1. You are managing the database of a book publisher, you currently store the book orders your company receives in the following BookOrders table. Your manager has asked you to generate a report to list all the orders where the quantity ordered was greater than the average quantity per order for that book. Which of the following queries will satisfy the business requirements? (3 Points)

OrderID	BookID	OrderDate	QuantityOrdered	OrderMethod	CustomerID
1	1	2007-10-21 18:50:01.360	100	Fax	88
2	1	2007-10-21 18:50:01.360	200	Web	88
3	1	2007-10-21 18:50:01.360	20	Phone	99
4	2	2007-10-21 18:50:01.360	100	Web	99
5	2	2007-10-21 18:50:01.360	20	Web	88
6	3	2007-10-21 18:50:01.360	90	Fax	88

Picture for Question 1

A. select BookID from BookOrders A where QuantityOrdered > (select avg(QuantityOrdered) from BookOrders B where B.BookID = B.BookID)

B. select OrderID from BookOrders A where QuantityOrdered > (select avg(QuantityOrdered) from BookOrders B where B.BookID = A.BookID)

C. select BookID from BookOrders A where QuantityOrdered > (select avg(QuantityOrdered) from BookOrders B where B.BookID = A.BookID)

D. select OrderID from BookOrders A where QuantityOrdered > (select avg(QuantityOrdered) from BookOrders B where A.BookID = A.BookID)

2. Which one CANNOT be used to communicate between 2 processes on Windows? (3 Points)
   A. Named event
   B. Named pipe
   C. Critical Section
   D. Shared Memory

3. Which of the following operation is NOT basic operation of stack? (3 Points)
   A. Push an element to the stack
   B. Pop an element from the stack
   C. Check if the stack is empty
   D. Sort the stack

4. Which of the following design patterns is(are) "creational" pattern(s)? (3 Points)
   A. Façade

B. Singleton
C. Bridge
D. Composite
E. None of the above

5. Which of the follow TCP packets sequence is(are) correct for TCP handshake when setting up a connections? (3 Points)
A. SYN, SYN+ACK, SYN+ACK ?
B. SYN+ACK,SYC+ACK,SYN
C. SYN,SYN+ACK,RST ?
D. SYN, SYN, ACK
E. None of the above

6. The characteristics of functional programming are (3 Points)
A. Avoidance of changing state and mutable data
B. Referential transparency
C. Lambda calculus
D. Thread-safe
E. All of above

7. The Hypertext Transfer Protocol (HTTP) is an application protocol for distributed, collaborative, hypermedia information systems. It is the foundation of data communication for the World Wide Web. Which of the following statement(s) is(are) correct: (3 Points)
A. It functions as a request-response protocol in the client-server computing model
B. It is a stateless protocol is that treats each request as an independent transaction
C. It is the protocol that major Internet applications such as the World Wide Web and email rely on
D. The HTTP response includes a numeric status code, and the status code "404" often stands for "Page Not Found"
E. None of the above

8. Which is correct about shallow copy in C++? (3 Points)
A. Shallow copy only copy reference
B. Shallow copy will cause possible physical pointer duplication
C. Shallow copy may cause problems in case of assignment or parameter passing in function
D. Copy constructor may mitigate the risk of shallow copy

9. There are 15 balls that are put into 4 bags. It is required that every bag has at least 1 ball but the number of balls in every bag should be different. How many different ways, totally, can be used to put the balls into the 4 bags? (5 Points)
A. 4
B. 5

C. 6
D. 7
E. None of the above

10. What will be the output of this program? (5 Points)

```cpp
class Base
{
public:
char Value() { return 'A'; }
virtual char VirtualValue() { return 'V'; }
};

class Derived : public Base
{
public:
virtual char Value() { return 'D'; }
};

class VirtualDerived : virtual public Base
{
public:
char Value() { return 'Z'; }
char VirtualValue() { return 'X'; }
};

int main()
{
   Base* b1 = new Derived();
   Base* b2 = new VirtualDerived();

cout<< b1->Value()       <<''<<
       b1->VirtualValue() <<''<<
       b2->Value()       <<''<<
       b2->VirtualValue() << endl;
}
```

A.   A V A X
B.   D V A X
C.   A V Z X
D.   A V Z V
E.   D V Z X

11. Two 32 bit integer values A and B, are processed to give the 32 bit integers C and D as per the following rules. Which of the rules is(are) reversible, i.e. is it possible to obtain A and B given C and D in all conditions? (5 Points)
    A. $C = (int32)(A + B)$, $D = (int32)(A - B)$
    B. $C = (int32)(A + B)$, $D = (int32)((A - B) >> 1)$
    C. $C = (int32)(A + B)$, $D = B$
    D. $C = (int32)(A + B)$, $D = (int32)(A + 2 * B)$
    E. $C = (int32)(A * B)$, $D = (int32)(A / B)$

