Answer Keys

1	A	**2**	D	**3**	A	**4**	A	**5**	D	**6**	A	**7**	C
8	C	**9**	D	**10**	C	**11**	D	**12**	20	**13**	D	**14**	C
15	D	**16**	B	**17**	B	**18**	1	**19**	B	**20**	C	**21**	1536
22	A	**23**	B	**24**	C	**25**	B	**26**	14.32	**27**	A	**28**	A
29	C	**30**	A	**31**	C	**32**	B	**33**	5	**34**	C	**35**	B
36	D	**37**	B	**38**	D	**39**	32	**40**	C	**41**	D	**42**	D
43	C	**44**	A	**45**	A	**46**	B	**47**	D	**48**	3	**49**	3
50	A	**51**	D	**52**	D	**53**	A	**54**	D	**55**	D	**56**	B
57	A	**58**	D	**59**	C	**60**	C	**61**	D	**62**	B	**63**	D
64	A	**65**	D										

Explanations:-

1. $P(6) = \frac{1}{6} \qquad P(1 \text{ or } 2 \text{ or } 3 \text{ or } 4 \text{ or } 5) = \frac{5}{6}$

$$P(P_2 \text{ wins}) = q.p + q^2.q.p + q^2.q^2.q.p + \ldots.. = qp\left[1 + q^2 + (q^2)^2\ldots\ldots\right]$$

$$= qp\left(\frac{1}{1-q^2}\right) = \frac{5}{36}\left(\frac{1}{1-\frac{25}{36}}\right) = \frac{5}{11}$$

$$P(P_1 \text{ wins}) = p + q^2.p + (q^2)^2.P + \ldots\ldots = P\left[\frac{1}{1-q^2}\right] = \frac{1}{6}\left(\frac{1}{1-\frac{25}{36}}\right) = \frac{6}{11}.$$

2. $(\neg P \wedge (\neg Q \wedge R)) \vee (Q \wedge R) \vee (P \wedge R)$

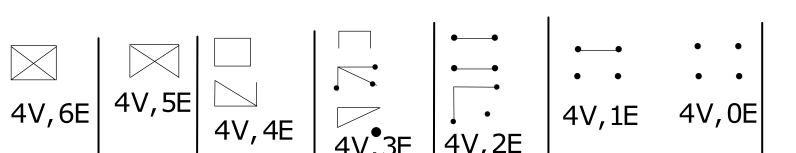
$\Leftrightarrow ((\neg P \wedge \neg Q) \wedge R) \vee ((Q \vee P) \wedge R)$ (Association law & Distributive law)

$\Leftrightarrow (\neg(P \vee Q) \wedge R) \vee ((Q \vee P) \wedge R)$ (Demorgan's laws)

$\Leftrightarrow (\neg(P \vee Q) \vee (P \vee Q)) \wedge R$ (Distributive laws)

$\Leftrightarrow (T \wedge R) \qquad [(\neg x \vee x) = T]$

$\Leftrightarrow R.$

3. 

$1 + 1 + 2 + 3 + 2 + 1 + 1 \neq 11$

11 graphs.

4. If a=time needed for context switch, b=time quantum, c=avg time before blocking on I/O,
Then no of context switch=c/b, time spent on context switch=a*(c/b).
CPU efficiency= $= \frac{c}{c + a * (c/b)} = \frac{10}{10 + 0.045} = 99.55\%$.

6. Rotation time $= \frac{60}{r}$ sec

$\frac{60}{r}\text{sec} \longrightarrow \text{'s' Bytes}$

$1 \text{ s} \longrightarrow \quad ?$

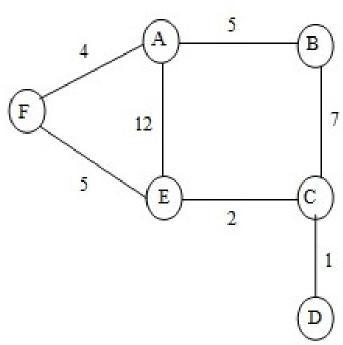
Data transfer rate $= \frac{r * s}{60}$ Bytes/sec.

7. If you are updating any tuple in DEPT which has been referenced by any tuple in EMP then this will cause referential integrity constraint violation.

8. Since any of X and Y can be taken as primary keys of R, it implies X and Y wont take duplicates, so FD: X → Y and FD: Y → X both are valid.

