

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

1. Correct Answer: D

SOLUTION:

Items that are protected may not be accessed outside of the class directly, unless they are accessed by a derived class. All of the other statements are true.

2. Correct Answer: D

SOLUTION:

A trace of the code follows.

i	c[0]	L	W	c[1]	L	W	c[2]	L	W	c[3]	L	W	c[4]	L	W	
0	1	1		1	1		1	1		1	1		1	1		Starts
0	1	2		1	1		1	1		1	1		1	1		1st pass
1	1	2		2	3		1	1		1	1		1	1		2nd pass
2	1	2		2	3		3	6		1	1		1	1		3rd pass
3	1	2		2	3		3	6		4	11		1	1		4th pass
4	1	2		2	3		3	6		4	11		5	18		5th pass
5	loop stops															

So the area of $c[2]$ is 18 and perimeter of $c[3]$ is 30.

3. Correct Answer: D

SOLUTION:

The `length` variable is accessed 5 times to change it in the loop and then once to get the area and once to get the perimeter.

4. Correct Answer: E

SOLUTION:

A binary search starts at the middle of the list. It either finds the item or moves to the bottom half of the list or top half of the list and repeats the process. Because the list is cut in half each time, it is $O(\log_2 n)$. A

bubble sort is not a very efficient sort, although fairly easy to implement. Merge and quick sorts, while more complex, tend to be more efficient, with the merge being $O(n \log n)$. The quick sort is $O(n \log n)$, but in the worst case is $O(n^2)$.

5. Correct Answer: A

SOLUTION:

The contents of the queue are traced as follows.

ENQUEUE (F) ;	F
ENQUEUE (T) ;	FT
ENQUEUE (G) ;	FTG
ENQUEUE (DEQUEUE ()) ;	TGF
DEQUEUE () ;	GF
ENQUEUE (C) ;	GFC

6. Correct Answer: E

SOLUTION:

A binary tree has nodes that have 2, 1 or zero children. A tree is a connected graph with no loops and as such, if it has n nodes, it requires $n-1$ edges. Binary search trees are organized so the each element has nodes that are smaller than it to its left and larger to the right. Due to this, if it is balanced, it can result in very efficient searching. However, if it is not balanced, it can require as many comparisons as an unordered list. For this reason, algorithms exist to rebalance trees as items are added and removed from the tree.

7. Correct Answer: A

SOLUTION:

In-order traversals go left, visit the current node and then go right.
 Pre-order traversals visit the current node, go left then right.
 Post order traversals go left, right then visit the current node.

The first answer is an in-order traversal, the second answer is a pre-order, and the third answer is a post-order traversal. The last two answers are top and bottom level order traversals, respectively.

8. Correct Answer: C

SOLUTION:

The carries from the addition of each power of two are listed in the top row.

```

CARRIES  0001111
          10101111
          + 01001101
RESULT   11111100
    
```

The binary result is then converted.

$$\begin{aligned}
 11111100 &= 1 \cdot 2^7 + 1 \cdot 2^6 + 1 \cdot 2^5 + 1 \cdot 2^4 + 1 \cdot 2^3 + 1 \cdot 2^2 + 0 \cdot 2^1 + 0 \cdot 2^0 \\
 &= 128 + 64 + 32 + 16 + 8 + 4 \\
 &= 252
 \end{aligned}$$

9. Correct Answer: A

SOLUTION:

$$\begin{aligned}
 1011.0110 &= 1 \cdot 2^3 + 0 \cdot 2^2 + 1 \cdot 2^1 + 1 \cdot 2^0 + 0 \cdot 2^{-1} + 1 \cdot 2^{-2} + 1 \cdot 2^{-3} + 0 \cdot 2^{-4} \\
 &= 8 + 4 + 1 + .25 + .125 \\
 &= 11.375
 \end{aligned}$$

10. Correct Answer: D

SOLUTION:

This is a direct application of DeMorgan's Law. When inverting a logical OR expression, the internal terms become inverted and the OR flips to an AND. A truth table is used to show the equivalence.

A	B	C	(AB)' OR (BC)'	A'B' OR B'C'	AB AND BC	(AB)' AND (BC)'	(AB OR BC)'
F	F	F	T	T	F	T	T
F	F	T	T	T	F	T	T
F	T	F	T	F	F	T	T
F	T	T	T	F	F	F	F
T	F	F	T	T	F	T	T
T	F	T	T	F	F	T	T
T	T	F	T	F	F	F	F
T	T	T	F	F	T	F	F

11. Correct Answer: A

SOLUTION:

The truth table is clearly true when C is true. Answer A is the correct answer, although it can be shown to be simplified below to equal C.

ABC + B'C + A'BC	Commutative property
ABC + A'BC + B'C	Distributive property
(A+A')BC + B'C	Anything ORed with the negative of itself is true
T(BC) + B'C	True and a value is just that value
BC + B'C	Distributive
(B + B') C	Repeat above steps.
C	

12. Correct Answer: B

SOLUTION:

A microblog allows one to publish short sentences that take only a few seconds to write, rather than long stories or posts like a traditional blog. Twitter is the microblog in the list.

Facebook and Google+ are social networking sites.

