WYSE – Academic Challenge
Computer Science Test (Sectional) – 2014
Solution Set

1. Correct Answer: E
SOLUTION:
Open source refers to the practice of allowing anyone wishing to view the code of a program to view it for free. Because there is no monetary cost involved in obtaining the code, others are much more likely to study the code, debug the code, and otherwise improve the code for others. Some of the most popular software packages used today are distributed using the open source model. These would include Open Office, Linux, the Apache web server, and the MySQL database.

2. Correct Answer: C
SOLUTION:
An optical disc is changed by a laser, with bumps and flat areas representing 0s and 1s. An optical disc is not magnetic, nor does it have an acoustic quality for storing data. An optical disc does use tracks and sectors to store data, but these tracks and sectors store a considerable amount of data, not just a single bit.

3. Correct Answer: B
SOLUTION:
If storage is volatile, it will lose its contents if it loses power. As soon as the computer is turned off, the contents of RAM are lost. The other types of storage are designed to store data in the absence of power. To store data, a hard disk uses magnetic properties and an optical disk uses changes in its surface. Thumb drives and SD cards are both solid state and use electrical charges in their circuitry to store data.

4. Correct Answer: E
SOLUTION:
WiMax has an operational range of 31 miles.
Satellite communications to a geosynchronous satellite travel approximately 23,000 miles.
Microwave transmissions have traveled up to 92 miles, though the effective range is approximately 35 miles due to the curvature of the earth.
Wi-fi has a range of approximately 65 feet.
Bluetooth only has a range of approximately 33 feet.

5. Correct Answer: A
SOLUTION:
The original expression can be simplified using DeMorgan's Law. An example of which is
!(A && B) == !A || !B
Note that the ! (not) is simply not distributed, but that the && (and) is changed to || (or) as well.

```
!( (x>y) && (y != z) )      ==  !(x>y) || !(y!=z)     DeMorgan's
                            ==  (x<=y) || (y==z)      Apply the negation
```

The truth tables for each could also be constructed to prove this result as well.

6. Correct Answer: B
SOLUTION:
The value of the circuit is (A'B)(A or C)(AB). Since A'B and AB cannot both be true at the same time, the output of the final AND gate will always have at least one input of false, making it false always.

7. Correct Answer: D
SOLUTION:
Encapsulation allows the programmer to protect data elements of the class so that the user cannot modify them with non-standard values. For example, negative widths would not be appropriate for a rectangle. Set and get methods are then used to allow the user of the class to access the data values. The set methods should only allow legal values for the data elements.

8. Correct Answer: E
SOLUTION:
Because the width of b is attempted to be set at -3, setWidth will make it 2. a is instantiated with no parameters, so it will be passed the default values of 1 for both width and length. So the perimeter of b is 2*2 + 2*2 or 8 and the width of a is 1.

9. Correct Answer: A
SOLUTION:
While the first term c[1].getPerimeter() would return a 1, the second, a.width will result in a compiler error because the width is not accessible outside of the class due to its status as a protected element.

10. Correct Answer: A
SOLUTION:
*xx points to a memory location that was set to 55 on line 6. Line 7 sends to contents of that memory location, 55, to standard output.

11. Correct Answer: E
SOLUTION:
If the `new` on line 3 fails to allocate memory for an int, `xx` will be set to NULL. Otherwise, xx will contain a memory address of a location that can contain an int. If the pointer variable is not initialized to another existing variable or pointed to newly allocated memory using the new statement, it can point to any location on the system. If it is used without initialization, it can cause a "segment fault" when the program attempts access the location a segment of memory that the program is prohibited from viewing or editing.

12. Correct Answer: C
SOLUTION:
The purpose of `delete` is to deallocate memory that was previously allocated with the `new` command. In this case, the `delete` statement deallocates the memory location pointed to by `xx` that was allocated on line 3.

13. Correct Answer: D
SOLUTION:
Answer A is an in-order traversal where the nodes are processed on the left, then the current node and then the nodes on the right. Answer B is a pre-order traversal where the node is processed, then the nodes on the left and then the nodes on the right. Answers C and E are level order traversals. Level order traversals process all nodes on a given level before moving to another
level.

14. Correct Answer: E
SOLUTION:
a. A comment is indicated by // or bracketed by /* and */.
b. Nonsensical
c. A parameter that is passed by pointer will use a * instead of the &. These methods are similar in that both will have access to the variable in main(). However, when passed by reference, no de-referencing of a pointer is necessary to access the variable.
d. If a parameter is passed by value, the ampersand would not be present. A copy of the variable will be provided to the function. Any changes to the variable will not be reflected in the variable in main().

15. Correct Answer: A
SOLUTION:
The purpose of myfunc is to return 10 more than the parameter that was passed in. In this case, 3 and 6 were passed to myfunc, in that order. The returned values, 13 and 16, are stored in z, and then output to standard output with the cout statements.

16. Correct Answer: E
SOLUTION:

In main(), x is a constant and its value cannot be modified. The addition of this line of code will cause a compile error and the program will not run.

17. Correct Answer: A
SOLUTION:
The adjacency matrix will have a 1 if there is a connection between the two nodes. Since it is the first row, it is for connections from node A. A has five edges, so there must be five 1's in the row, which eliminates answers B and C. A has no edge to itself, so that eliminates answer E and D. Node A has connections to B, C, D, E and F.

