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1.Ans. C

Sol. 'Breaks down' is a transitive phrasal verb which means to divide something such as a total amount into separate parts.

Option (c) is most suitable.

2. Ans. A

Sol.The search engine business model revolves around the fulcrum of trust.

Fulcrum is any thing that plays a central or essential role in an activity, event, or situation.

3.Ans. B

Sol. Speed of car A = 50 km/hr

Speed of car B = 60 km/hr

Since, both cars A and B are moving in same direction, the relative speed = 60 – 50 = 10 km/hr

Distance required between them = 20 km

$$\therefore \quad \text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{20}{10} = 2 \text{ hrs}$$

4.Ans. C

Sol. Let share of each student = x

Total cost of gift = 10 × x

x = 8(x + 150)

x = 600

Total cost = 10 × 600 = 6000

5.Ans. D

Sol. A 'court' is for a 'judge' as a 'school' is for a 'teacher'.

Court is a place where a judge works.

Similarly, school is a place where a teacher works.

6.Ans. B

Sol. Case I:

Criminals	P	Q	R	S
Assumption	F	T	F	F
Result	Q_{NC}	S_C	R_C	S_C

S and R are criminal in the result is impossible because only one person committed the crime.

Case II:

Criminals	P	Q	R	S
Assumption	T	F	F	F
Result	Q_C	S_{NC}	R_C	S_C

Q and R are criminal in the result is impossible because only one person committed the crime.

Case III:

Criminals	P	Q	R	S
Assumption	F	F	T	F
Result	Q_{NC}	S_{NC}	R_{NC}	S_C

S_{NC} and S_C in the result which is contradiction. [S committed crime and same time not committed crime which is contradiction]

Case IV:

Criminals	P	Q	R	S
Assumption	F	F	F	T
Result	Q_{NC}	S_{NC}	R_C	S_{NC}

R is criminal in the result.

Hence this case satisfies only one person committed the crime.

7.Ans. C

Sol. Percentage of Administrators

$$= \frac{\text{Administrators}}{\text{Total}} \times 100$$

$$= \frac{50}{160} \times 100 = 31.25$$

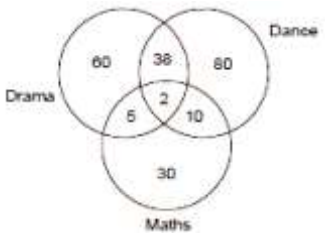
8.Ans. B

Sol.The passage states that the underlying disease behind begging is the failure of the state to protect citizens who fall through the social security net.

option b can be concluded from the above.

9.Ans. C

Sol.



Total number of students = 60 + 80 + 30 + 38 + 5 + 10 + 2 = 225

25% = 225

$$\Rightarrow \qquad 100\% = \frac{225}{25} \times 100 = 900$$

10.Ans. D

Sol. According to conditions mentioned in the question 'D' is the best suited option.

11.Ans. D

Sol. Cache memory size = 16 kB

Block size = 16 B

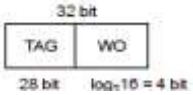
Main memory address = 32 bit

Number of lines (N) $= \frac{16K}{16} \Rightarrow \frac{2^{14}}{2^4} = 2^{10}$

Fully associative cache memory (N-way)

So, number of sets (S) $= \frac{N}{P-way} \Rightarrow \frac{2^{10}}{2^{10}} = 1$

∴ Address format:



So, TAG = 28 bit

Index = 0 bit (No address)

12.Ans. A

Sol.

[C800 to CFFF]

13.Ans. D

Sol. LR parser is a bottom up parser. Hence it uses right most derivation in reverse order.

14.Ans. C

Sol.+28 ⇒ 0000 0000 0001 1100

−28 ⇒ 1111 1111 1110 0100 (2's complement form)

15.Ans. C

Sol.A = {(x, X), x ∈ X and X ⊆ U}

The number of k element subsets of a set U with n elements $= \binom{n}{k} = {}^nC_k$.

The number of possible ordered pairs (x, X) where x ∈ X is $k \cdot {}^nC_k$ for a given value of k from 1 to n.

So total number of ordered pairs in A

$$= |A| = \sum_{k=1}^{n} k \cdot {}^nC_k = \sum_{k=1}^{n} k.\binom{n}{k}$$

So II is correct.

(Note that k = 0 is excluded since empty set has no elements and cannot form an order pair such as (x, X)).

But since by the combinational identity

$$\sum_{k=1}^{n} k.\binom{n}{k} = n.2^{n-1}$$

So I is also correct.

So both I and II are correct.

