Computer Science Answer Key
UIL State 2014

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

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. $527_8 + 910_{10} = 1253_{10} = 2345_8 = 4E5_{16} = 10011100101_2$
2. 23 / 4 + 9.4 % 3 = 5 + 0.4 = 5.4
3. The %s format specifier of the printf statement accepts the string representation of any data element, and any extra parameters, such as the "true" string in this statement, are ignored.
4. The contains method of the String class returns true if there is an exact match of the given parameter somewhere in the string. "tor" does not match due to the uppercase "T", but "tug" does.
5. This expression, NOT(P XOR Q), simplifies to be P equals Q, which means that for the expression to evaluate to true, P and Q must be the same value, either both false or both true.
6. The square root of 225 is 15, and since the Math.sqrt method returns a double, and the %.1f format specifier is used, the output is 15.0.
7. A compound expression evaluates from right to left, therefore x changes from 15 to 2 (15 % 3.14 = 2.44, which is autocast to 2), y gets the ASCII value of 'X' (88), which is then subtracted by 2, resulting in 86. The value of z does not change.
8. The String produced by `"xoxoxo".substring(2)` is `"xoxo"`, which matches the first case in the switch, resulting in a value of 4 for sum.
9. The only input values that produce the value 10 are "xox" and 2, resulting in the String "x", which matches the fourth case, adds 1 to sum, then drops down to the next case and multiplies sum by 10, resulting in an output value of 10.
10. This is essentially the calculation of the log, base 10, of 10,000,000, which is 7. This means that 10,000,000 is equal to 1 X 10^7.
11. The sequence of calculations is as follows:
    - list[1] (currently 2.2) is assigned the value 3.3*2, which is 6.6
    - list[2] (currently 3.3) is assigned the value 6.6*3, which is 19.8
12. The input sequence is as follows:
    - `nextInt` grabs the 3
    - `nextLine` gobbles up the whitespace after the 3
    - `nextLine` takes the String, `"The Cosmos is all that is"`
    - `next` gets the String, `"or"`, the last output
13. Since `Math.toRadians(360)` produces the value 2PI, it will take the variable x three additions of PI to exceed that value, therefore the value of y after the loop is 3.
14. Even though this expression is using the `&&` logic operator and the `|` bitwise operator (which really evaluates first in the Java order of precedence), the result is the same…true. False OR True is True, and then True AND True is True.
15. The double data type uses 64 bits of storage.
16. After all of the elements are added, "Dick" is in position 1. Once the list is sorted, "Harry" is in position 2, and after the list is reversed, "Harry" is in position 3.
17. Omitted
18. The output of 1100 should be 1101, which shows that when P = true, Q = true, and R = false, (P OR Q) AND (P AND NOT R) evaluates to `(true OR true)AND(true AND NOT false)`, which simplifies to `true AND (true AND true)` which further simplifies to `true`, not `false` as 1100 shows.
19. With the values 2014 (year of this test), 2000 (pounds in one ton), and 9(square feet in one square yard), the expression is 2014%2000*9, which evaluates to 14*9, or 126. Mod has the same level of precedence as times, therefore it occurs first and is evaluated first.
20. Since division has a higher precedence than shift operations, 4/10 evaluates to 0, which causes y to have a net left shift of 1, which means 2014 is multiplied by 2^1, resulting in 4028. The most likely error of 1611 would be the result if the shift operations went first (net left shift 8), with the shift result of 16112 integer divided by 10 to make 1611.
21. This method calculates a person's paycheck, with double overtime for any hours over 48, time-and-a-half for hours over 40 up to 48, and regular pay for 40 hours or less. For 50 hours at $10 an hour, the pay is calculated at 2 hours at double time (2*2*10), plus 8 hours at time-and-a-half (8*1.5*10), plus 40 hours at regular pay (40*10), for a total paycheck of $560.00.
22. After the initial " " split into the array of Strings, the for loop takes the first and last character of each word and builds a new String. `"I want to win state!"` produces `"IIwttowns!"`. The "I" counts twice since it is both the first letter and last letter of that word.
23. The first match `(".*\\d\\w.+")` looks for zero or more characters + a single digit + single word character + one or more of any character, which is `true` since the ".*" can be ignored, the "1" matches the single digit, the "a" matches the single word character, and the rest of the string matches the ".+". The next match `(".\\D\\S.*")` means a single character + single non-digit + single non-space + zero or more characters, also `true`. The third match (`"[abc]+"`) checks for one or more characters from the `[abc]` set, and nothing more. This match is false since the first character is NOT from the `[abc]` set.
24. In computability theory, the **Ackermann function**, named after Wilhelm Ackermann, is one of the simplest and earliest-discovered examples of a total computable function that is not primitive recursive. All primitive recursive functions are total and computable, but the Ackermann function illustrates that not all total computable functions are primitive recursive. See the recursive trace below. As you can see, it doesn't take much for this recursive process to get out of hand. As an example, A(4,1) will most likely cause a stack overflow if you try to run it on a PC, and just forget about even trying to trace it by hand!
25. Same as 24.
26. All of these are classic Object Oriented Programming concepts. Inheritance is represented by the Mork class extending the Ork class. Polymorphism is shown by the fact that the toString method defined in both Ork and Mork classes. This is also referred to as overriding. Overloading is represented by two constructors in either class with different parameter signatures.
27. Since the Comparable is implemented specifically for the Ork class, the parameter must be of type Ork, and not just Object.
28. Since the output of an object is controlled by the toString method, examine the toString method for each class and you will see the result. Also, since the nanu field is present in both classes, the toString method will use the nanu version that belongs to the object, but when outputting the nanu field directly, the one that belongs to the object reference is used. However, in the trey version, a curious thing happens – the compiler uses the value zero instead of the super class nanu value…interesting.
29. In the compareTo method arithmetic, the `one` object evaluates to 0 (1+2-3), and both the `two` and `trey` objects evaluate to 3 (1+2-0). Therefore the `one` object is less than both `two` and `trey` objects, and the `two` and `trey` objects are equal to each other.

30. The maximum value of the 16-bit short data type is 32767, which is 0111111111111111 in binary (0 + 15 1s), and is output without the leading zero.
31. The integer value 1000 takes 9 divisions by 2 to reach a value of 1….500, 250, 125, 62, 31, 15, 7, 3, 1.
32. See the Double class in the Java API for further clarification of the Double.toHexString method.
33. The contents of the list after the three fill statements is [0, 1, 2, 3, 3, 3, 3, 3, 2, 1], with a sum of 21.
34. In this replacement process, any "s" followed by another word character is replaced with "ss".
35. The Bubble and Insertion sorts each have an O(N) time complexity in the best case scenario, which is when the list is already sorted, or very nearly sorted.
36. Eight scenarios are rated at O(N^2) – Quicksort(worst), Bubble and Insertion(average and worst), Selection(all three scenarios)
37. O is 1 step away, N and T 2 steps, E and S 3 steps, and T 4 steps, for a total of 1+2+2+3+3+4 = 15
38. In the STATE tree, only A and T on level 1 have just one child, and in the CONTEST tree, C, N, T, and S have just one child, for a total of 6 nodes with just one child.
39. The remaining values in the first stack after the sequence (top to bottom) are 1 and 4, with 2 and 5 left in the second stack, 2 being the next one to be popped from the second stack.
40. The seven cycles in this directed graph are: GFG, GCG, CGDC, CFGC, CFGDC, ABCGDA, and ABCFGDA