11. Ans. A.
p=P [at least three computers are working]
= P (3 or 4 computers working)

$$= \frac{(4_{C_3}) \times (6_{C_1})}{10_{C_4}} + \frac{4_{C_4}}{10_{C_4}} = \frac{5}{42}$$

$$\Rightarrow 100\ p = 11.9$$

12. Ans. A.
Given words are
THE, QUICK, BROWN, FOX, JUMPS, OVER, THE, LAXY, DOG
LET X be the random variable such that X =length of the word
The Length of the words THE, FOX, THE, DOG is 3
The Length of the words OVER, LAXY is 4
The length of the words QUICK, BROWN, JUMPS, is 5
The corresponding probabilities are given below

x	3	4	5
P(X)	4/9	2/9	3/9

Expected length of the word

$$= \sum xp(x) = 3\left(\frac{4}{9}\right) + 4\left(\frac{2}{9}\right) + 5\left(\frac{3}{9}\right) = 3.8889$$

13. Ans. B.
The number of edges in a bipartite graph on n-vertices is atmost $\frac{n^2}{4}$

The maximum number of edges in a bipartite graph on 12 –vertices is $\frac{n^2}{4} = \frac{12 \times 12}{4} = 36$

14. Ans. A.

$$A = \begin{bmatrix} 2 & 18 & 10 \\ -4 & -36 & 20 \\ 7 & 63 & 35 \end{bmatrix}$$

$$\Rightarrow |A| = 0\ (\because \qquad -2R_1).$$

15. Ans. A.
Since, the roots of f(x) = 0 i.e., x = 1, 2, 3 lies between 0 and 4 and f(x) is of degree 3

$\therefore$ $f(0)$ and f(4) are of opposite signs

$$\Rightarrow f(0).f(4) < 0.$$

16. Ans. D.
A function F is self dual if it has equal number of minterms and maxterms, also mutually exclusive terms should not be included.
The number of mutually exclusive terms (pair wise) is

$$\frac{2^n}{2} = 2^{n-1}$$

Number of functions possible by taking any of the one term from the above mentioned mutually exclusive pair is $= 2^{2^{n-1}}$.

17. Ans. C.
In case of decoder output, single output will be 1 and remaining will be zero at a time. The output that is high will give the count of the ring counter at that time.

18. Ans. B.

$$(123)_5 = (x8)_y$$

Converting both sides to decimal:

$$\Rightarrow 25 + 10 + 3 = xy + 8$$

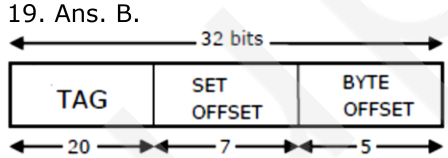
$$\Rightarrow xy + 8 = 38 \Rightarrow xy = 30$$

$$\Rightarrow x = 1, y = 30$$

or $x = 2, y = 15$ or, $x = 3$, $y = 10$

$\therefore$ Total number of solutions: 3

19. Ans. B.



Sol. Physical address size = 32 bits
Cache size = 16k bytes = 2^{14} Bytes
block size = 8 words $= 8 \times 4$ Byte 32 Bytes
(where each word = b Bytes)

No. of blocks $== \frac{2^{14}}{2^5} = 2^9$

block offset $= 9^{bits}$

No. of sets $= \frac{2^9}{4} = 2^7$

set of set = 7 bits

Byte offset $= 8 \times 4$ Byte 32 Bytes $= 2^5 = 5$ bits

$$TAG = 32 - (7 + 5) = 20 \text{ bits}$$

20. Ans. C.

```
int func (int num)
{
int count = 0;
while (num) //After each right shift, checks whether the num value is not zero//
{
count ++;
num >>= 1; //shifts all bits of num one slot to the right//
}
return(count);
}
```

Initially num = 110110011, count = 0
count = 1; num = 101100110 after 1st right shift
count =2; num = 011001100 after 2nd right shift
:
:
Count = 9; num = 000000000 after 9th right shift.
After nine right shifts, num = 0; and while loop terminates count = 9 will be returned.

