

ENTRANCE EXAMINATIONS – 2018
(Ph.D. Admissions - January 2019 Session)

Ph.D. in Computer Science

Time: 2 Hours

Max. Marks: 80

Hall Ticket Number:

INSTRUCTIONS

1. Write your Hall Ticket Number in the above box and on the OMR Sheet.
2. This test is for 2 hours duration carrying 80 marks.
3. This test is objective type and has two parts: Part A contains 40 questions on Research Methodology, and Part B contains 40 questions on Computer Science. Please make sure that all the questions are clearly printed in your paper.
4. Every correct answer gets 1 (one) mark. There is negative marking of 0.33 marks for every wrong answer.
5. All answers should be marked clearly in the OMR answer sheet only.
6. Do not use any other paper, envelope etc. for writing or doing rough work. All the rough work should be done in your question paper or on the sheets provided with the question paper at the end.
7. During the examination, anyone found indulging in copying or have any discussions will be asked to leave the examination hall.
8. Use of non-programmable calculator and log-table are allowed.
9. Use of mobile phone is strictly prohibited inside the hall.
10. Submit the OMR sheet to the invigilator before leaving the examination hall.

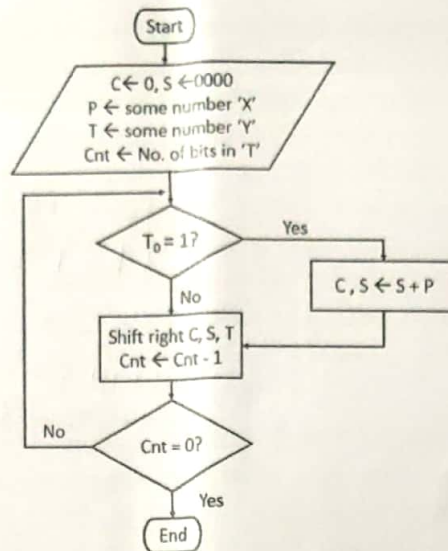
PART -A

1. A pilgrim covers half of his journey by bus at 60 km/h, two thirds of the remainder by auto at 20 km/h and the rest by walk at 4 km/h. The average speed of the tourist in km/h during his entire journey is
- A. 12
B. 15
C. 20
D. 25
2. The number of divisors of 2022 is
- A. 6
B. 7
C. 8
D. 3
3. The product of the ages of Ravi and Ramu is 260. If twice the age of Ravi is more than Ramu's age by 6 years, what is Ravi's age?
- A. 16
B. 14
C. 12
D. 13
4. The value of the expression $13^{112} \pmod{17}$
- A. 1
B. 4
C. 13
D. 16
5. How many positive integers less than 1000 are co-prime with 14?
- A. 571
B. 142
C. 429
D. None of these
6. There are 25 horses among which you need to find out the fastest 3 horses. You can conduct race among at most 5 to find out their relative speed. At no point you can find out the actual speed of the horse in a race. Find out how many races are required to get the top 3 horses.
- A. 5

- B. 6
C. 7
D. 8
7. A cube of side 1 unit is placed in such a way that the origin coincides with one of its vertices and the three (positive) axes along three of its edges. What are the co-ordinates of the vertex which is diagonally opposite to the vertex whose co-ordinates are (1, 0, 1)?
- A. (0, 0, 0)
B. (1, 1, 0)
C. (0, 1, 0)
D. (1, 1, 1)
8. If $pqr \neq 0$ and $p^{-x} = \frac{1}{q}$, $q^{-y} = \frac{1}{r}$, $r^{-z} = \frac{1}{p}$, what is the value of the product xyz ?
- A. -1
B. $\frac{1}{pqr}$
C. 1
D. pqr
- Handwritten solution for Q8:
 $p^x = q, q^y = r, r^z = p$
 $p^x q^y r^z = pqr$
 $xyz = 1$
9. The minimum number of cards to be dealt from an arbitrarily shuffled deck of 52 cards to guarantee that three cards are with same number is
- A. 14
B. 27
C. 30
D. 39
10. A container originally contains 10 litres of pure spirit. From this container 1 litre of spirit is replaced with 1 litre of water. Subsequently, 1 litre of the mixture is again replaced with 1 litre of water and this process is repeated one more time. How much spirit is now left in the container?
- A. 7 litres
B. 7.21 litres
C. 7.29 litres
D. 7.31 litres

