

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

1. Correct Answer: C

SOLUTION:

Compilers first attempt to parse the syntax of the code to determine if it contains any errors. Division by zero, logic and infinite loops are all classifications of runtime errors that can occur. In fact, some programs such as different types of servers (mail, web, etc.) actually require infinite loops. These types of runtime errors should be avoided through the use of good design and debugging practices.

2. Correct Answer: E

SOLUTION:

iOS is the operating system used by Apple iPhones.

RIM OS is the operating system used by Blackberry phones.

Android is the operating system from Google that is used on a variety of smart phones.

Windows Phone is the mobile operating system from Microsoft.

MVS is an operating system that was used on IBM mainframes.

3. Correct Answer: B

SOLUTION:

- a. Utility programs allow users to complete tasks such as file management, viewing status of system resources, or file editing, but are not critical to the functioning of the system. These programs work closely with the operating system, but need not be directly included in it.
- b. An operating system manages computers resources such as memory, provides a user interface such as a GUI, and schedules application programs for execution by the CPU.
- c. General-purpose applications include word processors, spreadsheets, database management systems, and presentation graphics.
- d. Source code is instructions written for a computer, usually by a computer programmer. The source code is in a human-readable form and written in a specific computer language. Common languages are C++ and Java. Before the source code can be executed by the computer, it normally must be run through a language translator such as a compiler or interpreter.
- e. A storage area networks (SAN) is a dedicated network that provides access to specialized storage devices, such as disk arrays, tape libraries, and optical jukeboxes. A SAN is only accessible to servers and the devices appear like locally attached devices to the operating system. A SAN typically has its own network of storage devices that are generally not accessible through the local area network by other devices.

4. Correct Answer: D

SOLUTION:

Solid state drives do not contain any moving parts, hence the name solid state.

5. Correct Answer: D

SOLUTION:

$$\begin{aligned} 189 &= 1*2^7 + 0*2^6 + 1*2^5 + 1*2^4 + 1*2^3 + 1*2^2 + 0*2^1 + 1*2^0 \\ &= 1*128 + 0*64 + 1*32 + 1*16 + 1*8 + 1*4 + 0*2 + 1*1 \\ &= 128 + 32 + 16 + 8 + 4 + 1 \\ &= 189 \end{aligned}$$

6. Correct Answer: B

SOLUTION:

The hexadecimal digits are in base 16. A is equivalent to decimal 10, B 11, C 12 and D 13. Since D is in the second digit location, it is multiplied by 16 to the first power.

$$\begin{aligned} D9 &= 13 \cdot 16^1 + 9 \cdot 16^0 \\ &= 208 + 9 \\ &= 217 \end{aligned}$$

7. Correct Answer: D

SOLUTION:

Answer provided on exam.

8. Correct Answer: E

SOLUTION:

A	B	C	AB	A'BC	a)	AC	c)	BC	d)
F	F	F	F	F	F	F	F	F	F
F	F	T	F	F	F	F	F	F	F
F	T	F	F	F	F	F	F	F	F
F	T	T	F	T	T	F	T	T	T
T	F	F	F	F	F	F	F	F	F
T	F	T	F	F	F	T	F	F	T
T	T	F	T	F	T	F	T	F	F
T	T	T	T	F	T	T	T	T	T

Note that in the case, the xor and or yield the same output, however this is rarely the case.

9. Correct Answer: A

SOLUTION:

Constructors are called when an object is created and most generally are used to set the initial values of the data within the object. Constructors unlike destructors may accept arguments. Destructors, which are called when an object loses scope, are most useful for cleaning up dynamically allocated memory associated with the given object. In C++, if a destructor is not provided by the programmer, the compiler will provide one to de-allocate the data values within the object.

10. Correct Answer: B

SOLUTION:

The four key principles of OOP are encapsulation, abstraction, inheritance and polymorphism. Encapsulation relates to the data objects being accessed only through get and set accessor methods to prevent users of the class from altering the data in a non-prescribed way. Abstraction involves placing the details of the implementation of the class where the user need not be concerned about them in order to use the class. Inheritance allows the creation of new objects that inherit the properties of another class without having to rebuild the class from scratch. An example would be a student class that inherits a person class. The more general base class can then be used to derive more advanced classes that inherit its properties. Polymorphism allows the creation of functions or objects to be created that can have more than one meaning. Examples of polymorphism include the use of virtual functions, functions with the same name that carry different sets of parameters or operator overloading.

