Computer Science Answer Key
UIL Invitational A 2015

1) C

2) C

3) D

4) C

5) B

6) B

7) A

8) D

9) D

10) E

11) B

12) C

13) A

14) C

15) A

16) B

17) D

18) D

19) E

20) C

21) C

22) C

23) C

24) A

25) E

26) A

27) D

28) B

29) B

30) E

31) B

32) B

33) A

34) C

35) A

36) C

37) B

38) A

39) 6

40) $B(\overline{A \oplus C})$

Note: Since AND and XOR have the commutative property, any answer that is a correctly commuted version of this answer is correct.

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. C 88_{16} - 206_8 = 136_{10} - 134_{10} = 2_{10} = 2_8 = 2_{16} = 10_2
2. C 23 / 10 % 3 - 4 = 2 % 3 - 4 = 2 - 4 = -2
3. D The 5 designates the total field width, including the decimal places and the period, and the 2 shows the number decimal places to show. That leaves only two places for the whole number portion.
4. C The "[IE]+" pattern finds "E", "I", and any multiple sequence containing "E" or "I" and replaces it with a single "O".
5. B Since p is true and q is false, p OR q is true, which makes the NOT of P and Q false.
6. B The square root of 100 (100 to the power of 1/2) is 10.0
7. A 42 - 7.6 = 34.4, which truncates to 34 in the autocast provided by -=
8. D The value of 25 % -6 is 1, not -1 as you might think, therefore the output is 1.
9. D The trace values of x and y are 100 and 0, 33 and 2, 11 and 4, 3 and 6, and finally 0 and 8, with an output of 8.
10. E The value in position 4 is -3, which when used as an index value causes an ArrayIndexOutOfBoundsException runtime error since there is no position -3 in the array.
11. B Since nextDouble() retrieves a double value, which can only be assigned to a double variable, the only choice that will work is `double d = f.nextDouble();`
12. C The sequence for a and b is: 0 1, 2 2, 6 4, 14 8, 30 16, 62 32, 126 64
13. A The **< > <= >= instanceof** operators are on line 6 of the chart, followed by **`&`** on line 8, and **`&&`** on line 11.
14. C The long(V) and double(II) data types both use 64 bits, float(III) and int(IV) both 32, and char(I) 16 bits of storage.
15. A The toArray method creates new memory for the ***`list`*** array since the original capacity of ***`list`*** is too small, therefore this method works just fine.
16. B This is the merge sort, which sorts a list of numbers in ascending order. The output is simply the choice that shows all of the numbers in order from least to greatest.
17. D The comparison operator in `<statement 4>` needs to be reversed to be `<if (list[i] > list[j])>` in order to sort the list in descending order.
18. D `<doc 7>` should `be` **`clean up remaining first half elements, if any`**
19. E The running time for a merge sort in any case is O(N log N).
20. C To convert back from two's complement, use the same process as described to find the positive value, then just make it negative. 10010101 converts back to 01101011, which is the value 107, hence the original bit string is -107.
21. C 31 - 19.5 + 48 is equal to 59.5.
22. C
23. C
24. A
25. E With inheritance, early (static) binding occurs at compile time, while late (dynamic) binding occurs at run time. If at compile time the compiler can make a decision about what to use, it will, which is called **early binding**. The method call in statement 1 uses the power field of the super class (Vehicle), an example of this. Statement 2 is an example of **downcasting**, which forces the compiler to use the subclass instance field. If it is not possible for the compiler to decide due to ambiguity at compile time, **late binding** occurs, as in statement 3, where the view() method called is the one that belongs to the subclass (Car) class.
26. A The split pattern "`[B-E R-W]+`" means split on one or more (+) of any capital letters between B and E, R and W, or the space character.
27. D Since the values of '0' through '4' are 48, 49, 50, 51, and 52, the characters are output only when these values are divisible by the values 1 through 5. They are all divisible by 1, hence "01234". Only 48, 50, and 52 are divisible by 2, producing "024", and so on.
28. B This simple example of a linked list creates three nodes with instance field values of 0, 3, and 5, linking them together in reverse order. The while loop traverses the list and outputs each value.
29. B There are four rows, three columns in row 3, and the value in row 2, column 2 is 4.0 (zero indexing makes the first row and first column at position [0][0])
30. E A division by zero error occurs in the first method call when x, y, and z start at 8, 2, and -1, become 3, 2, -1 in the first assignment statement, and then 3, 0, -1 in the second statement, causing a run time error in the third assignment statement of the method.
31. B The sequences of values for each method call are:

```
5 2 -1, 1 2 -1, 1 -1 -1, 1 -1 -2 = -3
8 5 3, 4 5 3, 4 3 3, 4 3 4 = 5
9 3 -1, 2 3 -1, 2 -1 -1, 2 -1 -3 = -5
```

