gradeup

GATE 2020

Computer Science & Information Technology

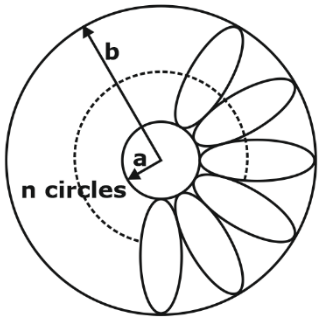
Solution

GENERAL APTITUDE

1.

Ans. B

Sol.



Radius of inner circle = a

Radius of outer circle = b

Radius of small circle = $\frac{b-a}{2}$

area of donut shaped figure = $\pi(b^2 - a^2)$

Area of each small circle = $\pi\left(\frac{b-a}{2}\right)^2$

total area of all small circle $= n\pi\left(\frac{b-a}{2}\right)^2$

Area of remaining portion

$= \pi(b^2 - a^2) - n\pi\left(\frac{b-a}{2}\right)^2$

$= \pi[(b^2 - a^2) - \frac{n}{4}(b-a)^2]$

2.

Ans. B

Sol. Billions of people are affected by melting glaciers.

3.

Ans. D

Sol. His knowledge of the subject was excellent, but his classroom performance was extremely poor.

4.

Ans. D

5.

Ans. A

Sol. $P = 3^1$

$Q = 3^2 = 9$

$R = 3^3 = 27$

$S = 3^4 = 81$

$T = 3^5 = 243$

So, $Q + S = 9 + 81 = 90$

6.

Ans. B

Sol. GST is imposed at the point of usage of goods and services.

7.

Ans. A

Sol. within, for

8.

Ans. D

Sol. Flying

9.

Ans. A

Sol. Total expenditure = 2500 million

Total revenue = 3000 million

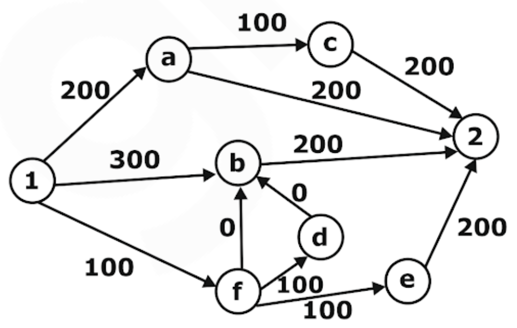
profit % $= \frac{500}{2500} \times 100$

profit % = 20

10.

Ans. D

Sol.



Source 1, Destination 2

from Node 1 shortest is $1 \to f$

From $f \to e$ cost 100

$f \to b$ cos 0

So, $f \to b$ is selected.

Then $b \to 2$ is selected

$\Rightarrow$ so, $1 \to f \to b \to 2$

TECHNICAL

1.

Ans. 19

Sol.

Given Array size $\Rightarrow$ C [4] [4]

4 rows 5columns

a[4] [5] $\Rightarrow$

	Column → 1	2	3	4	5
row → 1	**1** 1000	**2** 1002	**3** 1004	**4** 1006	**5** 1008
2	**6** 1010	**7** 1012	**8** 1014	**9** 1016	**10** 1018
3	**11** 1020	**12** 1022	**13** 1024	**14** 1026	**15** 1028
4	**16** 1030	**17** 1032	**18** 1034	**19** 1036	**20** 1038

base address of a = 1000

"*" → has higher precedence the "+"

((a + ** a + 2) + 3)

$*(*(a + **a + 2) + 3))$

$*a \rightarrow 1000$

enter into 1st row

access 1st element of 1st row ≡ 1

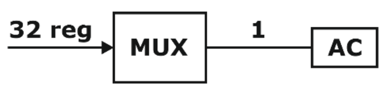
$*(*(a + 1 + 2) + 3))$

$*(*\underbrace{(a + 3)}_{\text{skip the first 3 rows entirely}} + 3) \equiv$ a[4][4] ≡ 19

2.

Ans. 5

Sol.



MUX: 2^n inputs, n selection lines, 1 o/p

$2^n = 32 \quad \Rightarrow n = 5$

3.

Ans. A

Sol. Insertion of an element into AVL requires O(log n) time.

To insert an element

1. Find the position, where to insert

2. After insertion, to satisfy AVL properly, we may need to perform rotation.

So, (1) take 'log n time' and (2) take 'log n' time.

Total time for inserting one element into AVL tree is

$\log n + \log n = 2 \log n \Rightarrow O(\log n)$.

Now, To insert n^2 elements $\Rightarrow n^2 \log n$

$\Rightarrow O(n^2 \log n)$

4.

Ans. B

Sol. Let $L_1 = a^n b^n \Rightarrow$ CFL

$L_2 = \Sigma^* \Rightarrow$ Regular

$L_1 \cup L_2 = (a^n b^n) \cup \Sigma^* = \Sigma^* \Rightarrow$ Regular

Since $L_1 \cup L_2$ is regular but L_1 is not regular, Hence statement I is false.

Regular language is not closed under infinite union.

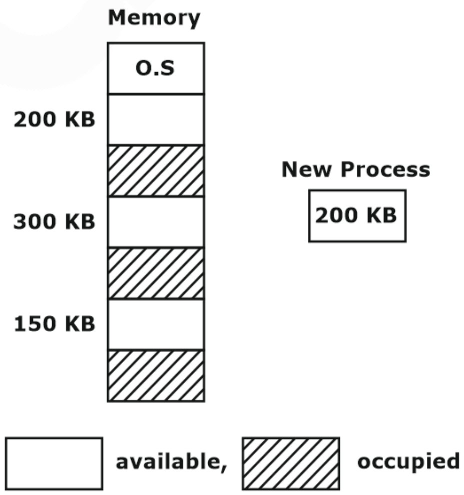
Hence, statement-II is also false.

