2.
Which of the following decimal numbers has an exact representation in binary notation.

a. 0.1
b. 0.2
c. 0.3
d. 0.4
e. 0.5

3.
Bob writes down a number between 1 and 1000. Mary must identify that number by asking "yes/no" questions of Bob. Mary knows that Bob always tell the truth. If Mary uses an optimal strategy, then she will determine the answer at the end of exactly how many questions in the worst case?

a) 1.000
b) 999
c) 500
d) 32
e) 10

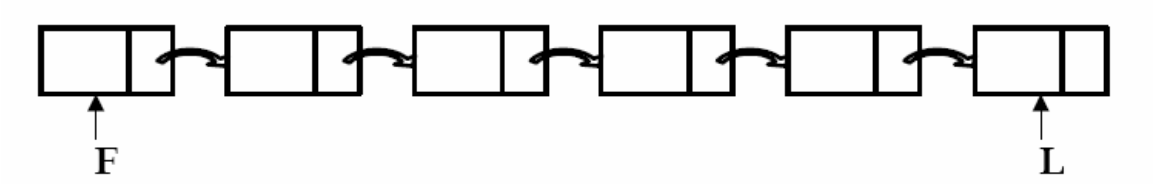
7.
Consider the following Pascal-like program fragment:

```
var i, j : integer;
procedure P(k, m : integer);
begin
k := k – m;
m := k + m;
k := m – k;
end
i := 2
j := 3
P(i , j);
```

If both parameters to P are passed by reference, what are the values of i and j at the end of the program fragment?

(A) i = *0, j = 2*
(B) *i = 1, j = 5*
(C) *i = 2, j = 3*
(D) ***i = 3, j = 2***
(E) None of the above.

9.
Consider a singly linked list of the form:



where F is a pointer to the first element in the list and L is a pointer to the last element en the list. The time of which of the following operations depends on the length of the list?

(A) Delete the last element of the list.
(B) Delete de first element of the list.
(C) Add an element after the last element of the list.
(D) Add an element before the first element of the list.
(E) Intechange the first two elementsof the list.

10.

```
p := 1; k := 0;
while k < n do
begin
p := 2 * p ;
k := k + 1 ;
end
```

For the program fragment above involving integers p, k, and n, which of the following is a loop invariant; i.e., true at the beginning of each execution of the loop and the Completion of the loop?

(A) $p = k + 1$
(B) $p = (k + 1)_2$
(C) $p = (k + 1)2_k$
(D) $p = 2_K$
(E) $\mathbf{p = 2_{k+1}}$

Questions 13-14 relate to the following C-like program.

```
#include <stdio.h>
main()
{
 float som = 0.0, j = 1.0, i = 2.0;
 while (i/j > 0.001)
 {
  j = j + j;
  sum = sum + i/j;
  printf("%f\n", sum);
```

}
}

13.
How many lines of output does the program produce?

(A) 0-9
(B) 10-19
(C) 20-29
(D) 30-39
(E) More than 39

14.
Which of the following is the integer that best approximates the last number printed?

(A) 0
(B) 1
(C) 2
(D) 3
(E) 4

15.
An integer c is a common divisor of two integers x and y if and only if c is a divisor of x and c is a divisor of y. Which of the following sets of integers could be possibly be the set of all common divisors of two integers?

(A) {-6, -2, -1, 1, 2, 6}
(B) {-6, -2, -1, 0, 1, 2, 6}
(C) {-6, -3, -2, -1, 1, 2, 3, 6}
(D) {-6, -3, -2, -1, 0, 1, 2, 3, 6}
(E) {-6, -4, -3, -2, -1, 1, 2, 3, 4, 6}

17.
A particular parallel program computation requires 100 seconds when executed on a single processor. If 40 percent of this computation is "inherently sequential" (i.e., will not benefit from additional processors), then the theoretically best possible elapsed times for this program running with 2 and 4 processors, respectively, are:

(A) 20 and 10 seconds.
(B) 30 and 15 seconds.
(C) 50 and 25 seconds.
(D) 70 and 55 seconds.
(E) 80 and 70 seconds.

20.
Let P be a procedure that for some inputs calls itself (i.e., is recursive). If P is guaranteed to terminate, which of the following statements must be true?

P has a local variable.

P has an execution path where it does not call itself.
P either refers to a global variable or has a least one parameter.

(A) I only.
(B) II only.
(C) I and II only.
(D) II and III only
(E) I, II and III.

26.
Let S be the statement:
for i := 1 **to** N **do** V [i] := V [i] + 1
Which of the following perform (s) the same changes to V as S?

I. i := 0;
while i <= N **do**
begin i := i + 1; V[i] := V[i] + 1 **end**

II. i := 1;
while i < N **do**
begin V[i] := V[i] + 1; i := i + 1 **end**

III. i := 0;
while i < N **do**
begin V[i + 1] := V[i + 1] + 1; i := i + 1 **end**

(A) I only.
(B) II only.
(C) III only.
(D) II and III only.
(E) I, II and III.

27.
```
var i, j, x: integer;
read (x);
i := 1; j := 1;
while i < 10 do
begin
j := j * i;
i := i + 1;
if i = x then exit
end
```

For the program fragment above, which of the following statements about the variables i and j must be true after execution of the fragment?
(A) (j = (x - 1)!) ∧ (i > x)
(B) (j = 9!) ∧ (i = 10)
(C) (j = 10!) ∧ (i = 10)
(D) ((j = 10!) ∧ (i = 10)) v ((j = (x - 1)!) ^ (i = x))

(E) ((j = 9!) ∧ (i > 10)) v ((j = (x - 1)!) ^ (i = x))

Question 63 refer to the following information.

An array A [1 … n] is said to be k-ordered if
A [i - k] < A [i] < A [i + k]
for each i such that k < i < n – k. For example, the array 1 4 2 6 3 7 5 8 is 2- ordered.

63.
In a 2-ordered array of 2N elements, what is the maximum number of positions that an element can be from its position if the array were 1-ordered?

(A)2N – 1
(B) 2
(C) N/2
(D) 1
(E) N

64. In a 2-ordered array of 2N elements that is both 2- and 3-ordered, what is the maximum number of positions that an element can be from its position if the array were 1-ordered?
(A) 2N – 1
(B) 2
(C) N/2
(D) 1
(E) N