11. Correct Answer: C

SOLUTION:

Overloaded operators allow programmers to implement the behavior of a given operator for a class. Classes created by the programmer will contain data that the compiler could not necessarily anticipate, so in order to have the operator behave properly, the programmer must provide the code. Overloaded operators may return values of the same type as the class, however that is not necessary. An example would include the comparison operators such as  $>$ , which would return a Boolean value. The  $=$  automatically copies the data values for a class and is provided by default by the compiler, however if a class has dynamically allocated elements, the programmer should insure that the  $=$  makes copies of all data and not just a copy of a pointer to the dynamically allocated elements. Both the pre and post increment may be overloaded for a class, just as the pre and post decrement operator may be overloaded. When the post increment operator is overloaded, it carries a "dummy" argument of  $\text{int}$  to differentiate the two.

12. Correct Answer: E

SOLUTION:

This tree has a head or top node of H. It has 4 leaves, or nodes with no children. It is a binary search tree in that higher valued nodes are to the right of each parent node and lower value nodes are to the left. While the tree has 7 edges, its maximum depth is 3 for node L.

13. Correct Answer: B

SOLUTION:

A binary search will examine the middle element and then discard half of the list if the item is not found on that comparison, eliminating half of the list on every comparison. Binary searches are  $O(\log_2(n))$  where in this case since  $\log_2 100$  equals 6.64385, the ceiling of that is 7. So it takes 7 comparisons at most. Follow below to trace the worst case.

# comparisons	max # items left to search
0	100
1	50
2	25
3	12
4	6
5	3
6	1
7	0

14. Correct Answer: D

SOLUTION:

For a Queue and Stack, the order of the elements has to do with when they are added to the structure, not the values themselves. A hash uses an external key to determine the placement of the element, not the element being stored. An array and linked list may be ordered by the element, but do not have to be. A priority queue and binary search tree will use the value of the element to determine placement.

15. Correct Answer: D

SOLUTION:

The  $\text{if}$  statement is used, but it is not an operator. The  $\%$ , or modulus operator is the only operator on the line. The modulus returns the integer remainder after the division of the two integer elements. In this case, as the division is by 2, it will return a 1 or a 0.

16. Correct Answer: C

SOLUTION:

The output is traced below. Note that the loop will execute 10 times, but the `\0` that terminates the character array does not print anything to the screen. The modulus operator will return a 0 when is even and 1 when odd. When it is odd, the output will come from string one and when even from string two.

```
i      i%2  screen output
0      0    E
1      1    EE
2      0    EEJ
3      1    EEJL
4      0    EEJLO
5      1    EEJLO // Space printed, but not visible here
6      0    EEJLO L
7      1    EEJLO LO
8      0    EEJLO LOH
9      1    EEJLO LOH // \0 string terminator does not print to screen
10     // loop terminates
```

17. Correct Answer: E

SOLUTION:

For this code, actually two `i` variables are declared. The second one is the one that is used with the for loop and it loses scope as soon as the for is finished executing. So on line 10, the first `i` that was declared on line 3 is used. As that variable was never assigned a value or initialized, its value cannot be determined. The value will be whatever is stored in the RAM at the time the program is loaded, which can cause the value to change depending upon whatever RAM contained prior.

18. Correct Answer: A

SOLUTION:

Assignment operators assign a value to the left operand. Answer b adds the item on the right to the left and assigns it to the left. Answer c mods the item on the right with the item on the left and assigns it to the left. Answer d just assigns the right to the left item. Answer a though is a comparison operator that compares the right and left item and returns true if they are equal.

19. Correct Answer: A

SOLUTION:

After the `for` loop on lines 3 & 4, the array will contain the following data. As the `for` statement on line 5 stops when `i` is not greater than 0, the first element (element 0) will not be output to the screen.

