Answer Keys

1	D	**2**	C	**3**	C	**4**	C	**5**	D	**6**	B	**7**	0
8	8	**9**	C	**10**	A	**11**	C	**12**	C	**13**	C	**14**	6
15	D	**16**	B	**17**	A	**18**	25	**19**	B	**20**	C	**21**	3
22	120	**23**	A	**24**	A	**25**	D	**26**	**B**	**27**	A	**28**	C
29	C	**30**	C	**31**	B	**32**	A	**33**	B	**34**	B	**35**	D
36	A	**37**	D	**38**	C	**39**	A	**40**	D	**41**	C	**42**	B
43	D	**44**	C	**45**	B	**46**	B	**47**	A	**48**	B	**49**	D
50	A	**51**	B	**52**	A	**53**	B	**54**	B	**55**	A	**56**	D
57	C	**58**	C	**59**	A	**60**	B	**61**	D	**62**	D	**63**	C
64	C	**65**	A										

Explanations:-

1. For a complete graph $K_{m,n}$

   Line covering number $\alpha_1 = \max(m,n) = 5$

   Line Independence number $\beta_1 = \min(m,n) = 4$.

2. $$a_1 = a_0 + 1$$
   $$a_2 = a_1 + 2$$
   $$= a_0 + 1 + 2$$
   $$a_n = a_o + 1 + 2 + ... + n$$
   $$= 2 + \frac{n(n+1)}{2}$$
   $$a_n = \frac{n^2 + n + 4}{2}$$

3. $[A/B] = \left[\begin{array}{ccc|c} 1 & 4 & 8 & 16 \\ 3 & 2 & 4 & 12 \\ 4 & 1 & 2 & 10 \end{array}\right]$ Reducing into Echelon form

   $$\begin{array}{l} R_2 \to R_2 - 3R_1 \\ R_3 \to R_3 - 4R_1 \end{array} \sim \left[\begin{array}{ccc|c} 1 & 4 & 8 & 16 \\ 0 & -10 & -20 & -36 \\ 0 & -15 & -30 & -54 \end{array}\right] R_3 \to 2R_3 - 3R_2 \sim \left[\begin{array}{ccc|c} 1 & 4 & 8 & 16 \\ 0 & -10 & -30 & -36 \\ 0 & 0 & 0 & 0 \end{array}\right]$$

   Here $e(A) = e(A/B)$

   < 3(Number of unknowns)

   $\Rightarrow$ Given system has infinitely many solutions

4. Contention time = RTT for CSMA/CD

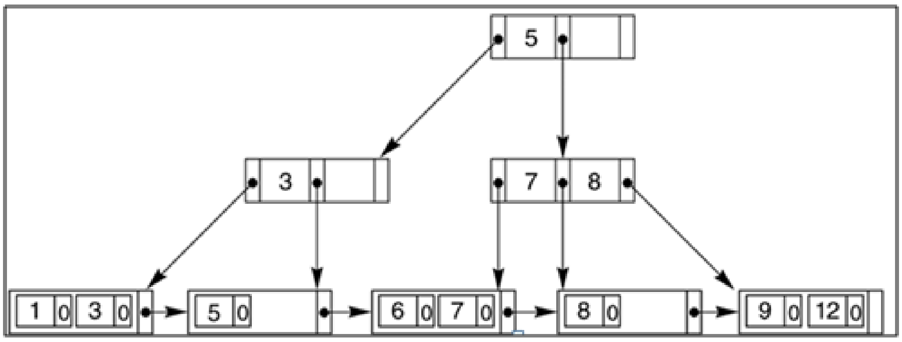
   RTT= 2*End to end propagation delay

6.

S $\rightarrow$ aaX
$\rightarrow$ aaSc
$\rightarrow$ aaaaXc
$\rightarrow$ aaaaScc
$\rightarrow$ aaaabcc

7. The inner query returns {2, 3, 4, NULL}.When outer query checks whether each eno is not in {2, 3, 4, NULL}, the where condition will return false due to the NULL value. Hence no rows will be selected.

8. Total number of nodes =8



At leaf level each key is associated with its record pointer which is shown as '0' in the tree.

9. Maximum size of both sender and receiver window for data transmission using Go back N protocol with n bit frame sequence number is 2^n -1 and 1 respectively.

We can use the piggybacking technique to improve the efficiency of bidirectional protocols.