12. if a pre-order traversal sequence of a binary tree is abcdefg, which of the following(s) is(are) possible in-order traversal sequence? (5 Points)
    A. abcdefg
    B. gfedcba
    C. bcdefga
    D. bceadfg
    E. bcdaefg

13. $T(x) = 1$ $(x <= 1)$, $T(n) = 25 * T(n/5) + n^2$ What is $T(n)$? (5 Points)
    A. $O(nlogn)$
    B. $O(n^2logn)$
    C. $O(n^2)$
    D. $O(n^3)$
    E. $O(n^3logn)$

14. There are two threads running on a dual-core machine. Their main body are listed as following c code snippet thread 1: $x = 1$; $r1 = y$; thread 2: $y = 1$; $r2 = x$; x, y are two global variables initialized as zero. Which is(are) the possible value(s) of r1 and r2 ? (5 Points)
    A. r1=1, r2=1
    B. r1=1, r2=0
    C. r1=0, r2=1
    D. r1=0, r2=0

15. The depth of a complete binary tree with n elements is (5 Points)
    A. $D(n) = log2(n)$
    B. $D(n) = 1 + log2(n)$
    C. $D(n) = n * log2(n)$
    D. $D(n) = 1 + n * log2(n)$

16. How many 0 appears in 1, 2, 3, ..., 999, 1000? (5 Points)
    A. 189
    B. 191
    C. 193
    D. 195

17. What is the probability for born on 2/28 vs born on 2/29? And what for born on 2012/2/28 vs born on 2012/2/29? (5 Points)
    A. 1:1 and 1:1
    B. 4:1 and 1:1
    C. 1:1 and 4:1
    D. 4:1 and 4:1

18. Which of following use(s) greedy strategy? (5 Points)
    A. Dijkstra algorithm in single-source shortest path
    B. Prim's algorithm in minimum spanning tree
    C. Kruskal's algorithm in minimum spanning tree
    D. Floyd-Warshall algorithm in all-pairs shortest paths
    E. KMP algorithm in string match

19. Given the following code: (13 Points)

```
class A
{
public:
    int k1; int k2;
};

int comp(A x, A y) { return x.k1 - y.k1; }

void exchange(A a[], int i, int j) { A t = a[i]; a[i] = a[j]; a[j] = t; }

void f1(A a[], int l, int (*c)(A x, A y))
{
    for (int i = 0; i < l; ++i)
    {
        int min = i;
        for (int j = i + 1; j < l; ++j)
        {
            if (c(a[j], a[min]) < 0) min = j;
        }
        exchange(a, i, min);
    }
}

void f2(A a[], int l, int (*c)(A x, A y))
{
    for (int i = 1; i < l; ++i)
    {
```

```
                A t = a[i]; int j = i - 1;
                while (c(t, a[j]) < 0 && j >= 0)
                {
                        a[j + 1] = a[j];
                        j = j - 1;
                }
                a[j + 1] = t;
        }
}


void f3(A a[], int l, int (*c)(A x, A y))
{
    for (int i = 0; i < l; ++i)
            for (int j = l - 1; j > i; --j)
                    if (c(a[j], a[j - 1]) < 0) exchange(a, j - 1, j);
}


int _f41(A a[], int low, int high, int (*c)(A x, A y))
{
    int i = low; A t = a[low];
    for (int j = low + 1; j < high; ++j)
    {
            if (c(a[j], t) <= 0)
            {
                    i++;
                    if (i != j) exchange(a, i, j);
            }
    }
    exchange(a, low, i);
    return i;
}


void _f42(A a[], int low, int high, int (*c)(A x, A y))
{
    if (low < high)
    {
            int p = _f41(a, low, high, c);
            _f42(a, low, p, c);
            _f42(a, p + 1, high, c);
    }
}

void f4(A a[], int l, int (*c)(A x, A y))
```

```
{
    _f42(a, 0, I, c);
}
```

An array is declared as below:

A a[5] = { { 3, 4 }, { 6, 5 }, { 2, 7 }, { 3, 1 }, {1, 2 } };

Which of the function calls can transform it into:

{ { 1, 2 }, { 2, 7 }, { 3, 1 }, { 3, 4 }, { 6, 5 } }

A. f1(a, 5, cmp)
B. f2(a, 5, cmp)
C. f3(a, 5, cmp)
D. f4(a, 5, cmp)
E. None of the above

20. A particular BNF definition for a "word" is given by the following rules (13 Points)

<word>::=<letter>|<letter><pairlet>|<letter><pairdig>
<pairlet>::=<letter><letter>|<pairlet><letter><letter>
<pairdig>::=<digit><digit>|<pairdig><digit><digit>
<letter>::=a|b|c|...|y|z
<digit>::=0|1|2|...|9

Which of the following lexical entities can be derived from <word>? I. abcd II.bcdef III. d22

A. None
B. I and II only
C. I and III only
D. II and III only
E. I, II and III