



I. Answer any 10 of the following questions:

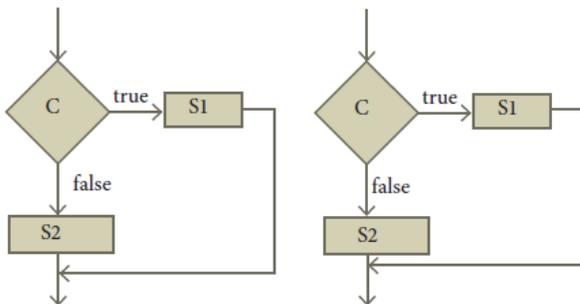
[10 x 2 = 20]

1. Distinguish between a condition and a statement.
2. Both conditional statement and iterative statement have a condition and a statement. How do they differ?
3. What is the difference between an algorithm and a program?
4. Why is function an abstraction?
5. How do we refine a statement?
6. What are the disadvantages of flowcharts?
7. What is problem decomposition?
8. What is an invariant?
9. Define a loop invariant.
10. What is the relationship between loop invariant, loop condition and the input- output recursively
11. What is recursive problem solving?
12. Define factorial of a natural number recursively

II. Answer any 5 of the following questions:

[5 x 3 = 15]

13. For the given two flowcharts write the pseudo code.



14. If C is false in line 2, trace the control flow in this algorithm.

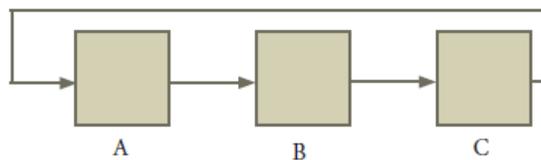
1. S1
2. -- C is false
3. if C
4. S2

5. else
 6. S3
 7. S4
15. Define a function to double a number in two different ways: (1) $n + n$, (2) $2 \times n$
 16. What are the different notations used mainly for representing algorithm?
 17. There are 7 tumblers on a table, all standing upside down. You are allowed to turn any 2 tumblers simultaneously in one move. Is it possible to reach a situation when all the tumblers are right side up? (Hint: The parity of the number of upside down tumblers is invariant.)
 18. A knockout tournament is a series of games. Two players compete in each game; the loser is knocked out (i.e. does not play any more), the winner carries on. The winner of the tournament is the player that is left after all other players have been knocked out. Suppose there are 1234 players in a tournament. How many games are played before the tournament winner is decided?

III. Answer any 7 of the following questions:

[7 x 5 = 35]

19. Exchange the contents: Given two glasses marked A and B. Glass A is full of apple drink and glass B is full of grape drink. Write the specification for exchanging the contents of glasses A and B, and write a sequence of assignments to satisfy the specification.
20. Circulate the contents: Write the specification and construct an algorithm to circulate the contents of the variables A, B and C as shown below: The arrows indicate that B gets the value of A, C gets the value of B and A gets the value of C.



21. Decanting problem. You are given three bottles of capacities 5, 8, and 3 liters. The 8L bottle is filled with oil, while the other two are empty. Divide the oil in 8L bottle into two equal quantities. Represent the state of the process by appropriate variables. What are the initial and final states of the process? Model the decanting of oil from one bottle to another by assignment. Write a sequence of assignments to achieve the final state.
22. Trace the step-by-step execution of the algorithm for factorial (4).

factorial(n)

-- inputs : n is an integer , $n \geq 0$

-- outputs : $f = n!$

$f, i := 1, 1$

while $i \leq n$

$f, i := f \times i, i+1$

23. What is flowchart? What are the different boxes used in flow chart? Give example.

24. Assume an 8×8 chessboard with the usual coloring. "Recoloring" operation changes the color of all squares of a row or a column. You can recolor re-peatedly. The goal is to attain just one black square. Show that you cannot achieve the goal.

(Hint: If a row or column has b black squares, it changes by $(|8 - b) - b|$).

25. Power can also be defined recursively as

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1 if $n = 0$

$a \times a^{n-1}$ if n is odd

$a^{n/2} \times a^{n/2}$ if n is even

$a^n =$

Construct a recursive algorithm using this definition. How many multiplications are needed to calculate a^{10} ?

26. A single-square-covered board is a board of $2n \times 2n$ squares in which one square is covered with a single square tile.

Show that it is possible to cover this board with triominoes without overlap.

-----ALL THE BEST-----

70 marks will be converted to 100 marks

Test should be written under the supervision of your parents and get the answer paper signed from them.

No corrections should be made after the test timings. We expect your honesty.

Test Papers have to be submitted after the completion of all the 4 tests.

Submission Date of Test Papers: 1st December, 2nd December, 3rd December Timings: 9 AM – 12.30 PM / 5 PM- 7 PM