Answer Keys:

1	D	**2**	D	**3**	A	**4**	B	**5**	D	**6**	A	**7**	D
8	D	**9**	A	**10**	D	**11**	B	**12**	A	**13**	20	**14**	C
15	C	**16**	5.8	**17**	B	**18**	4	**19**	D	**20**	C	**21**	C
22	B	**23**	B	**24**	C	**25**	2	**26**	C	**27**	C	**28**	D
29	C	**30**	A	**31**	A	**32**	A	**33**	B	**34**	D	**35**	D
36	D	**37**	D	**38**	D	**39**	17	**40**	A	**41**	C	**42**	B
43	B	**44**	C	**45**	B	**46**	5	**47**	C	**48**	A	**49**	A
50	D	**51**	C	**52**	A	**53**	D	**54**	B	**55**	C	**56**	D
57	A	**58**	A	**59**	C	**60**	B	**61**	C	**62**	A	**63**	B
64	A	**65**	D										

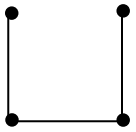
Explanation:

1. Sum of the degrees of all vertices = 2E

$\therefore 2 + 2(n-2) = 2E$

$\therefore E = n - 1$

E=n-1 and it is connected so it will look like



for $n = 4$

number of articulation points $= 2$

In general for any n, number of articulation points= n-2

2. BFS traversals are as follows

$$H\,F\,G\begin{pmatrix}\text{Any sequence}\\ \text{of } B,C\\ =2!\end{pmatrix}\begin{pmatrix}\text{Any sequence}\\ \text{of } D,E\\ =2!\end{pmatrix}A = 4$$

$$H\,G\,F\begin{pmatrix}\text{Any sequence}\\ \text{of } D,E\\ =2!\end{pmatrix}\begin{pmatrix}\text{Any sequence}\\ \text{of } B,C\\ =2!\end{pmatrix}A = 4$$

Total number of BFS traversals $= 8$

3. If SAT α_p π, then all the problems of class NP can be solved in polynomial time on deterministic machine as SAT is in NP and that would imply P=NP

4. $$\text{Utlization} = \frac{\text{Transmission time}}{\text{Transmission time} + \text{contention time} + \text{Idle time}}$$

$$= \frac{1}{1+7+2} = 0.1 \times 100\% = 10\%$$

5. The number of corresponding bits that differ between two codewords is the hamming distance of those two codewords.

The minimum hamming distance of a code is the minimum of the hamming distance between all possible pairs of code words of that code.

$d_{min} = 6(\text{given})$

$d_{min} = s + 1$ where s is the number of bit errors that can be detected.

Hence s=5

6. $A + \bar{A}B + \bar{A}\bar{B}C + \bar{A}\bar{B}\bar{C}D + \ldots\ldots\ldots$

For example if we take these four terms

$= A + \bar{A}B + \bar{A}\bar{B}C + \bar{A}\bar{B}\bar{C}D$

$= A + \bar{A}\left[B + \bar{B}\left(C + \bar{C}D\right)\right]$

$= A + \bar{A}\left[B + \bar{B}\left(C + D\right)\right]$

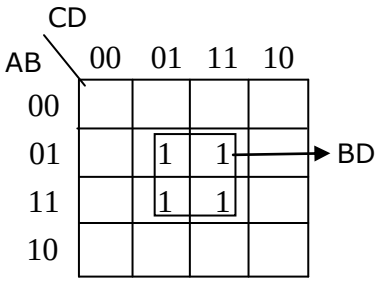
$= A + \bar{A}\left[B + C + D\right]$

$= A + B + C + D$

$\left[\because x + \bar{x}y = (x + \bar{x})(x + y) = 1.(x + y) = x + y\right]$

$= A + \bar{A}B + \bar{A}\bar{B}C + \bar{A}\bar{B}\bar{C}D + \ldots\ldots = A + B + C + D + \ldots\ldots\ldots$

7. Pair, quad and octet eliminates 1, 2 and 3 variables respectively.
Following is an example for looping a quad of adjacent 1's.



8.