21. Ans. B.

$$P = n_{C_3} = \frac{n(n-1)(n-2)}{6}$$

It we multiply n, (n-1), (n-2) at once, it might go beyond the range of unsigned integer (resulting overflow). So options A. and D. are rested out. If n is even or odd n×(n-1)/2 will always result in integer value (no possibility of truncation, so more accuracy) where as incase of n*(n-1)/3, its not certain to get integer always (truncation possible, so less accuracy).

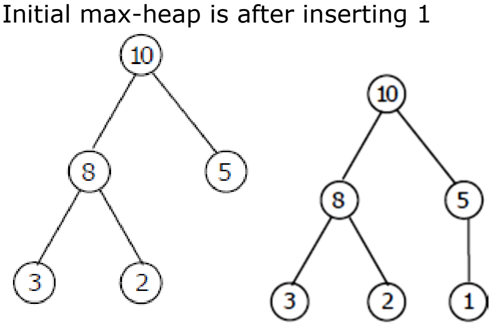
$$P = \underbrace{n*(n-1)/2}_{P_1} * \underbrace{(n-2)/3}_{P_2}$$

As P_1 will be having no error, resultant p will be more accurate.

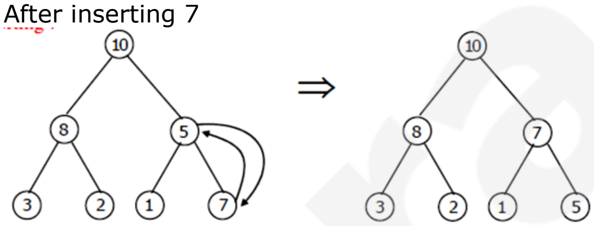
$$P = \underbrace{n*(n-1)/3}_{P_1} * \underbrace{(n-2)/2}_{P_2}$$

As there is a possibility of truncation in P_1, there will be less accuracy in final result of P.

22. Ans. A.
Initial max-heap is after inserting 1



Heapification is not required as it satisfies max-heap property
After inserting 7



Hence level order traversal is 10, 8, 7, 3, 2, 1, 5

23. Ans. A.
By Master's theorem case (i) $T(n)$ is O(n)

Here $a = 2, b = 2, f(n) = \log n$

$\log_b^a = \log_2^2 = 1$

we can choose $\in > 0$, in such a way that

$f(n) = O(n\log_b^{a-\epsilon})$; i.e., $\log n = O(n \log_b^{a-\epsilon})$

By master theorem, If $f(n) = O(n \log_b^{a-\epsilon})$ for some $\in > 0$, then

$T(n) = \theta(n\log_b^a) = \theta(n)$

24. Ans. B.
One of the application of BFS algorithm is to find the shortest path between nodes u and v.

But in the given question the BFS algorithm starts from the source vertex w and we can find the shortest path from w to every vertex of the graph.

25. Ans. A.
L1.L2 is also regular since regular languages are closed under concatenation.

But L1.L2 is not $\{a^n b^n \mid n \geq 0\}$ because both the variable is independent in both languages.

26. Ans. D.
A language A is mapping reducible to a language B, if there is a computable function $f: \varepsilon^* \to \varepsilon^*$ where for every $w, w \in A \Leftrightarrow f(w) \in B$

If $A \leq mB$ and B is Turing recognizable then A is Turing recognizable.
If $A \leq mB$ and A is not recursively enumerable then B is not recursively enumerable
So last option is wrong.

27. Ans. B.

$S \to T * P$

$T \to U \mid T * U$

$P \to Q + P \mid Q$

$Q \to Id$

$U \to Id$

As the production rule $T \to T \times U$ is defined as left recursive rule, so * is left associate operator.
As the production rule $P \to Q + P$ is defined as right recursive rule, so + is right associative operator.