9. Given 6 nodes and symmetric costs on each link. Given that once the routes are stabilized, the cost of link A – E is increased to 12. So, we need to compute the stabilized costs before cost of A-E is increased.
The stabilized distance vectors of each node is
A: (0, 5, 5, 6, 3, 4)
B: (5, 0, 7, 8, 8, 9)
C: (5, 7, 0, 1, 2, 7)
D: (6, 8, 1, 0, 3, 8)
E: (3, 8, 2, 3, 0, 5)
F: (4, 9, 7, 8, 5, 0)

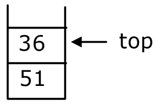
After stabilizing the distance vector of each node, cost of link A – E is raised to 12. So the network with the new costs looks like



So distance vector of A is (0, 5, 12, 13, 12, 4) and of E is (12, 9, 2, 3, 0, 5).

10. After every 2 consecutive 1's a 0 is stuffed.
Data will be sent as "011011001001101101100011010"
So, total no. of zeros in the resultant bit stream is 12.

11. Postfix expression $= 272\ \wedge + 94 * - 62 \div +$
After scanning the 8^{th} symbol '*' , stack is as follows:-



12. N (H) = Minimum number of nodes in an AVL tree of height H.
N (5) = 20 using following recurrence relation.

$$N(H) = \begin{cases} 1, & H = 0 \\ 2, & H = 1 \\ N(H-1) + N(H-2) + 1 & H > 1 \end{cases}$$

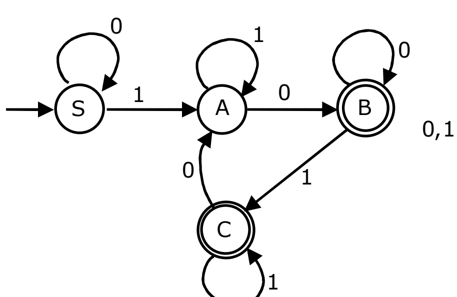
14.

10×5	+	6×0	+	7×0	=	50
3×1	+	5×0	+	7×0	=	3
10×0	+	12×0	+	5×7	=	35
2×0	+	4×3	+	4×0	=	12
2×0	+	5×0	+	7×2	=	14
		Total				114

15. $\text{First}(S) = \text{First}(ACB) \cup \text{First}(CbB) \cup \text{First}(Ba)$
$\text{First}(ACB) = \{d, g, h, \in\}$, $\text{First}(CbB) = \{h, b\}$, $\text{First}(Ba) = \{g, a\}$
$\therefore \text{First}(S) = \{d, g, h, \in, b, a\}$.

16. $\frac{L_1}{L_2} = \left(0^+1^* + 10\right) / 1^+$
$= 0^+1^*$.

17. The DFA corresponding to the given grammar is
[Only B and C generates $\in$. So, these two are accepting states.]



The DFA cannot be minimized any more. Hence no. of accepting states is 2.

18. As projection is RA operator it eliminates duplicates automatically so only one tuple will be displayed which is 1 1 1.

19. $w^1y^1 + xw + xy^1z = w^1y^1 + xw + \underbrace{xy^1}_{\text{add directly}} + xy^1z$

$$\boxed{(A + P_1)(A^1 + P_2)(P_1 + P_2) = (A + P_1)(A^1 + P^1)}$$

$$= w^1y^1 + xw + xy^1 + xy^1z$$

$$= w^1y^1 + xw + \underbrace{xy^1}_{\text{reducer } xy^1}$$

$$= w^1y^1 + xw$$

20. $A \oplus A = 0$

$A \oplus A \oplus A = 0 \oplus A = A$

if n is even $F = 0$

n is odd $F = A$.

21. Size of tag Array = No. of lines $*$ tag entry bits

6	8	7
tag	Line No.	offset

$\longleftrightarrow$ 21 bit

$M.M = 2\text{ MB}\ \ 80 = 2^{21}\text{byte}$

Block size $= 2^7$byte

No. of lines $= \dfrac{32 * 2^{10}}{2^7}$ byte

$= 2^{15}/2^7 \Rightarrow 2^8$lines

tag Array $= 2^8 * 6$ bits

$= 256 * 6$ bits

$= 1536$ bits.

