Answer Keys

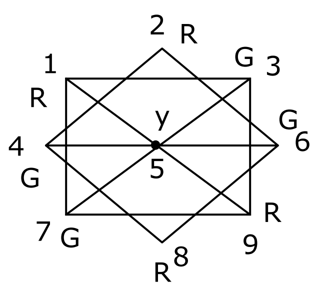
1	A	**2**	3	**3**	C	**4**	C	**5**	76.92	**6**	C	**7**	B
8	24	**9**	480	**10**	C	**11**	A	**12**	C	**13**	C	**14**	10
15	D	**16**	D	**17**	D	**18**	B	**19**	7	**20**	11	**21**	C
22	2	**23**	266	**24**	D	**25**	5.97	**26**	B	**27**	D	**28**	C
29	C	**30**	B	**31**	A	**32**	A	**33**	D	**34**	B	**35**	B
36	B	**37**	B	**38**	B	**39**	A	**40**	B	**41**	A	**42**	D
43	D	**44**	D	**45**	A	**46**	506	**47**	D	**48**	D	**49**	C
50	C	**51**	B	**52**	B	**53**	C	**54**	B	**55**	B	**56**	B
57	B	**58**	B	**59**	A	**60**	A	**61**	A	**62**	A	**63**	A
64	C	**65**	C										

Explanations:-

1. $V(x-4) = V(x)$

$V(ax+b) \le a^2\, V(x) \qquad (\because V(\text{constant}) = 0$

2.



4. Given that $f(x) = \dfrac{6x}{5}(1+x) \quad 0 \le x \le 1$

$$\text{Mean } E(x) = \int_0^1 x f(x)\,dx$$

$$= \int_0^1 x\,\frac{6x}{5}(x+1)\,dx = \frac{6}{5}\int_0^1 (x^2 + x^3)\,dx = \frac{6}{5}\int_0^1 \left[\frac{x^3}{3} + \frac{x^4}{4}\right]_0^1$$

$$= \frac{6}{5}\left[\frac{1}{3} + \frac{1}{4}\right] = \frac{6}{5} \times \frac{7}{12} = \frac{7}{10}$$

5.
4 5 1 2 (4 misses)
5 1 2 3 (1 miss)
1 2 3 4 (1 miss)
2 3 4 5 (1 miss)

3 4 5 1 (1 miss)
4 5 1 2 (1 miss)
5 1 2 3 (1 miss)
Total no of miss=10, total (hit+miss)=13
Page fault percentage=(10/13)*100%=76.92%

6. $S \Rightarrow SA$
$\Rightarrow BA \Rightarrow 1A0A \Rightarrow 10B10A \Rightarrow 101A010A \Rightarrow 101A0010A \Rightarrow 101000100$

7. Unrepeatable read problem because 'T1' wants to assign value of A to B and C but 'T2' modified the value of A before next read of 'T1' and due to that the final values of B and C are different.

8. $k(6)+(k-1)(9+7) \le 512 \Rightarrow k \le 24$

9. Condition for minimum size of token is given by
Transmission delay = propagation delay
$\frac{L}{B} = \frac{d}{v} \Rightarrow d = \frac{L}{B} \times v = \frac{36 \times 2.4 \times 10^8}{18 \times 10^6} = 4.8 \times 10^2 = 480\text{meters}$

10. M bit is 0, means this datagram is the last fragment and there are no datagram after this.
Offset is 800 i.e., there are 800*8 bytes = 6400 bytes before this fragment.
Total length field is 500 bytes
Given HLEN is 8, so header length is 8*4 =32bytes
Therefore the data present in this fragment is 500 – 32 = 468 bytes
The sequence no. of the first byte of this fragment is 6400, since there are 6400 bytes before this datagram and sequence no. starts from 0.
The sequence no. of the last byte of this fragment is 6400+468-1 = 6867.

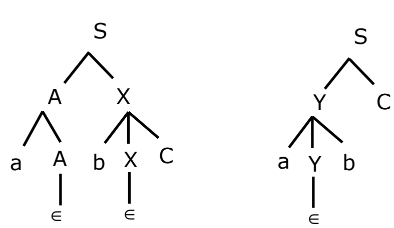
11. Use BFS using a queue; All three are valid.

12. In list, we have to traverse whole edge set for that vertex to find whether there is an edge (u,v) but in matrix representation, we can look up (u,v) entry directly.