28. Ans. A.
Symbol table management is done during compitation to store and retriew the information about tokens. Type checking is one of the check performed during semantic analysis of compitation.
Inline expansion is a compiler optimization that replaces a function call by the body of respective function.
Dynamic memory allocation is when an executing pregoram request the operating system to give it a block of main memory, so ti is performed during sum time not during complete time. Option A. is answer

29. Ans. C.
Prototyping comes under the requirements validation.

30. Ans. A.
Number of entries in the FAT = Disk Capacity/Block size

$= 10^8/10^3 = 10^5$

Total space consumed by FAT $= 10^5 * 4B = 0.4 * 10^6 B$
Maximum size of file that can be stored

$= 100 * 10^6 - 0.4 * 10^6 = 99.6 * 10^6 B$

Answer: 99.6

31. Ans. C.

The maximum number of super keys for the relation schema R(E,F,G,H) with E as the key is $2^3 = 8$ as any subset of non key attributes along with key attribute will form the super key of R.
As we have 3 nonkey all (F, G and H) so subsets will be 2^3

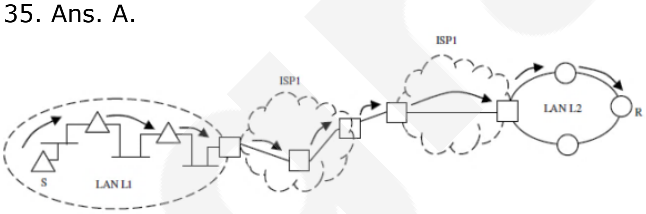
32. Ans. B.
For (Student Name, student age) to be a key for given instance of STUDENTS relation, the pair value should not get repeated in any two tuples p and q (uniqueness in forced by the definition of key)

Tuple	Student Name	Student Age
P	Shankar	$\otimes \rightarrow$ should not be 19
Q	Shankar	19

33. Ans. A.
RIP Uses Distance Vector Routing and OSPF uses Link State Routing.

34. Ans. C.
A) The connect function is used by a TCP client to establish a connection with a TCP server.
B) The bind function assigns a local protocol address to a socket. With the Internet protocols, the protocol address is the combination of either a 32-bit IPv4 address or a 128-bit IPv6 address, along with a 16-bit TCP or UDP port number.
C) The listen function converts an unconnected socket into a passive socket, indicating that the kernel should accept incoming connection requests directed to this socket.
D) The accept function is called by a TCP server to return the next completed connection from the front of the completed connection queue. If the completed connection queue is empty, the process is put to sleep (assuming the default of a blocking socket).

35. Ans. A.



The TTL field is set by the sender of the datagram, and reduced by every router on the route to its destination. So, there are 5visits at 5 routers and one visit at receiver R in above figure which leads 32 – 6 = 26.

36. Ans. D.
Given Bandwidth $= 10^6$ bytes/sec
$L = 10^3$ bytes
Case: 1
$L = 1000$ bytes
Header size = 100 bytes
Total Frame size $= 1000 + 100 = 1100$ bytes

$$\therefore \quad T_x = \frac{1100 \times 8}{10^6 \times 8} = 1100 \ \mu s$$

So, $T_1 = 3300 \ \mu s$
Case : 2
$L = 100$ bytes
Header size = 100 bytes
Total Frame size $= 100 + 100 = 200$ bytes

$$\therefore \quad T_x = \frac{200 \times 8}{10^6 \times 8} = 200 \ \mu s \text{ for 1 packet}$$

For 10 packets $\Rightarrow Tx = 2000 \ \mu s$
So, $T_2 = 2000 + 200 + 200 = 2400 \ \mu s$
Case: 3
$L = 50$ bytes
Header size = 100 bytes
Total Frame size $= 50 + 100 = 150$ bytes

$$\therefore \quad T_x = \frac{150 \times 8}{10^6 \times 8} = 150 \ \mu s \text{ for 1 packet}$$