Please answer the following questions Q??-?? based on the flowchart given below:

Note:- Here T_0 represents the least significant bit; C,S,T are stored in consecutive 9 bits where each variable can be accessed independently and shift operation is performed on the 9 bits representing C,S,T.



11. If the values of P and T are 1011 and 1101 respectively, then the contents of S and T at the end of execution are
- S = 1010, T = 1111
 - S = 1000, T = 1111
 - S = 1010, T = 1110
 - S = 1010, T = 1100
12. What kind of operation the flowchart performs?
- Unsigned Binary Division
 - Signed Binary Division
 - Unsigned Binary Multiplication
 - Signed Binary Multiplication
13. Given that T = 1010, the number of shift right operations performed is?
- 1
 - 2
 - 3
 - 4
14. What would be the smallest natural number which when divided by any of the numbers 20, 44 and 76 leaves a remainder 7 in each case is,
- 4187
 - 6047
 - 7987
 - 63847

15. 25 persons are in a room. 15 of them play hockey, 17 of them play football, 5 of them play chess, 13 of them play both hockey and football, 2 of them play both chess and hockey, 2 of them play both football and chess and none play all three games. Then the number of persons who play neither hockey nor football nor chess is:
- $h = 15$ $(h \cap f) = 13$
 $f = 17$ $(h \cap c) = 2$
 $c = 5$ $(f \cap c) = 2$
 $= 15 + 17 + 5 - 13 - 2 - 2 + 8$ $(h \cap f \cap c) = 8$
 $= 37 - 20 = 17$
- A. 4
B. 5
C. 7
D. 8
16. There are 5 bags labeled 1 to 5. All the coins in a given bag have the same weight. Some bags have coins of weight 10 gm, others have coins of weight 11 gm. I pick 1, 2, 4, 8, 16 coins respectively from bags 1 to 5. Their total weight comes out to 323 gm. Then the labels of the bags having 11 gm coins is
- $37 + 17$
 $20 + 8$
- A. 1, 2, 5
B. 2, 3, 4
C. 1, 3, 4
D. 2, 3, 5
17. Two parallel chords of length 30cm and 16cm are drawn on the opposite sides of the center of a circle with radius 17cm. The distance between the chords is
- A. 23cm
B. 21cm
C. 19cm
D. None of the above
18. In the year 1980, the age (in years) of a person was $\frac{1}{89}$ th of his year of birth. What is the age (in years) of this person in 2018?
- A. 54
B. 64
C. 80
D. 60

Read the passage carefully and answer Questions Q??-??.

The problems of heuristic programming - of making computers solve really difficult problems - are divided into five main areas: Search, Pattern Recognition, Learning, Planning, and Induction. Wherever appropriate, the discussion is supported by extensive citation of the literature and by descriptions of a few of the most successful heuristic (problem-solving) programs constructed to date.

The adjective "heuristic," as used here and widely in the literature, means related to improving problem-solving performance; as a noun it is also used in regard to any method or trick used to improve the efficiency of a problem-solving system. A "heuristic program," to be considered successful, must work well on a variety of problems, and may often be excused if it fails on some. We often find it worthwhile to introduce a heuristic method, which happens to cause occasional failures, if there is an over-all improvement in performance. But imperfect methods are not necessarily heuristic, nor vice versa. Hence "heuristic" should not be regarded as opposite to "foolproof"; this has caused some confusion in the literature.