Go back N protocol is less efficient in noisy channel than Selective Repeat protocol as it has to send all the packets if one is missed.

10.

2 MB----------------------1sec

4 KB-----------------------2 ms

RTT=2*50=100 ms

Utilization=transmission time/(transmission time +RTT)=(2/102)*100%=1.96 %

11. $\text{Length}(\text{LCS}(x, y)) = 6$

$\langle 0,0,1,1,0,1 \rangle$ is one example of $\text{LCS}(x, y)$

14. If team size is n then the number of communication channel is $n(n-1)/2$

15. Some node-x dominates node-y if and only if all the paths from initial node to node-y passes through node-x.

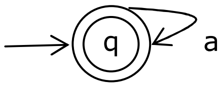
16. Transition function of DFA is $Q \times \Sigma \to Q$

Transition function of NFA is $Q \times \Sigma \to 2^Q$

Transition function of 2-way DFA $Q \times \Sigma \to Q \times \{L, R\}$

Transition function of NFA with $\in$ is $Q \times \{\Sigma \cup \in\} \to 2^Q$

17. $(a + aaa)^* = a^*$



This is simply because, all the patterns $\{\in, a, aa, aaa......\}$ can be generated by $(a + aaa)^*$

18. $n \times (8) + (n-1) \times (4+8) \le 512 \Rightarrow 20 \times n \le 524 \Rightarrow 20 \times n \le \left\lfloor \frac{524}{20} \right\rfloor \Rightarrow n \le 26$

Number of search keys is one less than the order.

19.

$f(x,y,z) = x'y(z+z') + xy'(z+z') = x'yz + x'yz' + xy'z + xy'z'$

Mint erms

$$\begin{array}{ccccccl} x & y & z & & y & z & x \\ 0 & 1 & 1 & & 1 & 1 & 0 - s_3 \\ 0 & 1 & 0 & & 1 & 0 & 0 - s_2 \\ 1 & 0 & 1 & & 0 & 1 & 1 - s_1 \\ 1 & 0 & 0 & & 0 & 0 & 1 - s_0 \end{array}$$

$s_0 = x,\ s_1 = x,\ s_2 = \overline{x},\ s_3 = \overline{x}$

20. Decimal difference = 16

A =0

BC \ DE	00	01	11	10
00	0	1	3	2
01	4	5	7	6
11	12	13	15	14
10	8	9	11	10

A = 1

BC \ DE	00	01	11	10
00	16	17	19	18
01	20	21	23	22
11	28	29	31	30
10	24	25	27	26

Take any two cells in the maps, ex: 5, & 21 $\Rightarrow$ 21 – 5 = 16

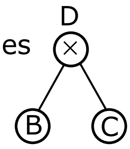
21. Speed up $= \dfrac{t_n}{t_p} = \dfrac{(5+2+3+1+4)}{5} = \dfrac{15}{5} = 3$

($\because$ t_p : Maximum time unit of all stages + overhead $\rightarrow$ overhead is zero here)

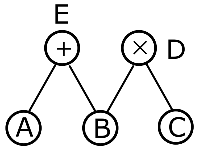
22. If we want to achieve maximum parallelism then we use horizontal micro programming, so the size of control word is equal to the number of control signals i.e. 120 bit.

23. Starting with 1^{st} statement

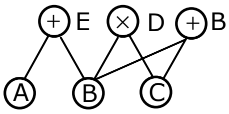
i) $D = B \times C$, the DAG becomes



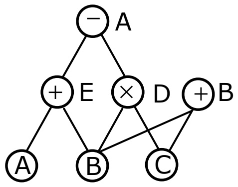
ii) $E := A + B \Rightarrow$



iii) $B := B + C \Rightarrow$



iv) $A := E - D \Rightarrow$



24. $p = \dfrac{20}{100} = 0.2, \quad q = 0.8, n = 10$

Required prob $= P(x = 3)$

$= 10_{C_3} \times (0.2)^3 \times (0.8)^7$

$= 0.4915$

25. $(-8+2) * (8+2) = -6 \times 10 = -60$

26.

A	F	C	6
1 0 1 0	1 1 1 1	1 1 0 0	0 1 1 0
$A_{15}\ A_{14} A_{13}\ A_{12}$	$A_{11} A_{10} A_9 A_8$	$A_7 A_6 A_5 A_4$	$A_3 A_2 A_1 A_o$

$101011\underline{00}11000110$ Valid address (ACC6)

$101011\underline{01}11000110$ Valid address (ADC6)

$101011\underline{10}11000110$ Valid addess (A,EC6)

27.

