WYSE – Academic Challenge
Computer Science Test Solutions (Regional) – 2017

1. Correct Answer: C
SOLUTION:
Items within a class do not require the dot operator to be accessed. Private and protected items are both directly available to friends of a class. Protected items behave similar to private items with the exception that classes derived from the base class may also access them.

2. Correct Answer: A
SOLUTION:
Hiding the data behind set and get methods that prevent inappropriate changes to data is an example of encapsulation. Abstraction involves hiding the details of how the given methods are implemented. Polymorphism allows methods to change functionality as they are used in the program. Inheritance allows a class to be built/constructed using methods from a base class.

3. Correct Answer: B
SOLUTION:
A constructor is only called when an item is instantiated/created, not whenever the programmer wishes to call it. Constructors must be named as the same as the class name and destructors also carry the same name with a preceding ~. Classes may have more than one constructor and the program will decide which to use based upon the parameters it is called with. A constructor is called as soon as an item is created. Since an array has multiple items, the constructor will be called multiple times. When items lose scope, they are destructed, so the destructors are called in the reverse order in which they are created.

4. Correct Answer: C
SOLUTION:
Break the number up into numbers that are powers of two.
$10010010 = 1*2^7 + 0*2^6 + 0*2^5 + 1*2^4 + 0*2^3 + 0*2^2 + 1*2^1 + 0*2^0$
$= 128 + 16 + 2$
$= 146$

5. Correct Answer: B
SOLUTION:
The two parts of the function are given and then the final result in the last column.

A	B	C	AB	B'C	AB + B'C
F	F	F	F	F	F
F	F	T	F	T	T
F	T	F	F	F	F
F	T	T	F	F	F
T	F	F	F	F	F
T	F	T	F	T	T
T	T	F	T	F	T
T	T	T	T	F	T

6. Correct Answer: D
SOLUTION:
The logic gates are as follows in this order: NOT, OR, NAND (not and), XOR (exclusive or), and AND. The NOT is the only one that accepts just one input, the XOR requires two and the rest two or more inputs. The exclusive OR gate is only true when the input values are opposite.

7. Correct Answer: E
SOLUTION:
2's complement numbers can represent positive and negative integer values and unlike signed magnitude, which can have two different values for zero, 2's complement only has one. Also, as inverting a 2's complement number is a fairly easy process, subtraction involves inverting the second value of the subtraction and then using addition. This saves the hardware designers effort as they only need to build an adder for a computer, not both an adder and subtracter. For an 8 bit number, the first bit represents -128 with all of the succeeding bit representing the standard positive values. So 1000000 is the lowest value of -128 and 01111111 is the maximum value of 127.

8. Correct Answer: E
SOLUTION:
Because a linked list uses a pointer that is contained in a given element to find the next element, a series of elements must be accessed to find a given item. The worst case would involve finding the last item in the list which would involve accessing all items in the list. For an array, the programmer can jump directly to the item desired. Since a linked list also includes a pointer in addition to the data element, it will require more memory than an array. However, the linked list can grow and shrink as the program runs, while an array has a fixed size. If the number of items required is not known prior to the program running, the array may have to allocate much more memory than is required for many applications. Both linked lists and arrays may use user defined data types and either may be used to implement a Queue.

9. Correct Answer: C
SOLUTION:
A tree can add elements to many parts of the structure at any given time. The Stack is a last in first out (LIFO) structure. The queue is a first in first out (FIFO) structure. A linked list may be used to implement a stack or queue, but it can add elements at various points of the list at any given time. A hash is a associative array that uses the data itself to calculate the position of the data element in the list, the order in which items are entered and removed is not dependent upon the position in the hash. The placement is determined by order added for just Stacks and Queues and can vary for the other structures.

10. Correct Answer: A
SOLUTION:
Of the three elements in the sum, the third term dominates the expression as n gets large. So as n gets large, it looks like (n^4/n) which simplifies to n cubed.

11. Correct Answer: A
SOLUTION:
B. Icons – An icon is a pictogram displayed on a computer screen in order to help the user navigate a computer system or mobile device.
C. Bookmarks – A bookmark is a link to a website that makes it easy to get back to a favorite website.
D. Plug-ins – A plug-in is a software component that adds a specific feature to an existing computer program.