19. What is heuristic programming?
- A. Making computers solve hard problems
 - B. Making computers do pattern recognition
 - C. Making computers solve problems by searching for a solution
 - D. Programming a unique solution to a hard problem
20. Which of the following is NOT a feature of a heuristic program?
- A. Works well on a large number of problems ✓
 - B. It is "foolproof"
 - C. Does not matter if it fails on certain instances of a problem ✓
 - D. Causes overall performance improvement ✓
21. To what does the boldface text, **the discussion**, in Paragraph 1 refer?
- A. Extremely hard problems
 - B. Development of "foolproof" solutions
 - C. Improving algorithm performance
 - D. Heuristic programming
22. What, according to the author, are divided into five main areas?
- A. Discussions on using computers to solve problems
 - B. Problems that require the use of heuristics
 - C. Descriptions of the most successful heuristic programs
 - D. Tricks to improve problem solving performance
23. Which of the following equations has the greatest number of real solutions?
- A. $x^2 + 5x - 7 = x + 8$
 - B. $x^3 = 10 - x$
 - C. $7x + 5 = 1 - 3x$
 - D. $e^x = x$

24. In a class, Chumley, Peter, Kennel, Donald, and Senthil are sitting on a bench. Chumley is sitting next to Peter, Kennel is sitting next to Donald. Donald is not sitting with Senthil. If Chumley and Senthil sit on either end of the bench where does Peter sit?

- A. Between Chumley and Donald
B. Between Donald and Senthil
C. Between Chumley and Kennel
D. Between Kennel and Senthil

PC
DKSPC
SPCDK

25. In an archery match, Peter's team got more score than David's team but not as many as Smith's team. Smith's team got more scores than Taiwa's team. Taiwa's team got less score than David's team. Which team is in second place in descending order of scores?

- A. Smith's team
B. Taiwa's team
C. David's team
D. Peter's team

Use the following table to answer Questions ?? - ??.

	2014		2015		2016		2017	
	PT	FT	PT	FT	PT	FT	PT	FT
Enrolled	2000	200	1600	400	1200	400	1000	500
Passed	45%	5%	40%	40%	40%	70%	50%	35%

26. Which year had the maximum pass percentage?
- A. 2014
B. 2015
C. 2016
D. 2017
27. Which year had maximum number of students passing?
- A. 2014
B. 2015
C. 2016
D. 2017
28. Which year had minimum number of students failing?
- A. 2014
B. 2015
C. 2016

$$\begin{aligned} 15 \times 20 &= 300 \\ 40 \times 16 &= 640 \\ 40 \times 12 &= 480 \\ 50 \times 10 &= 500 \end{aligned}$$

$$\frac{0 \times 2200}{100} = 1100$$

$$\frac{80}{100} \times 2000 = 1600$$

$$\frac{110}{100} \times 1600 = 1760$$

$$\frac{85}{100} \times 1500 = 1275$$

$$5 \times 2 = 10$$

$$40 \times 4$$

$$70 \times 4$$

$$35 \times 5$$

$$\begin{array}{r} 2251 \\ 16 \\ 11 \\ 16 \\ 16 \\ 16 \\ 176 \end{array}$$

$$\begin{array}{r} 85 \\ 15 \\ 2 \\ 425 \\ 854 \\ 1275 \end{array}$$

D. 2017

29. If QKKQUGQL is the code of OMISSION, which word is coded as RYVIWZB?

- A. PATKUBZ
B. BZWIVYR
C. BZWVIYR
D. PTAKBZU

A B C D E F G H I J K L M
3 Y X W V U T S R Q P O N
PAT

30. In a class of 90 students, where number of girls is twice that of boys, Shridhar ranked fourteenth from the top. If there are 10 girls ahead of Shridhar, how many boys are after him in rank?

- A. 22
B. 23
C. 25
D. 26

90
g = 26
b = 30, g = 60
10
-14
50

31. The average age of a group of 10 students is 14. The average age increases by 1 year when two new students joined the group. What is the average age of the two new students who joined the group?