$A \rightarrow \alpha\beta_1 \| \alpha\beta_2 | ..... | \alpha\beta_m | \gamma$

Then left factored grammar is :

$A \rightarrow \alpha A' | \gamma$

$A^1 \rightarrow \beta_1 | \beta_2 | .. | \beta_m$

28. $EAT = h_t * (t_b + t_m) + (1 - h_t)(t_b + (n+1)t_m)$

$150\ ns = h_t * (10\ ns + 100\ ns) + (1 - h_t)(10\ ns + 3 * 100\ ns)$

$150\ ns = 110\ h_t\ ns + 310\ ns - 310\ h_t$

$200\ h_t = 160 \Rightarrow h_t = 0.8$

29. There will be dead lock if order of wait () changes in P_0

	$\underline{P_0}$		P_1	
	$\rightarrow wait(S_y)^{S_y=0}$	$\longrightarrow$	$wait(S_x)^{S_x=0}$	
$S_x = -1$ block	$wait(S_x)$	$\longrightarrow$	$wait(S_y)$	$S_y = -1$ block
	$\langle C.S \rangle$		$\langle C.S \rangle$	

30. A: student knows the answer

B: student guesses the answer

P(A)=P, P(B)=1-p

E: correct answer

$P\left(\frac{E}{B}\right) = \frac{1}{5}, P\left(\frac{E}{A}\right) = 1$

$P(E) = P(A).P\left(\frac{E}{A}\right) + P(B).P\left(\frac{E}{B}\right)$

$= P * 1 + (1-p) * \frac{1}{5} = \frac{4p+1}{5}$

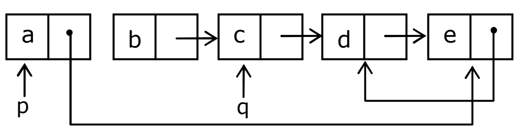
$P\left(\frac{A}{E}\right) = \frac{P(A \cap E)}{P(E)} = \frac{P * 1}{\frac{4p+1}{5}} = \frac{5p}{4p+1}$

31. Cardinality = 1:1

Tables **=** M(<u>M1</u>, M2, N1), N(<u>N1</u>, N2)

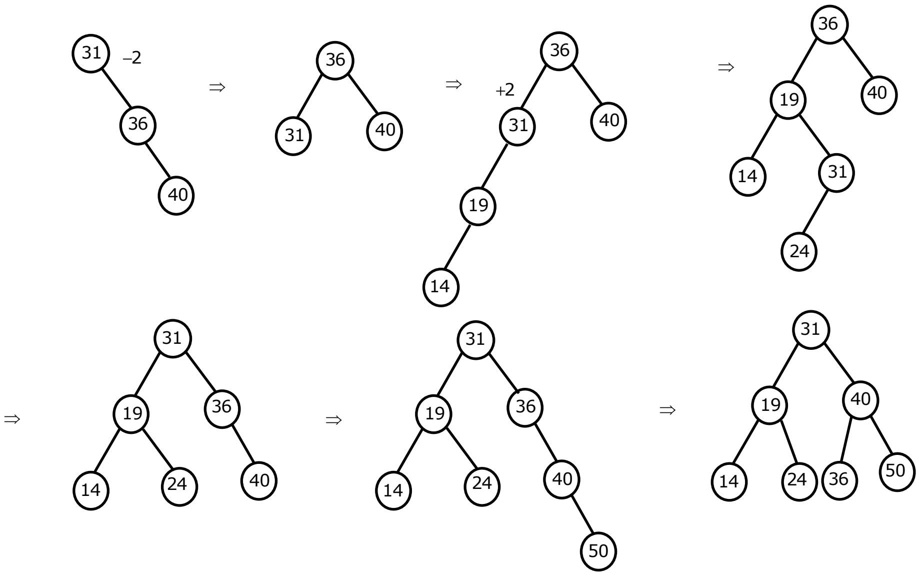
We have to include the foreign key towards the TOTAL PARTICIPATION SIDE

32. After performing given operations, linked list is shown below



printf will print info 'e'.

33.



Pre-order traversal = 31, 19, 14, 24, 40, 36, 50

34. The two printf ("") calls outside the loop are said to have a constant time complexity i.e., O(1). The loop has no. of steps equal to size of array, the loop linear time complexity O(N). The entire function 'f' has a time complexity of 2*O(1)+O(N). If constants are removed then O(N).