$\therefore$ Neither I nor II is true.

5.

Ans. A

Sol. Let us consider a new process required 120 kb memory and existing holes in the memory are 200, 300, 150 kb as shown in the diagram in the same order.



Now, when we allocate, this new process a memory using different algorithms, it would be like given below

Algorithm	Allocated partition	size of new tube
First Fit	200 KB	80 KB
Best Fit	150 KB	30 KB
Worst Fit	300 KB	180 KB
Next Fit	300 KB	180 KB

6.

Ans. 1034

Sol. Byte addressable 1 KB RAM

$\Rightarrow 2^{10}$ bytes

$m = 10$

$n = 2^m$

$m = 10, n = 1024$

so, $m+n= 1024+ 10 = 1034$

7.

Ans. B

Sol. Statement 1: False, Because, Intermediate router may modify fields like TTL, offset checksum.

Statement 2: True, router may not implement routing protocol, for static routing.

Statement 3: False, It is not mandatory to reassemble.

8.

Ans. (7)

Sol. $S \rightarrow aSB$

$\rightarrow aaSBB$ [$S \rightarrow aSB$]

$\rightarrow aaaSBBB$ [$S \rightarrow aSB$]

$\rightarrow aaadBBB$ [$S \rightarrow d$]

$\rightarrow aaadbBB$ [$B \rightarrow b$]

$\rightarrow aaadbbB$ [$B \rightarrow b$]

$\rightarrow aaadbbb$ [$B \rightarrow b$]

Total 7 steps required.

9.
Ans. B

Sol.

Catalog	
S.no	Cost
S_1	50
S_1	250
S_1	100
S_2	200
S_2	250
S_3	150
S_3	250
S_3	300
S_4	200

AVG.
225

S.no	pno	cost
S_2	P_4	200
S_4	P_4	250

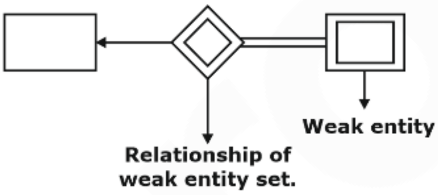
Result

S.no	S name
S_1	M/s Royal Furniture
S_2	M/s Balaji Furniture
S_3	M/s Premium Furniture
S_3	M/s Premium Furniture

Therefore 4 rows returned by the above query.

10.
Ans. B

Sol.



11.

Ans. (13.5)

Sol. Cache Memory = 1 MB

Word size = 64 bit = 8 B

Block size = 256 B

Hit rate, x = 0.94 miss rate= 1-x = 0.06

Cache access time, Tc = 3ns

Number of words / Block = 256/8 = 32

Using Hierarchical Approach,

Tavg= (x.Tc) + (1-x)[Tc + 1st word access time + remaining word access time]

Tavg = (0.94 × 3) + (1 – 0.94) [3 + 20 + (31 × 5)]

Tavg = 13.5 ns

12.

Ans. 0.125

Sol. No. of relation on A = 2^9

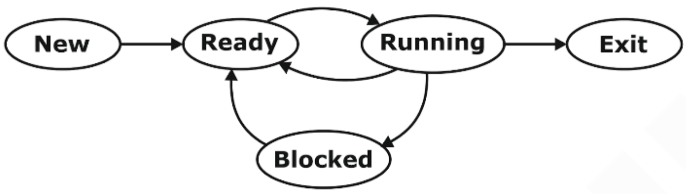
No. of reflexive relation on A = $2^\wedge(n^2-n) = 2^\wedge(3^2-3) = 2^6$

$\therefore$ Probability (reflexive) $= \dfrac{2^6}{2^9} = \dfrac{1}{8} = 0.125$

13.

Ans. B

Sol.



1,2,4 are True

14.

Ans. A

Sol. Given steps:

1. R_{2r}, $TEMP^1{}_r$, ALU_{add}, $TEMP^2{}_W$
2. R_{1r}, $TEMP^1{}_W$
3. PC_r, MAR_W, MEM_r
4. $TEMP^2{}_r$, RO_W
5. MDR_r. IR_W

Instruction fetch is first step to be done which is indicated by step 3 and 5

$$\begin{matrix} 3\ Pc_r,\ MAR_w,\ MEM_r \\ 5\ MDR_r,\ IR_w \end{matrix} \Rightarrow \begin{cases} MAR \leftarrow PC \\ IR \longleftarrow Read\ (MAR) \\ IR \longleftarrow MDR \end{cases}$$

Then instruction decoded by cu and then operand fetch should be performed. If is indicated with step 2 and operand fetch and perform operation by step 1

$$\begin{matrix} 2\ R1_r,\ TEMP^1{}_w \\ R_{2r},\ TEMP_{1r},\ ALUa_{dd},\ TEMP^2{}_w \end{matrix} \Rightarrow \begin{cases} TEMP_1 \longleftarrow R_1 \\ TEMP_2 \longleftarrow R_2 \\ (add)ALU \longleftarrow TEMP_1, TEMP_2 \end{cases}$$

4. Now, write result operations should be performed. It is indicated by step 4 as result should be in R_0.

Step 4:

$$TEMP_{2w},\ RO_w \Rightarrow \begin{cases} TEMP_2 \longleftarrow ALU\ (result) \\ R_0 \longleftarrow TEMP_2 \end{cases}$$

Hence correct order of execution should be, 3, 5, 2, 1, 4

15.
Ans. 7

Sol. According to Lagrange's theorem, state that for any finite group G, the order (number of element) of every subgroup t_1 of G divides the order of G. therefore, possible subgroup of group of 35 elements.

