★ANSWER KEY – CONFIDENTIAL★

UIL COMPUTER SCIENCE – 2024-2025 INVITATIONAL A

Questions (+6 points for each correct answer, -2 points for each incorrect answer)

1) E

2) D

3) A

4) C

5) A

6) C

7) A

8) D

9) C

10) A

11) D

12) A

13) A

14) D

15) C

16) A

17) D

18) D

19) C

20) A

21) A

22) B

23) C

24) B

25) C

26) A

27) B

28) A

29) D

30) D

31) E

32) B

33) C

34) C

35) A

36) D

37) C

38) D

*39) -103

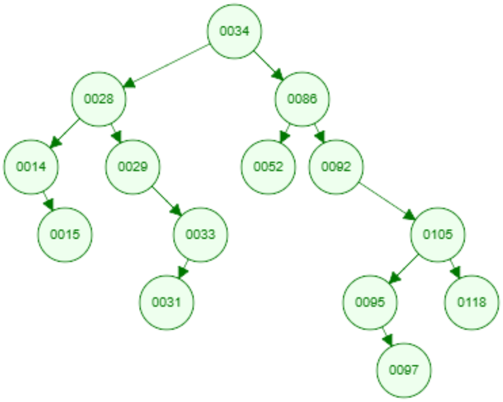
*40) A D F C G A

** See "Explanation" section below for alternate, acceptable answers.*

Note: Correct responses are based on **Java SE Development Kit 22 (JDK 22)** from Sun Microsystems, Inc. All provided code segments are intended to be syntactically correct, unless otherwise stated (e.g., "error" is an answer choice) and any necessary Java SE 22 Standard Packages have been imported. Ignore any typographical errors and assume any undefined variables are defined as used.

Explanations:

1.	E	All of the values are equivalent
2.	D	Simple order of operations problem
3.	A	Printf is formatting output, “`%.3f`” **rounds** the decimal value to 3 places
4.	C	Simple substring problem, substring is inclusive of first value, exclusive of last (if present)
5.	A	Simple Boolean solving
6.	C	`Math.ceil` returns next “whole” number as a double that is above the given value
7.	A	`i++` returns value of `i`, **THEN** increments, so value returned is one less than actual value
8.	D	Simple order of operations problem
9.	C	Simple math problem, tracing the loop
10.	A	Array problem, no tricks really just trace it out
11.	D	`File` class is in the `java.io` package
12.	A	Just trace the loop, you could also estimate and knock out the wrong answers
13.	A	Simple order of precedence
14.	D	Integer = 32 bits
15.	C	add to the end, Arraylists are 0-indexed. Trace it out.
16.	A	char arrays print out like a string, all other array types do not print legibly.
17.	D	In ternary, the char at the second term will be cast to an int if the first term is an int.
18.	A	Arraylist tracing, rotate will rotate the list like a circle.
19.	C	Arraylist tracing, removeIf removes a value if the expression is true for it.
20.	A	Simple bitwise tracing.
21.	A	Simple recursion tracing.
22.	B	Simple recursion tracing. There is a trick for this question, the answer will be equivalent to 2 ^ (n / 5 + 1).
23.	C	Simple recursion tracing. There is a trick for this question, the answer will be equivalent to 2 ^ (n / 5 + 1).
24.	B	`this.i` points to the instance variable, `i` points to the parameter in the constructor.
25.	C	`super(7, s)` is the only one that does not cause an error.
26.	A	For both of these question explanations I will refer to `i` as the value of each class instance. Both instances of the `B` class will be initialized with value `7`, and their `add` methods will add `3` every time they are called, giving both `b` and `c` a value of `10` (2 are added in the `add` method of class `B`, one is added in the `super` call to the `add` method of class `A`). The `A a` will have value `3`, and will add one when the `add` method is called, giving `a` a value of `4`. `c` is actually an instance of class `B`, because the `B` constructor is called when it is initialized.
27.	B	Since `c` is an instance of class `B`, and has a value of `10` after the code for question 26 (see the explanation for question 26). The `add` method is called twice so the value will be `16` after the code has executed. The `toString` method will return “`c 16`”, as “`c`” is the string `s` and the value is `16`.
28.	A	The value `true` is returned because the pattern described by `s2` is matched by the string `s1`. The pattern described by `s2` is as follows: the character `H`, followed by 3-5 characters (`.` means any character, do not need to be any specific character), followed by a non-whitespace character (`\\S`), followed by 3-6 characters (`.` means any character, do not need to be any specific character). `{a,b}` after a character means a match will be between `a` and `b` occurrences of that character.
29.	D	The methods `push` and `add` both will work to add a value to a stack.
30.	D	Stack tracing, First in First out.

