

Department of Computer Science and Engineering

IIT Bombay

PhD Admissions Test

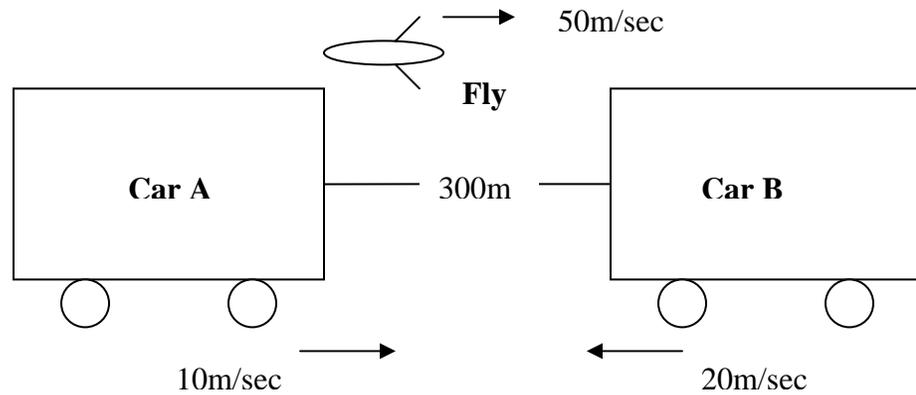
(Model Paper)

Attempt any three sections. Each section has 6 questions of 5 marks each. An explanation for the answer is a must and should be given in the space provided.

(only 3 questions are given in each section by way of examples for the model question)

Section-I (*General Aptitude*)

(1) A car A is approaching at a speed of 10m/sec another car B moving in the opposite direction at a speed of 20m/sec as shown in the diagram below.



A fly whose absolute speed is 50m/sec goes **repeatedly from A to B and back**, without loosing any time at any of the cars. This repeated moving back and forth stops when the two cars crash into each other. Answer the following:

- (i) The distance traveled by the fly before the collision is _____m.
- (ii) The number of trips made by the fly back and forth is _____

Explanation:

(2) Exactly 7 persons - P , Q , R , S , T , U and V - participate in and finish all of a series of races. There are no ties for any position at the finish of the races. The following statements about the races are always true:

V finishes somewhere ahead of P

P finishes somewhere ahead of Q

Either R finishes first and T finishes last, or S finishes first and U or Q finishes last

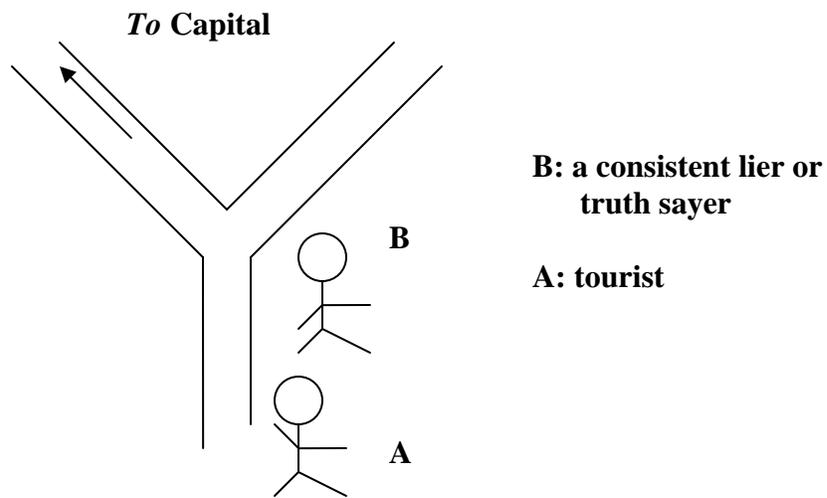
If in a race S finishes sixth and Q finishes fifth, which of the following can be true?

- A. V finishes first or fourth
- B. R finishes second or third
- C. P finishes second or fifth
- D. U finishes third or fourth
- E. T finishes fourth or fifth

Answer:

Explanation:

(3) A tourist A comes to a country where people are divided into two categories: *Liers* (L) and *Truth Sayers* (T). L s always lie and T s always speak the truth. Intending to walk to the capital, the tourist comes to a cross road from where the left road goes to the capital. An inhabitant B of the country is standing at the junction (see the figure below).



