

उम्मीदवार इस पुस्तिका के सबसे ऊपरी शील को खोलकर पृष्ठ संख्या 2 और 3 के मध्य स्थापित OMR उत्तर शीट को निकालें।  
Candidates should open the top side of the seal of this Booklet and take out the OMR Answer Sheet placed at page no. 2 and 3.

पुस्तिका सं. :  
Booklet No. :

परीक्षा पुस्तिका श्रृंखला :  
Test Booklet Series :

A

BCS

निर्धारित समय : 180 मिनट  
Time Allowed : 180 Minutes

## परीक्षा प्रश्न-पुस्तिका / EXAMINATION QUESTION BOOKLET

## COMPUTER SCIENCE

अधिकतम अंक : 120  
Maximum Marks : 120

रोल नं.  
Roll No. :

उत्तर शीट सं.  
Answer Sheet No. :

प्रश्नों के उत्तर देने से पहले निम्नलिखित अनुदेशों को ध्यान से पढ़ लें। / Read the following instructions carefully before you begin to answer the questions.

## उम्मीदवारों के लिए अनुदेश

## Instructions to the Candidates

- प्रश्नों के उत्तर लिखना आरंभ करने से पहले आप इस पुस्तिका की जाँच करके सुनिश्चित कर लें कि इसमें पूरे पृष्ठ (1-24) हैं तथा कोई पृष्ठ या उसका भाग कम या दुवारा तो नहीं आ गया है। उम्मीदवारों को यह भी जाँच करनी है कि उनको केवल उस स्ट्रीम की सही परीक्षा-पुस्तिका मिली है जिसके लिए उन्होंने अपने देवन किया है और जो उनके Admit Card में छापा है अर्थात् कंप्यूटर साइंस या इलेक्ट्रॉनिक्स & कम्यूनिकेशन। यदि आप इस पुस्तिका में कोई त्रुटी पाएं, तो तत्काल इसके बदले दूसरी पुस्तिका ले।
- ओएमआर उत्तर-शीट प्रश्न-पुस्तिका में ही उपलब्ध रहेगी। कृपया सुनिश्चित करें कि ओएमआर शीट संख्या और परीक्षा पुस्तिका संख्या समान हैं। ओएमआर शीट पर जानकारी भरने से पहले ओएमआर शीट पर छपे निर्देशों को ध्यान से पढ़ें। आपको ओएमआर उत्तर-प्रत्रक पर सभी विवरणों को सही ढंग से पूरा और कोड करना होगा, ऐसा न करने पर आपकी उत्तर पुस्तिका का मूल्यांकन नहीं किया जा सकता है। प्रश्नों का उत्तर देना शुरू करने से पहले आपको ओएमआर उत्तर-प्रत्रक पर दिये गए निर्धारित स्थान पर अपने हस्ताक्षर करने होंगे। इन निर्देशों का पूर्ण रूप से पालन किया जाना चाहिए, ऐसा न करने पर आपकी ओएमआर उत्तर-पुस्तिका का मूल्यांकन नहीं किया जा सकता है।
- ओएमआर उत्तर-शीट तीन प्रतियों में होंगी (मूल तथा कार्बन के दो प्रतिलिपियाँ)। परीक्षा समाप्ति के बाद ओ.एम.आर. की मूल शीट तथा एक कार्बन प्रतिलिपि निरीक्षक को सौंपने के पश्चात् उम्मीदवार अपने साथ एक कार्बन प्रतिलिपि ले जा सकते/सकती हैं। यदि कोई भी उम्मीदवार ऐसा करने में असफल रहता/रहती है तो उसकी उम्मीदवारी रद्द कर दी जायेगी। यदि कोई उम्मीदवार अपनी कार्बन प्रतिलिपि में किसी भी प्रकार का फेरबदल कर उसका दावा करता/करती है तो इस रिस्तेति में भी उसका/उसकी उम्मीदवारी रद्द की जायेगी।
- इस प्रश्न-पुस्तिका में 120 बहुविकल्पीय प्रश्न हैं। प्रत्येक प्रश्न के 4 विकल्प दिए गए हैं, (A), (B), (C) और (D)। किसी भी रिस्तेति में प्रत्येक प्रश्न का केवल एक विकल्प ही सही उत्तर है। यदि आपको एक से अधिक विकल्प सही लगें तो सबसे अधिक उत्तर एक विकल्प का चुनाव करें और उत्तर शीट में सम्बद्धित प्रश्न के सामने वाले उपर्युक्त गोले को काला करें।
- प्रश्न पुस्तिका में दो भाग हैं: भाग A: सामान्य (42 प्रश्न) और भाग B: तकनीकी (78 प्रश्न)। उम्मीदवार को दोनों भागों के उत्तर लिखना अनिवार्य है।
- प्रत्येक सही उत्तर के लिए 1 अंक दिया जाएगा और प्रत्येक गलत उत्तर के लिए 0.25 अंक कट दिया जाएगा।
- गोले को काला करने के लिए केवल काले/बीले वॉल प्लाइंट पेन का प्रयोग करें। गोले को एक बार काला करने के बाद इसको मिटाने या बदलने की अनुमति नहीं है। यदि किसी प्रश्न के सामने एक से ज्यादा गोले काले किये गए हों तो मशीन द्वारा उसके लिए शून्य अंक दिया जाएगा।
- किसी भी रिस्तेति में उत्तर शीट को न मोड़ें।
- उत्तर-पुस्तिका पर कोई भी रफ कार्य नहीं करना है। रफ कार्य के लिए इस पुस्तिका में स्थान दिया जाया है।
- परीक्षा हॉल/कमरों में मोबाइल फ़ोन तथा बेतार संचार साधन पूरी तरह निषिद्ध हैं। उम्मीदवारों को उनके अपने हित में साला ही जाती है कि मोबाइल फ़ोन/किरी अन्य बेतार संचार साधन की विवर और करके भी अपने पास रखें। इस प्रवधान का अनुपालन न करने को परीक्षा में अनुचित उपायों का प्रयोग माना जायेगा और उनके विनिमय कार्यवाही की जाएगी, जिसमें उनकी उम्मीदवारी रद्द करना भी शामिल है।
- अभ्यर्थी अपनी उत्तर पुस्तिका पर्यावरक को सौंपने विना और अपने रोल नंबर के सामने उत्तर स्थान पर उपरिदित प्रत्रक पर हस्ताक्षर किए विना परीक्षा हॉल/कमरे से बाहर नहीं जा सकता। इसके अलावा अभ्यर्थी को उपरिदित प्रत्रक पर हस्ताक्षर करने से पहले यह भी सुनिश्चित करना चाहिए कि बुकलेट बंबर, बुकलेट सीरीज और ओएमआर उत्तर पुस्तिका संख्या सही ढंग से लिखी गई हो। ऐसा ना करने पर, ओएमआर उत्तर पुस्तिका को अमान्य माना जाएगा/मूल्यांकन नहीं किया जा सकता है।
- Candidate should not leave the examination hall / room without handing over his/her Answer-Sheet to the invigilator and without signing on the attendance sheet at proper place against your roll number, further candidate should also ensure that booklet no., booklet series and OMR Answer-Sheet No. are correctly written on attendance sheet before signing on it, failing in doing so, may lead to disqualification / no evaluation of OMR Answer-Sheet.