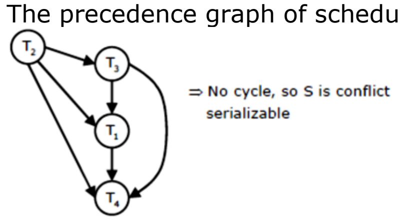
For 10 packets $\Rightarrow Tx = 3000 \ \mu s$
So, $T_3 = 3000 + 150 + 150 = 3300 \ \mu s$

$$\therefore \quad T_1 = T_3$$
$$T_3 > T_2$$

37. Ans. C.
An Intruder can't learn [I1] through sniffing at R2 because URLs and Download are functioned at Application layer of OSI Model.
An Intruder can learn [I2] through sniffing at R2 because Port Numbers are encapsulated in the payload field of IP Datagram.
An Intruder can learn [I3] through sniffing at R2 because IP Addresses and Routers are functioned at network layer of OSI Model.
An Intruder can't learn [I4] through sniffing at R2 because it is related to Data Link Layer of OSI Model.

38. Ans. B.
Whenever a browser opens a webpage, it makes a separate request for each object of page like image, css, javascript, etc. However if multiple resources are served from same server, then one TCP connect is sufficient.

39. Ans. C.
The precedence graph of schedule s is as follows.



In the schedule S of transactions T_1, T_2, T_3 and T_4 for each pair of transaction T_i and T_j, such that T_j reads a data item previously written by T_i the commit operation of T_j appears after the commit operation of T_i hence the schedule is recoverable schedule.

40. Ans. A.
A join between r(R) and s (S) using nested loop method will be as follows.
For each tuple r in R do
For each tuple s in S do
If r and s satisfy the join condition then output the tuple <r,s>
This algorithm will involve $n_r * b_s + b_r$ block transfers and $n_r + b_r$ seeks, where b_r and b_s are number of blocks in relations R and S respectively and nr is number of tuple in relation R. Now to have less block accesses, n_r should be less and it is already given that |R|<|S|. Relation r(R) should be in the outer loop to have fewer number of disk block accesses.

41. Ans. C.
A) The producer will be able to add an item to the buffer, but the consumer can never consume if given statement is false, because once producer produces an item and places in buffer, the next turn to execute can be given to consumer ( ). [The value of s = 1 and n=1]. So consumer will be definitely able to consume it by performing successful down operations on s and n.
B) The consumer will remove no more than one item from the buffer.
Given statement is false as if p( ) produces and adds to buffer, C. will consume the added item, this sequence of alteration (p and c) will always make consumer to remove items from buffer.
This statement would have been true if it was said that the consumer will remove no more than one item from the buffer one after the other. (at a time).
C) Dead lock occurs if the consumer succeeds in acquiring semaphore's' when the buffer is empty. Given statement is true as when buffer is empty initially if consumer gets the turn to execute as follows:-
$S = 1, n = 0;$

```
Consumer ( )
{
while (True)
{
p(s);[s = 1\0]
p(s); [m = 0; it blocks consumer]
}
}
Producer ( )
{
while (True)
{
producer ( );
p(s); [s = 0; it blocks p ( )]
}
}
```

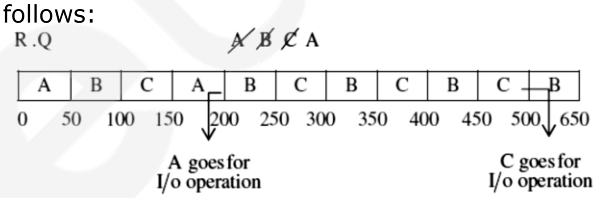
So from the above execution both producer and consumer goes in block state waiting for each other to wake them up and hence dead lock occurs.