13. Apply Havel Hakimi's theorem II & IV fail.

14. Cyclomatic complexity $C = \text{predicates} + 1$
$C = (4+2+3)+1 = 10$

16.



Two parse trees for w=abc
∴ Ambiguous G.

17. The language of grammars is $(01)^n \quad n \geq 0$

18. Page size=2^{12}B, so if we convert the address into binary:
$(4370)_{10}= (1000100010010)_2$
Now if we take LSB 12 bits, we will get the page offset and remaining part (MSB) will be page no.
So Page no=1 and Page offset= $(000100010010)_2$=274

19. $$(5\times 1024+3\times 256+128+3)$$
$$=\left(2^2+2^0\right)\times 2^{10}+\left(2^1+2^0\right)\times 2^8+2^7+\left(2^1+2^0\right)$$
$$=2^{12}+2^{10}+2^9+2^8+2^7+2^1+2^0=1011110000011$$

20. length 1 strings a
Length 2 strings aa
ba
ab
Length 3 strings aaa
aba
bba
abb
aab
bab
Total 1+3+7=11 strings

21. 1+2+3+……+10=55MB

22. Cache set mapping= (main memory request) % (number of sets)

0	0
1	~~5~~ 13
	~~9~~ 25
2	
3	7
	15

$0\%\ 4=0$
$5\%\ 4=1$
$9\%\ 4=1$
$13\%\ 4=1$
$7\%\ 4=3$
$0\%\ 4=0$
$15\%\ 4=3$
$25\%\ 4=1$
So total conflict miss = 2

23. Fixed size partition says for each partition one process should be allocated. So internal fragmentation is=(100-60)+(100-40)+(100-55)+(100-75)+(100-84)+(100-20)=266KB.

24.Eigen values are 1, 8, 27, …., n^3

$$\therefore \text{sum} = \left[\frac{n(n+1)}{2}\right]^2$$

25. Speed up $= \dfrac{nt_n}{(k+n-1)t_p} = \dfrac{1000 * 60}{(6+1000-1)*10} = \dfrac{60000}{10050} = 5.97$

26.

RAW	WAR	WAW
$I_1 \xrightarrow{R_5} I_2$	$I_1 \xrightarrow{R_0} I_2$	$I_1 \xrightarrow{R_5} I_4$
$I_2 \xrightarrow{R_0} I_3$	$I_2 \xrightarrow{R_5} I_4$	
$I_2 \xrightarrow{R_0} I_4$		

27. In activation tree the root node represents the activation of main program.

28. No of entries in inner page table=LAS/PS=2^{20}
Inner page table size (ITS) is =2^{20}*4B=4MB
No of entries in outer page table=ITS/PS=2^{10}
Outer page table size (OTS) is =2^{10}*4B=4KB (which fits into single page).
We need 12 bits for page offset, so outer index, inner index and offset will have 10, 10 and 12 bits respectively.

29. Worm is an example of System and network threat.
Access Matrix is one of the models of system protection in operating system to protect the violation of an access restriction by a user.
Symmetric Encryption is preferred over Asymmetric encryption for encrypting large amount of data.

30. A simple graph G with n vertex is necessarily connected if it has more than $\dfrac{(n-1)(n-2)}{2}$ edges.

31. Q1 produces different a,b combinations. Q2 first groups tuples based on different a,b combinations and select those combinations. So both produce same result always.

32.

$$\begin{pmatrix} \text{First Pass:} \\ \underline{6\ 4}\ 5\ 3\ 7\ 1 \\ 4\ \underline{6\ 5}\ 3\ 7\ 1 \\ 4\ 5\ \underline{6\ 3}\ 7\ 1 \\ 4\ 5\ 3\ \underline{6\ 7}\ 1 \\ 4\ 5\ 3\ 6\ \underline{7\ 1} \\ 4\ 5\ 3\ 6\ 1\ 7 \end{pmatrix} \quad \begin{pmatrix} \text{Second Pass:} \\ \underline{4\ 5}\ 3\ 6\ 1\ 7 \\ 4\ \underline{5\ 3}\ 6\ 1\ 7 \\ 4\ 3\ \underline{5\ 6}\ 1\ 7 \\ 4\ 3\ 5\ \underline{6\ 1}\ 7 \\ 4\ 3\ 5\ 1\ \underline{6\ 7} \\ 4\ 3\ 5\ 1\ 6\ 7 \end{pmatrix} \quad \begin{pmatrix} \text{Third Pass:} \\ \underline{4\ 3}\ 5\ 1\ 6\ 7 \\ 3\ \underline{4\ 5}\ 1\ 6\ 7 \\ 3\ 4\ \underline{5\ 1}\ 6\ 7 \\ 3\ 4\ 1\ \underline{5\ 6}\ 7 \\ 3\ 4\ 1\ 5\ \underline{6\ 7} \\ 3\ 4\ 1\ 5\ 6\ 7 \end{pmatrix}$$

34. By Master's theorem case(i)

35.