$\text{Ex}: (1100)_2 = 1\ \ 1\ \ 0\ \ 0 = (12)$

$\searrow\searrow\searrow$

Shift right : $(0)\ \ 1\ \ 1\ \ 0 = (6)$

9. Given that mean $=4 \Rightarrow \dfrac{a+b}{2} = 4$

$\Rightarrow a + b = 8 \quad \ldots\ldots(1)$

$\text{variance} = 12 \Rightarrow \dfrac{(b-a)^2}{12} = 12$

$\Rightarrow (b-a)^2 = 144$

$\Rightarrow b - a = \pm 12 \quad \ldots\ldots(2)$

$a + b = 8$	$a + b = 8$
$b - a = 12$	$b - a = -12$
$2b = 20$	$2b = -4$
$b = 10$	$b = -2$
$a = -2$	$a = 10$

$\therefore a = -2$ and $b = 10$ $(\because a < b)$

10. Since, scalar matrix 'A' of order 'n' has 'n' Eigen values, all are equal.
$\therefore$ It has 'n' linearly inependent eigen vectors as rank of $[A - \lambda I] = 0$

12. In all the strings, 1's should be followed by 0's and length of the string should be even. This is possible only when even number of 1's are followed by even number of 0's or odd number of 1's are followed by odd number of 0's.

13.

$E \to T$

$E \to F$

$E \to (E)$

$E \to (T)$

$E \to (F)$

$E \to ((E))$

$E \to ((T))$

$E \to ((T * F))$

$E \to ((F * F))$

$E \to (((E) * F))$

$E \to (((E + T) * F))$

$E \to (((T + T) * F))$

$E \to (((F + T) * F))$

$E \to (((I + T) * F))$

$E \to (((a + T) * F))$

$E \to (((a + F) * F))$

$E \to (((a + I) * F))$

$E \to (((a + b) * F))$

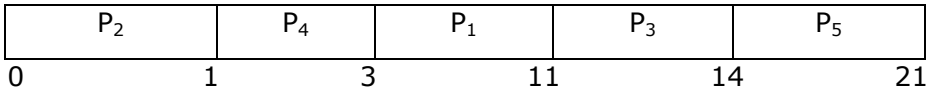
$E \to (((a + b) * I))$

$E \to (((a + b) * C))$

14. (A) Attribute term is associated to an entity or data item which can have many forms e.g. type, address, value etc.
(B) Scope is a spatial concept which refers to the portion of program text where the meaning(definition) of variable is accessible.
(C) Extent is a temporal concept which refers to the time during which the variable holds its value in the memory location.
(D) Binding is an association between an attribute and an entity or variable, such as associating a storage location with the data item(Address binding).

15. In language processing model which is using compiler as well as assembler, compiler gives assembly code as target code which is further converted in relocatable machine code by assembler.
Absolute machine code is the output of linker/loader module of LP model.

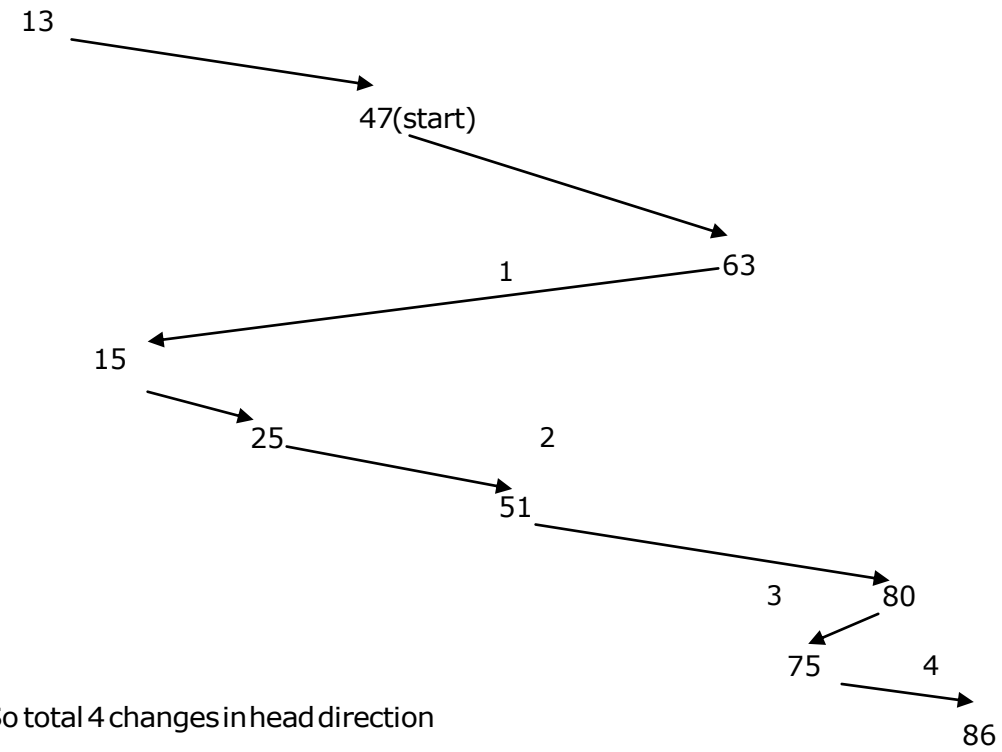
16. Gantt Chart for priority scheduling is:



Avg waiting time= (0+1+3+11+14)/5=5.8

17.
I. Race condition is where several processes access and manipulate sharable data concurrently and the outcome of execution depends on particular order of access. This can be solved by semaphores.
II. Only the processes which are NOT getting executed in their remainder section can participate in deciding which process will enter in critical section next.
III. A non pre-emptive kernel is always free from race condition on kernel data structure because only 1 process is active in kernel at a time.
IV. Peterson solution is a software based solution to Critical section problem.

18.



So total 4 changes in head direction

19. Candidate keys of R under FD set F are A, BC and D. As there are no partial and transitive dependencies and LHS of each FD are super keys it is in BCNF. Candidate keys of R under FD set G are A and D. As there are no partial and transitive dependencies and LHS of each FD are super keys it is in BCNF

20. Foreign Key column accepts NULL

21. Only 1-table is enough. Foreign key constraint is a relationship between 2 columns; those 2 columns can be on single table. EMP (eno, ename, manager) → manager referring to eno of employee is foreign key constraint.

22. It is not dependency preserving as C → D is lost.

24. Dual of $\Pi M(0,2) = \sum m(5,7)$

$\because$ Dual means POS changes to SOP but not the variable complement.

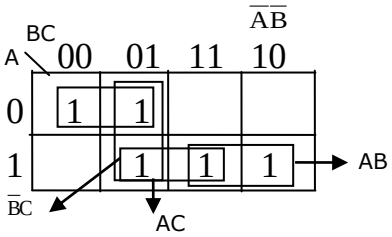
25. Span of control: number of immediate subordinates.

26. A function is invertible iff it is both one-one and onto.
Out of given four functions, only f2 is both one-one and onto, hence it is invertible.

27. Using Bayes theorem: $(.96\times.08)/(.96\times.08+.09\times.92)$

28. For (2),(b,c) doesn't have least upper bound.

29.



Implicants :5 (0,1,5,6,7)

Prime Implicants: $4\left(\bar{A}\bar{B}, AB, \bar{B}C, AC\right)$

Essential Prime Implicants $2\ \left(\bar{A}\bar{B}, AB\right)$

31. These statements are driven directly from theorems over Injection, Bijection, and Surjection.

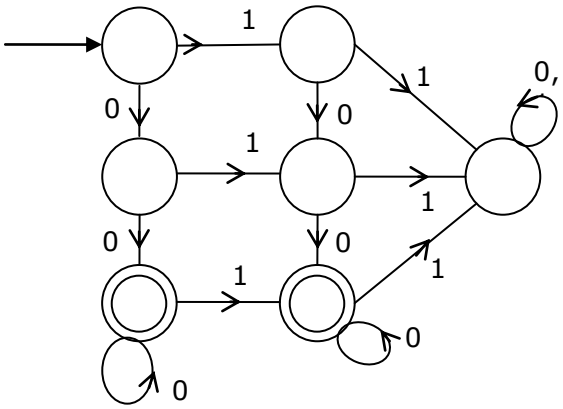
32. Datagram=data + header;
So data to be transferred=3500-20=3480 B
Max capacity of channel=1000 B.
Each has header of size 20 B
So data sent at each segment=976 B(not 980,as it should be divisible by 8)
So total no of segments=ceil(3480/976)=4(976,976,976,552)
Last segment contains=> 3480-3*976=552 B

33. Let 'k' and 'p' be the order of internal and leaf nodes respectively.

$$k\times7+(k-1)\times14\le512\Rightarrow k\le\left\lfloor\frac{526}{21}\right\rfloor\Rightarrow k\le25$$

$$p\times(14+9)+7\le512\Rightarrow p\le\left\lfloor\frac{505}{23}\right\rfloor\Rightarrow p\le21$$

34.