D) Even if the starting value for the semaphore 'n' becomes 1, there will be invalid execution of consumer on buffer empty condition, which should not happen. So statement is false.

42. Ans. A.

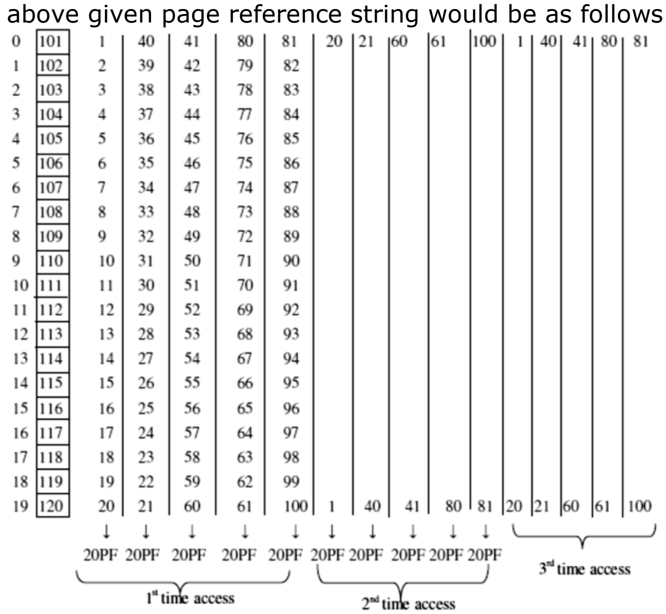
Process id	t_c	t_{io}	A.T	TQ = 50 ms
A	100 ms	500 ms	0 ms	
B	350 ms	500 ms	5 ms	
C	200 ms	500 ms	10 ms	

The Gantt chart for Round robin algorithm for the first iteration execution for each of the 3 processes is as follows:



After finishing t_c CPU ms at time 500ms, C goes for I/O operation, that needs 500ms more, so the time at which process C would complete its first I/O operations is 500+500 = 1000ms

43. Ans. D.
Page reference string for the program will be:-
1, 2, 3, 4, ------------100, 1, 2, 3, 4, ------------100, 1, 2, 3, 4, ------------100,
The current status of 20 frames shows page numbers from 101 to 120.
Implementation of optimal page replacement policy for above given page reference string would be as follows:

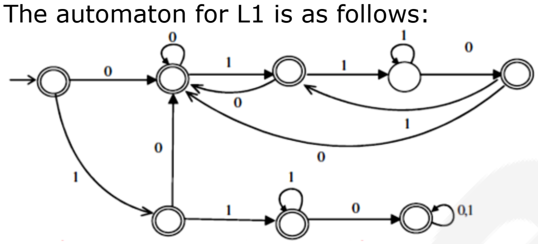


So there would be 300 page faults in total (each access 100 page faults).
Also it is visible that every time a replacement is done for the page which is most recently referred as it will be least recently referred in future. So for the given page reference string optimal page replacement policy is working same as most recently used policy and thus number of page faults will be same in both of them.

44. Ans. A.
It is given that Size of int is 4B and of char is 1B. The memory is byte addressable.
Let the array be declared as Type X[A][B][C] (where Type = int/char and A,B,C are natural numbers).
From t0 = i*1024, we conclude that B*C*(size of Type) = 1024.
From t1 = j*32, we conclude that C*(size of Type) = 32.
From t2 = k*4, we conclude that size of Type = 4.
Type = int, and
C = 8, and
B = 32.

45. Ans. B.
The language accepted by the Turing machine is recursively enumerable. If is undecidable as the Turing machine may halt or it may loop for the strings whose length is not equal to 2014.

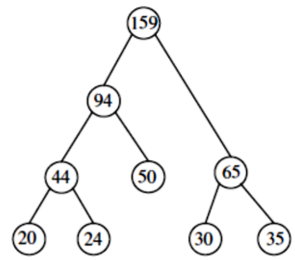
46. Ans. A.
The automaton for L1 is as follows:



No finite state automata can be constructed for L2.