{1, 5, 7, 35}

16.
Ans. B

Sol. $T(n) = T(n^{\frac{1}{a}}) + 1 \;\; \& \;\; T(b) = 1$

$$T(n^{\frac{1}{a}}) = T\left((n^{\frac{1}{a}})^{\frac{1}{a}}\right) + 1 \;\; \& \;\; T(b) = 1$$

$$= \left(T\left(n^{\frac{1}{a^2}}\right) + 1\right) + 1$$

$$T(n^{\frac{1}{a^2}}) = \left(T\left((n^{\frac{1}{a^2}})^{\frac{1}{a}}\right) + 2\right) + 1$$

$$= T\left(n^{\frac{1}{a^3}}\right) + 3$$

$$\vdots$$

$$\vdots$$

$$T\left(\frac{1}{n^{a^K}}\right) + K$$

$\Rightarrow \log_a \log_b n$

$\Rightarrow O(\log_a \log_b n)$

17.
Ans. B

Sol. Statement I – False, symbol table can be accessed during any phase of compiler.

Statement II- False, For recursion support it is not necessarily be heap storage, as stack storage also supports recursion.

Statement III – False, "Variable must be declared before use" are detected during semantic analysis.

Hence, None of the statements is correct.

18.

Ans. 6

Sol. In non-persistent HTTP, each packet takes 2 RTT (Round trip Time): one for TCP connection, one or HTTP Text (Image file As, it is given text and 5 images that totals 6 objects.)

So, it takes 12 RTT in total. But,

12 RTT includes 6 HTTP connections + 6TCP connections.

So, the minimum number of TCP connections required is 6.

19.

Ans. B

Sol. Statement I-- $L = \{a^n \mid n \geq 0\} \cup \{a^n b^n \mid n \geq 0\}$

↓ ↓

Linear power, well know DCFL

∴ it is regular

∴ L = Regular ∪ DCFL {use the closure properties}

L = DCFL

Statement--III As we cannot write LL(k) grammar, for any value of k, Hence statement III is correct.

20.

Ans. B

Sol. Eliminate the options.

--Option (A) is incorrect, it forces the string to start with 1, we cannot generate strings like 01, 0111, ….

-- Option (C) is incorrect, it generates string ending with 1, so cannot generate strings like 10, 1110

-- Option (D), not always generates strings with odd 1's as it can generate 110.

-- Options (B), is correct, as it can generate all the string with odd number of 1's.

21.

Ans. (13)

Sol. Given Hash Function ⇒ h_1 (k) = k mod 23

h_2 (k) = 1 + (k mod 19)

Table size = 23

Key = 90

h1 (k) = 90 mod 23 ≡ 21

h2 (k) = 1 + 90 mod 19 ≡ 1 + 14 = 15

Double hashing, (h1 (k) + i.h2(k)) mod 23

Asked for probe 1, put i = 1

(21 + 1. (15) mod 23

36 mod 23 = 13

22.

Ans. D

Sol. (i) e^{-x} is decreasing

(ii) $f(x) = x^2 - \sin x$

$f'(x) = 2x - \cos x$

Now check $f'(x)$ at [0, 1]

$f'(0) = -1$

$f'(1) = 2 - \cos 1 = 1.4596$

$\therefore$ f(x) is not increasing everywhere

(iii) $f(x) = \sqrt{x^3 + 1}$

$$f'(1) = \frac{1}{2\sqrt{x^3+1}} \times 3x^2$$

$f'(x) \geq 0$ for all x.

$\therefore$ f(x) is an increasing function.

23.

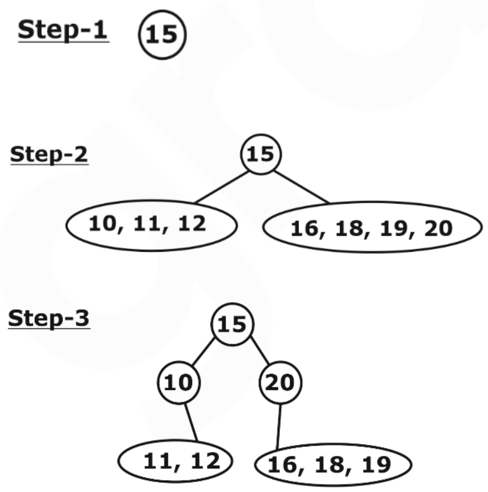
Ans. C

Sol. Inserting an element at the beginning of the linked list takes O(1) time. But, If it needs to be sorted, then in the worst case, it takes (log n) time using merge sort. To insert such n elements and make sure it is in sorted order, the worst case time complexity would be O(n log n).

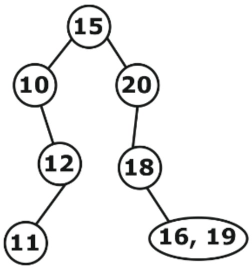
24.

Ans. A

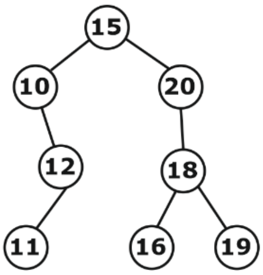
Sol.