Array Element	0	1	2	3	4	5	6	7
Value	1	2	3	4	5	6	7	8

20. Correct Answer: C

SOLUTION:

The output would be undefined. The reference to `myarray[8]` would be out-of-bounds of the declared space for the array. The legal subscripts for `myarray` are 0 through 7, as the first array item in C++ is referenced using 0 as the subscript. It would return undefined data, possibly causing the program to crash.

21. Correct Answer: A

SOLUTION:

See table below for the value of k after each loop iteration. When k = 10, the loop is not executed.

Answer	Initial value of k	Value of k after 1 <sup>st</sup> loop iteration	Value of k after 2 <sup>nd</sup> loop iteration	Value of k printed to stdout
a.	9	18		<b>18</b>
b.	4	8	16	<b>16</b>
c.	3	6	12	<b>12</b>
d.	8	16		<b>16</b>
e.	10			<b>10</b>

22. Correct Answer: B

SOLUTION:

- A declaration statement is used to introduce new names into the current scope. These new names could be variable, types, constants, etc.
- A while statement is a repetition, as are for loops.
- A conditional statement test a condition similar to a repetition statement, but a conditional statement only executes once and does not loop.
- An assignment statement is used to assign a value to a variable.

23. Correct Answer: D

SOLUTION:

This code will accept input until the user enters the sentinel value of 99. Within the while loop, the user input is totaled in  $y$  and the count of the number of user inputs is totaled in  $x$ . When the user enters 99, the loop terminates and the average of the user input is then computed and output to stdout. In this case,  $8 + 16 + 66$  is equal to 90. 90 divided by 3 is equal to 30.

24. Correct Answer: A

SOLUTION:

See above. As the user entered 99, no values will be computed and the initial value of  $y$ , 0, will be output to stdout.

25. Correct Answer: B

SOLUTION:

As two integers are being divided, this is called integer division. The results will be an integer. Any remainder is truncated. In this case,  $8 + 11$  is equal to 19. 19 divided by 2 is equal to 9, not 9.5 or 10. The remainder of 1 is dropped.

If one wishes to get the remainder of integer division, the modulus operator (%) would be used. If line 12 was changed to this statement:

$$y = y \% x$$

the value of  $y$  would be 1, the remainder of 19 divided by 2.

26. Correct Answer: E

SOLUTION:

See the walk-through below. Line 9 doesn't really do anything as it assigns the value of `y` to itself.

	Value after statement		
	<code>xx</code>	<code>x</code>	<code>y</code>
Initial values	Undefined	19	21
<code>xx = &amp;x;</code>	Points to x	19	21
<code>x += 3;</code>	Points to x	22	21
<code>y += *xx;</code>	Points to x	22	43
<code>xx = &amp;y;</code>	Points to y	22	43
<code>y = *xx;</code>	Points to y	22	43

27. Correct Answer: C

SOLUTION:

See previous solution.

28. Correct Answer: C

SOLUTION:

`xx` is declared as `int * xx`, which means that `xx`'s type is a pointer to an int.

29. Correct Answer: A

SOLUTION:

After the user input, the array would contain the following values:

Array Element	0	1	2	3	4	5	6	7
Value	1	2	3	4	5	6	7	8

Within the display function, the array elements are output to stdout in the for loop. As can be seen on line 2, the subscript for the array is initialized to 0 and incremented by 2. Therefore, the values contained in array elements 0, 2, 4, & 6 will be output to stdout and the output will be 1357.

30. Correct Answer: E

SOLUTION:

- When a parameter is passed by value, a copy of the parameter is made and changes made to the parameter by the called function do not affect the value of the parameter in the calling function. In this problem, the second parameter, `int size`, is passed by value.
- When a parameter is passed by reference, a copy of the parameter is not made, rather the parameter in the called function points to the same memory location as parameter in the calling function. Passing by reference allows a function to return more than one value. It also can be more efficient when working with large data structures. In C++, arrays are always passed by reference. In this problem, the first parameter, `const int list[]`, is passed by reference. By using `const` with the parameter, it prevents the called function from changing any of the values in the array.
- Global constants are declared and initialized outside of any function. An example would be:  

```
const int MAX_ARRAY_ITEMS = 8;
```

Once declared, constants cannot be changed; the value and type of a constant are static.