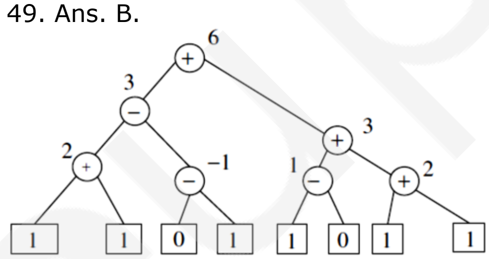
47. Ans. B.
Given is
A = "qpqrr" B = "pqprqrp"
The longest common subsequence (not necessarily contiguous) between A and B is having 4 as the length, so $x = 4$ and such common subsequences are as follows:
A. qpqr
B. pqrr
C. qprr
So $y = 3$ (the number of longest common subsequences) hence
$x + 10y = 4 + 10 * 3 = 34.$

48. Ans. B.
The implementation of optimal algorithm for merging sequences is as follows.



In the above implementation, total number of comparisons is
$$(44-1)+(94-1)+(65-1)+(159-1)=358$$
Hint: The number of comparisons for merging two sorted sequences of length m and n is $m+n-1$.

49. Ans. B.



So as per the above tree where leaves have been given the values, the maximum possible value of the expression represented by the tree is 6.

50. Ans. A.
If condition given in function definition should be 'TRUE', for f (q) to return value q.
The condition is as follows:
if $(abs(x \times x - 3) < 0.01)$return x;
The above condition will be true when $x = 1.73$.

51. Ans. C.
Option (a) is false because queue can be implemented by using the modified stack as by reversing the stack. LIFO will become FIFO.
Implementation of ENQUEUE & DEQUEUE takes four sequence of instructions as follows:
1) Enqueue: Reverse, Push, Reverse
Dequeue: POP
(OR)
2) Enqueue: Push
Dequeue: Reverse, POP, Reverse

52. Ans. D.
For any value of 'j' other than 50 the function will return 0, for j=50, then condition (i==j) will be true, it will print "something" and function will be called recursively with same value till the run time stack overflows.

53. Ans. D.
When a cache block size is smaller, it could accommodate more number of blocks, it improves the hit ratio for cache, so the miss penalty for cache will be lowered.

54. Ans. D.
When associativity is doubled, then the set offset will be effected, accordingly, the number of bits used for TAG comparator be effected.

Width of set index decoder also will be effected when set offset is changed.
Width of wag selection multiplexer wil be effected when the block offset is changed.
With of processor to main memory data bus is guaranteed to be NOT effected.

55. Ans. A.

S	E	M
1 bit	8 bit	23 bits

$$(14.25)_{10} = (1110.01)_2$$

$$1110.01 \times 2^0$$

$$= 1.11001 \times 2^3$$

$$S:1$$

$$E:(3+127)_{10} = (10000010)_2$$

$$M:11001000-----$$

Value stored :

$$\underbrace{110}_{|C}\underbrace{0001}_{1}\underbrace{0110}_{6}\underbrace{100}_{4}\ \ 00---$$

0 0 0 0 In

56. Ans. B.

Let $A = \begin{pmatrix} 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 \end{pmatrix}$

Let $X = \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix}$ be eigen vector

By the definition of eigen vector, $AX = \lambda X$

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 0 \\ 1 & 0 & 0 & 0 & 1 \end{pmatrix}\begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix} = \lambda \begin{pmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{pmatrix}$$

$$x_1 + x_5 = \lambda x_5$$

$$x_2 + x_5 + x_4 = \lambda x_2$$

$$x_2 + x_5 + x_4 = \lambda x_3$$

$$x_2 + x_5 + x_4 = \lambda x_4$$

$$x_1 + x_5 = \lambda x_4 \Rightarrow x_1 + x_5 = \lambda x_5 = \lambda x_4$$

and $x_2 + x_3 + x_4 = \lambda x_2 = \lambda x_3 = \lambda x_4$

(1) If $\lambda \neq 0$ say $x_1 = x_5 = a$

$$x_2 = x_3 = x_4 = b$$

$$\Rightarrow x_1 + x_5 = \lambda a \Rightarrow 2a = \lambda a \Rightarrow \lambda = 2$$

$$x_2 + x_3 + x_5 = \lambda a \Rightarrow 3a = \lambda a \Rightarrow \lambda = 3$$