Step-4



Step-5



Post order: 11, 12, 10, 16, 19, 18, 20, 15

25.

Ans. C

Sol. Statement 1: True, Daisy chaining assign non-uniform priorities in attending interrupts.

Statement 2: False, A vectored interrupt means, CPU knows the source of the interrupt.

Statement 3: True, polling technique makes CPU to periodically verity states bits and service for need

Statement 4: False: During DMA also, CPU will have master control over the bus. (OR) IOP (I/O processor) and CPU can be mastered but not at the same time.

Hence, I and III are true

26.

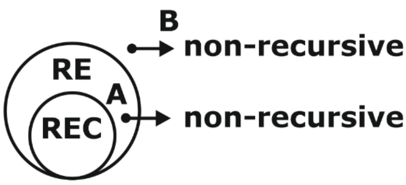
Ans. C

Sol. L_1 $L(m) = \varphi \Rightarrow$ emptiness problem of TM.

TM is undecidable under emptiness.

L_2 = where a TM visits a particular state in finite steps in decidable, as we can do this with UTM.

L_3 = L(m) is non-Recursive,



Clearly from the diagram

L(A) $\Rightarrow$ non recursive language accepted by TM

L(B) $\Rightarrow$ non-recursive language not accepted by TM.

$\therefore$ it is a non-trivial property, hence undecidable.

L_4 = Undecidable problem using rice-theorem.

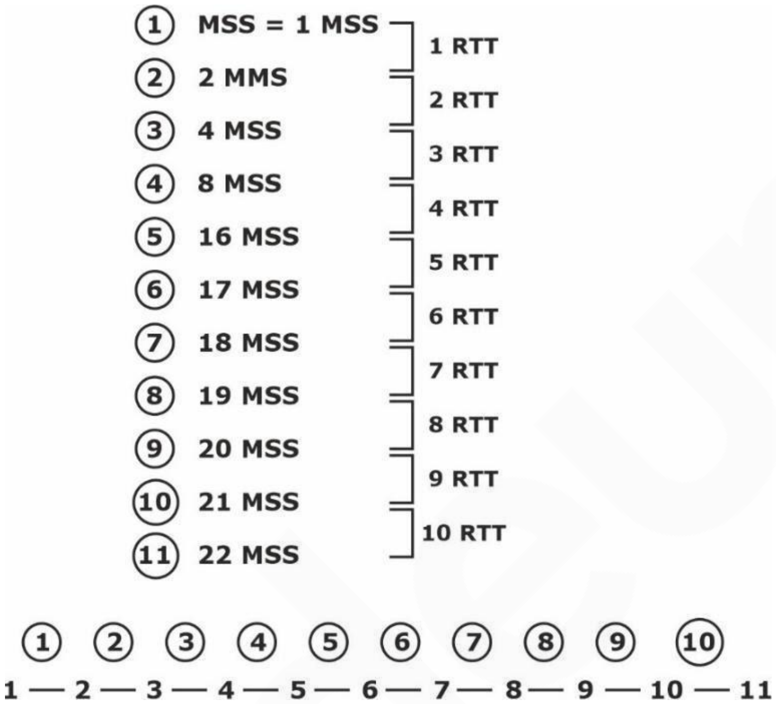
Hence, L_1, L_3, and L_4 are undecidable.

27.
Ans. 44 KB

Sol. TCP connections at t = 0

1MSS = 2KB Threshold = 32KB (slow start)

RTT = 6ms. Then how big packet it (packet size) may deliver after t + 60 ms



1 RTT = 6 ms

⇒ 10 RTT = 60 ms

t + 60 = 0 + 60 = 60 ms

At 60 ms, CWND = 22 MSS

1 MSS = 2KB

⇒ 22 MSS = 22 × 22 = 44 KB

28.
Ans. A

Sol. No. of host = 1500

No. of host bits = $[\log_2 1500]$ = 11 bits

∴ Total possible hosts = $2^{11} = 2^3 \times 2^8$

n is the netmask bits,

Range of addresses is = 2^{32-n}

$2^{11} = 2^{32-n}$

Available IP address ⇒ 202.61.0.0/17

$$\left.\begin{array}{r}0000\ 0000.0000\ 0000\\0000\ 0111.1111\ 1111\end{array}\right\}0.0-7.255$$

$$\left.\begin{array}{r}0000\ 1000.0000\ 0000\\0000\ 1111.1111\ 1111\end{array}\right\}8.0\text{ to }15.255$$

So the IP address follow the pattern

$$\begin{array}{l}0.0\text{ to }7.255\\8.0\text{ to }15.255\\16.0\text{ to }23.255\\\quad\vdots\\64.0\text{ to }\ldots\\\quad\vdots\\104.0\text{ to }\ldots\end{array}$$

$\therefore$ The possible IP addresses are 202.61.64.0/21 & 202.61.104.0/21

29.

Ans. B

Sol. R has a nontrivial functional dependency $X \to A$, where X is not a sup and A is a prime attribute.

30.