32. B The stack contents sequence is as follows, with the end of the list being the top of the stack: [9], [9, 3], [9, 3, 5], [9, 3], [9, 3, 4], [9, 3], [9], [9, 7]. The last value popped was 3, and 7 is at the top of the stack.
33. A

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

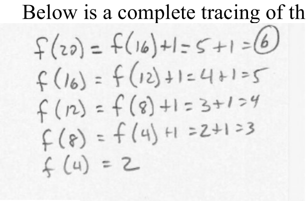
34. C The first rule is that the operands stay in the same order, 3 9 6 5 2. Then insert the operators as shown. The * is immediately after the 3 and 9, so it goes between them, likewise with the ^ between the 5 and 2. The - is after the 3*9 and 6, so it goes between them, and finally the + goes between the 3*9-6 and 5^2 to complete the expression.
35. A The value 100 right shifted 7 times equals zero. This is the equivalent of 100 /2/2/2/2/2/2/2, which in sequence equals 50, 25, 12, 6, 3, 1, and finally 0. The toBinaryString method only shows significant digits, therefore leading zeroes are not shown.

36. C The function of the pattern for the number of edges for any complete graph is N(N-1)/2, so for three nodes, 3*2/2 = 3, four nodes is 4*3/2=6, five nodes 5*4/2=10, and six nodes 6*5/2=15.

37. B In a Priority Queue, the elements are stored in a min heap, as is shown in the first output. When an element is added, it "finds" itself in the natural order of the list, again within the structure of the min heap. order for that data type.

38. A The signals A and NOT B go into a NXOR gate, which feeds into an AND gate, which also receives the NOT OR signal from C and D.

39. 6 Below is a complete tracing of this recursive function call shown above.



$f(20) = f(16)+1 = 5+1 = \textcircled{6}$

$f(16) = f(12)+1 = 4+1 = 5$

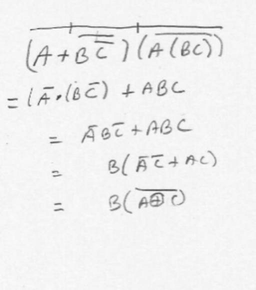
$f(12) = f(8)+1 = 3+1 = 4$

$f(8) = f(4)+1 = 2+1 = 3$

$f(4) = 2$

40. $B(\overline{A \oplus C})$

Explanation: In the diagram below, DeMorgan's law is used to break the NOT over the OR and the AND, resulting in two sets of double NOTs "flying away". In the resulting expression, B is factored out, leaving the simplification of NXOR, which when returned to NXOR results in the final simplified expression, which has two gates, AND, XOR, and one NOT over the XOR.



$\overline{(A+\overline{B\overline{C}})(\overline{A(BC)})}$

$= (\bar{A}\cdot(B\bar{C}) + ABC$

$= \bar{A}B\bar{C} + ABC$

$= B(\bar{A}\bar{C} + AC)$

$= B(\overline{A \oplus C})$