12. Correct Answer: E
SOLUTION:
A. Passwords should be at least eight characters. The longer the password is, the harder it is to crack.
B. Passwords should not contain any words that can be associated with you. Using words like this will allow hackers to use social engineering techniques to crack your password.
C. Passwords should not be complete words. If complete words are used, hackers can use a dictionary attack to crack your password.
D. If a password for one account is compromised, hackers will attempt to use that password on your other accounts.
E. Using more and varied characters makes a password harder to crack.

13. Correct Answer: C
SOLUTION:
A computer can access one word at a time and there are 8 bits to a byte. Therefore a 32-bit-word computer can access 4 bytes at a time.

14. Correct Answer: C
SOLUTION:
Virtual memory is used in most of today's computers. It allows a computer to execute a program that is larger than the installed primary storage. Prior to virtual memory, all of a program had to fit in available primary storage. With virtual memory, a program can be significantly larger than the installed primary storage. The computer uses secondary storage to supplement primary storage, allowing the computer to have "virtual memory" that is considerably larger than the installed memory.

15. Correct Answer: D
SOLUTION:
The ! operator is the not operator, which inverts the next item and works with just one operand.
The ++ operator is the pre or post increment operator, which work with just one operand.
The - - operator is the pre or post decrement operator, which work with just one operand.
The % operator works with two operands to provide the remainder from integer division.

16. Correct Answer: D
SOLUTION:
The +=, % and ++ are all arithmetic operators.
The >> and << are used to work with the standard input and output streams.
The = is an assignment operator. Note that += is arithmetic and assignment.
The > and < are comparison operators.
The ?: operator is the only ternary operator and performs a similar function as if/else.

17. Correct Answer: E
SOLUTION:
A trace of the code follows

a	b	c	
6	2	10	
5	2	10	5 is assigned to a
5	2	12	5 > 2 so execute if. 5 % 3 is 2 which is added to c
			Display 5212, which is not given as a possible answer.

18. Correct Answer: D
SOLUTION:
A trace of the code follows

a	b	c	
6	2	10	
0	2	10	0 is assigned to a
0	2	10	0 < 2 so execute else
0	2	10	0 is not < 0 so execute b++. b is first returned and placed
0	2	2	into c, then b is incremented.
0	3	2	Now display 032

19. Correct Answer: A
SOLUTION:
`fun1` passes `x` and `y` by value. `fun2` passes `x` by value and `y` by reference. `fun3` passes the `int x` by value and the pointer (or reference) to an int by value. So all of the functions use pass by value, but only `fun2` uses pass by reference. While `fun3` passes a pointer or reference, it does not use pass by reference, it passes the reference by value. `fun3` will compile.

20. Correct Answer: D
SOLUTION:
A trace of the code follows below. Recall that since pass by value is used, the variables for the calling function do not change, only those in the called function change. So only those in the called function will appear in the trace.

```
Call to fun1(y, y), fun1's vars:
x  y     z
2  2     ?
2  2     2     //   int z = x++;

3  2     2     // x++ post increment now takes effect
3  4     2     // since x%2 is equal to 1 increment y by 2
return 5;
Calling function prints: 5123
```

21. Correct Answer: E
SOLUTION:
A trace of the code follows below. Unlike `fun1`, `fun2` uses pass by reference, so if `y` changes, it changes the value of `y` in main. So both sets of variables are listed in the trace.

```
main x   main y   main z     fun x   fun y     fun z
1        2        3          2       2         ?         call to fun2
1        2        3          2       2         2         set z
1        2        3          3       2         2         postinc x
1        4        3          3       4         2         change y
returns 5
prints 5143
```

22. Correct Answer: B
SOLUTION:
`fun3` will compile, static variables are acceptable. Static variables are instantiated once during the entire program execution on the first function call. Unlike other variables within the function, they retain their values from one call to the next. The second parameter being passed to `fun2`, must be an integer variable so that pass by reference can pass the pointer or memory location to that variable to the function. So, while `fun1(x,x)` and `fun2(y,y)` are legal calls, `fun2(fun1(x,x), fun2(y,y))` is not. Likewise `fun2(5,6)` is not legal due to the value 6 being passed, which is an integer, not a variable that has a location in memory. `fun3` requires an integer for the first parameter, but a reference to an integer for the second parameter. This is exactly what `fun3(x, &x)` provides, so this is the only true statement.

