WYSE – Academic Challenge
Computer Science Test (State) – 2013
Solution Set

1. Correct Answer: E

   2's complement systems are often used in computing because negating a number involves simple operations in the hardware, specifically inverting all of the bits and adding 1 to the resulting number. As a result, the electronics required in the arithmetic logic unit (ALU) needed for subtraction are simplified. Overflow that results from adding two numbers of the same type is easy to detect as the lead bit will change. Overflow never occurs when adding a positive and negative number.

   ```
   10110101 =  -1*2⁷ + 0*2⁶ + 1*2⁵ + 1*2⁴ + 0*2³ + 1*2² +0*2¹ +1*2⁰
            = -128 + 32 + 16 + 4 + 1
            = -75
   ```

2. Correct Answer: C

   With 14 bits, 2^{14} or 16384 different combinations may be represented. With 16384 different combinations, four decimal digits may be represented.

   $$0000 \text{ thru } 9999 < 2^{14} = 16384$$

   In order to represent 5 decimal digits, 17 bits are needed.

   $$00000 \text{ thru } 99999 < 2^{17} = 131072$$

3. Correct Answer: E

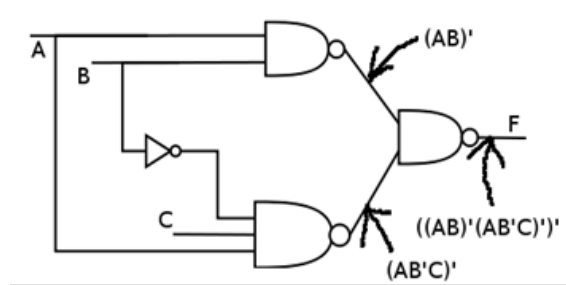   From the circuit, the function is given.
   ((AB)' (AB'C)')'
   This is a direct application of DeMorgan's Law.
   (AB)'' OR (AB'C)''
   Now remove the double negatives.
   AB OR AB'C

4. Correct Answer: E

   Answers a, c, d and e all cover all of the true conditions. However, only e covers them all minimally when using the don't care conditions. The bold conditions are for B. The italicized conditions are for AC'.

	A'B'	A'B	AB	AB'
C'D'	F	**D**	***T***	*T*
C'D	F	**D**	**T**	*T*
CD	F	**T**	**D**	F
CD'	F	**T**	**D**	F

5. Correct Answer: B

   Within a relational database, foreign keys are used to link or relate tables to each other. Primary keys are attributes that are used to uniquely identify records with a table. Foreign keys are these same attributes that are used in other tables, linking the two tables together. For example, a table about a student would most likely have StudentID as a primary key. StudentID will uniquely identify each student. In a table that connects students to a class, StudentID would be used to show which student took a particular class. StudentID would also link the two tables together.

6. Correct Answer: C

When an object is created, its constructor is called automatically. When an object is derived from another class, first the base class constructor is executed followed by the derived class constructor. Since object a is both a Baseball and a Ball, first the Ball constructor is called followed by they Baseball constructor. The Ball constructor is executed for b and then the Ball constructor followed by the Basketball constructor is called for c.

7. Correct Answer: A

Abstraction, inheritance, encapsulation, and polymorphism all form the cornerstone of an object oriented language. A function that can have more than one meaning or execute differently depending upon how it is used is an example of polymorphism. Virtual functions allow the function to be defined in the base class and then have the specific code required for a derived class specifed in the derived class. This allows pointers of the base class to actually point to objects that are in of the derived class and have the more specific virtual function execute for that object.

8. Correct Answer: E

Close examination of the declaration of the Baseball class shows that it inherits the Ball class privately. This means that while Baseball may use the public methods of Ball within the class, no access is allowed to the methods of Ball from any Baseballs. Even though the methods are inherited, they are now considered to be private.

9. Correct Answer: D

No access is allowed directly to the radius of c, so answer a is incorrect. The methods must be accessed for a using the . (dot) operator, so answers b and c are incorrect. No method of accessing the radius of a Baseball exists, but Basketballs publically inherit the public methods of Ball. The bounce method does return the height of the object being bounced, but the value returned is not saved or printed to the screen, it is discarded. While this is legal, it does not produce any result that is saved in any way and would be purely an academic exercise.

10. Correct Answer: D

A depth first search will not backtrack until it reaches a point where adding another node causes a loop. Starting at B, node A or C could be searched, since A is lower alphabetically, it is added first. Now at node A, D or E could be added and since D is lower alphabetically, it is added. From D, B has already been searched, so C is added. At this point, the algorithm must backtrack from C to D and back to A where then E is added.

11. Correct Answer: B

This tree with a root of Q has a depth, or longest path from the root of 3. The tree has 4 leaves, which are nodes with no children. The placement of several nodes prevents this tree from being a binary search tree (M and H for example). A post-order traversal will indeed process node A and then RMHKFZTQ in that order.

12. Correct Answer: A

A pre-order traversal processes the given node then the left subtree and last the right subtree. So Q will be processed, then it would proceed to the left subtree and process F and its subtrees before returning to Q and processing the right subtree of Q.