Direct mapping No. of blocks $= \dfrac{64kB}{2kB}$

Physical Address size = 2 millions = 2^{21}

Block size = 1kw

= 1k x 2B

$\because$ w = 16bits = 2B

Direct Mapping	Tag	Cache Block off set	Word off set
	6	5	10

36. Given 145.75.0.0/16 is the starting address. So, we have 2^{16} = 65,536 addresses with the ISP initially.

For the 1st group, each customer needs 256 addresses. So, 8 bits are needed to define each host. The prefix length is 32 – 8 = 24. Therefore the addresses of 1st group are:

1st customer ➔ 145.75.0.0/24 to 145.75.0.255/24

2nd customer ➔ 145.75.1.0/24 to 145.75.1.255/24

128th customer ➔ 145.75.127.0/24 to 145.75.127.255/24

So, for 1st group the ISP has allocated 128*256 = 32768 addresses

For the 2nd group, each customer needs 64 addresses. So, 6 bits are needed to define each host. The prefix length is 32 – 6 = 26. Therefore the addresses of 2nd group are:

1st customer ➔ 145.75.128.0/26 to 145.75.128.63/26

2nd customer ➔ 145.75.128.64/26 to 145.75.128.127/26

3rd customer ➔ 145.75.128.128/26 to 145.75.128.191/26

4th customer ➔ 145.75.128.192/26 to 145.75.128.255/26

128th customer ➔ 145.75.159.192/26 to 145.75.159.255/26

So, for 2nd group the ISP has allocated 128*64 = 8192 addresses

For the 3rd group, each customer needs 128 addresses. So, 7 bits are needed to define each host. The prefix length is 32 – 7 = 25. Therefore the addresses of 3rd group are:

1st customer ➔ 145.75.160.0/25 to 145.75.160.127/25

2nd customer ➔ 145.75.160.128/25 to 145.75.160.255/25

64th customer ➔ 145.75.191.128/25 to 145.75.191.255/25

So, for 3rd group the ISP has allocated 64*128 = 8192 addresses.

Hence the total no.of addresses available after allocating is 65536 – (32768 + 8192 + 8192) = 16384 addresses

37. Throughput of TCP $= \dfrac{\text{Window size}}{\text{RTT}}$

$$= \frac{1000\,\text{KB}}{\text{RTT}}$$

$$= \frac{10^6\text{B}}{100 \times 10^{-3}}$$

$$= \frac{1000 \times 10^3}{100 \times 10^{-3}}$$

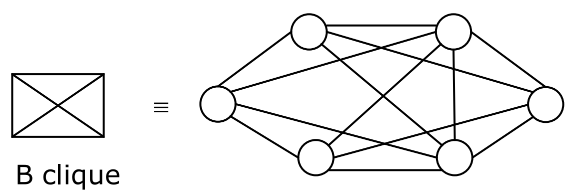
$$= 10\,\text{MBPS}$$

38. (i) False because A graph is traversable if the no. of odd degree vertex is zero or two. But here all one odd degree.

(ii) True all the complete Graph $k_n\,(n \geq 3)$ has a Hamiltonian cycle.

(iii) True A complete Graph $k_n\,(n > 2)$ has $\dfrac{(n-1)!}{2}$ Hamiltonian cycle.

(iv) Line Graph of clique is not a clique.



B clique

(Not a clique).

39. A query in tuple relational calculus is expressed a $\{t \mid p(t)\}$ that is, it is the set of all tuples t such that predicate P is true for t.

$\{t \mid t \in \text{Account} \wedge t[\text{acc.bal}] > 1200\}$

$t[\text{acc.bal}] \rightarrow$ denote the value of tuple to on attribute acc.bal.