31.	E	A copy of the binary search tree has been provided below:  Internal nodes are those nodes that have 1 or more children. There are a total of 9 nodes that have 1 or more child (nodes 34, 28, 14, 29, 33, 86, 92, 105, and 95).
32.	B	Leaf nodes are those nodes that have no children of their own. There are a total of 5 nodes that have no children of their own (nodes 15, 31, 52, 97, and 118).
33.	C	The diameter of a tree is the greatest number of edges between any two nodes within the tree. In the case of this tree, those nodes are 31 and 97, which have 9 edges between them.
34.	C	The worst-case scenario for an Unbalanced Binary Search Tree is that the nodes are inserted in sorted order. This effectively creates a Linked List, which has a linear time complexity for search operations.
35.	A	The key word `extends` is the only one among the ones listed which allows to specify which interfaces or classes the generic types must implement or inherit. This is commonly confused with the `implements` key word, which is used when declaring a class or interface that should express the behaviors of another interface. The `requires` key word, while a valid key word in the Java library, denotes a required library within a module, and thus is irrelevant to this question.
36.	D	Since there are no local versions of the variable `head`, either option A or option B will reference the global `head` variable and perform the function as intended. Option C will break since the return type of the function is of type `T` and not of provided type `Node`.
37.	C	This is a `Stack` since it denotes the methods `peek()`, `pop()`, and `push()` and has the FIFO (First-in-First-out) property with regards to how elements are handled. While the FIFO property *can* also be obtained using a `Deque`, for this to be a `Deque`, we would need to have separate methods for peeking, pushing, and popping elements from both sides of the `Queue`, which is not present in the provided implementation.
38.	D	`Integer`, `String`, and `BigInteger` all implement the `Comparable` interface. While `double[]` *can* actually be stored in a normal `Stack`, since `double[]` does not implement the `Comparable` interface, it cannot be stored in *this* implementation of a `Stack`.

39.	-103	The following is the process of evaluating the postfix expression (elements shown in parenthesis are the value pushed to the operand stack after performing the next operation):
		`252 42 36 - 2 ^ / -2 -34 89 + * +`
		`252 (6) 2 ^ / -2 -34 89 + * +`
		`252 (36) / -2 -34 89 + * +`
		`(7) -2 -34 89 + * +`
		`7 -2 (55) * +`
		`7 (-110) +`
		`(-103)`

40.	A D F C G A *or* ADFCGA	A simple cycle is a cycle in a graph with no repeated vertices (except the first to denote this as being a cycle and not a non-cyclic path) Note that to make a cycle as lexicographically small as possible, simply choose the node within the cycle with the lexicographically smallest label as the start of the cycle, and among its two (or more) neighbors, select the one that is lexicographically smallest. This ensures that the Three major simple cycles exist within the graph: 1. $B \rightarrow J \rightarrow E \rightarrow K \rightarrow B$ 2. $D \rightarrow H \rightarrow M \rightarrow L \rightarrow I \rightarrow D$ 3. $A \rightarrow D \rightarrow F \rightarrow C \rightarrow G \rightarrow A$ Of these, the largest simple cycle that is also the lexicographically smallest option is #3