Ans. D

Sol. $R_2(B)$ is conflicting with $W_1(B)$ so, $W_1(B)$ should always come after $R_2(B)$

$W_2(B)$ is conflicting with $W_1(B)$ similarly, $W_1(B)$ should always come after $W_2(B)$

$R_2(D)$ is conflicting with $W_1(D)$, so, $W_1(D)$ should always come after $R_2(D)$

$R_1(C)$ is conflicting with $W_2(C)$ so, $W_2(C)$ should always come after $R_1(C)$

Therefore the transaction will be:

T1	T2
	R(B)
	W(B)
	R(D)
R(A)	
R(C)	
W(D)	
W(B)	
	W(C)
Commit	
	Commit

31.
Ans. 4

Sol. No. of records = 10^6

Block size = 8 KB

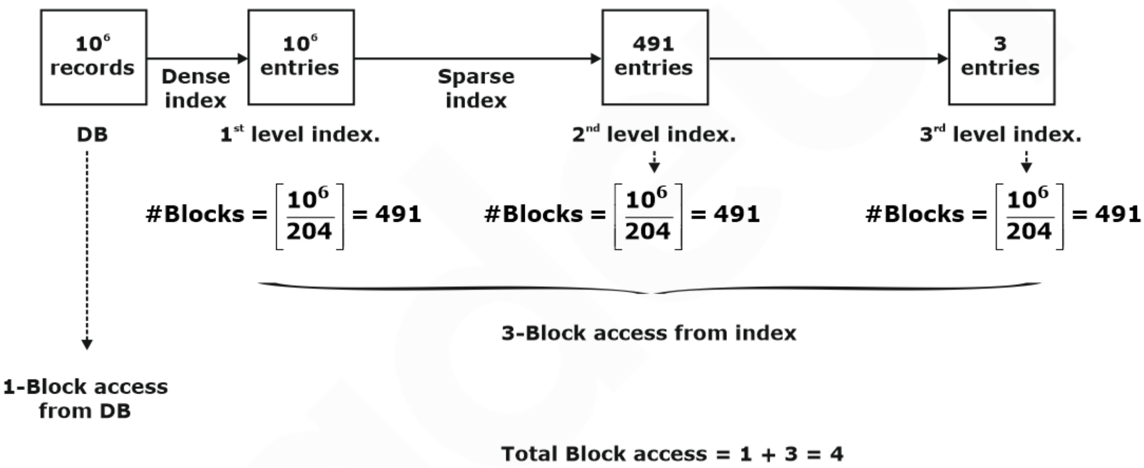
Search key = 13 bytes

Block pointer size = 8 bytes

$$\text{Balancing factor og index file} = \left\lceil \frac{\text{Block size}}{\text{search key} + \text{Blcok pointer}} \right\rceil$$

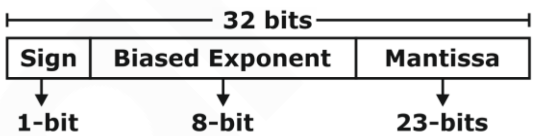
$$= \left\lceil \frac{4\text{ KB}}{12+8} \right\rceil = \left\lceil \frac{2^{12}}{20} \right\rceil$$

Balancing Factor of index file =204



32.
Ans. B

Sol. IEEE-754 single precision floating point format



R1 : 0 × 42200000 ⇒ 01000 0010 0010 0000 0000 0000 ...

R1 : 0 × C1200000 ⇒ 1100 0001 0010 0000 0000 ...

R3 :

0	100 00100	010000...
S	BE	M

R2 :

0	1000 0010	010000...
S	BE	M

Need to perform $R3 = \frac{R1}{R2}$

1. Actual exponent = R1 exponent – R2 exponent

$$\begin{array}{r} 1000\ 0100 \\ 1000\ 0010 \\ \hline \text{AE}: 0000\ 0010 \end{array}$$

In IEEE-754, Bias = $\underline{2^{n-1}} - 1 = 2^{8-1} - 1 = 127$

Bias = 01111111

BE = AE + Bias

AE:0000 0010

Bias:0111 1111

BE :1000 0001

2. Divide the Mantissa of R1 by R2.

$$\begin{array}{r} M_{R1}: 1.0100\ldots \\ M_{R2}: 1.0100\ldots \\ \hline : 1.\underbrace{00000}_{\text{Mantissa of result is all zero}} \end{array}$$

3. Sign of divisor and dividend is opposite,

∴ Result sign = –ve. (1)

∴ **R3 :**

S	BE	M
⊥	100 00001	00000...

C 0 8 0

∴ R3 = C0800000

33.

Ans. 5.25

Sol. Average turnaround time

$P_1 = 21, P_2 = 13, P_3 = 2, P_4 = 6$

$$\text{Avg.} = \frac{21+13+2+6}{4} = \frac{42}{4} = 10.5$$

RR

P_1	P_2	P_3	P_4	P_1	P_2

0 4 8 10 14 18 21

Average turnaround time

$P_1 = 18, P_2 = 21, P_3 = 10, P_4 = 14$

$$\text{Avg.} = \frac{18+21+10+14}{4} = \frac{64}{4} = 15.75$$

Difference = 15.75 – 10.5 = 5.25

34.