$t \in r \rightarrow$ to denote that tuple t is in relation r

$\downarrow$ Account $\quad\quad$ $\downarrow$ Account

40. The regular expression for $\{a^n b^{2m} c^k \mid n, m, k \geq 0\}$ is $a^*(bb)^*c^*$

41. Here only one candidate key exist which is AB. The FDs A->C, C->D are partial and transitive dependencies respectively. Hence the highest normal form is 1NF.

42. AP=PD

$A = PDP^{-1}$

where $P = \begin{bmatrix} 1 & 2 \\ 1 & -5 \end{bmatrix} \Rightarrow |P| = -5 - 2 = -7$

$$P^{-1} = \frac{-1}{7}\begin{bmatrix} -5 & -2 \\ -1 & 1 \end{bmatrix}$$

$$D = \begin{bmatrix} -1 & 0 \\ 0 & 6 \end{bmatrix}$$

$$\therefore A = \begin{bmatrix} 1 & 2 \\ 1 & -5 \end{bmatrix}\begin{bmatrix} -1 & 0 \\ 0 & 6 \end{bmatrix}\frac{1}{7}\begin{bmatrix} -5 & -2 \\ -1 & 1 \end{bmatrix}$$

$$= \frac{-1}{7}\begin{bmatrix} -1 & 12 \\ -1 & -30 \end{bmatrix}\begin{bmatrix} -5 & -2 \\ -1 & 1 \end{bmatrix} \quad = \frac{-1}{7}\begin{bmatrix} -7 & 14 \\ 35 & -28 \end{bmatrix} \quad = \begin{bmatrix} 1 & -2 \\ -5 & 4 \end{bmatrix}$$

43. $F(x,y,z)=x'y+z'+xyz=x'y(z+z')+(x+x')(y+y')z'+xyz$

$=x'yz+x'yz'+xyz'+xy'z'+x'y'z'+xyz$

$F(x,y,z) = \sum m(0,2,3,4,6,7)$

44. $\text{Probability} = (1-0.6)*(1-0.7) = 0.4*0.3 = 0.12.$

45. Given that $P(A) = \frac{1}{2}$ $P(B) = \frac{3}{4}$ $P(\bar{C}) = \frac{3}{4}$

$\Rightarrow P(\bar{A}) = \frac{1}{2}$ and $P(B) = \frac{1}{4}$

$\text{Prob(problem is not solved)} = P(\bar{A})P(\bar{B})P(\bar{C})$

$= \frac{1}{2}\times\frac{1}{4}\times\frac{3}{4}$

$\text{Prob(is solved)} = 1 - \frac{1}{2}\times\frac{1}{4}\times\frac{3}{4}$

$= \frac{29}{32}$

46. 1^{st} Instruction requires $2*16$ bit $= 4$ byte

2^{nd} instruction requires $1*16 = 2$ byte

So I^{st} Instruction $500-503$

II^{nd} instruction $504-505$

So the address of III^{rd} instruction (506)will be stored on the top of the stack.

47. In $L_1 = ww^R$,if we know where the string w ends and where the reverse starts then it is DCFL otherwise not. Same case is for language L_2 also.

48.

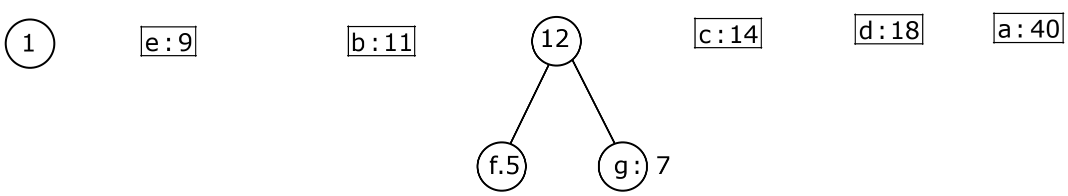
AB \ CD	00	01	11	10
00	1*	1	1	*1
01	0	1	1	0
11	0	1	1	*1
10	0	1*	0	0

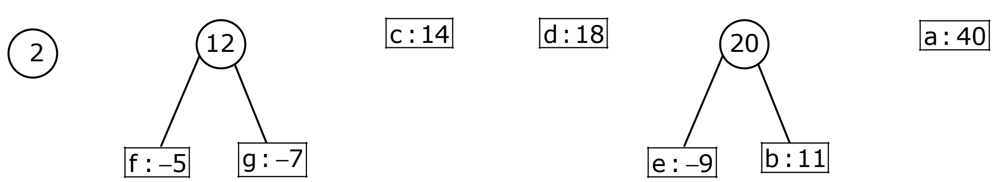
The prime implicants are $A'B', C'D, A'D, BD$ and ABC.
So ABD is not a prime implicant