36. q_5 is the final state minimum string to reach 9_5 is aabb after that number of b's can be used to reach q_5. Some of the examples are

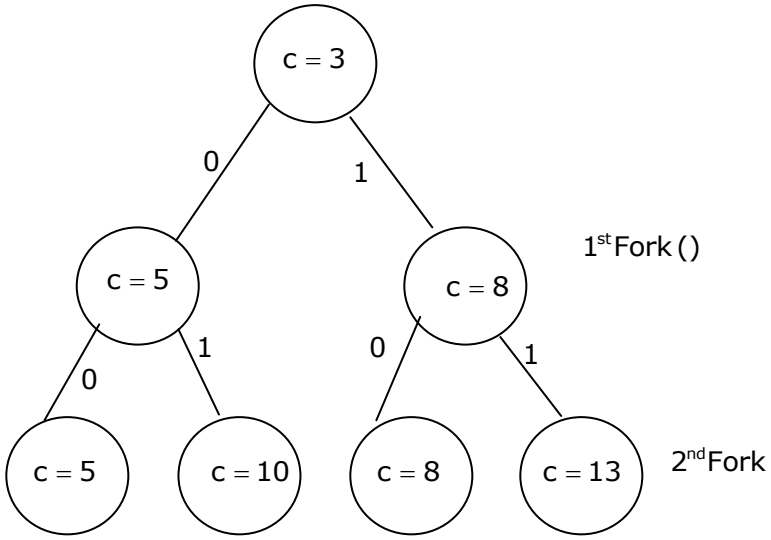
aabb

aabbb

aabbb

so $\left|a^n b^m \right| n = z \;\&\; m > 2\left|\right.$

37.



38. For string "010101", P has to execute 1st then Q and then same thing alternatively for 2 more times. For P executing first, P(m1) is must for process P as m1=1; m2=0.

39. Page size=8 KB= 2^{13} B

As MM is byte addressable, So No of pages= $2^{32}/2^{13}=2^{19}$ (the size of the virtual address is 32 bit)
No of frames in physical memory= $2^{28}/2^{13}=2^{15}$ (the size of physical address is 28 bit)
Page table entry contains its corresponding frame no and other information such as bits for protection, etc.
As total size of page table entry is 32 bit
So maximum number of bits can be used for protection and other information keeping in each page table entry=32-15=17 bit

40.

Intruction		Number of clock cycle
Direct	–	2 cycle
Indirect	–	4 cycle
Register	–	0 cycle
Immediate	–	0 cycle
Index	–	3 cycle (1(index arithmetic) + 2(memory))

So average number of clock cycles required for operand fetch is
T_{avg}–= 30%(2 clock)+20%(4)+15%(0 clock)+10%(0 clock)+25%(3 clock)=2.15 clock cycle

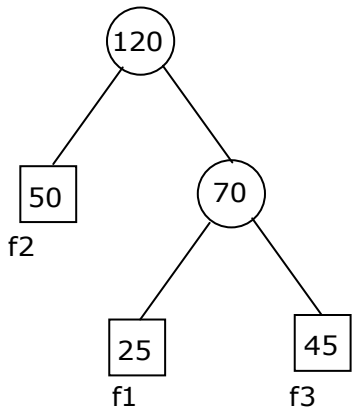
41. $\int_0^t t e^{-4t}\cos 3t\,dt = L\left[t\cos 3t\right]_{s=4} = \left[-\frac{d}{ds}\left(\frac{s}{s^2+9}\right)\right]_{s=4} = \frac{7}{625}$

42. $e \to f \equiv \neg f \to \neg e$ …..{Contra positive}
It means *e* = *False*, since it is given that *f* = *False*.
The 2nd implication is actually $c \to d$ XNOR e
Replacing *e* by '*False*',
$c \to d$XNOR *False* reduces to simply: $c \to \neg d$
And thus, $d \to \neg c \to \neg(a \vee b)$, i.e. $d \to (\neg a \wedge \neg b)$
Which is same as saying: $(d \to \neg a) \wedge (d \to \neg b)$

43. $^{15+2}C_2$ {Partition problem}

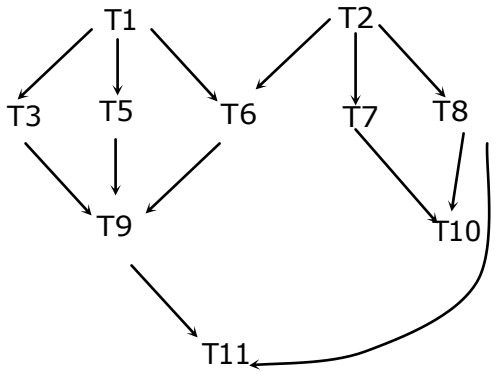
44. A subsequence is a sequence that can be derived from another sequence by deleting some elements without changing the order of the remaining elements

45.