Ans. 55

Sol.

fun2(5)

$\downarrow$

Step – I $\quad 0 + \text{fun1}(5) = 0 + 5 = 5$

$\downarrow \quad \uparrow$

returns $(0 + 5)$

fun2(4)

$\downarrow$

Step – 2 $\quad 5 + \text{fun1}(4) = 5 + (5 + 4) = 14$

$\downarrow \quad \uparrow$

returns $(5 + 4)$

fun2(3)

$\downarrow$

Step – 3 $\quad 14 + \text{fun1}(3) = 5 + (5 + 4) + (5 + 4 + 3)$

$\downarrow \quad \uparrow \quad = 5 + 9 + 12 = 26$

returns 12

fun2(2)

$\downarrow$

Step – 4 $\quad 26 + \text{fun2}(2) = 5 + (5 + 4) + (5 + 4 + 3) + (5 + 4 + 3 + 2)$

$\downarrow \quad \uparrow \quad = 5 + 9 + 12 + 14 = 40$

returns 14

fun2(1)

$\downarrow$

Step – 5 $\quad 40 + \text{fun2}(1) = 5 + (5 + 4) + (5 + 4 + 3)$

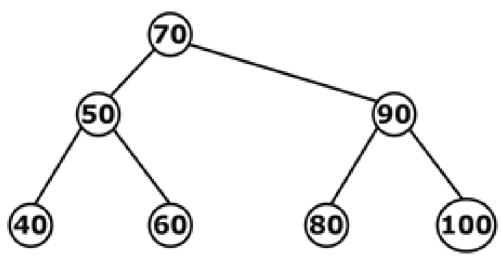
$\downarrow \quad \uparrow \quad + (5 + 4 + 3 + 2) + (5 + 4 + 3 + 2 + 1)$

returns 15 $\quad = 5 + 9 + 12 + 14 = 55$

35.

Ans. A

Sol.



To find a number between range [x, y] requires log n comparisons.
As, K numbers are to be found, K + log n would be time complexity.

36.
Ans. D

Sol. d(AB) = d(A) × d(B)

d(A + B) ≥ d(A) + d(B)

r(A + B) ≤ r(A) + r(B)

r(AB) ≠ r(A) r(B)

37.
Ans. 81

Sol. PP(3, 4) = ______

PP function:

a	b	tot	ex
3	4	1	3

Len = tob(b, arr)

tob functions:

b: 1

arr:

0	1	2	3
0	0	1	

i = 0 4 > 0, (with b = 4)

if (4 % 2) False, so else gets executed

So, arr[0] = 0,

if t b = b/2

i = 1 2 > 0 (with b = 2)

if (2 % 2) false

So, else gets executed ⇒ arr [1] = 0, i = i + t b = b/2

i = 2 1 > 0 (with b = 1)

if (1 % 2) True arr [2] = 1 i + 1, b = b/2

i = 3 0 > 0 (with b = 0) false

return I, returns '3' to len, in PP function.

In PP function: len = 3

For loop.

i = 0 ex = 3 × 3 = 9	i = 1 ex = 9 × 3 = 81	i = 2 tot = t * t * ex = 1 * 81 = 81

38. Consider the following five disk access requests of the form (request id, cylinder number) that are present in the disk scheduler queue at a given time.

(P, 155), (Q, 85), (R, 110), (S, 30), (T, 115)

Assume the head is positioned at cylinder 100. The scheduler follows Shortest Seek Time First scheduling to service the requests.

Which one of the following statements is FALSE?

A. T is serviced before P.

B. The head reverses its direction of movement between servicing of Q and P

C. R is serviced before P.

D. Q is serviced after S, but before T.

Ans. D

Sol. Given P : 155

Q : 85

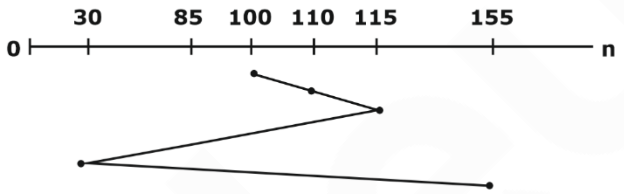
R : 110

S : 30

T : 115

Current head position = 100

SSTF = algorithm



From the above sequence, we can say that option D is correct.

39.

Ans. L_1 is regular and L_2 is CFL.

Sol. L_1: $\{\omega\ xyx \mid \omega, x, y \in (0 + 1)^*\}$

We can write the regular expression for this,

Let, x = 0

$L_{11} = \omega\ 0\ Y\ 0 \Rightarrow (0 + 1)^+\ 0(0 + 1)^+0$

x = 1

$L_{12} = \omega\ 1\ Y\ 1 \Rightarrow$ we can generate all the strings and since a regular expression can be written for 4, we can say 4 is regular.

L_2 is CFL:

$L_2 = \{xy \mid x, y \in (a + b)^*, |x| = |y|, x \neq y\}$

L_2 generates strings of even length, which can be done by PDA, therefore L_2 is CFL.

40.

Ans. 2.16

Sol. Non-pipeline

Clock frequency = 2.5 GHz.

$$\text{Cycle time} = \frac{1}{2.5\text{GHz}} = 0.4\text{ns}$$

Given, CPI = 5

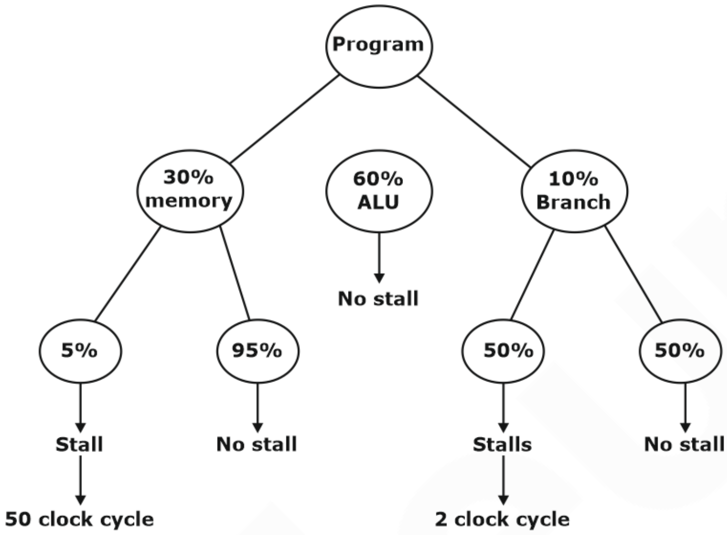
So, $ET_{non\text{-}pipe}$ = CPI × Cycle time