35. 28%10 = 8. We have to search bucket 8 linearly, which requires 4 searches to find.

36. $x^6 + x^3 + x^2 + x$

```
1 0 0 1 | 1 0 0 1 1 1 0 0 0 0 | 1 0 0 0 1 1 0
          1 0 0 1
          -------
            0 0 0 1
            0 0 0 0
            -------
              0 0 1 1
              0 0 0 0
              -------
                0 1 1 0
                0 0 0 0
                -------
                  1 1 0 0
                  1 0 0 1
                  -------
                    1 0 1 0
                    1 0 0 1
                    -------
                      0 1 1 0
                      0 0 0 0
                      -------
                        1 1 0
```

$x^2 + x$

$x^7 + x^5 + x^4$

```
1 0 0 1 | 1 0 1 1 0 0 0 0 0 0 0 | 1 0 1 0 0 1 0
          1 0 0 1
          -------
            0 1 0 0
            0 0 0 0
            -------
              1 0 0 0
              1 0 0 1
              -------
                0 0 1 0
                0 0 0 0
                -------
                  0 1 0 0
                  0 0 0 0
                  -------
                    1 0 0 0
                    1 0 0 1
                    -------
                      0 0 1 0
                      0 0 0 0
                      -------
                        0 1 0 0
                        0 0 0 0
                        -------
                          1 0 0
```

x^2

$x^8 + x^5 + x^3$

```
1 0 0 1 | 1 0 0 1 0 1 0 0 0 0 0 0 | 1 0 0 0 0 1 0 0 1
          1 0 0 1
          -------
            0 0 0 0
            0 0 0 0
            -------
              0 0 0 1
              0 0 0 0
              -------
                0 0 1 0
                0 0 0 0
                -------
                  0 1 0 0
                  0 0 0 0
                  -------
                    1 0 0 0
                    1 0 0 1
                    -------
                      0 0 1 0
                      0 0 0 0
                      -------
                        0 1 0 0
                        0 0 0 0
                        -------
                          1 0 0 0
                          1 0 0 1
                          -------
                            0 0 1
```

37. 1011=11 in decimal.
So option + header=11*4 B=44 B
As header size in IPv4 is 20 B, So option=44-20 B=24 B

39.

$$\begin{array}{lll|lll} S & \to & S\alpha \mid \beta & S & \to & \dfrac{S\,aSbS}{\alpha} \Big| \dfrac{ab}{\beta} \\ S & \to & \beta S' & S & \to & abA \\ S' & \to & \alpha S' \mid \varepsilon & A & \to & aSbSA/\varepsilon \end{array}$$

40. Let us apply the state elimination algorithm,

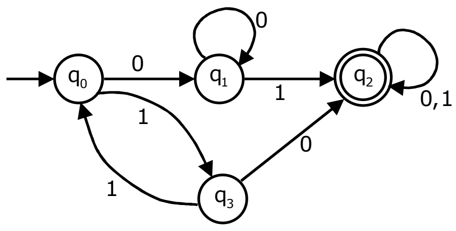
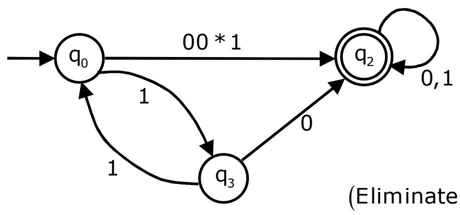


Fig – 1

$\Rightarrow$



(Eliminate q_1)

Fig – 2

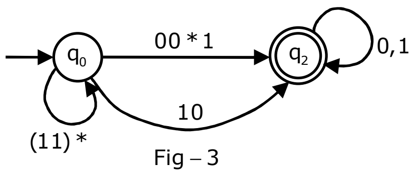


Fig – 3

(Eliminate q_3)

$\therefore$ The regular expression
$= (11)^*(00^*1 + 10)(0+1)^*$

41.