YouTube is a video-sharing site.

Pinterest is photo-sharing site.

13. Correct Answer: B

SOLUTION:

Bitcoin is a form of digital currency, created and held electronically.

PayPal is an online payment system that uses traditional currencies.

Visa and American Express are credit cards.

Barclays is a British bank.

14. Correct Answer: C

SOLUTION:

DVDs are the slowest in the list, with current 16x devices achieving transfer speeds of approximately 21MB/second

With a memory clock frequency of 100 MHz, DDR3 SDRAM gives a maximum transfer rate of 6400 MB/s. Cache is placed between the CPU and RAM, and is used to speed access to data and instructions by the CPU.

Registers are usually word-sized and are a part of the CPU architecture.

15. Correct Answer: B

SOLUTION:

Pentesting, or penetration testing, is the practice of testing a computer system, network or Web application to find vulnerabilities that an attacker could exploit. It is an attempt to evaluate the security of an computer system by safely trying to exploit vulnerabilities.

16. Correct Answer: D

SOLUTION:

Note that the variable `a` is passed by reference to the function `add`. Any changes made to the variable `a` in the function `add` are reflected in the value of the variable `a` in `main`.

The trace of the code is as follows:

```
1st iteration of for loop
    i = 0, a = 0, ans = 0
    after call to function mult
        i = 0, a = 0, ans = 0
    after call to function add
        i = 0, a = 0, ans = 0
2nd iteration of for loop
    i = 1, a = 0, ans = 0
    after call to function mult
        i = 1, a = 0, ans = 0
    after call to function add
        i = 1, a = 1, ans = 1
3rd iteration of for loop
    i = 2, a = 1, ans = 1
    after call to function mult
        i = 2, a = 1, ans = 2
    after call to function add
        i = 2, a = 3, ans = 3
4th iteration of for loop
```

```

i = 3, a = 3, ans = 3
after call to function mult
    i = 3, a = 3, ans = 9
after call to function add
    i = 3, a = 6, ans = 6

```

17. Correct Answer: A

SOLUTION:

There are three ways to pass a parameter to a C++ function.

`int*` indicates the parameter is being passed by pointer.

`int&` indicates the parameter is being passed by reference.

`int` indicates the parameter is being passed by value.

18. Correct Answer: B

SOLUTION:

There are three ways to pass a parameter to a C++ function.

`int*` indicates the parameter is being passed by pointer.

`int&` indicates the parameter is being passed by reference.

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19. Correct Answer: C

SOLUTION:

This recursive function returns the greatest common divisor of the two numbers. `RetVal` is set to 20 and the `if` statement is false since `200%20` is 0, so the function does not call itself and returns 20. The static variable is initialized on the first function call and retains its value during the entire program execution. It can then keep track of the number of times the function is called.

20. Correct Answer: E

SOLUTION:

This is a recursive function that finds the greatest common divider (GCD) of the two integers. The trace of the function call follows.

<code>retval(35, 300)</code>	<code>c</code> goes to 1	1 displayed
<code>35%300 = 35</code>		
<code>retval(300, 35)</code>	called, <code>c</code> goes to 2	2 displayed
<code>300%35 = 20</code>		
<code>retval(35, 20)</code>	called, <code>c</code> goes to 3	3 displayed
<code>35%20 = 15</code>		
<code>retval(20, 15)</code>	called, <code>c</code> goes to 4	4 displayed
<code>20%15 = 5</code>		
<code>retval(15, 5)</code>	called, <code>c</code> goes to 5	5 displayed
<code>15%5 = 0</code>		
returns 5 which gets successively returned to the original calling function.		

21. Correct Answer: B

SOLUTION:

See trace above.

22. Correct Answer: B

SOLUTION:

This recursive function has a base case of `a%b` equal to zero.

23. Correct Answer: E

Any input from the user will be a string and valid input to the program.

24. Correct Answer: E

SOLUTION:

The `do {} while` loop is a posttest loop, which means that lines 4 & 5 will always be executed at least once.

25. Correct Answer: E

In C++, `\0` is used to denote the end of a string. The do-while loop will continue to execute until the end of the string `a` is reached.

26. Correct Answer: C

SOLUTION:

The `a` array is passed by reference to `my_func()`, meaning that any changes made in `my_func()` will be made to the array in `main()`.

Line 4 subtracts one from the value of each element in the array. This sets the value of the element to the preceding character in the character set.

27. Correct Answer: D

The variable `i` is defined on line 1, outside of any functions. Because of this, its scope is global. Any function can refer to the variable `i`.

28. Correct Answer: C

The variable `k` is defined in the function declaration on line 2. The variable `k`'s scope is local and available only in the function `my_func`. In addition, note that on line 3 the variable `j` is declared. As a result the variable `j` only has scope for the for loop from lines 3 through 6.

29. Correct Answer: B

SOLUTION:

If the user input is less than 5, `Hey` will only be output 5 times. As `i` is a global in scope, its value will remain at 5 after the first iteration of the outer loop.

30. Correct Answer: A

SOLUTION:

The inner loop will not execute as `j` is set to `k`, which is 5, which makes the test expression `j < 5` to be false. Therefore, neither the outer or inner loop will execute.