जब तक आपसे कहा न जाए तब तक प्रश्न-पुस्तिका न खोल / DO NOT OPEN THE QUESTION BOOKLET UNTIL YOU ARE TOLD TO DO SO.

उम्मीदवार का नाम/Name of Candidate : \_\_\_\_\_ उम्मीदवार के हस्ताक्षर/Signature of Candidate : \_\_\_\_\_

## PART - A GENERIC



4. A man rows downstream at 20 km/hr and rows upstream at 15 km/hr. At what speed he can row in still water ?  
(A) 17.5 km/hr      (B) 18 km/hr  
(C) 20.5 km/hr      (D) 22 km/hr

5. Following question contains four arguments of three sentences each. Choose the set in which the third statement is a logical conclusion of the first two.  
I. All envelopes are rectangles. All rectangles are rectangular. All envelopes are rectangular.  
II. Some things are smart. Some smart things are tiny. All things are tiny.  
III. Learneds are well read. Well read know. Learneds know.  
IV. Dieting is good for health. Health foods are rare. Dieting is rare.  
(A) IV only      (B) III only  
(C) Both I and III      (D) All of these

6. In a family of six persons A, B, C, D, E and F, there are two married couples. The family has equal number of male and female.  
(i) D is the grandmother of A and mother of B  
(ii) C is the wife of B and mother of F.  
(iii) F is the granddaughter of E.  
Which of the following is true?  
(A) A is the brother of F  
(B) A is the sister of F  
(C) D has two grandsons  
(D) None of these

7. The tops of two poles are connected by a wire. The heights of the poles are 10 m and 14 m respectively. If the wire makes a  $30^\circ$  angle with the horizontal, find the length of the wire ?  
(A) 7 m      (B) 7.5m  
(C) 8m      (D) 9.5m

8. The first republic day of India was celebrated on January 26, 1950. What day of the week was it ?  
 (A) Wednesday      (B) Friday  
 (C) Thursday      (D) Tuesday
9. What is the compound interest on Rs. 2500 for 2 years at rate of interest 4% per annum ?  
 (A) Rs. 180      (B) Rs. 204  
 (C) Rs. 210      (D) Rs. 220
10. Ten eggs are distributed among ABCD in ratio 1 : 2 : 3 : 4 randomly. It is known that A gets less eggs than B, and C gets more eggs than D. If A gets half the number of eggs of B, then which one of the following is necessarily true ?  
 (A) C gets an even number of eggs  
 (B) D gets an even number of eggs  
 (C) C gets an odd number of eggs  
 (D) D gets an odd number of eggs
11. It is 8.00 p.m., when can Hemant get next bus for Ramnagar from Dhanpur ?  
 (I) Buses for Ramnagar leave after every 30 minutes, till 10 p.m.  
 (II) Fifteen minutes ago, one bus has left for Ramnagar.  
 (A) If the data in statement I alone are sufficient to answer the question  
 (B) If the data in statement II alone are sufficient to answer the question.  
 (C) If the data either in I or II alone are sufficient to answer the question.  
 (D) If the data in both the statements together are needed.
12. Four years ago a man was 6 times as old as his son. After 16 years he will be twice as old as his son. What is the present age of man and his son ?  
 (A) 34, 9      (B) 33, 7  
 (C) 35, 5      (D) 36, 6
13. Gold is 19 times as heavy as water and copper 9 times as heavy as water. In what ratio should these metal be mixed so that the mixture may be 15 times as heavy as water ?  
 (A) 3 : 2      (B) 9 : 5  
 (C) 2 : 3      (D) 7 : 5
14. Find the odd one out :  
 4, 9, 256, 529, 573  
 (A) 256      (B) 573  
 (C) 529      (D) 9
15. Hypsiphobia: Height :: Hylophobia: ?  
 (A) Forests  
 (B) Animals  
 (C) Water  
 (D) All of the above
16. Ramesh and Suresh enter into a partnership with capitals in the ratio of 10 : 12. At the end of 8 months, Ramesh withdraws. If they receive profits in the ratio of 10 : 18. Find how long Suresh's capital was used.  
 (A) 7 months      (B) 8 months  
 (C) 10 months      (D) 12 months
17. Today it is Thursday. After 132 days, it will be :  
 (A) Monday      (B) Sunday  
 (C) Wednesday      (D) Thursday
18. If TOUR is written in a certain code as 1234, CLEAR as 56784 and SPARE as 90847, what will be the 5<sup>th</sup> Digit for SCULPTURE in the same code ?  
 (A) 3      (B) 4  
 (C) 6      (D) 0

19. In the following question, a number series is given with one term missing. Choose the correct alternative that will continue the same pattern and fill in the blank spaces.

97, 86, 73, 58, 45, (...)

(A) 24      (B) 34  
(C) 44      (D) 54

20. Which of the following set of letters complete the letter series, when sequentially placed at the gaps ?

- bc \_ca \_ aba \_ c\_ ca

(A) abcbb      (B) bbbcc  
(C) baaba      (D) abbcc

21. Which largest number of five digits is divisible by 99 ?

(A) 99999      (B) 99981  
(C) 99909      (D) 99990

22. In a race of 600 m, A can beat B by 50 m, and in another race of 500 m, B can beat C by 60 m. Then by how many meters will A beat C in a race of 400 meters ?

(A)  $77\frac{1}{3}$  m  
(B) 80 m  
(C) 70 m  
(D) None of these.

23. In a code, CORNER is written as GSVRIV. How can CENTRAL be written in that code?

(A) GIRXVEP      (B) GJRYVEP  
(C) GNFKJER      (D) DFOUSBM

24. Consider the following relationships among members of a family of six persons A, B, C, D, E and F :

  - (i) The number of males equals that of females.
  - (ii) A and E are sons of F.
  - (iii) D is the mother of two, one boy and one girl.
  - (iv) B is the son of A.
  - (v) There is only one married couple in the family at present.