Message	M_1	M_2	M_3	M_4
Number of bits	1	2	3	3

Average bits per message $= 0.5(1) + 0.3(2) + 0.15(3) + 0.05(3) = 1.7$

42. Given that P(A)=2P(B)=3P(C) and A,B,C are mutually exclusive

$\Rightarrow P(A) + P(B) + P(C) = 1$

let $P(A) = 2P(B) = 3P(C) = k$

$\Rightarrow P(A) = k,\ P(B) = \dfrac{k}{2} \quad P(C) = \dfrac{k}{3}$

$\therefore k + \dfrac{k}{2} + \dfrac{k}{3} = 1$

$\Rightarrow k = \dfrac{6}{11}$

$\therefore P(A) = k = \dfrac{6}{11} \Rightarrow P(\overline{A}) = 1 - P(A) = 1 - \dfrac{6}{11} = \dfrac{5}{11}$

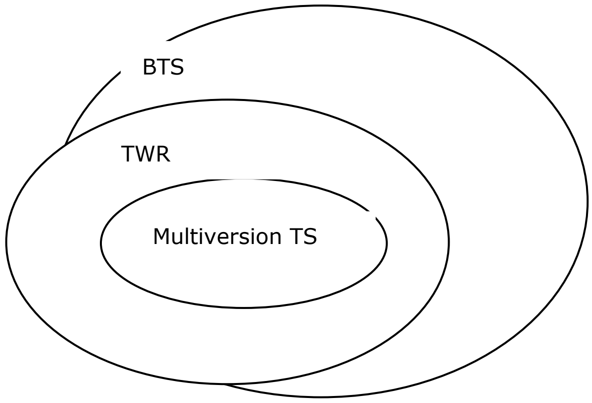
43.

(A)
I_0 $A'B'C'(0)$
$AB'C'(4)$
I_1 $AB'C(5)$
$A'B'C(1)$
I_3 $ABC(7)$
$A'BC(3)$

(B)
I_0 $A'B'C'(0)$
$AB'C'(4)$
I_1 $AB'C(5)$
I_3 $ABC(7)$
$A'BC(3)$

(C)
I_0 $A'B'C'(0)$
$A'B'C(1)$
I_1 $A'BC(3)$
I_2 $AB'C(5)$
I_3 $ABC'(6)$
$ABC(7)$

44. If a schedule is not allowed under Thomas write rule it may be allowed under multiversion time stamp ordering protocol.



45. Characteristic equation of 'A' is $|A - \lambda I| = 0 \Rightarrow \begin{vmatrix} 1-\lambda & 0 & 3 \\ 2 & 1-\lambda & -1 \\ 1 & -1 & 1-\lambda \end{vmatrix} = 0$

(Or) Characteristics equation of 'A' is

$\lambda^3 - (\text{trace } A)\lambda^2 + (A_{11} + A_{22} + A_{33})\lambda - |A| = 0$

where $A_{11} \to$ cofactor of a_{11}

$A_{22} \to$ cofactor of a_{22}

$A_{33} \to$ cofactor of a_{33}

$\Rightarrow \lambda^3 - 3\lambda^2 + (0 - 2 + 1)\lambda - (-9) = 0 \Rightarrow \lambda^3 - 3\lambda^2 - \lambda + 9 = 0$

By Cayley Hamilton theorem, every square matrix satisfies its own characteristic equation

$\Rightarrow A^3 - 3A^2 - A + 9I = 0$

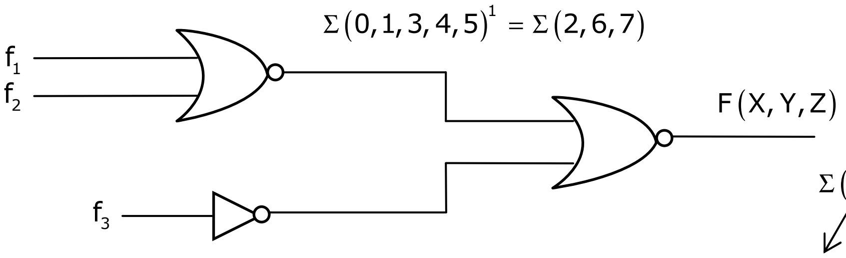
46. $(P \vee Q \vee P) \wedge (P \vee Q \vee Q) \wedge (\neg P \vee \neg Q \vee \neg P) \wedge (\neg P \vee \neg Q \vee \neg Q)$

$\Leftrightarrow \left[(P \vee Q) \vee (P \wedge Q) \wedge \left(\neg(P \wedge Q) \vee (\neg P \wedge \neg Q)\right)\right]$

$\Leftrightarrow \neg(P \wedge Q) \leftrightarrow (P \vee Q) \quad \begin{pmatrix} \because A \to B \Leftrightarrow \neg A \vee B \\ \because (A \to B) \wedge (B \to A) \Leftrightarrow A \leftrightarrow B \end{pmatrix}$

47.