$= 5 \times 0.4 \text{ ns} = 2 \text{ ns}$

Pipeline:

Clock frequency = 24 GHz

$$\text{Cycle time} = \frac{1}{2\text{GHz}} = 0.5 \text{ ns}$$



∴ Number of stalls/instruction = $0.3 \times 0.05 \times 50 + 0.1 * 0.5 \times 2$

$= 0.85$

Avg. instruction ET_{pipe} = (1 + No. of stall instruction) * cycle time

$= (1 + 0.85) \times 0.5 \text{ ns} = 0.925 \text{ ns}$

$$S = \frac{ET_{non-pipe}}{ET_{pipe}} = \frac{2}{0.925} = 2.16$$

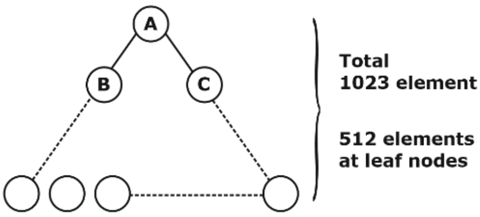
41.

Ans. 511

Sol. Min-heap contains 1023 elements.

Min-heap means, parent should be minimum or equal to it's children so, max children could be either left or right one.

Following this logic, maximum can be definitely at leaf nodes.



$$\text{No. of elements in leaf} = \left\lceil \frac{n}{2} \right\rceil = \left\lceil \frac{1023}{2} \right\rceil = 512$$

To find maximum among 512 elements, no. of comparisons needed is 511.

42.

Ans. 0.5

Sol. Let n = 3

$0 \in < 0,1]^3$

$$\text{Let } a = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}$$

x = 0 or 1

$$\sum_{i=1}^{3} a_i x_i = a_1 x_1 + a_2 x_2 + a_3 x_3$$

$= x_1 = x_3$ $(\because a_1 = 1, a_2 = 0, a_3 = 1)$

= 0 or 1 or 1 or 2.

$$\text{Let } a = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

$$\sum_{i=1}^{3} a_i x_i = a_1 x_1 + a_2 x_2 + a_3 x_3$$

$= x_3$ $(\because a_1 = a_2 = 0)$

= 0 or 1

$$\text{Let } a = \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix}$$

$$\text{again for } a = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, \sum_{i=1}^{3} a_i x_i = 0 \text{ or } 1$$

$$\text{Let } a = \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}$$

$$\sum_{i=1}^{3} a_i x_i = x_1 + x_2 = 0, 0, 1, \text{or } 2$$

$$\text{Similarly for } a = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix}$$

$$\sum_{i=1}^{3} a_i x_i = 0, 1, 1 \text{ or } 2$$

Total number of cases = 2 × 3 + 4 × 3 = 18

Now odd number of cases = 9

$$P = \frac{9}{18} = 0.5$$

43.

Ans. 99

Sol. If we consider a small graph with 5 vertices, then the minimum spanning tree will have a weight 4.

So, for n-vertices, MST weight would be (n – 1)

As n = 100 (no. of vertices), So, minimum spanning tree weight = (100 – 1) = 99

44.

Ans. 154.5 ns

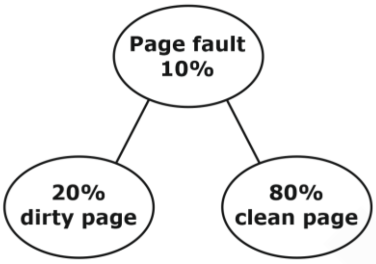
Sol. Main memory access time, T_m = 100 ns

TLB lookup, T_{TLB} = 20ns

Page transfer time, T_{PT} = 5000 ns

TLB hit ratio, x = 0.95 (95%)

page fault rate, p = 0.10 (10%)



We know,

EMAT for multilevel paging,

EMAT = x (T_c + T_m) + (1 – x) (T_c + (n + 1) T_m)

EMAT, when there is a page fault, S → is service time

EMAT = (1 – P) T_m + Ps

Here, we are using TLB, and page fault occurs whenever there is a miss in TLB, So the required EMAT is ,

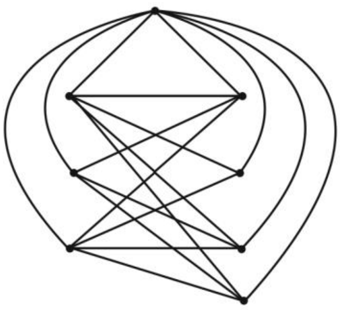
EMAT = x(T_{tlb} + T_m) + (1 – x) [(1 – P) (T_{tlb} + T_m + T_m) + p(% dirty (T_{tlb} + T_m + 2T_{PT}) + % clean (T_{tlb} + T_m + T_{PT})

∴ EMAT = 0.95 (20 + 100) + 0.05 (0.9 (20 + 100 + 100) + 0.1 (0.2 (20 + 100 + 2(5000)) + 0.8 (20 + 100 + 5000))

= 154.5 ns

45.

