Computer Science Contest #1415-05 Key

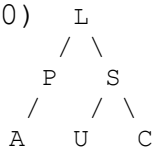
November 08, 2014

1) E
2) C
3) B
4) A
5) C
6) E
7) B
8) A
9) A
10) C

11) E
12) D
13) E
14) B
15) D
16) B
17) B
18) A
19) A
20) B

21) B
22) C
23) C
24) D
25) B
26) B
27) B
28) A
29) E
30) D

31) D
32) A
33) C
34) D
35) D
36) C
37) A
38) C
39) ABC (See explanations)
40)



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.

© A+ Computer Science – www.apluscompsci.com

Explanations:

1. E $1100011_2 + 10011101_2 = 99_{10} + 157_{10} = 256_{10} = 400_8 = 100_{16} = 100000000_2$
2. C 15 % 4 + 1 * 2 = 5
3. B The three values produced are: 11.2, 6.2test, and test5, all of which are received by the %s string format specifier, resulting in 11.26.2testtest5
4. A The replaceAll method here does indeed create the string "MUssUssUppUBurnUng", but since it does not change the String t (which is immutable), t remains "MississippiBurning"
5. C In the first expression, since p is true, the value of the expression is true, and the second part of the expression is immaterial. In the second expression, the XOR operator requires only one part to be true for the expression to be true, and since both variables are true, the expression is false.
6. E The Math.random() method produces a double value in the range 0.00 through 0.9999999... Adding 1 and multiplying by 10 creates a range of 10.00 to 19.99999, therefore 20.00 is not a possible value.
7. B 100 * 0.165 = 16.5
8. A 45 % 4 results in the value 1, which outputs "steven", and since there are no breaks, all of the rest of the outputs occur, including the default.
9. A The substring(3) method in this loop repeatedly shortens the string from the front, three letters at a time, until the length of the remaining string is 10 or less, which leaves the string "oconiosis". By the way, this word is the longest one in the English language, according to Google, and refers to a type of lung disease contracted from inhaling fine silica particles from the ash of a volcanic eruption.
10. C In a for each loop, any change to the utility variable, d in this case, is only temporary and does not alter the actual values in the source array, therefore each value is output, then doubled and output, but the last output loop shows the original values of the array.
11. E Indeed all of the code segments shown will properly input and output the data in the file.
12. D The output including the four resulting strings is:

```
1 3 2 nt
2 9 7 tidises
4 27 23 disestablishmentarianis
8 81 20 stablishmentarianism
```

13. E First in order are the prefix operators (II - line 2 on the precedence chart), followed by the additive operators (III – line 4 in the chart), then the bitwise XOR operator (I – line 9).
14. B The storage precision limit for a double value in effective decimal places is 15, while the float is only 7 places. The other two values represent the storage precision limit in number of bits, 23 for float, and 52 for double.
15. D The retainAll method keeps only the elements of list1 that are also contained in list2, essentially producing the intersection of these two lists.
16. B

A	B	C	A * B	$\overline{A * B}$	$\overline{A * B} + C$	$\overline{\overline{A * B} + C}$
0	0	0	0	1	1	0
0	0	1	0	1	1	0
0	1	0	0	1	1	0
0	1	1	0	1	1	0
1	0	0	0	1	1	0
1	0	1	0	1	1	0
1	1	0	1	0	0	1
1	1	1	1	0	1	0