- A. 15
B. 20
C. 21
D. 40

$x = 14 \Rightarrow 28$
15

10 \Rightarrow 14
12 \Rightarrow 15 = 18
 $\frac{46}{2}$

32. If a constant 1 is added to all the samples of a set of observations, which of the following statements is TRUE?

- A. While all the measures of central tendency of the set remain the same, all the measures of dispersion change.
B. While Mode of the set changes, Mean and Median of the set remain the same.
C. While Mean and Median of the set remain the same, Range and Standard Deviation of the set change.
D. While Mean and Median of the set change, Range and Standard Deviation of the set remain the same.

12 \times 15
15
12 6
 $\frac{180}{2}$

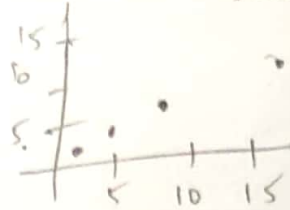
33. A set of alphabet consisting of n (n even) distinct symbols is used to construct a string of length $m \leq n$. If $m = \frac{n}{2}$, then how many strings can be constructed when no repetitions are allowed.

- A. $(n)(n-1)(n-2) \dots (\frac{n}{2} + 1)$
B. $n!$
C. $n(n+1)$

D. n^2

34. When the curves $Y = X^3$ and $Y = X^5$ are drawn in the X-Y plane, how many times do they intersect?

A. 1
B. 2
C. 3
D. 5



35. A young boy counted in the following way on the fingers of his left hand. He started by calling the thumb 1, the index finger 2, middle finger 3, ring finger 4, little finger 5, then reversed direction, calling the ring finger 6, middle finger 7, index finger 8, thumb 9, then back to the index finger for 10, middle finger for 11, and so on. He counted up to 1954; he ended up on his:

A. Thumb
B. Index Finger
C. Middle Finger
D. Ring Finger

36. How many real solutions does the equation $2^x - 2x = 0$ have?

A. No solutions
B. Infinite solutions
C. One
D. Two

37. Let $f(x) = x^2 \sin \frac{1}{x^2}$ for $x > 0$. Which of the following is a correct statement

A. f is unbounded
B. f is bounded by $\lim_{x \rightarrow \infty} f(x)$ does not exist
C. $\lim_{x \rightarrow \infty} f(x) = 0$
D. $\lim_{x \rightarrow \infty} f(x) = 1$

38. The equation of the circle that passes through the points $(1,0)$ and $(0,1)$ having the smallest radius is

A. $x^2 + y^2 = 1$
B. $x^2 + y^2 - x - y = 0$
C. $x^2 + y^2 - 2x - 2y + 1 = 0$
D. All of the above

39. The minimum value of $x^2 + y^2$ subject to $x + y = 1$ is

A. $\frac{1}{2}$

$$x^2 + y^2 + 2xy = 1$$

$$x^2 + y^2 = 1 - 2xy$$

- B. $\frac{1}{\sqrt{2}}$
 C. $\frac{1}{4}$
 D. 1

40. Let $f : R \rightarrow R^2$ be a function given by $f(x) = (x^m, x^n)$ where $x \in R$ and m, n are fixed positive integers. Suppose that f is one-one. Then
- A. both m and n must be odd
 B. atleast one of m and n must be odd
 C. exactly one of m and n must be odd
 D. neither m nor n can be odd

PART -B

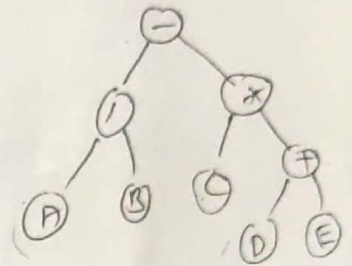
41. The postfix form for the prefix expression $-A/B * C + DE$ is

- A. $ABCDE + */ -$
 B. $ABC */ DE + -$
 C. $AB - C / DE + *$
 D. None of the above