Which one of the following inferences can be drawn from the above ?

  - (A) A, B and C are all females
  - (B) A is the husband of D
  - (C) E and F are children of D
  - (D) D is the daughter of F

25. Arrange the given words in alphabetical order and tick the one that comes at the second place.

  - (A) Interfere
  - (B) Interlude
  - (C) Intestine
  - (D) Interview

26. Choose the word which is least like the other words in the group :

  - (A) Shimmer
  - (B) Simmer
  - (C) Glimmer
  - (D) Glint

27. What is the average of first five multiples of 12 ?

  - (A) 36
  - (B) 38
  - (C) 40
  - (D) 42

28. The total number of digits used in numbering the pages of a book having 366 pages is :

  - (A) 730
  - (B) 792
  - (C) 990
  - (D) 1098



36. A clock is set at 4 am. It loses 16 minutes in 24 hours. What will be the correct time when the clock indicates 9 pm on the 4<sup>th</sup> day ?

- (A) 8 pm                    (B) 7 pm  
(C) 10 pm                (D) 11 pm

37. Assertion (A) : Increase in carbon dioxide would melt polar ice.

Reason (R) : Global temperature would rise.

- (A) Both (A) and (R) are true but (R) is not the correct explanation of (A)  
(B) Both (A) and (R) are true and (R) is the correct explanation of (A)  
(C) (A) is true but (R) is false.  
(D) (A) is false but (R) is true.

38. Sum of present age of Suresh and Dinesh is equal to the age of Hema six years back. Five years from now, the ratio of age of Suresh and Dinesh will be 3:2. Rajesh is 5 years older than Hema and his present age is four times the present age of Suresh. What is present age of the Dinesh ?

- (A) 1 year                    (B) 10 years  
(C) 2 years                (D) 12 years

39. In the following question, a statement is followed by two assumptions numbered I and II. Consider the statement and the following assumptions to decide which of the assumptions is implicit in the statement :

**Statement :** All the employees are notified that the organization will provide transport facilities at half the cost from the nearby railway station to the office except those who have been provided with travelling allowance.

**Assumption :**

- I. Most of the employees will travel by the office transport.  
II. Those who are provided with travelling allowance will not read such notice.  
(A) If only assumption I is implicit;  
(B) If either I or II is implicit;  
(C) If only assumption II is implicit;  
(D) If neither I nor II is implicit.

40. If the number 467X4 is divisible by 9, find the value of the digit marked as X.

- (A) 4                            (B) 5  
(C) 6                            (D) 7

41. P + Q means P is the brother of Q; P - Q means P is the mother of Q and P × Q means P is the sister of Q. Which of the following means M is the maternal uncle of R ?

- (A) M - R + K                    (B) M + K - R  
(C) M + K × R                (D) M + K + R

42. Three pipes A, B and C can fill a cistern in 8 minutes, 12 minutes and 16 minutes respectively. What is the time taken by three pipes to fill the cistern when they are opened together ?

- (A) 3.7 minutes                (B) 6 minutes  
(C) 4.5 minutes                (D) 5 minutes

## PART - B

### TECHNICAL



47. Consider the following types of languages :

  - L1 Regular,
  - L2: Context-free,
  - L3: Recursive,
  - L4: Recursively enumerable.

Which of the following is/are TRUE ?

  - I. L3' U L4 is recursively enumerable
  - II. L2 U L3 is recursive
  - III. L1\* U L2 is context-free
  - IV. L1 U L2' is context-free
  - (A) I only
  - (B) I and III only
  - (C) I and IV only
  - (D) I, II and III only

48. A bandlimited signal is sampled at the Nyquist rate. The signal can be recovered by passing the samples through :

  - (A) an RC filter
  - (B) an envelope detector
  - (C) a PLL
  - (D) an ideal low-pass filter with the appropriate bandwidth

49. A layer-4 firewall (a device that can look at all protocol headers up to the transport layer) CANNOT

  - (A) block entire HTTP traffic during 9:00PM and 5:00AM
  - (B) block all ICMP traffic
  - (C) stop incoming traffic from a specific IP address but allow outgoing traffic to the same IP address
  - (D) block TCP traffic from a specific user on a multi-user system during 9:00PM and 5:00AM

50. A sender uses the Stop-and-Wait ARQ protocol for reliable transmission of frames.

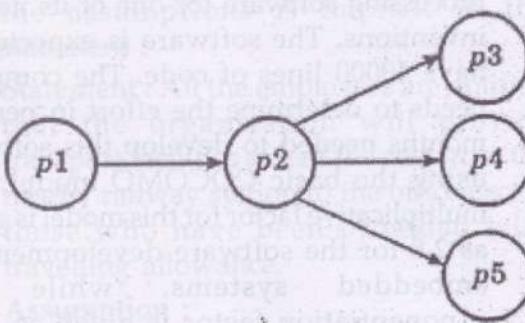
Frames are of size 1000 bytes and the transmission rate at the sender is 80 Kbps ( $1\text{Kbps} = 1000 \text{ bits/second}$ ). Size of an acknowledgement is 100 bytes and the transmission rate at the receiver is 8 Kbps. The one-way propagation delay is 100 milliseconds. Assuming no frame is lost, the sender throughput is \_\_\_\_\_ bytes/second.



51. Consider two hosts X and Y, connected by a single direct link of rate  $10^6$  bits/sec. The distance between the two hosts is 10,000 km and the propagation speed along the link is  $2 \times 10^8$  m/s. Hosts X send a file of 50,000 bytes as one large message to hosts Y continuously. Let the transmission and propagation delays be p milliseconds and q milliseconds, respectively. Then the values of p and q are :

- (A)  $p = 50$  and  $q = 100$
  - (B)  $p = 50$  and  $q = 400$
  - (C)  $p = 100$  and  $q = 50$
  - (D)  $p = 400$  and  $q = 50$

52. In a data flow diagram, the segment shown below is identified as having transaction flow characteristics, with p2 identified as the transaction center



A first level architectural design of this segment will result in a set of process modules with an associated invocation sequence. The most appropriate architecture is

- (A) p1 invokes p2, p2 invokes either p3, or p4, or p5
  - (B) p2 invokes p1, and then invokes p3, or p4, or p5
  - (C) A new module Tc is defined to control the transaction flow. This module Tc first invokes p1 and then invokes p2. p2 then invokes p3, or p4, or p5
  - (D) A new module Tc is defined to control the transaction flow. This module Tc invokes p2. p2 invokes p1, and then invokes p3, or p4, or p5

53. The routing table of a router is shown below:

Destination	Sub net mask	Interface
128.75.43.0	255.255.255.0	Eth0
128.75.43.0	255.255.255.128	Eth1
192.12.17.5	255.255.255.255	Eth3
default		Eth2

On which interfaces will the router forward packets addressed to destinations 128.75.43.16 and 192.12.17.10 respectively?