16.Ans.B

Sol.(a) $x \oplus y = (xy + x'y')'$

$= (xy)'$

$= x \oplus y$, it is valid.

(b) $(x+y) \oplus z = \overline{(x+y)}.z + (x+y)\bar{z}$

$= \overline{xy}\,z + x\bar{z} + y\bar{z}$

1 4,6 2,6

= Σm(1, 2, 4, 6)

$x \oplus (y+z) = \bar{x}(y+z) + x\overline{(y+z)}$

$= \bar{x}y + \bar{x}z + \bar{y}z$

2,3 1,3 4

= Σm(1, 2, 3, 4)

$(x + y) \oplus z \neq x \oplus (y + z)$

So option (b) is invalid.

(c) $(x \oplus y) \oplus z = x \oplus (y \oplus z)$

Associativity is true on Ex-OR operator so it valid.

(d) $x \oplus y = (x+y)(\bar{x}+\bar{y})$

$= (x+y)\overline{xy}$

$= (x+y)\bar{0}$

= (x + y), so it is valid.

17.Ans. B

Sol.If L is regular, $L \cdot L^R$ is also regular by closure property.

Suffix (L) and Prefix (L) are also regular by closure property.

However option (b) $\{ww^R \mid w \in L\}$ need not be regular since if L is an infinite regular language, then $\{ww^R \mid w \in L\}$ will not only be infinite, but also non-regular. Since it involves string matching and we can increase in length indefinitely and then finite automata FA will run out of memory.

18.Ans. C

Sol. For example:

Let,

$$\left.\begin{matrix} X = +6, n = 4 \\ Y = -5, n = 4 \end{matrix}\right\} \Rightarrow (X - Y) = +11$$

Hence,

Z = 11 which required 5 bits which is (n + 1) bits

19.Ans. D

Sol. Both I and II are equivalent statements.

20.Ans. B

Sol. R_1 : $\forall a, b \in G$, a R_1 b if and only if $\exists g \in G$ such that $a = g^{-1}bg$

Reflexive: $a = g^{-1}ag$ can be satisfied by putting g = e, identity "e" always exists in a group.

So reflexive

Symmetric: aRb $\Rightarrow a = g^{-1}bg$ for some g

$\Rightarrow b = gag^{-1} = (g^{-1})^{-1} ag^{-1}$

g^{-1} always exists for every $g \in G$.

So symmetric

Transitive: aRb and bRc $\Rightarrow a = g1^{-1}bg_1$ and $b = g_2^{-1} cg_2$ for some $g_1g_2 \in G$.

Now $a = g_1^{-1} g_2^{-1}cg_2g_1 = (g_2g_1)^{-1}cg_2g_1$

$g_1 \in G$ and $g_2 \in G \Rightarrow g_2g_1 \in G$ since group is closed so aRb and aRb $\Rightarrow$ aRc hence transitive

Clearly R_1 is equivalence relation.

R_2 is not equivalence it need not even be reflexive, since aR_2 a $\Rightarrow a = a^{-1}$ $\forall a$ which not be true in a group.

R_1 is equivalence relation is the correct answer

21.Ans. C

Sol. I. Strict 2PL guaranteed conflict serializable because of 2PL condition and also strict recoverable.

II. Thomas Write timestamp ordering ensures serializable. Thomas write rule timestamp ordering allowed to execute schedule which is view equal serial schedule based on timestamp ordering.

22.Ans. D

Sol. In a complete graph we can traverse the n vertices in any order and return to the starting vertex and form a Hamiltonian cycle. The number of such cycles will be n! However, since circular rotations will have to ignored. Since for example K4 with vertices {1, 2, 3, 4}, the cycle 1-2-3-4 is same as 2-3-4-1 is same as 3-4-1-2 etc. we now get only (n – 1)! distinct Hamiltonian cycles. Further, the cycle 1-2-3-4 and 1-4-3-2 are also same (clockwise and anticlockwise).

So ignoring this orientation also we finally get $\frac{(n-1)!}{2}$ distinct Hamiltonian cycles.

23.Ans. C

Sol. $\lim_{x \to 3} \frac{x^4 - 81}{2x^2 - 5x - 3} = \frac{0}{0}$ form.

So apply L'H rule

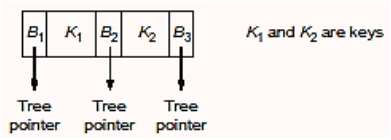
$$\lim_{x \to 3} \frac{4x^3}{4x - 5} = \frac{108}{7}$$

24.Ans. B

Sol. B+ tree non leaf node have pointer to data records is false statement.

B+ tree non leaf node consists of only keys and tree pointers (node pointers).