$-ABC$

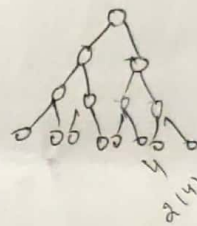
$-ABC */ DE +$

$ABC */ DE + -$



42. A full binary tree with n leaf nodes contains in total

- A. $2^n - 1$ nodes
 B. $2n - 1$ nodes
 C. $2n + 1$ nodes
 D. $n^2 - 1$ nodes



3
 $2n - 1 = 5$
 $2(5) - 1 = 5$

43. For a Zombie Process, which of the following choices is more appropriate?

- A. Process which has completed its execution by `exit()` system call but still has an entry in Process Table
 B. The process in terminated state
 C. Both (A) and (B) are true
 D. Only (A) is true

44. Let the page fault service time be 10ms in a computer with average memory access time being 20ns. If one page fault is generated for every 10^6 memory accesses, what is the closest effective access time for the memory?

- A. 21ns
 B. 30ns
 C. 23ns
 D. 35ns

45. Consider the methods used by processes P1 and P2 for accessing their critical sections whenever needed, as given below. The initial values of shared Boolean variables S1 and S2 are randomly assigned.

Method Used by P1	Method Used by P2
While (S1==S2); Critical Section S1=S2	While (S1 ≠ S2); Critical Section S2 = !(S1)

Which one of the following statements describes the properties achieved?

- A. Mutual exclusion but not progress
 B. Progress but not mutual exclusion
 C. Neither mutual exclusion nor progress
 D. Both mutual exclusion and progress
46. A process executes the following code
 for ($i = 0; i < n; i++$) fork;
 The total number of child processes created is
- A. n
 B. $2^n - 1$
 C. 2^n
 D. $2^{n+1} - 1$
47. A digital signaling system is required to operate at 9600 bps. If a signal element encodes a 4-bit word, what is the minimum required bandwidth of the channel?
- A. 1200 Hz
 B. 1400 Hz
 C. 1600 Hz
 D. 1900 Hz
48. Calculate the Polynomial code checksum (CRC) for a frame 1101011011 using the generator $G(x) = x^4 + x + 1$
- A. 1111
 B. 1110
 C. 1101
 D. 1100
49. This elementary problem begins to explore propagation delay and transmission delay, two central concepts in data networking. Consider two hosts, A and B, connected by a single link of rate R bps. Suppose that the two hosts are separated by m meters, and suppose the propagation speed along the link is s meters/sec. Host A is to send a packet of size L bits to Host B. Express the propagation delay, d_{prop} , in terms of m and s in seconds.

- A. m/s
- B. $(m - s)$
- C. $m * s$
- D. $m + s$

50. Which of the OSI layers handles each of the following:

- (i) Dividing the transmitted bit stream into frames.
- (ii) Determining which route through the subnet to use.

- ☒ A. (i) Data link layer. (ii) Network layer
- B. (i) Data link layer. (ii) Transport layer
- C. (i) Session layer. (ii) Network layer
- D. (i) Physical layer. (ii) MAC layer

51. The decimal equivalent of the hexadecimal IEEE format floating point number 0xC20F0000 is

- A. 35.25
- B. -35.25
- C. 35.75
- D. -35.75

52. In the following code snippet, which variable reference(s) exhibit temporal locality

```
sum = 0;
for (i = 0; i < n; i++)
    sum += a[i];
return sum;
```

- ☒ A. sum, i
- B. a[i]
- C. n
- D. none

Answer the following two questions Q?? and Q?? based on the following information.

Suppose a processor executes instructions in the following 4 stages (no pipeline), IF&ID, EX, MEM and WB. The IF&ID stage takes 10ns, EX stage 5ns, MEM stage 20ns and WB stage takes 5 ns to finish.