A asks a single yes/no question of the form “**Is it true that _____?**” to B, and the answer reveals the correct direction to the capital.

Construct A’s question by filling in the blank with a statement which makes use of the following two sub-statements (which are either true or false)

- (i) *Mr. B always lies*
- (ii) *The left road leads to the capital*

Ans=

Explanation:

Section-II (Mathematical Aptitude)

(4) n people each know a different piece of gossip. They can telephone each other and exchange all the information they know, so that after the call they both know everything that either of them knew before the call. Our interest is in coming up

with a scheme such that the smallest number of calls are made so that everyone knows everything. Find the best scheme you can as a function of n .

Ans:

Explanation:

(5) Two points are picked independently and uniformly at random from the circumference of a circle of radius R . Determine the function f such that the “*the probability that the distance between the two points is at least $f(R)$ is 0.5*”.

Ans: $f(R)=$

Explanation:

(6) Consider a cell phone network. Assume that the geographical area covered by the network has been divided into a 2-dimensional array of square cells. When there is an incoming call for a given mobile, the network has to find the cell in which the mobile is currently located.

This is done by having each mobile inform a central control of its current location, every once in a while. The network queries for the mobile in a group of

cells near the mobile's last known location.

One strategy is for the mobile to inform the central control after every k cell changes, for a given integer k . What is the number of cells the system must query if $k=3$?

Ans:

Explanation:

Section-III (*Programming Aptitude*)

(7) In the following C function, let $n \geq m$.

```
Int gcd (n, m)  
{  
    If (n%m == 0) return m;  
    n = n%m;  
    return gcd (m, n);  
}
```

How many recursive calls are made by this function?

- (a) $\Theta(\log_2 n)$
- (b) $\Omega(n)$
- (c) $\Theta(\log_2 \log_2 n)$
- (d) $\Theta(\sqrt{n})$

Ans:

Explanation:

(8) Consider the following C program:

```
int f(int n)
{
    if (n<=1) return 1;
    n= (n-1)*(n-1) - 2 - n*n + 3*n
    f(n);
    printf("%d", n);
}
```

What is the output, if the initial call is **f(6)**?

(a) 5 5 5 5 5 (b) 1 1 1 1 1 (c) 5 4 3 2 1 (d) 1 2 3 4 5

Ans:

Explanation:

(9) Consider the following fragment of a C program, where *i*, *j* and *n* are integer variables.

```
i = j = 0;
for (;) {
    j++;
    if (i > n) break;
    i++;
}
```

What is the value of j (as a function of n) when the *break* statement is executed?

Ans:

Explanation:

Section-IV (Computer Science and Engineering)

(10) Consider a disk pack with 16 surfaces, 128 tracks per surface and 256 sectors per track. 512 bytes of data are stored in a bit serial manner in a sector. The capacity of the disk pack and the number of bits required to specify a particular sector in the disk are respectively:

- (a) 256 Mbyte, 19 bits
- (b) 512 Mbyte, 20 bits
- (c) 256 Mbyte, 28 bits
- (d) 64 Gbyte, 28 bits

Ans:

Explanation:

(11) Let G be the non-planar graph with the minimum possible number of edges. Then G has

- (a) 9 edges and 5 vertices
- (b) 9 edges and 6 vertices
- (c) 10 edges and 5 vertices
- (d) 10 edges and 6 vertices

Ans:

Explanation:

(12) Consider the following set of processes on a uniprocessor system

Process Number	Arrival Time	Processing Time
1	0	3
2	2	6
3	4	4
4	6	5
5	8	2

Which of the following scheduling schemes will cause the process 3 to have the earliest finish time? Assume that process switching time is negligible.

- (i) FCFS
- (ii) Round Robin with Scheduling unit = 1 time unit
- (iii) Round Robin with Scheduling unit = 4 time units
- (iv) Non-preemptive shortest job first
- (v) Preemptive shortest job first

Ans:

Explanation:

=====**Paper Ends**=====