- (A) Eth1 and Eth2  
 (B) Eth0 and Eth2  
 (C) Eth0 and Eth3  
 (D) Eth1 and Eth3

54. Find out the maximum link speed at which a source can generate 1500-byte TCP payloads with packet lifetime of upto 120 msec before the 32-bit sequence numbers wrap around? Take into account TCP, IPv4, and Ethernet header overheads while doing all calculations.

(A) 137 Mbps      (B) 256 Mbps  
(C) 299 Mbps      (D) 512 Mbps

55. Suppose we are sorting an array of eight integers using heapsort, and we have just finished some heapify (either maxheapify or minheapify) operations. The array now looks like this :

16 14 15 10 12 27 28

How many heapify operations have been performed on root of heap ?

(A) 1      (B) 2  
(C) 3 or 4      (D) 5 or 6

56. Consider a disk pack with a seek time of 4 milliseconds and rotational speed of 10000 rotations per minute (RPM). It has 600 sectors per track and each sector can store 512 bytes of data. Consider a file stored in the disk. The file contains 2000 sectors. Assume that every sector access necessitates a seek, and the average rotational latency for accessing each sector is half of the time for one complete rotation. The total time (in milliseconds) needed to read the entire file is \_\_\_\_\_.

(A) 14020      (B) 14000  
(C) 25030      (D) 15000

57. Consider the following C code :

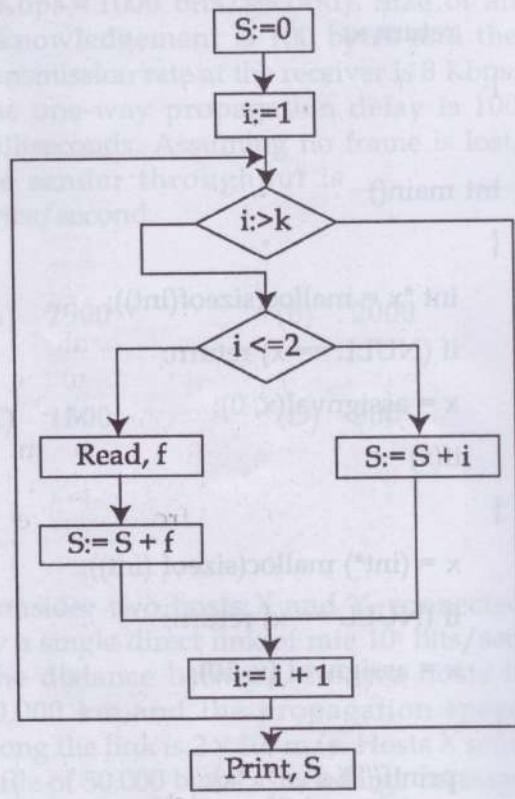
```
#include <stdio.h>
int * assignval (int *x, int val)
{
    *x = val;
    return x;
}

int main()
{
    int *x = malloc(sizeof(int));
    if (NULL == x) return;
    x = assignval(x, 0);
    if(x)
        x = (int*) malloc(sizeof (int));
    if (NULL == x) return;
    x = assignval (x, 10);
    printf("%d\n", *x);
    free(x);
}
```

The code suffers from which one of the following problems:

- (A) compiler error as the return of malloc is not typecast appropriately.  
(B) compiler error because the comparison should be made as  $x==NULL$  and not as shown.  
(C) compiles successfully but execution may result in dangling pointer.  
(D) compiles successfully but execution may result in memory leak.

58. To carry out white box testing of a program, its flow chart representation is obtained as shown in the figure below



For basis path based testing of this program, its cyclomatic complexity is

- (C) 3 (D) 2

59. Let R (A, B, C, D) be a relational schema with the following functional dependencies:

$$A \rightarrow B, B \rightarrow C,$$

$C \rightarrow D$  and  $D \rightarrow B$ .

## The decomposition of R into

- (A, B), (B, C), (B, D)

  - (A) gives a lossless join, and is dependency preserving
  - (B) gives a lossless join, but is not dependency preserving
  - (C) does not give a lossless join, but is dependency preserving
  - (D) does not give a lossless join and is not dependency preserving

60. Which of the following relational calculus expressions is not safe ?

- (a)  $\{t | \exists u \in R_1(t[A] = u[A]) \wedge \neg \exists s \in R_2(t[A] = s[A])\}$

(b)  $\{t | \forall u \in R_1(u[A] = "x") \Rightarrow \exists s \in R_2(t[A] = s[A] \wedge s[A] = u[A]))\}$

(c)  $\{t | \neg(t \in R_1)\}$

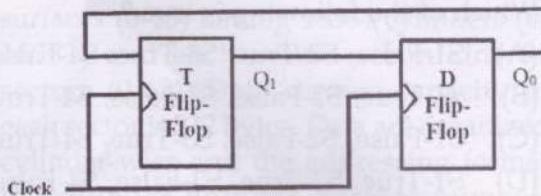
(d)  $\{t | \exists u \in R_1(t[A] = u[A]) \wedge \exists s \in R_2(t[A] = s[A])\}$

61. Consider a machine with 40 MHz processor which has run a benchmark program. The executed program consists of 100,000 instruction executions, with the following instruction mix and clock cycle count. What will be the effective CPI, MIPS rate, and execution time.

Instruction Type	Instruction Count	Cycles/Instructions
Integer arithmetic	45000	1
Data Transfer	32000	2
Floating point	15000	2
Control transfer	8000	2

- (A) CPI: 3.55; MIPS: 30; Execution time: 1.87 ms
- (B) CPI: 1.55; MIPS: 25.8; Execution time: 3.87 ms
- (C) CPI: 5.60; MIPS: 45.8; Execution time: 2.87 ms
- (D) CPI: 2.55; MIPS: 35.8; Execution time: 4.87 ms

62. Consider a combination of T and D flip-flops connected as shown below. The output of the D flipflop is connected to the input of the T flip-flop and the output of the T flip-flop is connected to the input of the D flip-flop.