Below is the structure of B+ tree non leaf node



25.Ans. D

Sol. L = {a2 + 3k or b10 + 12k} for k ≥ 0

= a2 (a3)* or b10 (b12)*

= {a2, a5, a8, ..., b10, b22, b34 .....}

The pumping length is p, than for any string w ∈ L with |w| ≥ p must have a repetition i.e. such a string must be breakable into w = xyz such that |y| ≥ 0 and y can be pumped indefinitely, which is same as saying xyz ∈ L ⇒ xy *z ∈ L.

The minimum pumping length in this language is clearly 11, since b10 is a string which has no repetition number, so upto 10 no number can serve as a pumping length. Minimum pumping length is 11. Any number at or above minimum pumping length can serve as a pumping length. The only number at or above 11, in the choice given is 24.

26.Ans. B
Sol.SMTP is push protocol and to send email and POP3 is pull protocol i.e. to retrieve email.

27.Ans. (31)

28.Ans. (26)

29.Ans. (31)
Sol. $S \rightarrow Aa$

$A \rightarrow BD$

$B \rightarrow b \mid \in$

$D \rightarrow d \mid \in$

Follow (B) = {d, a}
Hence their index in descending order is 31.

30.Ans. (0.08)

31.Ans. (2)
Sol.By Fermat's theorem

$3^{(5-1)} \bmod 5 = 1$

$3^4 \bmod 5 = 1$

$3^{51} \bmod 5 = (3^4)^{12} \cdot 3^3 \bmod 5$

$= 3^3 \bmod 5$

$= 2$

32.Ans. (0.502 to 0.504)

33.Ans. (80)

34.Ans. (6)

35.Ans. (29)

36.Ans. D
It will not print anything and will not terminate

37.Ans. B

38.Ans. C
Sol.

M →	100.10.5.2	2	00000010
	255.255.255.252	252	11111100
	194.56.10.0	0	00000000
N →	100.10.5.5	5	00000101
	255.255.255.252	252	11111100
	194.56.10.4	4	00000100
P →	100.10.5.6	6	00000110
	255.255.255.252	252	11111100
	194.56.10.4	4	00000100

N and P belongs to same subnet.
Hence, C is correct answer.

39.Ans. C
X sends an ARP request packet with broadcast MAC address in its local subnet

40.Ans. A
Sol.$f_1 \cdot f_2 = \Sigma(2, 8, 14)$

$f_1 = f_3 \oplus (f_1 \cdot f_2)$

$= \Sigma(7, 8, 11)$

41.Ans. C
Sol. (a) $\{ww^R \mid w \in \{a, b\}^*\}$ is a CFL

(b) $\{wa^n b^n w^R \mid w \in \{a, b\}^*, n \geq 0\}$ is a CFL, since we can first push w, then a's, b's pop with a's and w^R pops with the w. So PDA can accept the language.

(c) $\{wa^n w^R b^n \mid w \in \{a, b\}^*, n \geq 0\}$ is a not CFL because after pushing w, we need to push a's into stack which will stop the w from being matched with w^R. If we don't push a's after w, than later we cannot match with bn. So this language is not acceptable by a PDA and hence not a CFL.

(d) $\{a^n b^i \mid i \in \{n, 3n, 5n\}, n \geq 0\}$

$= a^n b^n \cup a^n b^{3n} \cup a^n b^{5n}$ is CFL since each of the three parts is a CFL and closure under union guarantees that result also is a CFL.

42.Ans. C

Sol.X(PQRS) {QR → S, R → P, S → Q} decomposed into

Y(PR)	Z(QRS)
{R → P}	{QR → S, S → Q}
Candidate key : R	Candidate key : QR, RS
Relation Y in BCNF	Relation Z in 3NF but not BCNF

Common attribute between Y and Z relations is R which is key for relation Y.

So that given decomposition is lossless join decomposition.

R → P in Y

$\left.\begin{matrix} QR \to S \\ S \to Q \end{matrix}\right\}$ are in Z

and dependency preserving decomposition.

Hence , C is the correct answer.

43.Ans. B

Sol. 1 word = 4 bytes

Page size = 8 kB = 213 B

Number of words in 1 page $= \frac{2^{13}}{2^2} = 2^{11}$

TLB can hold 128 valid entries so, at most 128×2^{11} memory address can be addressed without TLB miss.

$128 \times 2^{11} = 256 \times 2^{10}$

44.Ans. B

Sol.S_1: The set L_{RE} is known to be countably infinite since it corresponds with set of turing machines.

S_2: Since syntactically valid C programs surely run on Turing machines, this set is also a subset of set of Turing machines, which is countable.