17. B This one is tricky. The order of operations here is: ++i1, which makes its value 2, then times 2, which makes 4, then i3 is added, making 7, then decremented, making its new value 2, and i1 (value 2) is subtracted, making the expression value 5 so far, which is finally subtracted from i4, assigning the value of -1 to answer.
18. A In this 3D char matrix, the string formed is from the 1st letter of the first word of the first row ('b'), then the 2nd letter of the 2nd word on the first row ('o'), then the 3rd letter of the 3rd word on the 2nd row ('i'), and finally the 4th letter of the 4th word of the 2nd row ('t'), which spells "boit"
19. A To convert back from two's complement, use the same process as described to find the positive value, then just make it negative. 10101111 converts back to 01010001, which is the value 81, hence -81.
20. B The sine of a 30 degree angle is 0.5 (opposite over hypotenuse)
21. B This is the classic selection sort using a nested loop process to systematically and methodically **select** the "best" position for each element of the list. See the UIL canonical list of searches and sorts for a more detailed description of this sort. Since the outside loop contains (N-1) interations, there are N-1 output lines. In this list, there are 10 elements, therefore there are 9 output lines inside the sort routine.
22. C Since the first five elements have been moved into proper order from the original list, this is the output after the fifth iteration.
23. C With 10 elements in the list, there are (N-1) initializations of the ***best*** variable, N(N-1)/2 comparisons by the ***if*** statement, and (N-1) calls to the ***swap*** method, costing 3 steps each, which would be 9 + 45 + 27, or 81 steps in all.
24. D With 5 elements in the list, there are (N-1) initializations of the ***best*** variable, N(N-1)/2 comparisons by the ***if*** statement, and (N-1) calls to the ***swap*** method, costing 3 steps each, which would be 4 + 10 + 12, or 26 steps in all.
25. B Since this is a very stable nested loop process, the order of magnitude is O(N^2) for best, worst, and average, an equally bad sort in all cases.
26. B Reversing the direction of the comparison operator simply reverses the order of the sort, which in this case would be descending.
27. B A precondition of this binary search algorithm is that the list is in ascending sorted order.
28. A The element -3 will be in position 1 after the list is sorted.
29. E Since -4 is not in the list, this binary search algorithm returns the value -1 simply indicating that fact, unlike other versions that may report some value based on the expected position of the element.
30. D The binary search process is a "divide-and-conquer" process, and therefore has a O(log N) least restrictive running time.
31. D The ternary operator is just like an **if else** statement. This one is a nested ternary statement, checking for divisibility by 6, and there are 3 values here divisible by 6: 18, 72, and 24.
32. A 107 base 8 is equivalent to 71, base 10. The 1 is worth 64 and the 7 is 7, which add to 71.
33. C A queue is just a line, often referred to as First In First Out, or FIFO, such as a cafeteria line where no one cuts. LIFO is Last In First Out, and is associated with a stack.

© A+ Computer Science – www.apluscompsci.com

34. D This operation is the equivalent of multiplying 15 by 2^4 (16), which equals 240.

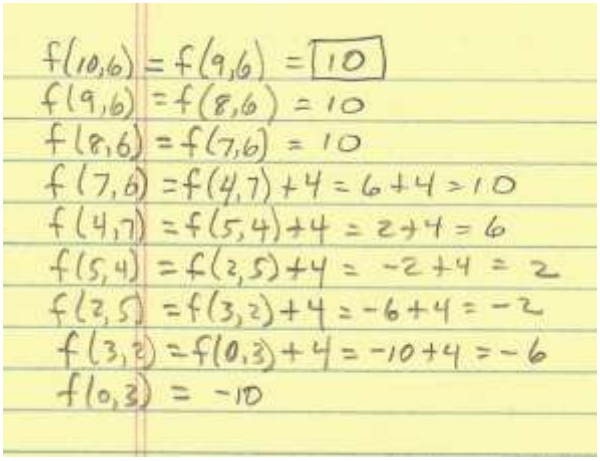
35. D In an adjacency matrix, a 1 means there is a directed edge from one vertex to another, and a 0 means there is not. From vertex A, there is only one directed edge (to vertex B). From B there are directed edges to all three, and from C, only to vertex A. This represented by the matrix:

```
ABC
A010
B111
C100
```

36. C With all operands staying put, from left to right, the * moves directly behind the 7 and 6, then a minus behind the 4 subtracting it from result of 7*6. The / follows 6 and 2 with a + adding the result of 7*6-4 and 6/2, and finally - at the end subtracting 9 from everything before it.

37. A In this sequence, since mappings must be unique (like a function), several duplicate mappings replace previous ones. The remaining keys are 2, 3, 5, 6 and 7, mapped to 5, 4, 2, 5,and 4 (entries can be duplicated). Removing a key that does not exist, like the statement to remove the 6 mapping, simply returns a null, and does not cause an error.

38. C



39. **ABC**

Explanation

$\overline{\overline{AB} + \overline{C(A + \overline{B} + \overline{C})}}$ - this original expression simplifies to

$AB(C(A + \overline{B} + \overline{C})$ - using DeMorgan's Law to break the NOT over the first OR, and using the Double Negative Law to remove all three "wings that fly away" (double NOT bars).

Then the Distributive Law with C, after which $C\overline{C}$ disappears, resulting in:

$AB(AC + \overline{B}C)$ - and then distribute the AB which results in a final answer of

ABC ($ABAC$ simplifies to ABC and $AB\overline{B}C$ disappears)

40. Resulting Binary Tree

```
      L
     / \
    P   S
   /   / \
  A   U   C
```

© A+ Computer Science – www.apluscompsci.com