Initially, both  $Q_0$  and  $Q_1$  are set to 1 (before the 1st clock cycle). The outputs \_\_\_\_\_

- (A)  $Q_1 Q_0$  after the 3rd cycle are 11 and after the 4th cycle are 00 respectively
- (B)  $Q_1 Q_0$  after the 3rd cycle are 11 and after the 4th cycle are 01 respectively
- (C)  $Q_1 Q_0$  after the 3rd cycle are 00 and after the 4th cycle are 11 respectively
- (D)  $Q_1 Q_0$  after the 3rd cycle are 01 and after the 4th cycle are 01 respectively

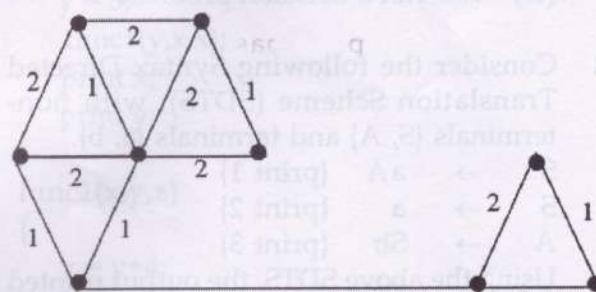
63. A Young tableau is a 2D array of integers increasing from left to right and from top to bottom. Any unfilled entries are marked with  $\infty$ , and hence there cannot be any entry to the right of, or below a  $\infty$ . The following Young tableau consists of unique entries.

1	2	5	14
3	4	6	23
10	12	18	25
31	$\infty$	$\infty$	$\infty$

When an element is removed from a Young tableau, other elements should be moved into its place so that the resulting table is still a Young tableau (unfilled entries may be filled in with a  $\infty$ ). The minimum number of entries (other than 1) to be shifted, to remove 1 from the given Young tableau is \_\_\_\_\_.

- (A) 2
- (B) 5
- (C) 6
- (D) 18

64. The number of distinct minimum spanning trees for the weighted graph below is \_\_\_\_\_.



- (A) 4
- (B) 5
- (C) 6
- (D) 7

65. Host A sends a UDP datagram containing 8880 bytes of user data to host B over an Ethernet LAN. Ethernet frames may carry data up to 1500 bytes (i.e. MTU = 1500 bytes). Size of UDP header is 8 bytes and size of IP header is 20 bytes. There is no option field in IP header. How many total number of IP fragments will be transmitted and what will be the contents of offset field in the last fragment ?  
 (A) 6 and 925      (B) 6 and 7400  
 (C) 7 and 1110      (D) 7 and 8880

66. The first order logic statement  $((R \vee Q) \wedge (P \vee \sim Q))$  is equivalent to which of the following ?  
 (A)  $((R \vee \sim Q) \wedge (P \vee \sim Q) \wedge (R \vee P))$   
 (B)  $((R \vee Q) \wedge (P \vee \sim Q) \wedge (R \vee P))$   
 (C)  $((R \vee Q) \wedge (P \vee \sim Q) \wedge (R \vee \sim P))$   
 (D)  $((R \vee Q) \wedge (P \vee \sim Q) \wedge (\sim R \vee P))$

67. Consider the following problem X.  
 Given a Turing machine M over the input alphabet  $\Sigma$ , any state q of M And a word  $w \in \Sigma^*$ , does the computation of M on w visit the state q ?  
 Which of the following statements about X is correct ?  
 (A) X is decidable  
 (B) X is undecidable but partially decidable  
 (C) X is undecidable and not even partially decidable  
 (D) X is not a decision problem

68. Consider the following Syntax Directed Translation Scheme (SDTS), with non-terminals {S, A} and terminals {a, b}.
- |        |           |
|--------|-----------|
| S → aA | {print 1} |
| S → a  | {print 2} |
| A → Sb | {print 3} |
- Using the above SDTS, the output printed by a bottom-up parser, for the input aab is :  
 (A) 1 3 2      (B) 2 2 3  
 (C) 2 3 1      (D) Syntax Error

69. Match the following :

List-I	List-II
(P) Condition coverage	(1) Black-box testing
(Q) Equivalence class partitioning	(2) System testing
(R) Volume testing	(3) White-box testing
(S) Alpha testing	(4) Performance testing

Codes :

P	Q	R	S
(I)	(2)	(3)	(1) (4)
(II)	(3)	(4)	(2) (1)
(III)	(3)	(1)	(4) (2)
(IV)	(3)	(1)	(2) (4)
(A)	(I)		(B) (II)
(C)	(III)		(D) (IV)

70. Given the function  $F = P' + QR$ , where F is a function in three Boolean variables P, Q and R and  $P' = \neg P$ , consider the following statements.

- S1:  $F = \sum (4, 5, 6)$   
 S2:  $F = \sum (0, 1, 2, 3, 7)$   
 S3:  $F = \prod (4, 5, 6)$   
 S4:  $F = \prod (0, 1, 2, 3, 7)$

Which of the following is true ?

- (A) S1-False, S2-True, S3-True, S4-False  
 (B) S1-True, S2-False, S3-False, S4-True  
 (C) S1-False, S2-False, S3-True, S4-True  
 (D) S1-True, S2-True, S3-False, S4-False

71. Consider sinusoidal modulation in an AM systems. Assuming no over modulation, the modulation index ( $\mu$ ) when the maximum and minimum values of the envelope, respectively, are 3V and 1V is

- (A) 0.1      (B) 0  
 (C) 0.3      (D) 0.5



77. What does the following C-statement declare?

```
int ( * f) (int * );
```

- (A) A function that takes an integer pointer as argument and returns an integer.
- (B) A function that takes an integer as argument and returns an integer pointer.
- (C) A pointer to a function that takes an integer pointer as argument and returns an integer.
- (D) A function that takes an integer pointer as argument and returns a function pointer

78. Match the following:

- |                        |  |
|------------------------|--|
| (1) Waterfall model    | (a) Specifications can be developed incrementally      |
| (2) Evolutionary model | (b) Inflexible partitioning of the project into stages |
| (3) Component-based    | (c) Explicit recognition of risk software engineering  |
| (4) Spiral development | (d) Requirements compromises are inevitable            |
- (A) (1)-(a), (2)-(c), (3)-(b), (4)-(d)
  - (B) (1)-(b), (2)-(a), (3)-(d), (4)-(c)
  - (C) (1)-(d), (2)-(b), (3)-(a), (4)-(c)
  - (D) (1)-(c), (2)-(a), (3)-(b), (4)-(d)