S_3: Set of all languages = 2^{Σ} which is known to be uncountable. Σ^* countably infinite

$\Rightarrow 2^{\Sigma}$ is uncountable.

S_4: Set of all non-regular languages includes set $L_{NOT\ RE}$ which is uncountable infinite and hence is uncountable.

So, S_3 and S_4 are uncountable.

Hence, B is the correct answer.

45.Ans. C

Sol.$\forall x[\forall z \boxtimes x \Rightarrow ((z = x) \vee (z = 1)) \Rightarrow \exists w\ (w > x) \wedge (\forall z\ z \boxtimes w \Rightarrow ((w = z) \vee (z = 1)))]$

The predicate ϕ simply says that if z is a prime number in the set then there exists another prime number is the set which is larger.

Clearly ϕ is true in S_2 and S_3 since in set of all integers as well as all positive integers, there is a prime number greater than any given prime number.

However, in S_1 : {1, 2, 3, ...100} ϕ is false since for prime number 97 ∈ S_1 there exists no prime number in the set which is greater.

So correct answer is C.

46.Ans. A

Sol.SDT for inserting type information in the symbol table

D → TL {L.idtype = T.stype}

T → int {T.stype = int}

T → float {T.stype = float}

L → L1, id {L1.itype = L.itype}

addtype(id.entry, L.itype)

L → id addtype(id.entry, L.itype)

47. Ans. C

Answer is O(n^2)

48.Ans. C

Sol.If no two edges of G have same weight surely G will have unique spanning tree is true.

So I is true

Also if, for every cut of G, there is a unique minimum weight edge crossing the cut then G will have unique spanning tree is also true. So II is true

[Note: The converse of II is not true, but that is not relevant to this question]

So both I and II are true.

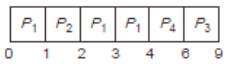
Option (d) is correct.

49.Ans. A

50.Ans. A

51.Ans. (2)

Let's assume , Z = 2



	Arrival time	CPU time	Completion time	Waiting time
P_1	0	3	4	1
P_2	1	1	2	0
P_3	3	3	9	3
P_4	4	Z = 2	6	0

Average waiting time (WT)

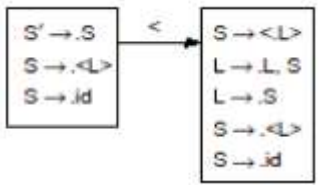
$$= \frac{1+0+3+0}{4} = 1 \text{ ms}$$

Hence, Z = 2

52.Ans. (4.0 to 4.1)

53.Ans. 5

Sol.



Total number of items in the set GOTO (I_0, ⟨ ⟩ is 5.

54.Ans. (12)

Sol.Product of eigenvalues is same as the determinant of a matrix.

$$\begin{bmatrix} 1 & 2 & 2^2 & 2^3 \\ 1 & 3 & 3^2 & 3^3 \\ 1 & 4 & 4^2 & 4^3 \\ 1 & 5 & 5^2 & 5^3 \end{bmatrix} = \begin{bmatrix} 1 & 2 & 2^2 & 2^3 \\ 1 & 3-2 & 3^2-2^2 & 3^3-2^3 \\ 1 & 4-2 & 4^2-2^2 & 4^3-2^3 \\ 1 & 5-2 & 5^2-2^2 & 5^3-2^3 \end{bmatrix}$$

$$= (3-2)(4-2)(5-2)\begin{bmatrix} 1 & 5 & 19 \\ 1 & 6 & 28 \\ 1 & 7 & 39 \end{bmatrix}$$

$$= 1.2.3\begin{bmatrix} 1 & 5 & 19 \\ 0 & 1 & 9 \\ 0 & 2 & 20 \end{bmatrix}$$

$$= 1.2.3.2 = 12$$

55.Ans. (160)

Sol.Total time to transfer a cache block = 1 + 3 + 8 = 12 cycles

8 W _____ 12 cycles

8 × 4 bytes _____ 12 cycles

? B _____ 1 sec

$$= \frac{32B}{12 \times \left(\frac{1}{60} + 10^{-6}\right) \text{sec}}$$

$$= 160 \times 10^6 \text{ bytes/sec}$$

56.Ans. 4.25

No. of pairs with path length 0=8.0=8.

No. of pairs with path length 1=0.1=0.

No. of pairs with path length 2=8.2=8.

No. of pairs with path length 3=0.3=0.

No. of pairs with path length 4=16.4=16.

No. of pairs with path length 5=0.5=0.

No. of pairs with path length 6=32.6=32.