$\Sigma(0,1,3,4,5)^{1} = \Sigma(2,6,7)$



$\Sigma(1,4,5)$

complement $= \Sigma(0,\underline{2},3,\underline{6},\underline{7})$

(a) $\Sigma(1,4,5) \Rightarrow f_3^1 = \Sigma(0,2,3,6,7)$

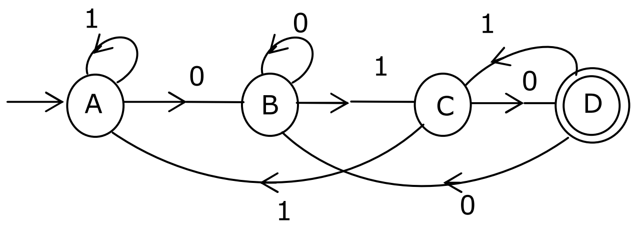
(b) $\pi(1,4,5) \Rightarrow f_3^1 = \pi(0,2,3,6,7)$

(c) $\Sigma(0,1,3,5) \Rightarrow f_3^1 = \Sigma(2,4,6,7)$

(d) $\pi(0,1,5) \Rightarrow f_3^1 = \pi(2,3,4,6,7)$

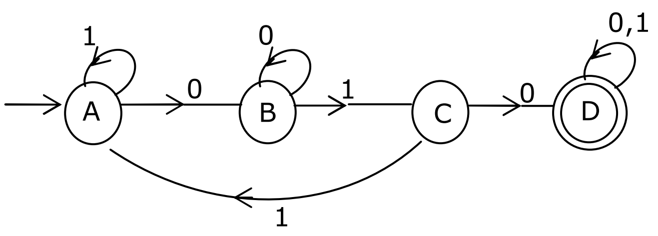
49. Number of maximal elements are two(i,a).
Infimum of {c,d} doesn't exist.

50.



51. $\delta(D,0) = 0,$ $\delta(D,1) = 1$

There is correction in option B.
The options B is
$\delta(D,0) = D, \delta(D,1) = D$ instead of $\delta(D,0) = B, \delta(D,1) = C$



52. Productivity is calculated by dividing total LOC by the programmer*days attribute to the project.

$P = (1000000)/(10 * 200)$

500 LOC/programmer – day.

53. If team size is 25 then

$P' = (1000000)/(25 * 200)$

$= 200$ loc/programmer – day

So difference is $P - P' = 300$ loc/programmer – day.

57. Furniture is always singular

58. The horse is quite good but too small to accommodate.

60. $s = \{1, 2, 3, 4 ....19, 20\}$

Let E = event of getting a multiple of 3 or 5

$= \{3, 6, 9, 12, 15, 18, 5, 10, 20\}$

$\therefore P(E) = \frac{n(E)}{n(s)} = \frac{9}{20}$

62. Unit digit in $(3474)^{1793}$ = unit digit in $(4)^{1793}$

= unit digit in $\left[\left(4^2\right)^{896} \times 4\right] = 6 \times 4 = 4$

= unit digit in $(225)^{317}$ = unit digit in $(5)^{317} = 5$

= unit digit in $(341)^{491}$ = unit digit in $(1)^{491} = 1$

Required digit = unit digit is $(4 \times 5 \times 1) = 0$

63. Percentage increment =

$= \frac{31.36 - 10.22}{10.22} \times 100\% = 206.84\% \cong 207\%$

64. Total amount=105

Amount left $= 540 - 105 = 435$

435 is divided in the ratio of 3: 8: 4

$A = \frac{3}{15} \times 435 = 87 + 15 = 102$

$B = \frac{8}{15} \times 435 = 232 + 60 = 292$

$C = \frac{4}{15} \times 435 = 116 + 30 = 146$

$\therefore$ The initial share of C = 146.

65. Let the distance is d & speed of the river is x.

$$\frac{d}{50+x} = 25.........(i)$$

mid journeys 12.5 hours

$2\frac{1}{2}$ hours late is 15 hours

$$\frac{d}{2(40+x)} = 15.......(ii)$$

$$\frac{(i)}{(ii)} = \frac{80+2x}{50+x} = \frac{5}{3} \Rightarrow 240+6x = 250+5x \quad \Rightarrow \quad x = 10\,\text{km/hr.}$$