49. The EPI's are $A'B'$, ABC, and $C'D$.
So, BD is a PI but not EPI, since there is no distinguished 1 present in quad.

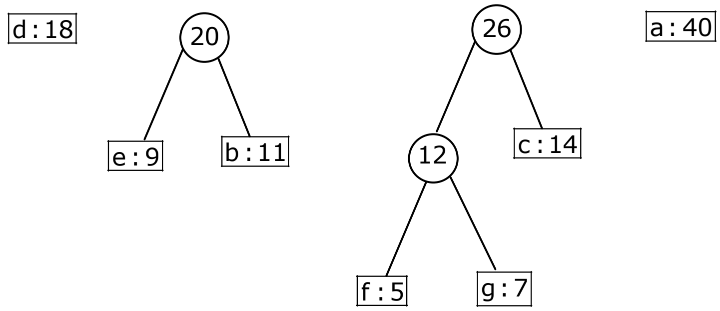
50 & 51.

f	g	e	b	c	d	a
5	7	9	11	14	18	40

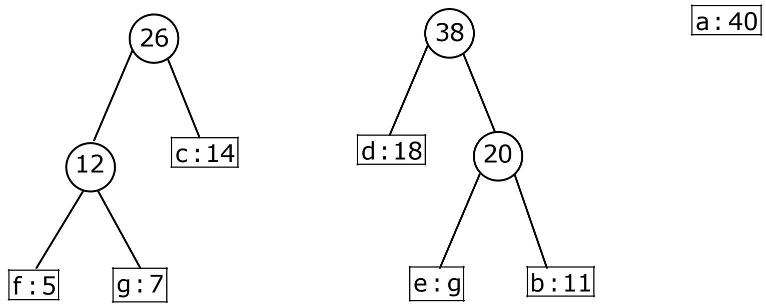




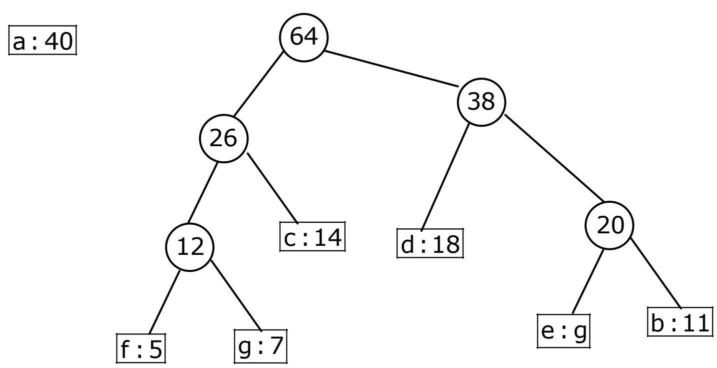
3


d : 18
20
e : 9
b : 11
26
12
c : 14
f : 5
g : 7
a : 40

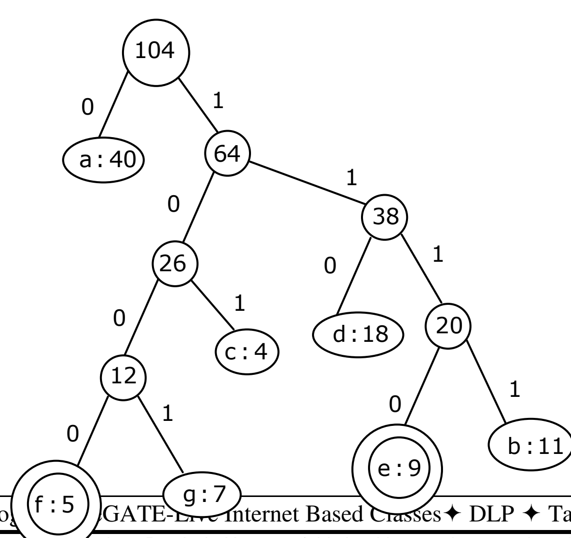
4


26
12
c : 14
f : 5
g : 7
38
d : 18
20
e : g
b : 11
a : 40

5


a : 40
64
26
38
12
c : 14
d : 18
20
f : 5
g : 7
e : g
b : 11

6


104
0
1
a : 40
64
0
1
26
38
0
1
0
1
12
c : 4
d : 18
20
0
1
0
1
f : 5
g : 7
e : 9
b : 11