79. A single array  $A[1..MAXSIZE]$  is used to implement two stacks. The two stacks grow from opposite ends of the array. Variables  $\text{top 1}$  and  $\text{top 2}$  ( $\text{top1} < \text{top 2}$ ) point to the location of the topmost element in each of the stacks. If the space is to be used efficiently, the condition for "stack full" is :

- (A)  $(\text{top1} = \text{MAXSIZE}/2)$  and  $(\text{top2} = \text{MAXSIZE}/2 + 1)$
- (B)  $\text{top1} + \text{top2} = \text{MAXSIZE}$
- (C)  $(\text{top1} = \text{MAXSIZE}/2)$  or  $(\text{top2} = \text{MAXSIZE})$
- (D)  $\text{top1} = \text{top2} - 1$

80. Consider these two functions and two statements S1 and S2 about them

```
int work1(int *a, int i, int j)
{
    int x = a[i+2];
    a[j] = x+1;
    return a[i+2] - 3;
}

int work2(int *a, int i, int j)
{
    int t1 = i+2;
    int t2 = a[t1];
    a[j] = t2+1;
    return t2 - 3;
}
```

S1 : The transformation form work1 to work2 is valid, i.e., for any program state and input arguments, work2 will compute the same output and have the same effect on program state as work1

S2 : All the transformations applied to work1 to get work2 will always improve the performance (i.e reduce CPU time) of work2 compared to work1

- (A) S1 is false and S2 is false
- (B) S1 is false and S2 is true
- (C) S1 is true and S2 is false
- (D) S1 is true and S2 is true

81. Consider the following two phase locking protocol. Suppose a transaction T accesses (for read or write operations), a certain set of objects {O<sub>1</sub>, ..., O<sub>k</sub>}. This is done in the following manner:

Step 1. T acquires exclusive locks to O<sub>1</sub>, ..., O<sub>k</sub> in increasing order of their addresses.

Step 2. The required operations are performed.

Step 3. All locks are released.

This protocol will

- (A) guarantee serializability and deadlock-freedom
- (B) guarantee neither serializability nor deadlock-freedom
- (C) guarantee serializability but not deadlock-freedom
- (D) guarantee deadlock-freedom but not serializability

82. In binary data transmission DPSK is preferred to PSK because :

- (A) a coherent carrier is not required to be generated at the receiver
- (B) for a given energy per bit, the probability of error is less
- (C) the 1800 phase shifts of the carrier are unimportant
- (D) more protection is provided against impulse noise

83. Let T be a binary search tree with 15 nodes. The minimum and maximum possible heights of T are :

The height of a tree with a single node is 0.

- (A) 4 and 15 respectively
- (B) 3 and 14 respectively
- (C) 4 and 14 respectively
- (D) 3 and 15 respectively

84. Consider the following two functions

```
void fun1(int n)
{
    if(n == 0) return;
    printf("%d", n);
    fun2(n-2);
    printf("%d", n);
}
void fun2(int n)
{
    if(n == 0) return;
    printf("%d", n);
    fun1(++n);
    printf("%d", n);
}
```

The output printed when fun1(5) is called is :

- (A) 53423122233445
- (B) 53423120112233
- (C) 53423122132435
- (D) 53423120213243

85. Given the following schema :

employees(emp-id, first-name, last-name, hire-date, dept-id, salary)  
departments(dept-id, dept-name, manager-id, location-id)

You want to display the last names and hire dates of all latest hires in their respective departments in the location ID 1700. You issue the following query :

```
SQL> SELECT last-name, hire-date
  FROM employees
 WHERE (dept-id, hire-date) IN (SELECT
  dept-id, MAX(hire-date)
  FROM employees JOIN departments
  USING(dept-id)
  WHERE location-id = 1700
  GROUP BY (dept-id);
```

What is the outcome ?

- (A) It executes but does not give the correct result.
- (B) It executes and gives the correct result.
- (C) It generates an error because of pairwise comparison.
- (D) It generates an error because the GROUP BY clause cannot be used with table joins in a subquery



94. Which of the following scenarios may lead to an irrecoverable error in a database system?
- A transaction writes a data item after it is read by an uncommitted transaction
  - A transaction reads a data item after it is read by an uncommitted transaction
  - A transaction reads a data item after it is written by a committed transaction
  - A transaction reads a data item after it is written by an uncommitted transaction

95. The atomic fetch-and-set  $x, y$  instruction unconditionally sets the memory location  $x$  to 1 and fetches the old value of  $x$  in  $y$  without allowing any intervening access to the memory location  $x$ . Consider the following implementation of P and V functions on a binary semaphore S.

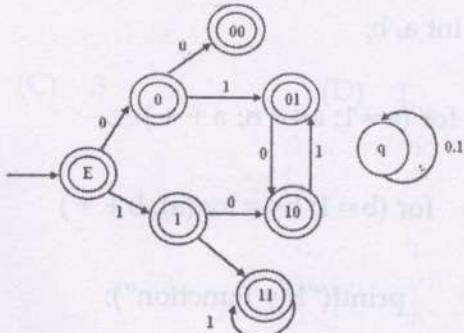
```
void P (binary_semaphore *s)
{
    unsigned y;
    unsigned *x = &(s->value);
    do
    {
        fetch-and-set x, y;
    }
    while (y);
}

void V (binary_semaphore *s)
{
    S->value = 0;
}
```

Which one of the following is true?

- The implementation may not work if context switching is disabled in P
- Instead of using fetch-and-set, a pair of normal load/store can be used
- The implementation of V is wrong
- The code does not implement a binary semaphore

96. Consider the set of strings on  $\{0,1\}$  in which, every substring of 3 symbols has at most two zeros. For example, 001110 and 011001 are in the language, but 100010 is not. All strings of length less than 3 are also in the language. A partially completed DFA that accepts this language is shown below.