(2) If $\lambda = 0 \Rightarrow$ eigen value = 0

∴ Three distinct eigen values are 0,2,3 product of non zero eigen values $= 2 \times 3 = 6$

57. Ans. A.
Let A = divisible by 2, B = divisible by 3 and C = divisible by 5, then

$$n(A) = 50, n(B) = 33, n(C) = 20$$

$$n(A \cap B) = 16, n(B \cap C) = 6, n(A \cap C) = 10$$

$$n(A \cap B \cap C) = 3$$

$$P(A \cup B \cup C) = P(A) + P(B) + P(C) -$$

$$P(A \cap B) - P(B \cap C) - P(A \cap C) + P(A \cap B \cap C)$$

$$= 74/100$$

∴ Required probability is

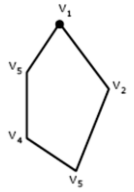
$$P(\bar{A} \cap \bar{B} \cap \bar{C}) = 1 - P(A \cup B \cup C) = 0.26.$$

58. Ans. C.
$2014 = 2 \times 19 \times 53$ i.e., product of prime factors
∴ Number of distinct positive integral factors of 2014 is
$(2) \times (2) \times (2) = 8.$

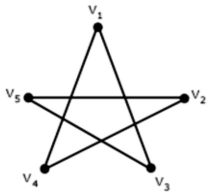
59. Ans. A.
From given data S1 is true, since null set is larger than every other set, and S2 is true since the universal set {1,2,...,2014} is smaller than every other set.
Both s1 and s2 are true.

60. Ans. A.
The number of edges in C_n is n where as the number of edges in C_n is $n_{c_2} - n$

Cycle graph C_n and its complement C_n have different number of edges if $n \neq 5$ Consider a cycle on five vertices C_5



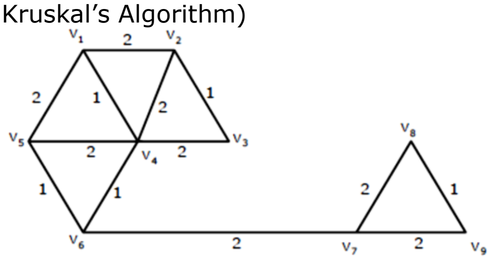
C_5



C_5 and C_5' are isomorphic
$\therefore n = 5$

$(\text{complement of } C_5) = C_5'$

61. Ans. B.
Consider the connected weighted graph (Application of Kruskal's Algorithm)

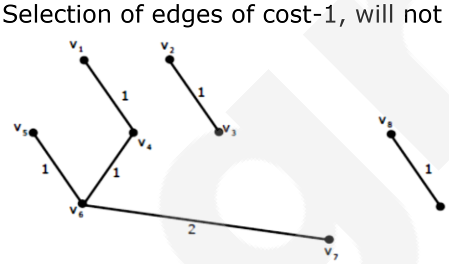


Sort the edges by increasing edges costs (weights)

$$\left[\{v_1,v_4\},\{v_2,v_3\},\{v_4,v_6\},\{v_5,v_6\},\{v_8,v_9\} \; (\text{Cost}-1)\right]$$

$$\left[\frac{3}{\{v_1,v_2\},\{v_2,v_4\},\{v_4,v_3\},}\{v_4,v_5\},\{v_1,v_5\} \; \{v_6,v_7\},\frac{\{v_7,v_8\},\{v_7,v_9\}}{2}(\text{cost}-2)\right]$$

Selection of edges of cost-1, will not form a cycle, so



Selection of $\{v_4,v_5\}$ and $\{v_1,v_5\}$ forms a cycle, so we will not consider the edges. The edge $\{v_6,v_7\}$ can be choosen because of connectedness.