22. Booth's notation of $-37 = 1\ 0\ 1\ 1\ 0\ 1\ 1$

so recording pattern is

6	5	4	3	2	1	0
-1	+1	0	-1	+1	0	-1

23. Ambiguity – multiple parse trees
Top down- left most derivation
Bottom up – Reverse of right most derivation
Unambiguous – unique parse tree.

24. Multiply with $A^{-1} \Rightarrow$
On both sides
$\Rightarrow A^2 - 6A + 11I - 6A^{-1} = 0$
$\Rightarrow 6A^{-1} = A^2 - 6A + 11I$
$\Rightarrow A^{-1} = \frac{1}{6}\left(A^2 - 6A + 11I\right).$

25. 2 way set

0	0
	16
1	5
	9
2	
3	~~3~~ 55
	7

$0\%\ 4 = 0$
$5\%\ 4 = 1$
$3\%\ 4 = 3$
$9\%\ 4 = 1$
$7\%\ 4 = 3$
$0\%\ 4 = 0$
$16\%\ 4 = 0$
$55\%\ 4 = 3$

7 is present in block no 7 and set number is 3.

26. $T_{avg} = (1 + \text{stall frequency} * \text{stall cycle}) * \text{clock cycle time}$

$$= \left(1 + 0.2\left(\underset{\text{Unconditional}}{\underset{\Downarrow}{40\%}} * 3 + \underset{\text{Conditional}}{\underset{\Downarrow}{60\%}}\left[\underset{\text{satisfy the condition}}{\underset{\Downarrow}{30\%}} * 3 + \underset{\text{Not satisfy the condition}}{\underset{\Downarrow}{70\%}} * 1\right]\right]\right) * 10 \text{ ns}$$

$\Rightarrow \left(1 + 0.2\left[0.4 * 3 + 0.6\left[0.3 * 3 + 0.7 * 1\right]\right]\right) * 10$
$\left[1 + 0.2\left(1.2 + 0.6\left[0.9 + 0.7\right]\right)\right] * 10$
$\left(1 + 0.2\left[1.2 + 0.96\right]\right) * 10$
$= 1.432 * 10 \text{ ns}$
$= 14.32 \text{ ns}.$

27. Precedence of operators are:
(1) – Unary minus highest precedence
(2) ↑Higher and right to left associatively
(3) *, / same left to right associatively
(4) – or + same left to right associatively

$\Rightarrow -a \uparrow b \uparrow c/d + e * f/g$

$\Rightarrow -a \uparrow \underline{\uparrow bc}/d + e * f/g$

$\Rightarrow \underline{\uparrow -a \uparrow bc}/d + e * f/g$

$\Rightarrow \underline{/ \uparrow -a \uparrow bcd} + e * f/g$

$\Rightarrow \underline{/ \uparrow -a \uparrow bcd} + \underline{*ef}/g$

$\Rightarrow \underline{/ \uparrow -a \uparrow bcd} + \underline{/ * efg}$

$\Rightarrow \underline{+/ \uparrow -a \uparrow bcd / *efg}$

28. $90 \rightarrow$ Beginning cylinder

$= (98-90)+(183-98)+(183-37)+(122-37)+(122-14)+(124-14)+(124-65)+(67-65)$

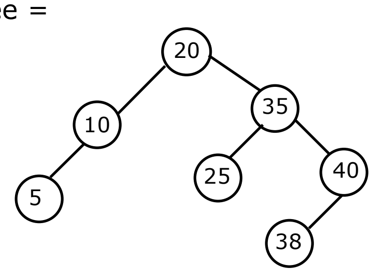
$= 8+85+146+85+108+110+59+2 = 603$ seeks

NTN/SSTF :

$= (98-90)+(122-98)+(124-122)+(124-67)+(67-65)+(65-37)+(37-14)+(183-14)$

$= 8+24+2+57+2+28+23+169 = 313$ seeks.

29. In order = 5, 10, 20, 25, 35, 38, 40
Post order = 5, 10, 25, 35, 38, 40, 35, 20
Tree =



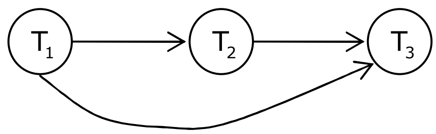
30. $32-$bit In SIPO means, it requires $32-$clocks.