52. Since $\int_{-\infty}^{\infty} f(x)dx = 1$

$$\int_{-\infty}^{\infty} k.e^{\frac{-x^2}{2}}dx = 1 \Rightarrow \int_{\infty}^{-\infty} k.e^{-\frac{x^2}{2}}dx = 1 \Rightarrow k\int_{-\infty}^{\infty} e^{-\frac{x^2}{2}}dx = 1 \Rightarrow 2k\int_{0}^{\infty} e^{-\frac{x^2}{2}}dx = 1$$

put $\frac{x^2}{2} = u$

$x^2 = 2u$

$2 \times dx = 2du$

$dx = \frac{du}{\sqrt{2u}}$

$2k\int_0^{\infty} e^{-u}u^{-\frac{1}{2}}\frac{du}{\sqrt{2}} = 1$

$\sqrt{2}k\int_0^{\infty} e^{-u}u^{\frac{1}{2}-1}du = 1$

$\sqrt{2}k\sqrt{\frac{1}{2}} = 1$

$k = \frac{1}{\sqrt{2}\sqrt{\pi}} = \frac{1}{\sqrt{2\pi}}$

53. V(k)=variance $= E(x^2) - (E(x))^2$

$E(x) = \int_{-\infty}^{\infty} xf(x)\,dx$

$= \frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} x.e^{\frac{-x^2}{2}}dx$

Mean $= 0 \therefore f(x)$ is odd function

$E(x^2) = \int_{-\infty}^{\infty} x^2 f(x)\,dx = \frac{1}{\sqrt{2\pi}}\int x^2 e^{\frac{-x^2}{2}}dx$

$= \frac{2}{\sqrt{2\pi}}\int_0^{\infty} x^2 e^{\frac{-x^2}{2}}dx$

$= \frac{\sqrt{2}}{\sqrt{\pi}}\int_0^{\infty} 2ue^{-u}u^{\frac{1}{2}}\frac{du}{\sqrt{2}} \quad = \frac{2}{\sqrt{\pi}}\int_0^{\infty} e^{-u}e^{\frac{3}{2}-1}du$

$= \frac{2}{\sqrt{\pi}}\sqrt{\frac{3}{2}} = \frac{2}{\sqrt{\pi}}.\frac{1}{2}\sqrt{\frac{1}{2}} \quad = \frac{1}{\sqrt{\pi}}.\sqrt{\pi} = 1$

Variance $= 1 - 0 = 1$

54. The language is containing the strings, where b is preceded by even number of a's and followed by any number of b's.

55. The strings with length less than 4 are b, bb,aab,bbb.

60. 60 30 30 45 90 ? =225

x.5 x1 x1.5 x2 x2.5

+.5 +.5 +.5 +.5

62. $x + y + z = 15$

$x^2 + y^2 + z^2 = 83$

since, x, y & z are in A.P

So, $y + z = 10 \Rightarrow y^2 + z^2 + 2yz = 100$.........(i)

Then x must be 5

$y^2 + 2^2 = 58$

putting the value of $y^2 + z^2$ in (i)

$2yz = 42$

$yz = 21$

so y & z must be 3 & 7

series will be 3, 5 & 7

63. Clearly marked price of Book = 120% of CP

Also, Cost of paper = 25% of CP

Let, cost of paper for a single book be Rs. n

Then 125 : 25 = 180 : n

$n = \frac{180 \times 25}{125} =$ Rs.37.50

64. Work done on the first three days in 37%. Hence work done on the next 7 days is 63%. Since this is A+B's work we get

One day's work of $(A + B) = 9\%$

Also, 5A = 4B,

Hence A=4% and B=5%. So B is the fastest worker.

So, B will take 20 days to complete the work.

65. While buying

He buys 1100 grams instead of 1000 gms.

Suppose he bought 1100 grams for Rs. 1000

While selling

He sell only 900 grams when he takes the money for 1 kg.

Now as per question he sells at a 8% profit. (20% markup & 10 % discount)

Hence his selling price is Rs.1080 for 900 grams, to calculate profit percentage we will equate the money.

1100 grams for Rs. 1000 (Buying)

1188 grams for Rs. 1080

900 grams for Rs. 1080 (selling)

Hence profit % = $\frac{288}{9W} = 32\%$