

WYSE – Academic Challenge
Computer Science Test (Sectionals) – 2015
Solution Set

1. Correct Answer: A

SOLUTION:

The log of a number is slower growing than the number itself. The squared, exponential and factorial of a number all grow faster than the number itself. The growth rates given in the answer may be shown using derivatives or proof by induction. As n gets larger (greater than 4) all of the last three function values are all greater than n itself.

2. Correct Answer: C

SOLUTION:

When traversing a tree in preorder, a node is visited before its left and right subtrees have been visited. Given that definition, it can be seen that 14 would be the first node visited, then 12, 10, and 8. This would complete the left subtree of 14 and now the right subtree of 14 would need to be visited. Node 7 would be visited first, then node 6. This would complete the right subtree of 14 and the preorder traversal of the tree.

3. Correct Answer: A

SOLUTION:

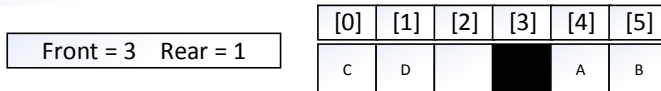
The traditional form used to write expressions is infix. In order for compilers to properly accept and evaluate expressions, these infix expressions are generally reworked into postfix notation, where the operator for an expression occurs after its operands. Note, that the precedence of the operators is the same in infix and postfix notations. For example $2 + 3$ would be written as $2\ 3\ +$, and $2 + 3 * 4$ would be written as $2\ 3\ 4\ * \ +$.

4. Correct Answer: B

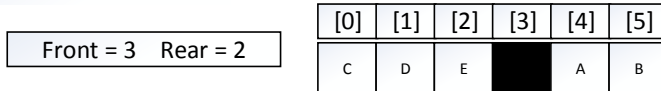
SOLUTION:

In an array implementation of a circular queue, there is always one empty cell. This empty cell is always pointed to by Front and, if the queue is empty, will be pointed to by Rear. If an enqueue is attempted when the array is full, the size of the array is doubled and any cells that were in the far right-hand positions of the original queue are moved to the far right-hand positions of the new queue. Below is a representation of the queue at the start and after each operation.

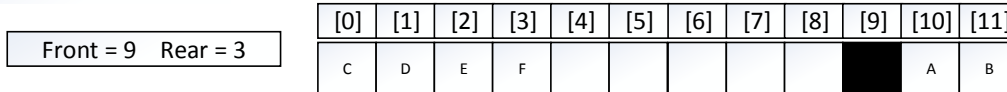
Queue at start



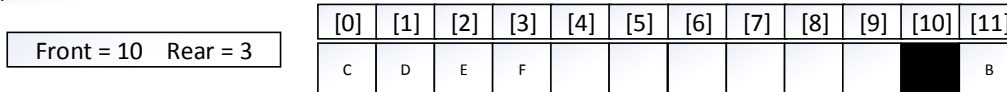
enqueue E



enqueue F



dequeue



5. Correct Answer: A

SOLUTION:

A is equal to 10 decimal. So in decimal, the answer would be $10 \times 16 + 7$ or 167. However when converting hexadecimal to binary, since each hex digit can be represented by four bits, each digit can be converted directly.

A = 1010

7 = 0111

Hence the answer 10100111.

6. Correct Answer: C

SOLUTION:

The expression is a direct application of DeMorgan's Law, distributing an inversion through an AND. The other form of DeMorgan's Law is below.

$(A \text{ OR } B)' = A' \text{ AND } B'$

7. Correct Answer: C

SOLUTION:

The bias of an 8 bit number would be $2^{(8-1)} - 1$ or 127. The original number is in decimal is given below.

$$\begin{aligned} 10110110 &= 1 \times 2^7 + 0 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 \\ &= 128 + 32 + 16 + 4 + 2 \\ &= 182 \end{aligned}$$

Then subtracting the bias yields the final answer. $182 - 127 = 55$.

8. Correct Answer: A

SOLUTION:

$(AB') \text{ xor } (BC) = (\text{True and !False}) \text{ xor } (\text{False and C})$

= True xor False

= True

9. Correct Answer: D

SOLUTION:

The flow chart starts with the total at 0 and adds all the even numbers that are less than n. If x started at 1, it would add all odd numbers. Changing the < to <= would add all odd or even less than equal to n. And incrementing x by 1 instead of 2 would add all numbers instead of just the odds or evens.

10. Correct Answer: E

SOLUTION:

Tape drives, CD and hard drives all have mechanical components that need to physically move in order to read data. Tape moves slower than the hard drives spin. The fastest CD drives can approach the speeds of hard drives.

Of the strictly electronic storage methods: cache, RAM and registers, registers are part of the CPU and are accessed the quickest. Cache memory is static memory that is often placed on or very close to the CPU socket and therefore faster than RAM. RAM is dynamic memory which must be refreshed or it will lose its value and is placed the furthest from the CPU socket making it slower than both registers and cache.

11. Correct Answer: B

SOLUTION:

The time for a bit to travel over the network refers to the latency of the network. The rate at which data is sent is the bandwidth. If connections are far apart, they will have higher latency than connections that are close together, however both may still have the same bandwidth or data rate regardless of how far apart or how many intermediate connections (or hops) are between the nodes.