23. Correct Answer: B
SOLUTION:
Counter controlled loops will run for a specific number of times, while sentinel controlled loops look for some specific condition to be met to stop (i.e.: press Y to continue or N to stop, N would be the sentinel).
For and while loops are pretest loops, which means the logical condition must be met to run.
A do while loop is a post-test loop and checks the condition after the loop has run.
As a result, the do while loop will ALWAYS run the code within the loop at least once.

24. Correct Answer: D
SOLUTION:
The for loop will execute 5 times, causing the if statement to be evaluated 5 times. A trace of the code follows.

i	j	A[0]	A[1]	A[2]	A[3]	A[4]	
?	?	1	2	3	4	5	variables initialized
?	4	1	2	3	4	5	user enters 4
0	4	1	2	3	4	5	i is set to 0 to start for loop
							if (j) is true so execute if portion of if/else
0	4	1	2	3	4	5	A[0] += 0; stays 1 (Line 5)
1	4	1	2	3	4	5	i++
1	4	1	3	3	4	5	A[1] += 1; 2+1=3
2	4	1	3	3	4	5	i++
2	4	1	3	5	4	5	A[2] += 2; 3+2=5
3	4	1	3	5	4	5	i++
3	4	1	3	5	7	5	A[3] += 3; 4+3=7
4	4	1	3	5	7	5	i++
4	4	1	3	5	7	9	A[4] += 4; 5+4=9
5	4	1	3	5	7	9	i++

Displays 5419
Note: Logical statements that have algebraic numbers are evaluated as true if they are not zero.

25. Correct Answer: A
SOLUTION:
See trace above.

26. Correct Answer: A
SOLUTION:
See trace above.

27. Correct Answer: E
SOLUTION:
A trace of the code follows.

i	j	A[0]	A[1]	A[2]	A[3]	A[4]	
?	?	1	2	3	4	5	variables initialized
?	0	1	2	3	4	5	user enters 0
0	0	1	2	3	4	5	i is set to 0 to start for loop
							if is false do else portion of if/else
0	1	1	2	3	4	5	++j pre-increment from line 7
0	1	1	2	3	4	5	A[0] = ++j; already 1, so still 1
1	1	1	2	3	4	5	i++
							Note if (j) is true now
1	1	1	3	3	4	5	A[1] += 1; 2+1=3
2	1	1	3	3	4	5	i++
2	1	1	3	5	4	5	A[2] += 2; 3+2=5
3	1	1	3	5	4	5	i++
3	1	1	3	5	7	5	A[3] += 3; 4+3=7
4	1	1	3	5	7	5	i++
4	1	1	3	5	7	9	A[4] += 4; 5+4=9
5	1	1	3	5	7	9	i++

The code displays 5119.

28. Correct Answer: B
SOLUTION:

	a	b	c	d	j	e[0]	e[1]	e[2]	e[3]	
`const int MAX_SIZE = 4;`	-	-	-	-	-	-	-	-	-	
`int a = 10;`	10	-	-	-	-	-	-	-	-	
`int b = 20;`	10	20	-	-	-	-	-	-	-	
`int c = 30;`	10	20	30	-	-	-	-	-	-	
`int d = 40;`	10	20	30	40	-	-	-	-	-	
`int e[MAX_SIZE];`	10	20	30	40	-	-	-	-	-	
`int j=0;`	10	20	30	40	0	-	-	-	-	
`e[j++] = a;`	10	20	30	40	1	10	-	-	-	e[0] set to a j is incremented after assignment
`e[j++] = b;`	10	20	30	40	2	10	20	-	-	e[1] set to b j is incremented after assignment
`e[++j] = c;`	10	20	30	40	3	10	20	-	30	j is incremented before assignment e[3] set to c
`e[j] = d;`	10	20	30	40	3	10	20	-	40	e[3] set to d

29. Correct Answer: E
SOLUTION:
See trace above

30. Correct Answer: D
SOLUTION:
Adding the statement will cause a compile error. MAX_SIZE is a constant, or read-only variable, and can only be assigned a value when it is instantiated.