$1\ MH_z \rightarrow 1\ \mu\ sec$

$1 \text{ clocks} = \dfrac{1}{1 \times 10^6} = 1\mu\ sec$

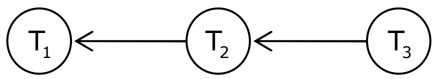
$32 \text{ clocks} \Rightarrow 32\mu\ sec.$

31. S1: Precedence graph.



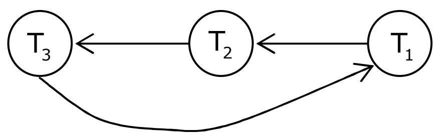
No cycle: So conflict serializable.

S2:



No cycle: Conflict serializable.

S3:



Cycle: Not conflict serializable.

32. First we have to locate node y in the set. One element to the right of y will give us the next higher node after y. Runtime complexity is $O(\log n)$.

33. $f(1,3) = f\{0, f(1,2)\} = f\left[0, f\{0, f(1,1)\}\right]$

$= f\left[0, f\{0, f(0, f(1,0))\}\right] = f\left[0, f\{0, f(0, f(0,1))\}\right]$

$= f\left[0, f\{0, f(0,2)\}\right] = f\left[0, f\{0,3\}\right] = f(0,4) = 5.$

34. 1, 2; a subset starting from 1 of max heap is max heap.

35. Availability = $\left(\dfrac{MTTF}{MTBF}\right) \times 100\%$

$MTTF = MTBF - MTTR$

$\Rightarrow \dfrac{95}{100} = \dfrac{480 - x}{480} \Rightarrow x = 24 \text{ hours} = 1 \text{ day}.$

36. Propagation delay 1-way latency = 0.5 sec

RTT (2-way latency) = 2*0.5 = 1 sec

B = 4Mbps

L = 2KB of data

T_{trans} = L/B = $\frac{2\times1024\times8\,\text{bits}}{4\times10^6\,\text{bits / sec}} = 4.096 * 10^{-3}\text{sec}$

RTT = 1 sec = 1000 * 10^{-3} sec

Window size $= \frac{T_{trans} + 2\times T_{prop}}{T_{trans}} = \frac{\left(4.096\times10^{-3}\right)+\left(1000\times10^{-3}\right)}{4.096\times10^{-3}}$ = 245.14

Therefore, no. of sequence bits = ceil($\log_2$ Ws) =ceil($\log_2$ 245.14) = 8.

37. UDP header is 64 bits has 4 parts each containing 16 bits.

1^{st}16bits for source port number
2^{nd} 16 bits for destination port number
3^{rd} 16 bits for total length
last 16 bits for checksum.

Given header is 5EFA00FD001C3297 in hexadecimal form.
0X5EFA is source port number and the value is 24,314 in decimal
0X00FD is destination port number and the value is 253 in decimal
0X001C is for total length
0X3297 is for checksum.

Datagram total length is 001C H bytes which is 28 bytes.

Now if port value is >1023 then it's a client and if <1023 then it's server.
Clearly source port number is 5EFA H which is 24314 >1023. So it's a client.
Destination port number is 00FD H i.e. 253 <1023. So it's a server.
So, packet is going from client to server.

38. A is $\left(100\left(00\ +10\right)^*\right)100$, by $\left(P^* + Q^*\right)^* = \left(P+Q\right)^*$

B is equal to $100\left(00+10\right)^* 100\Big)^*$ by (P+Q)R = PR+QR

C is $100\ \left(\left(00+10\right)^* 100\right)^*$ by $\left(P^*Q^*\right)^* = \left(P+Q\right)^*$.

39. Total cache miss $= \frac{32*32}{32} = 32$ Miss

(In a single cache miss 32 elements are inserted into one line of cache due to unit of replacement).

40. Transition function are defined as $\delta : Q \times \Sigma \to Q$

Now, for a function $f : A \to B$. Total no. of possible mappings are $|B|^{|A|}$. This follows from the fact that for each member of A, there are $|B|$ no. of possible mapping. Hence total no. of mappings are $\underbrace{|B| \times |B| \times ......|B|}_{|A| \text{times}} = |B|^{|A|}$

$\therefore$ for $\delta : Q \times \Sigma \to Q$, total no. of mappings $= |Q|^{|Q \times \Sigma|}$

$$= |Q|^{|Q| \times |\Sigma|}$$

Put, $|Q| = 2$, $|\Sigma| = 2$. The answer is 2^4

41. A process must have input and output.

42. $P(x \le \frac{1}{2}) = \int_0^{\frac{1}{2}} f(x)dx$

$$= \int_0^{\frac{1}{2}} 3x^2 dx = 3\left(\frac{x^3}{3}\right)_0^{\frac{1}{2}} = \frac{1}{8} = 0.125$$

43.