Selection of $\{v_1,v_2\}$ and $\{v_7,v_8\}$ forms one minimum spanning tree.

Selection of $\{v_1,v_2\}$ and $\{v_7,v_9\}$ forms one minimum spanning tree.

Selection of $\{v_2,v_4\}$ and $\{v_7,v_8\}$ forms one minimum spanning tree.

Selection of $\{v_2,v_4\}$ and $\{v_7,v_8\}$ forms one minimum spanning tree.

$$\left.\begin{array}{l}\text{Selection of } \{v_3,v_4\} \text{ and } \{v_7,v_8\} \\ \text{Selection of } \{v_3,v_4\} \text{ and } \{v_7,v_9\}\end{array}\right\} \text{forms two}$$

minimum spanning trees

∴ There are 6 distinct minimum spanning trees.

62. Ans. B.

D) $a \to (b \to a)(\Rightarrow \neg a \vee (b \to a))$

$(\Rightarrow \neg a \vee (\neg b \vee a)) \Leftrightarrow T$ (tauto log y)

C) $(a \wedge b \wedge) \to (c \vee a) \Leftrightarrow \neg(a \wedge b \wedge c) \vee (c \vee a)$

$\Leftrightarrow (\neg a \vee a) \vee P$ (where P is disjunction of literals)

$\Leftrightarrow T \vee P \Rightarrow T$

A) $\dfrac{\begin{array}{c} a \to b \\ b \to c \end{array}}{\therefore \; a \to c}$ by hypothetical syllog isom

$((a \to b) \wedge (b \to a)) \to (a \to c)$ is a tautology

Answer is B which is not tautology.

63. Ans. C.
Consider the following instances of R & S

a	b	c
1	2	3
1	2	3
3	4	5
3	4	5

a	d	e
1	2	3
2	3	4
3	4	6
3	4	6

O/P of given nested query is

a	b	c
1	2	3
1	2	3
3	4	5
3	4	5

A) O/P:- multiplicity of tuples is disturbed

a	b	c
1	2	3
1	2	3
3	4	5
3	4	5
3	4	5
3	4	5

B) O/P:-

a	b	c
1	2	3
3	4	5

C) O/P:-
Multiplicity of tuples is maintained

a	b	c
1	2	3
1	2	3
3	4	5
3	4	5

Multiplicity of duplicate tuples will be distributed when there is a match between R.a and S.a and for that match S.a's value is repeated.

64. Ans. D.
Each write request, the bus is occupied for 100 n.s
Storing of data requires 100 n.s.
In 100 n.s -1 store

$$\frac{100}{10^6} \text{n.s} = 1 \text{ store}$$

$$1 \text{ m.s} = \frac{10^6}{100} \text{stores}$$

$$= 10000 \text{ stores}$$

65. Ans. A.

$$f(x) = 0.75x^3 - 2x^2 - 2x + 4; f'(x) = 2.25x^2 - 4x - 2$$

$$x_0 = 2, f_0 = -2; f_0' = -1$$

$$\therefore x_1 = x_0 - \frac{f_0}{f_0'} = 0$$

$$\Rightarrow f_1 = 4; f_1' = -2$$

$$\therefore x_2 = x_1 - \frac{f_1}{f_1'} = 2$$

$$\Rightarrow f_2 = -2, f_2' = -1$$

$$\therefore x_3 = x_2 - \frac{f_2}{f_2'} = 0$$

Also, root does not lies between 0 and 1.
So, the method diverges if $x_0 = 2$
∴ only (I) is true.

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