53. What is average time per instruction for the unpipelined implementation

- A. 20ns

- B. 10ns
C. 40ns
D. 5ns
54. What is approximately the average time per instruction for the 4-stage pipelined implementation
- A. 20ns
B. 10ns
C. 40ns
D. 5ns
55. A computer has a cache, main memory, and a disk used for virtual memory. If a referenced word is in the cache, 20 ns are required to access it. If it is in main memory but not in the cache, 60 ns are needed to load it into the cache, and then the reference is started again. If the word is not in main memory, 12 ns (12×10^6 ns) are required to fetch the word from disk, followed by 60ns to copy it to the cache, and then the reference is started again. The cache hit ratio is 0.9 and the main memory hit ratio is 0.6.
- What is the average time in nanoseconds(ns) required to access a referenced word on this system?
- A. 20
B. 80
C. 1200089
D. 480026
56. The four-byte sequence 0x86, 0x65, 0x53, 0x82 stored in consecutive memory cells in Little Endian architecture represents which of the following, when represented as a 32-bit signed integer in Hexadecimal format
- A. 82536586
B. 7DAC799A
C. 7DAC9A7A
D. None of the above
57. List which of the following is/are **NOT TRUE** with respect to a double linked list.
1. Can be traversed in both forward and backward directions
 2. Insertion is possible easily
 3. No extra space is needed for a previous pointer
- A. Only 1
B. Both 1 and 2
C. Only 3

D. All of 1, 2, 3

58. The relation scheme Student Performance(name, courseNo, rollNo, grade) has the following functional dependencies:

name, courseNo \rightarrow grade

rollNo, courseNo \rightarrow grade

name \rightarrow rollNo

rollNo \rightarrow name

The highest normal form of this relation scheme is

Left | Right
C No

A. 2NF

B. BCF

C. 4NF

D. 3NF

59. From the following instance of a relation scheme R (X, Y, Z), we can conclude that:

X	Y	Z
1	1	1
1	1	0
2	3	2
2	3	2

- A. X functionally determines Y and Y functionally determines Z
- B. Y does not functionally determine Z
- C. X does not functionally determine Y and Y does not functionally determine Z
- D. None of the above

60. The statement that is executed automatically by the system as a side effect of the modification of the database is

- A. trigger
- B. backup
- C. assertion
- D. recovery

61. Which of the following command is used to delete a table in SQL?

- A. delete
- B. truncate
- C. remove
- D. drop

62. What is the equivalent serial schedule for the following transactions?

T1	T2	T3
		R(Y)
		R(Z)
R(X)		
W(X)		
		W(Y)
		W(Z)
R(Y)		
W(Y)		
	R(Y)	
	W(Y)	
	R(X)	
	W(X)	

- A. T1-T2-T3
 B. T2-T1-T3
 C. T1-T3-T2
 D. T3-T1-T2

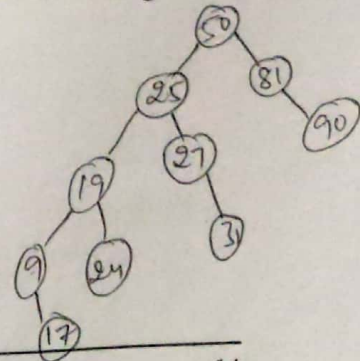
63. Given the STUDENTS relation as shown below, (StudentName, StudentAge) to be the key for this instance, the value X should NOT be equal to

StudentID	StudentName	StudentAge	CPI
2345	Shankar	X	9.4
1287	Swati	19	9.5
7853	Shankar	19	9.4
9876	Swati	18	9.3
8765	Ganesh	20	8.7
3465	Swati	21	9.3

- A. 18
 B. 19
 C. 20
 D. 21

64. The following numbers are entered into an empty binary search tree in the given order: 50, 25, 27, 81, 19, 9, 24, 31, 17, 90. What is the height of the binary search tree.