AB \ CD	00	01	11	10
00		1		1
01	1		1	
11		1		1
10	1		1	

X – OR

AB \ CD	00	01	11	10
00	1		1	
01		1		1
11	1		1	
10		1		1

X – NOR

AB \ C	0	1
00		1
01	1	
11		1
10	1	

full adder sum function

AB \ C	0	1
00	1	
01		1
11	1	
10		1

full adder carry function

45. Let $\alpha, -\alpha, \beta$ are roots

Standard form is, $x^3 - s_1x^2 + s_2x - s_3 = 0$

Given that, $x^3 - 3x^2 - 16x + 48 = 0$

$s_1 = 3 \Rightarrow \alpha - \alpha + \beta = 3 \Rightarrow \beta = 3$

$s_2 = -16 \Rightarrow \alpha\beta + \alpha(-\alpha) + \beta(-\alpha) = -16$

$\Rightarrow -\alpha^2 = -16 \Rightarrow \alpha = \pm 4$

If $\alpha = 4$, roots are $4, -4, 3$

If $\alpha = -4$, roots are $-4, 4, 3$

$\therefore$ Roots are $4, -4, 3$.

46. $\left(01 + (00)^* 1\right)^*$ R.E can generate 011 not acceptable by DFA.

$0(00)^* 10^*$ R.E can generate 00010 not acceptable.

0^*10^* R.E can generate 1 not acceptable.

47. Initial

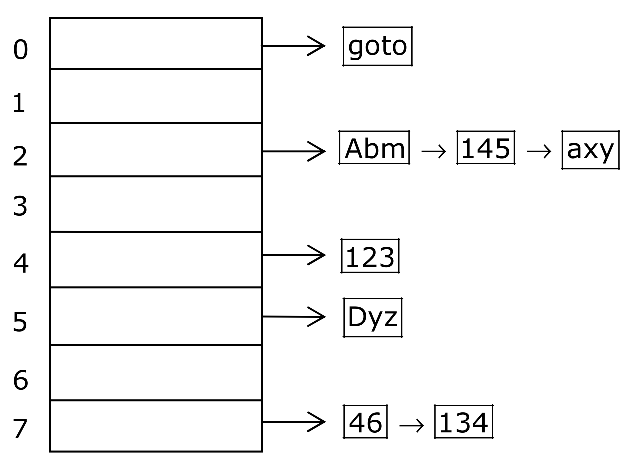
$Q_2Q_1Q_0 = 101$

$Q_{2N} = D_2 = Q_0,\ Q_{1N} = Q_2 \oplus \times (= D_1)$

$Q_{0N} = Q_1 = (D_0)$

		Present flate	Next state
Clk	x	$Q_2Q_1Q_0$	$Q_{2N}Q_{1N}Q_{0N}$
1	0	1 0 1	1 1 0
2	1	1 1 0	0 0 1
3	0	0 0 1	1 0 0
4	1	1 0 0	$\boxed{0\ 0\ 0}$

48-49.



50. $$\lim_{x\to\infty}\frac{1}{8}\cdot\frac{\left(8S_n+S_n\cdot S_{n^3}\right)}{\left(S_{n^2}\right)^2}=\lim_{n\to\infty}\frac{S_n\left(1+\frac{S_{n^3}}{8}\right)}{\left(S_{n^2}\right)^2}=\lim_{n\to\infty}\frac{\frac{n(n+1)}{2}\left(1+\frac{n^2(n+1)^2}{32}\right)}{\left(\frac{n(n+1)(2n+1)}{6}\right)^2}$$

$$=\lim_{n\to\infty}\frac{\frac{n(n+1)}{2}\left(\frac{32+n^2(n+1)^2}{32}\right)}{\frac{n^2(n+1)^2(2n+1)^2}{36}}=\frac{18}{32}\lim_{n\to\infty}\frac{32+n^2(n+1)^2}{n(n+1)(2n+1)^2}=\frac{18}{32}\times\frac{1}{4}=\frac{9}{64}$$