12. Correct Answer: E

SOLUTION:

Hypertext Transfer Protocol (HTTP) is used to describe how the server and browser transfer web pages.

Hypertext Markup Language (HTML) describes how the web pages are displayed in the browser.

13. Correct Answer: D

SOLUTION:

As the item `x` is private, it is not legal to access it directly outside of the class. `p.getName()` will function, even though the string returned by the method is discarded by the calling code.

14. Correct Answer: B

SOLUTION:

The object `p` was called with the default constructor and as a result obtained the default values of 1 and 1 since none were passed in.

15. Correct Answer: D

SOLUTION:

The point constructor is called once for object `p` and 10 times for the list of points. However the pointer to point is not technically an object, so no constructor is called when `pPtr` is created.

16. Correct Answer: C

SOLUTION:

Templates allow for what is known as generic programming. You can define the behavior of a class without regards to the datatype that the class will work with. As long as any operators used within the template function are defined for the class, the programmer is free to focus on the algorithm being implemented.

17. Correct Answer: A

SOLUTION:

The variable `j` is declared as a reference to `i`. Therefore, it is the same type as `i`.

A reference is an alias for another variable. The reference can be used in place of the variable. Unlike a pointer, the referenced variable must be declared before the reference and the reference cannot be changed to point to another variable.

18. Correct Answer: B

SOLUTION:

The variable `pi` is declared as a pointer to an int.

A pointer is a variable that stores the memory address of another variable of a particular type.

19. Correct Answer: E

SOLUTION:

The ampersand (&) is the address-of or reference operator.

The percent sign (%) is the modulus operator.

The equal sign (=) is the assignment operator.

The back slash is used for division and for escaping characters.

The asterisk (*) is the unary indirection operator. It is also called the de-referencing operator. The asterisk is used for both multiplication and for declaring a pointer. This is example of polymorphism and the compiler determines the meaning of the operator by the context of its use.

20. Correct Answer: A

SOLUTION:

The following trace illustrates the answer.

i	j	list[0]	list[1]	list[2]	list[3]	list[4]	
?	2	?	?	?	?	?	
0	2	?	?	?	?	?	Initialize the i to start the for
0	3	?	?	?	?	?	Pre-increment for j
0	3	0	?	?	?	?	Set the value for list[i]
1	3	0	?	?	?	?	Increment step on for
1	4	0	?	?	?	?	
1	4	0	6	?	?	?	
2	4	0	6	?	?	?	Increment step on for
2	5	0	6	?	?	?	
2	5	0	6	15	?	?	
3	5	0	6	15	?	?	Increment step on for
3	6	0	6	15	?	?	
3	6	0	6	15	27	?	
4	6	0	6	15	27	?	Increment step on for
4	7	0	6	15	27	?	
4	7	0	6	15	27	42	
5	7	0	6	15	27	42	Increment step on for and for terminates

Note that even though 1.5, a float, is used in the determination of each list item, it causes no problems and in these cases, the answer is not even truncated.

21. Correct Answer: C

SOLUTION:

See last line of previous solution.

22. Correct Answer: E

SOLUTION:

A function prototype provides the basic information that the compiler needs to check that a function is used properly. As `main()` is declared before `func1()` and `main()` makes a call to `func1()`, a function prototype for `func1()` must come before `main` so the compiler can ensure that the call in `main()` is formatted correctly.

23. Correct Answer: E

SOLUTION:

There are 11 calls to `func1()`. The first call is from line 5 and the other 10 are from within the for loop. The variable that is output is declared on line 12 and is a static variable. Static variables are initialized on the first call to the function where the variable is declared. A static variable exists for the duration of the

program and the value the variable had when the function exited is the value the variable will have on a subsequent call to the function. The post-increment operator is used on line 13 to increment numb after it has been output. On the 11th call to the function, the value 10 will be output and numb will then be incremented to 11.

24. Correct Answer: D

SOLUTION:

See preceding solution.

25. Correct Answer: C

SOLUTION:

Normal integer division will occur and 3 will be output.

26. Correct Answer: B

SOLUTION:

Normal integer division will occur and the answer will be rounded down to 2, which will be output.

27. Correct Answer: D

SOLUTION:

If the divisor is zero, an exception will be generated on line 9. This exception will terminate the processing in the try block and control will be transferred to the control block where "wrong" will be output.

28. Correct Answer: B

SOLUTION:

The percent sign (%) is the modulus operator. This operator will return the remainder from integer division. In this case, 12 divided by 5 has a remainder of 2, which is returned by the modulus operator.

29. Correct Answer: A

SOLUTION:

Exceptions provide a way to react to circumstances like runtime errors within a programs. When an exception is thrown, control is transferred to special function called handlers. In order to catch exceptions, the portion of code where the exception might occur is placed within a try block. If an exception occurs (is thrown) within the try block, control is then transferred to the catch block (the handler). If no exception is thrown, the catch block(s) are ignored and control transfers to the next statement following the catch block.

30. Correct Answer: D

SOLUTION:

The += is an algebraic assignment operator not a comparison operator. != is true if the operands are not equal, < is true if the first is less, and >= is true if the first is greater or equal.