false
 E. All of these statements are true

QUESTION 35

On the right is the definition of a Boat class. How many constructors are there in this definition ?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5

QUESTION 36

What is the output of the statement 1 in the client code below?

- A. skiff 1 1.5
- B. "skiff" 1 1.5
- C. 1 1.5 skiff
- D. 1-hull "skiff": minimum 1.5 feet of water
- E. 1-hull skiff: minimum 1.5 feet of water

QUESTION 37

Which of the following would most directly replace **code segment 2** to produce the output :

2-hull skiff: minimum 2.0 feet of water

I.
Boat b2 = new Boat(2);
b2.setDraft(2);
out.println(b2);

II.
Boat b2 = new Boat(2.0);
b2.setNumHulls(2);
out.println(b2);

III.
Boat b2 = new Boat("catamaran");
b2.setDraft(2);
b2.setNumHulls(2.0);
b2.setType("skiff");
out.println(b2);

- A. I only
- B. II only
- C. III only
- D. None of these
- E. All of these

```
static class Boat
{
    private String type;
    private int numHulls;
    private double draft;

    public Boat(){
        type = "skiff"; numHulls = 1;
        draft = 1.5;
    }
    public Boat(int n){
        type = "skiff";numHulls = n;
        draft = 1.5;
    }
    public Boat(double n) {
        type = "skiff";numHulls = 1;
        draft = n;
    }
    public Boat(String n){
        type = n; numHulls = 1;
        draft = 1.5;
    }
    public void setType(String s){
        type = s;
    }
    public String getType(){
        return type;
    }
    public void setDraft(double d){
        draft = d;
    }

    public double getDraft(){
        return draft;
    }

    public void setNumHulls(int n){
        numHulls = n;
    }

    public int getNumHulls(){
        return numHulls;
    }

    public String toString(){
        return numHulls+-hull "+type
            +": minimum "+draft
            +" feet of water";
    }
}

//client code
Boat b1 = new Boat();

//statement 1
out.println(b1);

//code segment 2
```

<p>QUESTION 38</p> <p>What is output by statement 1 in the code to the right?</p> <p>A. 65 B. -65 C. 97 D. -97 E. There is no output due to a compile error</p>	<pre>public static int myst(char[]list) { int s = 0; for(char a:list) s+=a%2==0?a:-a; return s; } //client code //statement 1 out.print(myst("bed".toCharArray()));</pre>
<p>QUESTION 39</p> <p>What is output by statement 2 in the code to the right?</p> <p>A. 94 B. -94 C. 62 D. -62 E. There is no output due to a compile error</p>	<pre>//statement 2 out.print(myst("MET".toCharArray()));</pre>
<p>QUESTION 40</p> <p>After the following elements {7, 2, 4, 9, 5, 6, 1} are correctly inserted into a min heap, which element is the right child of the root?</p> <p>A. 2 B. 4 C. 5 D. 6 E. 7</p>	

Computer Science Answer Key

UIL Region 2014

1) A	11) C	21) C	31) C
2) C	12) D	22) D	32) B
3) B	13) A	23) C	33) E
4) D	14) D	24) D	34) E
5) D	15) B	25) C	35) D
6) E	16) A	26) D	36) E
7) D	17) E	27) B	37) B
8) B	18) B	28) E	38) C
9) C	19) A	29) A	39) D
10) D	20) D	30) D	40) A