51. $$\lim_{n\to 0}\frac{8\,S_n+S_n.\,S_{n^3}}{8\,S_n}=\lim_{n\to 0}\frac{\frac{8n(n+1)}{2}+\frac{n(n+1)}{2}.\frac{n(n+1)(2n+1)}{6}}{\frac{8.\,n(n+1)}{2}}$$

$$=\lim_{n\to 0}\frac{4+n(n+1)(2n+1)/12}{4}$$

$$=1.$$

52.

$$(4+6+\ldots+n)+(6+8+\ldots+(n+2))$$

$$=(4+(n+2))+2\times 2\left[3+4+\ldots+\frac{n}{2}\right]$$

$$=(6+n)+4\left[\frac{n\left(\frac{n}{2}+1\right)}{2}-3\right]=\frac{1}{2}\left(n^2+4n-12\right)$$

53. Length of a path from V_n to V_{n-1} in MST

$$=\text{sum of}\begin{cases}w\left(e\left(V_{n-1,}V_1\right)\right)=n\\ w\left(e\left(V_n,V_2\right)\right)=n+2\\ w\left(e\left(V_1,V_2\right)\right)=0\end{cases}$$

So, the length of path = 2n+2.

54.

String	2	0	1	2	3	0	5	1	3	6	3	2	1	4	0
Frame0	**2**	2	2	0	0	1	2	3	0	5	5	1	6	3	2
Frame1		**0**	0	1	1	2	3	0	5	1	1	6	3	2	1
Frame2			**1**	2	2	3	0	5	1	3	6	3	2	1	4
Frame3					**3**	0	**5**	**1**	3	**6**	3	**2**	1	**4**	**0**

Bolds are representing misses. So total 10 miss

55.

String	2	0	1	2	3	0	5	1	3	6	3	2	1	4	0
Frame0	**2**	2	2	0	1	2	3	0	5	1	1	6	3	2	1
Frame1		**0**	0	1	2	3	0	5	1	3	6	3	2	1	4
Frame2			**1**	2	**3**	**0**	**5**	**1**	**3**	**6**	3	**2**	**1**	**4**	**0**

Bolds are representing misses. So 13 misses. So diff is 13-10=3

57. Action: state of water

58. "The" is followed by superlative degree

59. The article before honest should be "an"

60. $A \cup B = 40$

$A \cup B = A + B - (A \cap B)$

$40 = A + 22 - 12$

A=30 enrolled for English and included both subjects

Number of students enrolled for English only = 30-12=18.

62. Let Mr. Vikas buys LCM (8, 5, 9) = 360 Apples of each variety.

Amount spent on the 1st variety = $\frac{360}{8} = 45$ rs.

Amount spent on the 2nd variety = $\frac{360}{5} = 72$ rs.

$\therefore$ Total amount spent = 45+72 = Rs.117

Now the total (360+360) = 720 Apples are sold at 9 per rupee

$\therefore$ Total revenue = $\frac{720}{9} = 80$

Hence the loss = 117-80 = 37

$\therefore \text{ Loss}\% = \frac{37}{117} \times 100 = 31.62\%$

63. Since desired no. is divisible by 5, we have 5 at units place.
So only 1 way
Tens place can be filled by 2,3,6,7 & 9. so 5 ways of filling
Hundreds ………………………. Remaining 4 digits = 4 ways
Total ways = 1 x 5 x 4 = 20 ways

64. $A = \left[\frac{14+6+64}{28+14+6+64}\right] \times 100\% = \frac{84}{112} \times 100\% = 75\%$

$B = \left[\frac{12+17+55}{23+12+17+55}\right] \times 100\% = \frac{84}{107} \times 100\% = 78.5\%$

$C = \left[\frac{8+9+46}{17+8+9+46}\right] \times 100\% = \frac{63}{80} \times 100\% = 78.75\%$

$D = \left[\frac{13+15+76}{27+13+15+76}\right] \times 100\% = 79.39\%$

65. Ratio of distance = Ratio of speed = 30: 42 = 5: 7

$\therefore$ Distance travelled by both trains = 5x and 7x

According to given condition:

$7x - 5x = 60 \quad \Rightarrow \quad x = 30\,\text{km}$

$\text{Distance between A and B} = 150 + 210 = 360\,\text{km}$