- A. 3
 B. 4
 C. 5
 D. 6



65. struct Node
 {

```

    struct Node *left;
    struct Node *right;
    void *data;
};

int doSomething(struct Node* root)
{
    if(root == NULL) return 0;
    if(root->left == NULL && root->right == NULL)
        return 1;
    return (doSomething(root->left) + doSomething(root->right));
}

```

What does the function **doSomething** compute, if we pass the root of a non-empty binary tree.

- A. The number of nodes in the binary tree
 - B. The height of the binary tree
 - C. Number of non-leaf nodes of the binary tree
 - D. Number of leaf nodes of the binary tree
66. Consider the following pseudo code. What is the total number of multiplications being performed?

```

p = 2
for i = 1 to n do
    for j = i to n do
        for k = j + 1 to n do
            p = p * 3

```

- A. $\frac{(n-1)n(n+1)}{6}$
 - ~~B. $\frac{(n-1)n(n+1)}{12}$~~
 - C. $\frac{n(n+1)(2n+1)}{6}$
 - D. $\frac{n(n+1)}{2}$
67. Which one of the following correctly determines a tight solution of the recurrence relation $T(n) = 2T(n/2) + \log_2 n$, with $T(1) = 1$?
- ~~A. $\theta(n \log n)$~~
 - B. $\theta(n^2)$
 - C. $\theta(\log n)$
 - D. $\theta(n)$
68. Consider an undirected random graph of 8 vertices. The probability that there is an edge between a pair of vertices is $1/2$. What is the expected number of unordered cycles of length 3?

- A. $1/8$
~~B. 1~~
 C. 7
 D. 8
69. The problem 3-SAT and 2-SAT are
 A. both in P
 B. both NP complete
~~C. NP-complete and in P respectively~~
 D. undecidable and NP-complete respectively
70. Given the following system of linear equations with solutions of the form (w, x, y, z) , where w, x, y, z being real, which of the following statements is NOT TRUE.

$$w + 3x + 2y + 2z = 0$$

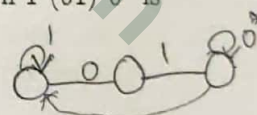
$$w + 4x + y = 0$$

$$3w + 5x + 10y + 14z = 0$$

$$2w + 5x + 5y + 6z = 0$$

- A. The system has infinitely many solutions
 B. The sum of any two solutions is a solution
 C. $(-5, 1, 1, 0)$ is a solution
 D. The system has no other solution other than a scalar multiple of $(-5, 1, 1, 0)$
71. Suppose L_1 and L_2 are languages on $\Sigma = \{0, 1\}$. Then the following statement is NOT True.
 A. If L_1 is regular then $\overline{L_1}$ is also regular
 B. If L_1 and L_2 are regular then $L_1 \cap L_2$ is regular
~~C. If L_1 and L_2 are Context Free languages(CFL) then $L_1 \cap L_2$ is a CFL~~
 D. If L_1 and L_2 are Context Free languages(CFL) then $L_1 \cdot L_2$ is a CFL
72. A string that is NOT generated by the Regular Expression $1^*(01)^*0^*$ is

- A. 00
 B. 10
 C. 010
~~D. 011~~

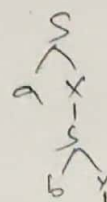
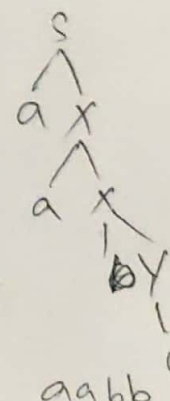