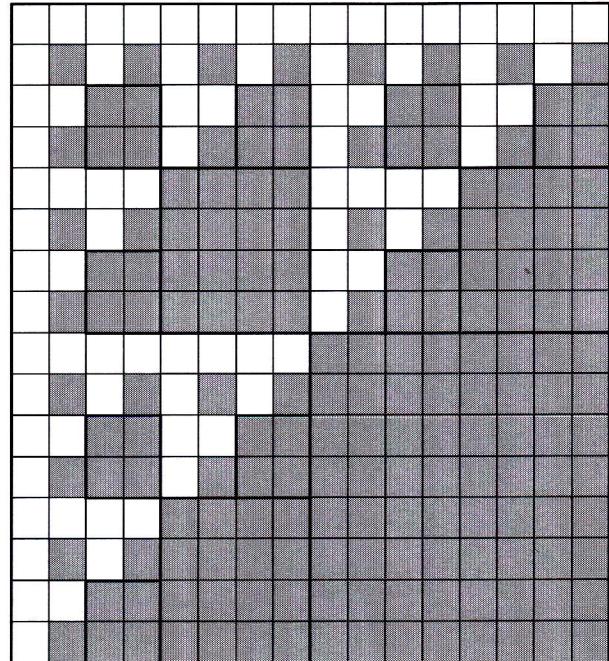
Note to Graders:

- All provided code segments are intended to be syntactically correct, unless otherwise stated (e.g. error is an answer). **Ignore any typographical errors.**
- Any necessary Standard Java 2 Packages are assumed to have been imported as needed.
- Assume any undefined (undeclared) variables have been defined as used.

Explanations:

1. $11101110_2 - F2_{16} = 236_{10} = 354_8 = EC_{16} = 11101100_2$
2. Using order of operations, 16%9 goes first (7), then $4 * 0.2$ (0.8), then $7 - 0.8$, which equals 6.2.
3. Since every Java data type has a String representation, the "%s" printf format specifier can take any data type, and this code works, with `HelloGoodbye` on one line, and `4_true` on the next line.
4. This method calls `returns` a String in all lowercase, but does not change `s` (since Strings are immutable) and since it was not reassigned to `s`, the output is the original value of `s`, `BalloonBomb`.
5. This Boolean expression is equivalent to `P || Q`, which is false only when both `P` and `Q` are both false.
6. Since `Math.round` returns a long when a double parameter is given, long is the best data type to use, even though a double could take it.
7. 70 divided by 3 equals 23. Add that to .5.2 and you get 28.2.
8. Since 'B' and 'b' are different values in the ASCII character map, they are not equal.
9. When `c` has a value of 14, the next column (15) is the first time water will be detected.
10. Since the default value of char Arrays is the zero value space (not the 32 value space), the values added here are 65+0+50, for a total of 115.
11. File and Scanner are the two main classes used for input. `FileWriter` and `PrintWriter` are used for file output.
12. The `a` and `b` values for this loop sequence are: 0 2.4, 4 4.8, 13, 9.6, 32 19.2. The last pair causes the loop to terminate since the sum is not less than 25. Those values are the ones output.
13. This tests your knowledge of operator precedence, something you should study and know very well. Since the `+` operator precedes the `<<`, the 2 and 1 are added first, then a `<<3` is applied to 5, in essence multiplying 5 by 2^3 , or 8, which equals 40. The common error is to shift first, then add 1, which would result in 21.
14. The float data type uses 32 bits of memory.
15. This question is about how the remove method works. Does it remove the value 2, or the value in position 2? It is the latter, the value in position 2, which is the 3. The resulting list contains [4, 1, 2].
16. The best way to remember the Digital Electronic shapes is this: bullet shapes (flat back) are AND, arrow shapes (curved back) are OR, double arrows are XOR, and a small circle means NOT. The expression for this one is A XOR NOT(B AND C) OR NOT D.
17. This double ternary operator works just like a nested if else statement: `if(a>50) if(a<75) output "red" else output "green" else output "blue"`. "red" will be output for 51 through 74 (24 times). "blue" is output for the values 45 through 50, and "green" for all the values 75 and beyond.
18. The first match is false. In the match string, "[^WIN]+.*", the dot means a single character, which correctly matches the "U". "[^WIN]+" means match one of more characters NOT in "WIN". The "I" causes this to be false, therefore the match is false. The match string with all the dots is an exact match since the length is the same, and a dot matches any character, there it is true.
19. The object method is always called when it overrides the super class method, which in this case outputs, "The dog is a: dachshund". Since it is not possible to determine which show method will be called (Animal reference could be reassigned during the execution), the show method called is determined during run time, an example of late (dynamic) binding.
20. When both base and derived classes have member values of the same name, the base class member value is always called by default. This is an example of early (static) binding.
21. This code demonstrates the difference between early and late binding. Statement C is the only one that is true. Statements A and B are reversed. Early binding occurs at compile time, and question 20 is an example of this. Question 19 is an example of late, or dynamic binding.
22. The somesort method is first called with the values 0 and 5, which gives a middle value of 2. Subsequent calls and middle values produced are: (0,2)->1, (0,1)->0, (3,5)->4, (3,4)->3. The (2,2) and (5,5) calls result in no middle values output.
23. This is the merge sort.
24. The Big O rating for this is $O(N \log N)$.
25. The array sizes produced in this matrix are of size 2, 4, 6, 8, and 10, for a total of 30 slots.
26. The decimal value 75 in base 7 is 135.
27. The priority queue step-by-step sequence produced by this code is: R, eg, gio, spaeino, LUino, spaeeLUino, 02LUino, 424LUino, resulting in final queue of "24LUino".
28. Since the order of precedence for bitwise operators is AND, XOR, then OR, the 4 AND 7 goes first, resulting in 4. 13 XOR 4 is 9, and then 9 OR 6 is 15.
29. This Boolean expression simplifies to $P \& \neg Q \mid P \& \neg Q$, which means 00 and 10 are the only two ordered pairs that result in true.
30. This expression simplifies to $196 - 12 * 2$, which equals 172.
31. To the right is the recursion diagram for this question. →
32. Preorder traversal starts at the root and outputs each element in "touch left side" traversal order.
33. The array contents, step by step, are as follows: [], [4], [4 5], [4,5,1,3,5,6,7], and [4,5,1,3,6,7].
34. A, B, and C are correct as stated.
35. The Boat constructors include the default constructor, `Boat()`, and three one parameter constructors.
36. The `toString` method constructs and returns the String designed to output the member values of this boat.
37. Although all three code segments will accomplish the desired output, the most direct Option is II, where the parameter values match the required data types exactly. Option I works OK, but has to make a data type promotion in the call to the `setDraft` method. Option III works as well, but is just a terribly inefficient way to accomplish it.
38. This method simply adds the ASCII values of the characters in the given string, making negative any values that are odd. "bed" returns the sum of 98 - 101 + 100 = 97.
39. "MET" returns the sum $-77 - 69 + 84 = -62$.