Sol.



Minimum number = 3 + 4

Of edge-colors required = 7

46.

Ans. Option D

Sol. G = (V, E) T = MST

Weighted edge (μ, v) is added to T.

To verify it is still a MST or not, we need to compare with all the vertices. So, it would be O(V).

47.

Ans. C

Sol. Subject Operating Systems

a = 1 b = 0 count = 0

Code section P: For process 1

Wait (a) ⇒ a = 0

Count ++ ⇒ count = 1

If (count = = n) ⇒ false

signal (a) ⇒ a = 0

wait (b) process blocked

As shown above, all processes execute wait (b) before, signal (b) in if condition.

Because, 'if' condition becomes True only for process P_n(n^{th} process) [∵ if (count = = n)]

So, before Pn process finishes the code section, P, no other process executes code section Q.

Hence, no process executes code section Q before every process has finished code section P.

48.

Ans. 12

Sol. LILAC

IAC

3! + LLAC

$$3+\frac{4}{2}+3+\frac{4}{2}+\frac{4}{2}$$

3 + 2 + 3 + 2 + 2 = 12

49.

Ans. C

Sol. Rule 1: It is L-attributed as a child is inheriting either from parent or left sibling.

Rule 2: In expression (X.i = A.i + Y. s), child is inheriting from its right sibling, which is not allowed in L-attributed. Hence, Rule 2 is not L-attributed.

50.
Ans. 14
Sol.

I-type : ← 16 bits →

Opcode	Reg	Am
6 bits	6 bit	4 bit

R-type : ← 16 bits →

Opcode	Reg	Reg
4 bits	6 bit	6 bit

$\Rightarrow$ # of instruction possible = 2^4 = 16
$\therefore$ No. of free opcodes = 16 – x
Let x is number of R-type instruction existed.
$\therefore$ No. of I-type instruction possible = (16 – x) * 2^2
8 = 64 – 4x

4x = 64 – 8 = 56

x = 14

51.
Ans. C

Sol. 1 word = 4 bytes

Main memory = 16 MB

Bytes – Addressable

Cache size = 64 KB

4-way SAM

Block size = 256 bytes

$A_1 = (42C8A4)_{16}$ $A_2 = (546888)_{16}$ $A_3 = (6A289C)_{16}$ $A_4 = (5E4880)_{16}$

Which two map to the same cache set?

TAG	SET	WORD

SAM:

$$\text{Address length} = \frac{\text{Main memory size}}{\text{Byte}} = 16 \times 2^{20}\text{Bytes}$$

$= 2^{24}$ Bytes

= 24 bits.

Word $\Rightarrow$ Block size = 256 bytes $\Rightarrow$ 8 bits for word

$$\text{No. of sets} = \frac{\text{Total Block}}{\text{Blokes Per set}} = \frac{2^8}{2^2} = 2^6\text{sets}$$

$$\text{No. of block in cache} = \frac{\text{cache size}}{\text{Blcok size}} = \frac{64\text{KB}}{256\text{B}} = \frac{2^{16}}{2^8} = 2^8$$

So, SET field 6 bits

Remaining bits for TAG = 24 – (8 + 6) = 10 bits

← 24 bits →

TAG	SET	WORD
10 bits	6 bits	8 bits

A_1 :	0100 0010 11	00 1000	1010 0100	SET : 8
A_2 :	0101 0100 01	10 1000	1000 1000	SET : 40
A_3 :	0110 1010 01	10 1000	1001 1100	SET : 40
A_4 :	0101 1110 01	00 1000	1000 0000	SET : 8

Hence, A_1 and A_4 maps to same set

A_2 and A_3 maps to same set

52.

Ans. C

Sol. $Z = a + \overline{bc}$

solving it with K-map

$Z = a + \bar{b}c$ =

a \ bc	00	01	11	10
0	$_0$	1 $_1$	$_3$	$_2$
1	1 $_4$	1 $_5$	1 $_7$	1 $_6$

∴ Minterms will be

$= \sum m(1, 4, 5, 6, 7)$

53.

Ans. B

Sol. $\forall \times (P(x) \to \omega) \equiv \forall x\ p(x) \to \omega$ is worng

since $\forall \times [(px) \to \omega] \equiv \forall x[\sim P(x) v\omega]$

$\equiv \forall x[\sim P(x) v\omega]$

$\equiv \sim [\exists \times P(x)] v\omega$

$\equiv \exists \times P(x) \to \omega$

54.

Ans. 6

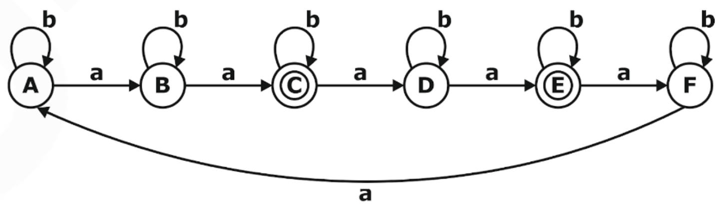
Sol. L = w ϵ (a, b)* $|n_a(w)$ = multiple of 2 but not 3.

$L_1 = \{n_a \bmod 2 = 0\} \Rightarrow$ need 2 states

$L_2 = \{n_a \bmod 3 \neq 0\} \Rightarrow$ need 3 states

$|L_1 \times L_2| = (2 \times 3) = 6$ states.

Minimal DFA design ⇒



∴ No. of states in min. DFA = 6 states.

55.

Ans. C

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