13. Correct Answer: A

The most common use of JavaScript is to write functions that are included in HTML pages. Among other things, JavaScript is used to load new page content without reloading the page, animate page elements, provide interactive content, and validate form data.
PHP is a server-side scripting language.
C++ is a general-purpose programming language. C++ was not developed as a web technology. While C++ can be used for server-side programming, it is not used for client-side programming.
HTML is a client-side, web technology, but it does not offer the functionality described.

14. Correct Answer: A

Solid state devices have no moving parts. The SD card and flash drive are both common types of solid state secondary storage devices. ROM and RAM are both memory chips. None of these have any internal moving parts. On the other hand, a hard disk does have several moving parts. The hard disk is made up of one or more metal platters that store the data. These platters rotate at very high RPMs. From these platters, the read/write move across the platters.

15. Correct Answer: D

The second and third answers do not work because the pointer/reference must use the arrow → operator to obtain the data elements in the structure. The first answer is not correct because it will miss the very last element in the list. When it is pointing to the last element and curNode->next is NULL the 12 will not have been added to the sum. The last code works properly and is traced below.

```
       curNode              sum              action
contains 7 (head)            0       curNode = head
contains 7 (head)            7       sum += curNode->data;
contains 4                   7       curNode = curNode->next;
contains 4                  11       sum += curNode->data;
contains 12                 11       curNode = curNode->next;
contains 12                 23       sum += curNode->data;
NULL                        23       curNode = curNode->next;
```

16. Correct Answer: C

The first answer does not use the → operator. The second will overwrite the first data element that had a 7 with a 3 without creating a new node. The fourth segment saves the pointer that head is pointing at and creates a new node, putting 3 in the new node. However the last statement points the head to the structure that contains 4 instead of the one that has 7. The item that had 7 is not deleted from memory but can no longer be accessed; this is referred to as a memory leak.

17. Correct Answer: B

The primary purpose of a router is to connect networks and forward data packets between the networks. The router reads the address information from each packet to help determine the packet's destination and to help forward the packet towards that destination.

18. Correct Answer: C

The table below shows the value of i and the corresponding value of tot after an iteration of the for loop. The * in the table indicates when i%3=1 and p1 was called.

	i	tot
	0	0
	2	2
*	4	11
	6	17
	8	25
*	10	40
	12	52

19. Correct Answer: D

Refer to the table above, the * indicates when i%3=1 and p1 was called.

20. Correct Answer: B

The parameter for p1 is defined as int& n1

3

The `&` after the type indicates that the variable is passed by reference. Any change to the parameter within `p1` will change `tot` in the main program. If the parameter were declared without the `&`, the parameter would be passed by value. If the parameter were passed by value, the value of `tot` in `main` would not be altered by `p1`.

21. Correct Answer: E

    Regardless of the value passed to `my_func`, the expression in the switch statement will never evaluate to 4. The switch statement's expression, (`n%4`), can only evaluate to 0, 1, 2, or 3.

22. Correct Answer: A

    When used in a switch statement, break causes the execution to be transferred to the statement following the switch code block. All statements following the selected case will be executed until a break is encountered or the end of the switch code block is reached. Breaks are not mandatory, as can be seen in case 2, so execution of the code continues to the code for case 3.

23. Correct Answer: A

    When 13 is passed to `my_func`, the first case will be executed. The switch condition, (`n%4`),will resolve to 1. When line 5 executes, n will be set to 26 (`n+=n`).

24. Correct Answer: B

    When 2 is passed to `my_func`, the switch condition, (`n%4`), will resolve to 2. Line 7, case 2, will then be selected and line 8 will execute and `n` will be set to 4 (`n*=2`). As there is no break after line 8, line 9 will also execute and `n` will be set to 16 (`n*=n`).

25. Correct Answer: D

    `&&` is the logical AND operator.
    `||` is the logical OR operator.
    `!` is the logical negation operator.
    While there is no logical XOR operator, there is a bitwise XOR operator, `^`.
    There is no logical NOR operator in C++.

26. Correct Answer: D

    In order for the expression on line 3 to evaluate to true and line 4 to execute, both comparisons must evaluate to true. In this case, only a capital letter will be `>=` `'A'` and `<=` `'Z'`.

27. Correct Answer: C

    The conditional operator, `?`, evaluates the expression `(a>b)`. If the expression is true, the value to the left of the : is returned. If the value is false, the value to the right of the : is returned. An equivalent statement to line 1 is:
    ```
    if (a>b)
       c = a;
    else
       c = b;
    ```

28. Correct Answer: E

    `&&` is the logical AND operator.
    Type casting involves converting a copy of the type of data used for assignment to another type before the assignment and usually involves the use of the new type and ().
    `&` is the bitwise AND operator.
    `!=` is the not equal operator.

?: is the conditional operator. ?: is the only ternary operator and it requires three arguments. The first argument is the condition. The next two arguments are the contain code that will be executed based on the results of the condition in the first argument. If the condition is true, the second argument will be executed. If the condition is false, the third argument will be executed.

29. Correct Answer: B

The call to `changearray` modifies `myarray`. The second parameter in `changearray` is used as an index into the array and that array element is set to the third parameter. In the call, 1 is the second parameter and 4 is the third parameter.

30. Correct Answer: D

When an array is passed to a function in C++, the array name is converted to a pointer and a copy of the pointer is passed by value to the function. This implementation was chosen because passing entire arrays, especially if the arrays were large, could be very time consuming.