Total no. of movements $= 120 + 70 = 190$

46. Dependency graph is show below.



From the above graph, we can see that there are at most five tasks T3, T5, T6, T7 and T8 can be done in parallel.

47. Go back n protocol with n=3 here has window size=2^3 -1=7. So frame no = 0 to 7. Now ACK3 is lost but when ACK4 is received then A knows that B received frame 3 also. But as B does not get frame 5, so A has to resend frames from frame 5. So it should be from 5,6,7,0,1,2,3.

48. $\text{FIRST}(E) = \text{FIRST}(TE') = \text{FIRST}(T)$

$\text{FIRST}(T) = \text{FIRST}(F) = \text{FIRST}((E), id)$

So $\text{FIRST}(E) = \{\text{FIRST}((), \text{FIRST}(id)\} = \{(, id)\}$.

49. FOLLOW(E) has $ as E is the start symbol.

from $E \to TE', FOLLOW(T) = FIRST(E') - \{\in\} = \{+\}$, Using rule (2)

As FIRST(E') has $\in$, FOLLOW $(T) = FOLLOW(E) + FOLLOW(E')$ (due to $E' \to +TE'$)

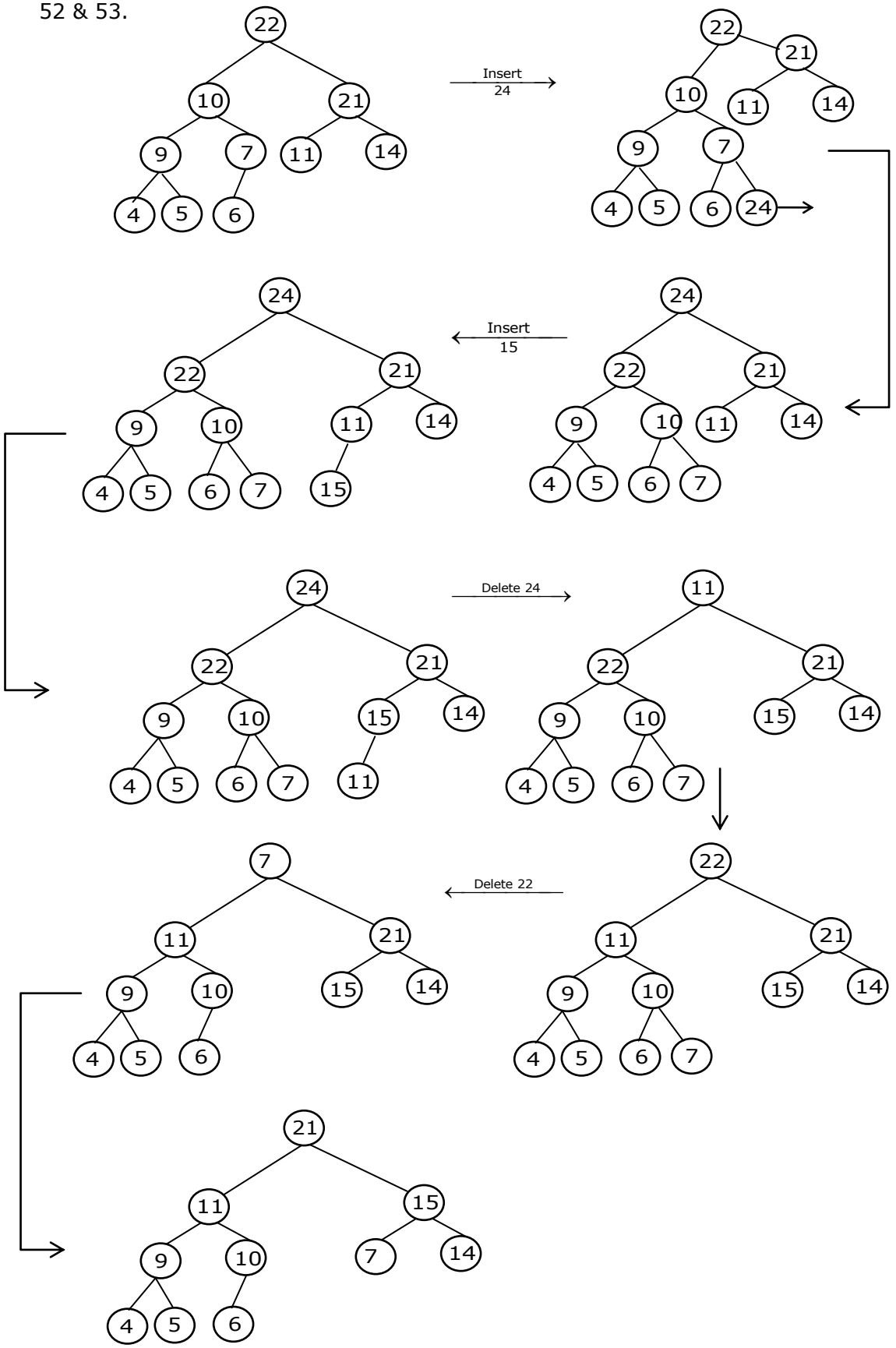
$= \{\$,)\} + \{\$,)\}$ (as FOLLOW(E') = FOLLOW(E))