73. The language of the Context Free Grammar (CFG) given below is

$$S \rightarrow aX \mid bY$$

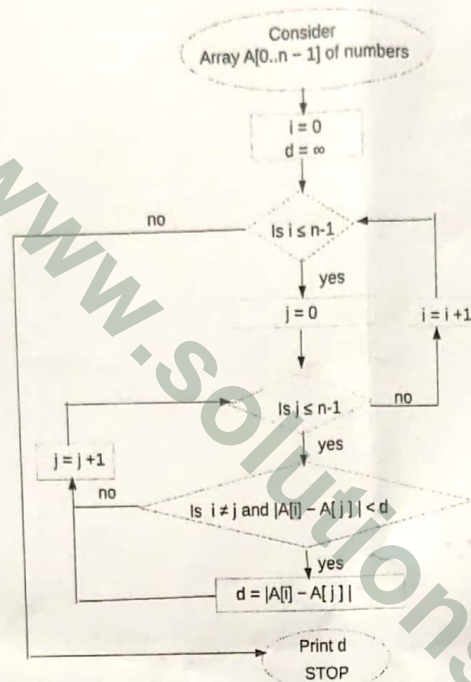
$$X \rightarrow aX \mid S \mid \epsilon$$

$$Y \rightarrow bY \mid S \mid \epsilon$$



- ☒ A. $a*b*$
 B. $(ab)^*$
 C. $(a+b)^*$
 D. None of the above

Please answer the following questions Q??-?? based on the flowchart given below:



74. Given the list $A = \{2, 6, 13, 8, 15\}$ of numbers, the value of d when $i = 2$ and $j = 3$ is

- A. 0
☒ B. 2
 C. 3
 D. 4

75. The flowchart determines the

- ☒ A. GCD of the numbers in A
☒ B. smallest of the numbers in A
 C. smallest difference between any pair of numbers in A
 D. largest difference between any pair of numbers in A

76. What is the time complexity if $j = 0$ is replaced by $j = i + 1$ in the flowchart?

- A. $\Theta(n)$
- ☒ B. $\Theta(n^2)$
- C. $\Theta(n \log n)$
- D. none of the above

77. What is the output of the following program:

```
int main()
{
    int a[5], i, b = 16 ;
    for(i = 0 ; i < 5 ; i++)
        a[i] = 2 * i ;
    f(a, b) ;
    for (i = 0 ; i < 5 ; i++)
        printf("%d ", a[i]) ;
    printf("%d", b) ;
}
```

```
f(int *x, int y)
{
    int i ;
    for(i = 0 ; i < 5 ; i++)
        *(x + i) += 2 ;
    y += 2 ;
}
```

- A. 4,6,8,10,12,16
- B. 2,4,6,8,10,26
- C. 2,4,6,8,10,18
- ☒ D. 2,4,6,8,10,16

78. What is the output of the following program:

```
int main()
{
    int n[3][3] = {2, 4, 3, 6, 8, 5, 3, 5, 1};
    int i, j;
    for(i = 0 ; i < 2 ; i++)
        for(j = 0 ; j < 2 ; j++)
            printf ("%d %d ", n[i][j], *( *( n + j ) + i) );
}
```

- ☒ A. 2,2,4,4,6,6,8,8
- B. 2,2,4,4,3,3,6,6
- C. 2,2,4,6,6,4,8,8

D. 2,2,6,4,4,6,8,8

79. Let $n = 4224165165$. Consider the statements p , q , r and s as below:

p : 3 divides n

q : 5 divides n

r : 7 divides n

s : 11 divides n

Which of the following logical expressions is TRUE?

A. $\bar{p} \wedge q \wedge r \wedge s$

B. $p \wedge \bar{q} \wedge r \wedge s$

☒ C. $p \wedge q \wedge \bar{r} \wedge s$

D. $p \wedge q \wedge r \wedge \bar{s}$

80. Given that $1591 = 37 \times 43$, the value of $2^{1513} \bmod 1591$ is

A. 1

B. 2

C. 4

D. 1024

Handwritten binary long division for $2^{1513} \bmod 1591$:

Divisor: 10011
Dividend: 1101011011 (11000111)

Steps shown:

- 10011 \times 10011 = 10011
- 10011 \times 10011 = 10011
- 10011 \times 10011 = 10011
- 00111
- 00000
- 11101
- 10011
- 11101
- 10011
- 1110