Total number of possible pairs =8×8=64=8×8=64

So, expected path length,E(x),

=0×864+2×864+4×1664+6×3264=27264 =4.25

57.Ans. (0.8)

Sol. It is given that, Polynomial $3x^2 + 6xY + 3Y + 6$ has only real roots

$$b^2 - 4ax \geq 0$$

$$(6Y)^2 - 4(3)(3Y + 6) \geq 0$$

$$Y^2 - Y + 2 \geq 0$$

$Y \in (-\infty, -1] \cap [2, \infty)$

$\Rightarrow Y \in [2, 6)$

Since y is uniformly distributed in (1, 6)

Probability distributed function,

$$f(Y) = \frac{1}{5} 1 < y < 6$$

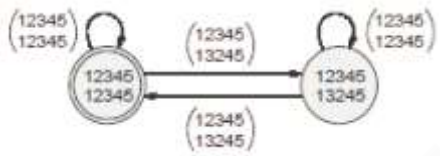
$$p(2 < y < 6) = \int_2^6 f(Y)dy$$

$$= \frac{1}{5}[Y]_2^6 = \frac{4}{5} = 0.8$$

58.Ans. (120)

Sol.The DFA for accepting L will have 5! = 120 states, since we need one state for every possible permutation function on 5 elements. The starting state will be "id" state, named as $\begin{pmatrix}12345\\12345\end{pmatrix}$ and from there n! arrows will go the n! states each named with a distinct permutation of the set {1, 2, 3, 4, 5}. Since composition of permutation function is closed every arrow has to go to some permutation and hence some state.

Since the language only has those strings where π(x) = id only the starting state ("id" state) will be the final state. Sample machine with only 2 states is shown below



59.Ans. (3)

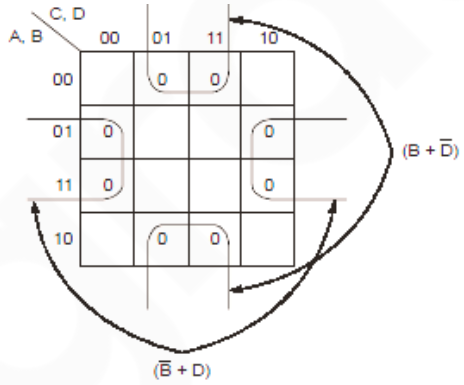
Sol.3 switches of ethernet are required to connect 15 computers.

Hence, 3 is correct answer.

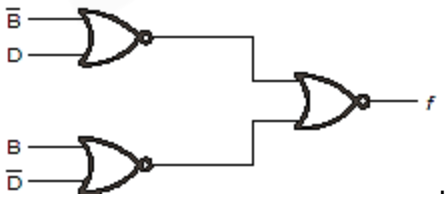
60.Ans. (3)

Sol.$f = \Sigma_m(0, 2, 5, 7, 8, 10, 13, 15)$

$f = \Pi_M(1, 3, 4, 6, 9, 11, 12, 14)$



$f = (\bar{B} + D)(B + \bar{D})$



61.Ans. (5)

Sol.

Student

Roll_no.	Student_name
1	Amit
2	Priya
3	Vinit
4	Rohan
5	Smita

×

Performance

Roll_no.	Student_code	Marks
1	A	80
1	B	95
1	C	90
2	A	89
2	C	92
3	C	80

Total 5 different student names all 5 group records in result.(In where condition no condition over Roll_no so query produces all groups.)

62.Ans. (5)

63.Ans. (10)

64.Ans. (97)

Sol. $n = p \times q = 3007$

$\phi(n) = (p - 1)(q - 1) = 2880$

By RSA algorithm, n = 31 × 97 in which 97 is prime factor which greater than 50.

65.Ans. (1)

Sol.

P

X	Y	Z
X1	Y1	Z1
X1	Y1	Z2
X2	Y2	Z2
X2	Y4	Z4

R

Y	V
Y1	V1
Y3	V2
Y2	V3
Y2	V2

$\Pi_X\left(\sigma_{(P.Y=R.Y\wedge R.V=V2)}(P\times)\right) \Rightarrow \boxed{\frac{X}{X2}}$ ...(I)

Q

X	Y	T
X2	Y1	2
X1	Y2	5
X1	Y1	6
X3	Y3	1

R

Y	V
Y1	V1
Y3	V2
Y2	V3
Y2	V2

$\Pi_X\left(\sigma_{(Q.Y=R.Y\wedge Q.T>2)}(Q\times R)\right) \Rightarrow \boxed{\frac{X}{X1}}$ ...(II)

$I - II \Rightarrow \boxed{\frac{X}{X2}}$ one record in result.

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