The missing arcs in the DFA are

	00	01	10	11	q
00	1	0			
01				1	
10	0				
11			0		

	00	01	10	11	q
00		0			1
01		1			
10			1	0	
11		0			

	00	01	10	11	q
00		1			0
01		1			
10			0		
11		0			

	00	01	10	11	q
00		1			0
01				1	
10	0				
11			0		

97. What is the time complexity of the following function ?

```

void myfun()
{
    int a, b;
    for (a = 1; a <= n; a++)
        for (b = 1; b <= log(a); b++)
            printf("My Function");
}

```

- (A)  $\theta(n)$
- (B)  $\theta(n^2)$
- (C)  $\theta(n \log n)$
- (D)  $\theta(n^2 \log n)$

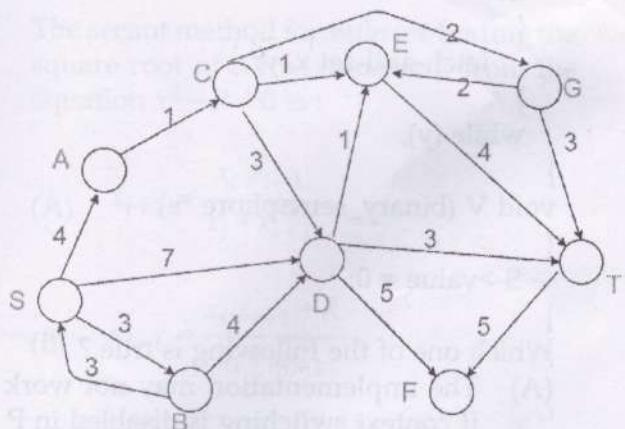
98. Flat top sampling of low pass signals \_\_\_\_\_.

- (A) gives rise to aperture effect
- (B) implies oversampling
- (C) leads to aliasing
- (D) introducing delay distortion

99. Consider three processes, all arriving at time zero, with total execution time of 10, 20 and 30 units, respectively. Each process spends the first 20% of execution time doing I/O, the next 70% of time doing computation, and the last 10% of time doing I/O again. The operating system uses a shortest remaining compute time first scheduling algorithm and schedules a new process either when the running process gets blocked on I/O or when the running process finishes its compute burst. Assume that all I/O operations can be overlapped as much as possible. For what percentage of time does the CPU remain idle ?

- (A) 0 %
- (B) 10.6 %
- (C) 30.0 %
- (D) 89.4 %

100. Consider the directed graph shown in the figure below. There are multiple shortest paths between vertices S and T. Which one will be reported by Dijkstra's shortest path algorithm? Assume that, in any iteration, the shortest path to a vertex v is updated only when a strictly shorter path to v is discovered.



- (A) SDT
- (B) SBDT
- (C) SACDT
- (D) SACET

101. The employee information in a company is stored in the relation

Employee (name, sex, salary, deptName)

Consider the following SQL query

select deptName

from Employee

where sex = 'M'

group by deptName

having avg (salary) > (select avg (salary) from Employee)

It returns the names of the department in which \_\_\_\_\_

- (A) the average salary is more than the average salary in the company
- (B) the average salary of male employees is more than the average salary of all male employees in the company
- (C) the average salary of male employees is more than the average salary of employees in the same department
- (D) the average salary of male employees is more than the average salary in the company

102. Consider the following two statements :

- (i) A hash function (these are often used for computing digital signatures) is an injective function.
- (ii) encryption technique such as DES performs a permutation on the elements of its input alphabet.

Which one of the following options is valid for the above two statements ?

- (A) Both are false
- (B) Statement (i) is true and the other is false
- (C) Statement (ii) is true and the other is false
- (D) Both are true

103. A connected planar graph having 6 vertices, 7 edges contains \_\_\_\_\_ regions.

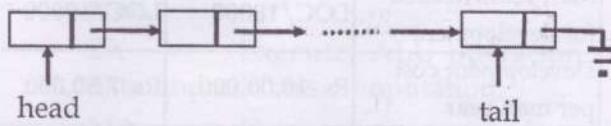
(A) 15

(B) 11

(C) 3

(D) 1

104. A queue is implemented using a non-circular singly linked list. The queue has a head pointer and a tail pointer, as shown in the figure. Let n denote the number of nodes in the queue. Let 'enqueue' be implemented by inserting a new node at the head, and 'dequeue' be implemented by deletion of a node from the tail.



Which one of the following is the time complexity of the most time-efficient implementation of 'enqueue' and 'dequeue', respectively, for this data structure ?

(A)  $\Theta(1), \Theta(1)$       (B)  $\Theta(1), \Theta(n)$

(C)  $\Theta(n), \Theta(1)$       (D)  $\Theta(n), \Theta(n)$

105. A 1 MHz sinusoidal carrier is amplitude modulated by a symmetrical square wave of period 100  $\mu$ sec. Which of the following frequencies will not be present in the modulated signal ?
- (A) 990 kHz      (B) 1010 kHz  
 (C) 1020 kHz      (D) 1030 kHz
106. A company needs to develop a strategy for software product development for which it has a choice of two programming languages L1 and L2. The number of lines of code (LOC) developed using L2 is estimated to be twice the LOC developed with L1. The product will have to be maintained for five years. Various parameters for the company are given in the table below.
- | Parameter                        | Language L1   | Language L2  |
|----------------------------------|---------------|--------------|
| Man years needed for development | LOC/10000     | LOC/10000    |
| Development cost per man year    | Rs. 10,00,000 | Rs. 7,50,000 |
| Maintenance time                 | 5 years       | 5 years      |
| Cost of maintenance per year     | Rs. 1,00,000  | Rs. 50,000   |
- Total cost of the project includes cost of development and maintenance. What is the LOC for L1 for which the cost of the project using L1 is equal to the cost of the project using L2 ?
- (A) 4000      (B) 5000  
 (C) 4333      (D) 4667
107. The particular solution of the recurrence relation  $a_{r+2} - 4a_{r+1} + 4a_r = 2^r$  is :
- (A)  $r \cdot 2^r$       (B)  $r(r-1)2^{r-1}$   
 (C)  $r(r-1)2^{r-2}$       (D)  $r(r-1)2^{r-3}$
108. A message is made up entirely of characters from the set  $X = \{P, Q, R, S, T\}$ . The table of probabilities of each character is shown below :
- | Character | Probability |
|-----------|-------------|
| P         | 0.22        |
| Q         | 0.34        |
| R         | 0.17        |
| S         | 0.19        |
| T         | 0.08        |
| Total     | 1           |
- A message of 100 characters over X is encoded using Huffman coding. Then the expected length of the encoded message in bits is \_\_\_\_\_.
- (A) 225      (B) 226  
 (C) 227      (D) 228

109. An operating system uses the Banker's algorithm for deadlock avoidance when managing the allocation of three resource types X, Y, and Z to three processes P0, P1, and P2. The table given below presents the current system state. Here, the Allocation matrix shows the current number of resources of each type allocated to each process and the Max matrix shows the maximum number of resources of each type required by each process during its execution.