Recursion Diagram – #31



40. Below is the step by step process for this min heap process.

Region 2014 - Question 40 - Min heap

{ 7, 2, 4, 9, 5, 6, 1 }

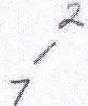
Insert 7



Insert 2



Heapify

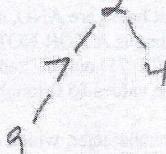


Insert 4



No heapify process needed

Insert 9

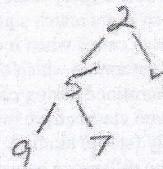


No process needed

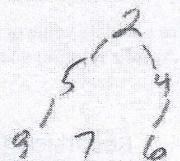
Insert 5



Heapify

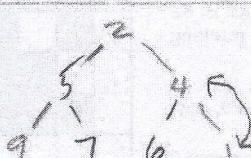


Insert 6

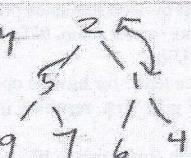


No process needed

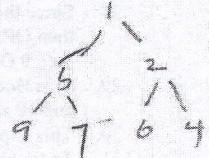
Insert 1



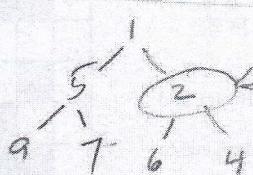
Heapify



Heapify again



Final Heap



Right child of
the root.