So FOLLOW(T) = {+, $,)}

50. Each entity sets needs separate table.
Among R1, R2, and R3, only R1 needs separate table as it is M:N relationship will
So total tables = 3 {M, N, R1}

51. Only R1 needs separate table with attributes being KEYS from M and N entity sets as it is M;N relationship.

52 & 53.



54 &55.

Total 256 Instructions & each instruction takes 16 micro operations on an average, i.e. each instruction will take 16 control words.

No. of words in control memory $= 2^8 \times 2^4 \text{words} = 2^{12}$ words $= 4096$ words

Address field require=12 bits and Flag field require=4 bits ($2^4 = 16$ flags)

Control signal field require=48 bits(as it is horizontal microprogramming)

Control Word Format :

Flag	Control Signals	Address

Total length of control word=4+48+12= 64 bits/word

Total Size of control memory $= \frac{4096 \times 64}{8} = 32\text{kB}$

60. A's 1 day work $= \frac{1}{12}$

B's 1 day work $= \frac{1}{16}$

(A +B) 's 1 day work $= \frac{1}{12} + \frac{1}{16} = \frac{4+3}{48} = \frac{7}{48}$

(A +B) 's 4 days work $= \frac{7}{48} \times 4 = \frac{7}{12}$

Remaining work $= 1 - \frac{7}{12} = \frac{5}{12}$

62. Let the ten's & unit digit be x & $\frac{8}{x}$

Then $\left(10x + \frac{8}{x}\right) + 18 = 10 \times \frac{8}{x} + x$

$10x^2 + 18x + 8 = 80 + x^2$

$9x^2 + 18x - 72 = 0$

$x^2 + 2x - 8 = 0$

$(x+4)(x-2) = 0 \Rightarrow x = 2$

$\therefore$ Number is 24

63. Ratio of initial investment = $\frac{7}{2} : \frac{4}{3} : \frac{6}{5} = 105x,\ 40x,\ 36x$

$A : B : C = \left(105x \times 4 + \frac{150}{100} \times 105x \times 8\right) : (40x \times 12) : (36x \times 12)$

$= 1680x : 480x : 432x = 35 : 10 : 9$

Hence B'share $= \text{Rs.}\left(21600 \times \frac{10}{54}\right) = \text{Rs.}4000$

64. Since first & second are mixed with equal proportions

There average price = Rs. $\left(\frac{75+85}{2}\right)$ = Rs.80

So, the mixture is formed by mixing two varieties, one of Rs. 80 per kg and the other at say, Rs. x per Kg in the ratio of 2 : 2 ie., 1 : 1

Bu the rule of Allegation

$\frac{x-115}{115-80} = 1 \Rightarrow x-115 = 35 \Rightarrow x = 150$

65. Required difference $= \left[(16\% + 18\%) \text{ of } 6000\right] - (18\% + 10\%) \text{ of } 9000$

$= 34\% \text{ of } 6000 - 18\% \text{ of } 9000$

$= 2040 - 1620 = 420$