18. Correct Answer: B
SOLUTION:
As both variables are declared as long, this is good programming practice to cast the literals as the same type.
long l = long (0);
long l = (long) 0;
long l = static_cast<long>(0);
All do the same thing. They take the integer 0 and "convert" it to long form before using it, which in this case is to initialize the variable l. Static casting is often used when floating point and integer types are used, for example:
C = static_cast<float>(5)/9 * (F - 32);
Will insure that the operation 5/9 is not performed as an integer division which would always result in zero for this problem otherwise.

19. Correct Answer: C
SOLUTION:
The loop will execute 5 times. The loop control variable, `i`, is initialized to zero and incremented by 1. The loop will continue while `i` is <= 4. Therefore, the loop will execute 5 times (`i`=0,1,2,3,4).

20. Correct Answer: D
SOLUTION:
The loop is executed 5 times. After the first iteration, `j` is added to itself on each subsequent iteration. The following table shows the value of `i` and `j` on each iteration:

Iteration	Value of `i`	Value of `j`
1	0	1
2	1	2
3	2	4
4	3	8
5	4	16

21. Correct Answer: D
SOLUTION:
2's complement numbers are very similar to binary numbers, except the leading digit carries a negative value along with its magnitude. So for an 8 bit number the 8th bit will have a value of -128 or $-2^{(8-1)}$.
01010101 = $\mathbf{0}*-2^7 + \mathbf{1}*2^6 + \mathbf{0}*2^5 + \mathbf{1}*2^4 + \mathbf{0}*2^3 + \mathbf{1}*2^2 + \mathbf{0}*2^1 + \mathbf{1}*2^0$
= 0*-128 + 1* 64 + 0* 32 + 1* 16 + 0* 8 + 1* 4 + 0* 2 + 1* 1
= 64 + 16 + 4 + 1
= 85

22. Correct Answer: A
SOLUTION:
The contents of the stack are given to the right after each command below.

push(A);	A
push(B);	AB
pop();	A
push(C);	AC
push(D);	ACD

push(E);	ACDE
pop();	ACD
push(A);	ACDA
push(G);	ACDAG
pop();	ACDA

23. Correct Answer: D
SOLUTION:
A 16 bit number has 2^{16} different possible values. Since one bit is used for the sign, only 15 bits can be used to represent the number. Since the first number is 0 and not 1, the maximum positive number will be 2^{15} -1. Using one bit for the sign is refered to as signed magnitude notation. 2's complement is also another way to store positive and negative integers, but the 2's complement representation using 16 bits will still have the same maximum value. The signed magnitude notation actually has a negative 0 possible which is not very useful if the sign value is 1 and the rest of the number is 0. 2's complement shifts this extra value to the very bottom of the set of numbers giving it one more negative value than signed magnitude with the same number of bits.

24. Correct Answer: B
SOLUTION:
The following table shows the values of i and j on each iteration. Note that the condition in the if statement on line 6 is actually an assignment, not a comparison. Therefore, the if statement will be true each time, j will be set to 1 on line 6 and then incremented to 2 on line 7. This will occur for each iteration of the loop.

Iteration	Value of `i`	Value of `j`
1	0	2
2	2	2
3	4	2

25. Correct Answer: B
SOLUTION:
See answer 24 above.

26. Correct Answer: D
SOLUTION:
The ASCII codes for lowercase letters are greater than the codes for uppercase letters. The ASCII codes for both lowercase and uppercase letters are in sequential order. The if statement on line 8 checks to see if the user entered an uppercase letter. If so, the difference between a lowercase letter and an uppercase letter is added to the user input, thereby making the letter lowercase.

In this case, an uppercase R was entered. The ASCII value for an uppercase R is 82 and a lowercase r is 114. The values for a lowercase a is 97 and an uppercase A is 65. Therefore:

R + (a – A) = r
82 + (97 – 65) = 114

27. Correct Answer: A
SOLUTION:
b. The logical OR operator is | |
c. There is no double addition operator
d. The logical negation operator (NOT) is !
e. There is no concatenation operator in C++. To achieve concatenation of strings, the insertion operator << is used.

28. Correct Answer: B
SOLUTION:
The function `myfunc` loops through the two-dimensional array `xx`. When an odd number is found (if statement on line 5), `zz` will be incremented. `zz` will be set to 4 as there are 4 odd numbers in the array. `zz` is then passed back to `main`, where the value is output to standard output.

29. Correct Answer: C
SOLUTION:
On line 15, `y` is set to `sizeof x/sizeof x[0]. sizeof x` is the size of the entire two-dimensional array. `sizeof x[0]` is the size of a row in the array. Dividing the size of the array by the size of a row returns the number of rows in the array; in this case, that is 3.

30. Correct Answer: C
SOLUTION:
The try/catch construct is used for exception handling. It provides the programmer a means of "catching" exceptions or possible runtime errors and providing code that can handle each of the exceptions. The programmer using the throw keyword can throw and exception in order to terminate running the code block. The program will then begin executing code in the catch portion that matches the exception thrown. Each try may be followed by multiple catch blocks. A catch block has an argument of (…) is known as the default catch which is executed in the event that the exception thrown does not match any of the other conditions. A default catch is not required.