	Allocation			Max		
	X	Y	Z	X	Y	Z
P0	0	0	1	8	4	3
P1	3	2	0	6	2	0
P2	2	1	1	3	3	3

There are 3 units of type X, 2 units of type Y and 2 units of type Z still available. The system is currently in a safe state. Consider the following independent requests for additional resources in the current state:

REQ1: P0 requests 0 units of X,

0 units of Y and 2 units of Z

REQ2: P1 requests 2 units of X,

0 units of Y and 0 units of Z

Which one of the following is TRUE ?

- (A) Only REQ1 can be permitted.
- (B) Only REQ2 can be permitted.
- (C) Both REQ1 and REQ2 can be permitted.
- (D) Neither REQ1 nor REQ2 can be permitted

110. What is the appropriate pairing of items in the two columns listing various activities encountered in a software life cycle ?

- |                    |  |
|--------------------|--|
| (P) Requirements   | (1) Module Development and Integration |
| Capture            |  |
| (Q) Design         | (2) Domain Analysis                    |
|                    |  |
| (R) Implementation | (3) Structural and Behavioral Modeling |
|                    |  |
| (S) Maintenance    | (4) Performance Tuning                 |
|                    |  |
- (A) (P)-(3), (Q)-(2), (R)-(4), (S)-(1)
  - (B) (P)-(2), (Q)-(3), (R)-(1), (S)-(4)
  - (C) (P)-(3), (Q)-(2), (R)-(1), (S)-(4)
  - (D) (P)-(2), (Q)-(3), (R)-(4), (S)-(1)

111. A 5 stage pipelined CPU has the following sequence of stages :

IF — Instruction fetch from instruction memory,

RD — Instruction decode and register read,

EX — Execute: ALU operation for data and address computation,

MA — Data memory access - for write access, the register read at RD stage is used,

WB — Register write back.

Consider the following sequence of instructions :

I1 : L R0, 1oc1;      R0 <= M[1oc1]

I2 : A R0, R0;      R0 <= R0 + R0

I3 : S R2, R0;      R2 <= R2 - R0

Let each stage take one clock cycle.

What is the number of clock cycles taken to complete the above sequence of instructions starting from the fetch of I1 ?

- (A) 8
- (B) 10
- (C) 12
- (D) 15

112. What is the time complexity of the following recursive function :

```
int DoSomething (int n)
{
    if (n <= 2)
        return 1;
    else
        return (DoSomething (floor(sqrt(n))) + n);
}
```

(A)  $\Theta(n)$                           (B)  $\Theta(n\log n)$   
(C)  $\Theta(\log n)$                       (D)  $\Theta(\log \log n)$

113. Which of the following are true ?

- (I) A programming language which does not permit global variables of any kind and has no nesting of procedures/functions, but permits recursion can be implemented with static storage allocation
  - (II) Multi-level access link (or display) arrangement is needed to arrange activation records only if the programming language being implemented has nesting of procedures/functions
  - (III) Recursion in programming languages cannot be implemented with dynamic storage allocation
  - (IV) Nesting of procedures/functions and recursion require a dynamic heap allocation scheme and cannot be implemented with a stack-based allocation scheme for activation records
  - (V) Programming languages which permit a function to return a function as its result cannot be implemented with a stack-based storage allocation scheme for activation records
- (A) (II) and (V) only  
(B) (I), (III) and (IV) only  
(C) (I), (II) and (V) only  
(D) (II), (III) and (V) only

114. The function  $f(x, y) = x^2 + y^2 + 6x + 12$  has :

- (A) minimum value, -3 and maximum value, 0.
- (B) only minimum value, 3.
- (C) only maximum value, 12.
- (D) neither maxima nor minima.

115. The Eigen values of a matrix

$$A = \begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$$
 are -3, -3 and 5,

then the trace of the matrix  $A^3 - 3A^2$  is :

- (A) 200                                  (B) 71  
(C) -58                                (D) -200

116. 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

- (A) 2 NF                                  (B) 3 NF  
(C) BCNF                                (D) 4NF

117. The upper triangular matrix U in the LU-decomposition of the matrix given below :

$$\begin{bmatrix} 1 & -2 & 3 \\ 2 & -5 & 8 \\ 1 & 2 & -10 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ l_{21} & 1 & 0 \\ l_{31} & l_{32} & 1 \end{bmatrix}$$

$$\begin{bmatrix} u_{11} & u_{12} & u_{13} \\ 0 & u_{22} & u_{23} \\ 0 & 0 & u_{33} \end{bmatrix}, \text{ is :}$$

- (A)  $\begin{bmatrix} 1 & 0 & 0 \\ 2 & 1 & 0 \\ 1 & -4 & 1 \end{bmatrix}$

(B)  $\begin{bmatrix} 1 & -2 & 3 \\ 0 & 1 & -6 \\ 0 & 0 & 1 \end{bmatrix}$

(C)  $\begin{bmatrix} 1 & -2 & 3 \\ 0 & -1 & 6 \\ 0 & 0 & 11 \end{bmatrix}$

(D)  $\begin{bmatrix} 1 & -2 & 3 \\ 0 & -1 & 6 \\ 0 & 0 & 10 \end{bmatrix}$

118. Consider the expression

$$(a - 1) * (((b + c) / 3) + d)).$$

Let  $X$  be the minimum number of registers required by an optimal code generation (without any register spill) algorithm for a load/store architecture, in which

- (i) only load and store instructions can have memory operands and
  - (ii) arithmetic instructions can have only register or immediate operands

The value of X is \_\_\_\_\_.



119. In an IPv4 datagram, the M bit is 0, the value of HLEN is 10, the value of total length is 400 and the fragment offset value is 300. The position of the datagram, the sequence numbers of the first and the last bytes of the payload, respectively are

- (A) Last fragment, 2400 and 2789
  - (B) First fragment, 2400 and 2759
  - (C) Last fragment, 2400 and 2759
  - (D) Middle fragment, 300 and 689

120. Consider the virtual page reference string  
 $1, 2, 3, 2, 4, 1, 3, 2, 4, 1$

On a demand paged virtual memory system running on a computer system that main memory size of 3 pages frames which are initially empty. Let LRU, FIFO and OPTIMAL denote the number of page faults under the corresponding page replacements policy. Then

- (A) OPTIMAL < LRU < FIFO
  - (B) OPTIMAL < FIFO < LRU
  - (C) OPTIMAL = LRU
  - (D) OPTIMAL = FIFO