# ASSIGNMENT 6
## CPG Parsing

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*20171099*

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1. **Show the constraint graph and solution graph(s) for each of the following sentences in Hindi.**

   **KARAKA SHARING RULES USED IN THE ASSIGNMENT:**[1]

   **Rule S1:** Karta of intermediate verb with TAM label 'kara' is the same as the karta of the verb modified by the intermediate verb.

   **Rule S2:** If an intermediate verb with the TAM label 'kara' takes a karma (as specified in its default karaka chart) while none has been obtained using karaka vibhakti mapping, then it shares its karma with the karta or the karma of the verb modified by the intermediate verb.

   **Rule S3:** An intermediate verb with TAM label 'taa_huaa' shares its karta with the karta of the verb modified by the intermediate verb.

   **Rule S4:** If a verb with TAM label taa_huaa modifies a noun, then that noun is its karta.

   a. Raama phala khaakara mohana ko bulaataa hai

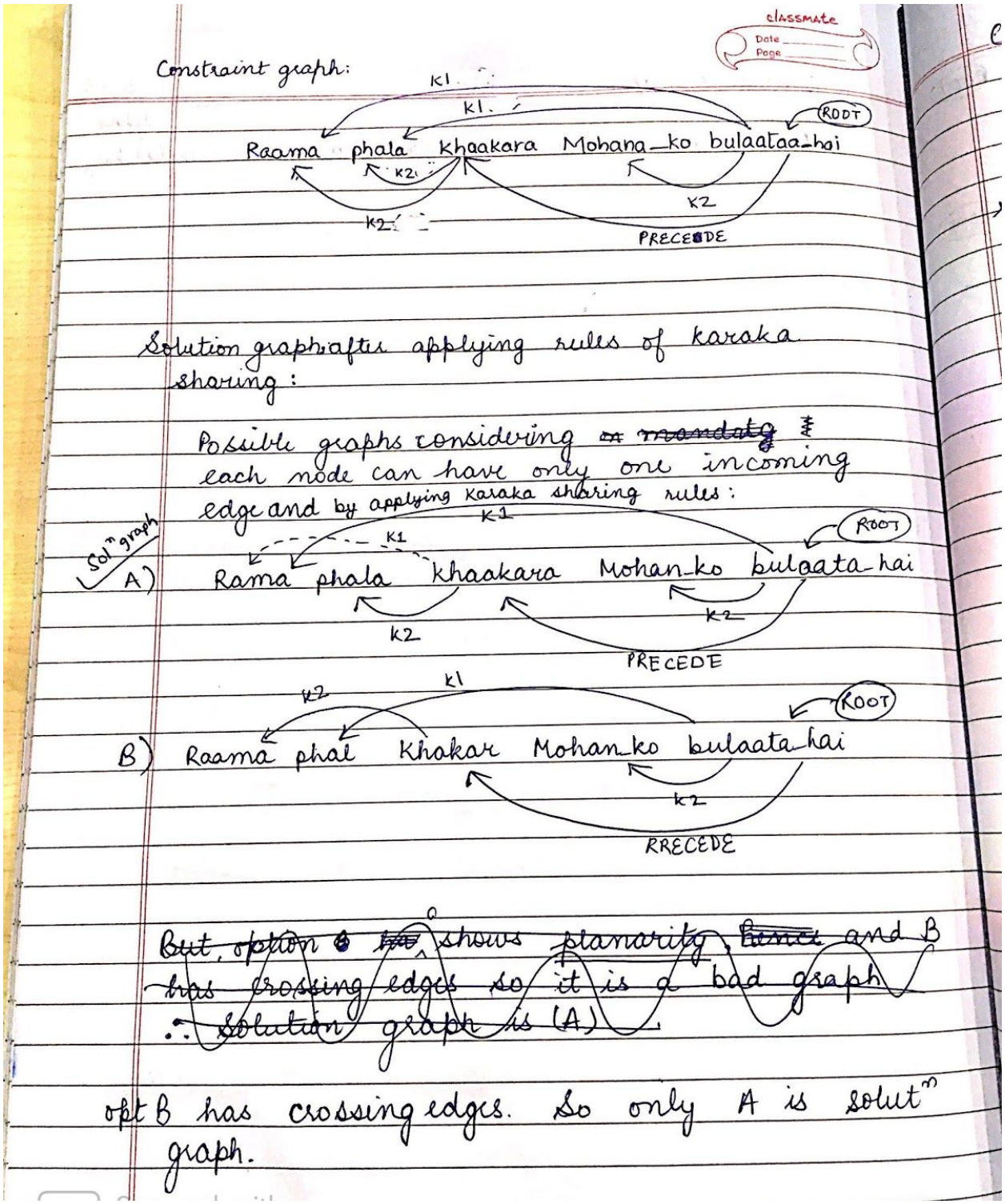
      Required karaka Charts:
      I. khaataa_hai -> k1(Φ), k2(Φ)[2]
      II. bulaataa_hai -> k1(Φ), k2(ko)

      Required transformation Charts:

[1] NLP: A Paninian Perspective Book
[2] Notation followed: karaka(vibhakti)

I. kara -> k1 must not be present; k2 is optional; add PRECEDE to parent verb(main verb)/ to the verb being modified

**Constraint Graph and Solution Graph:**

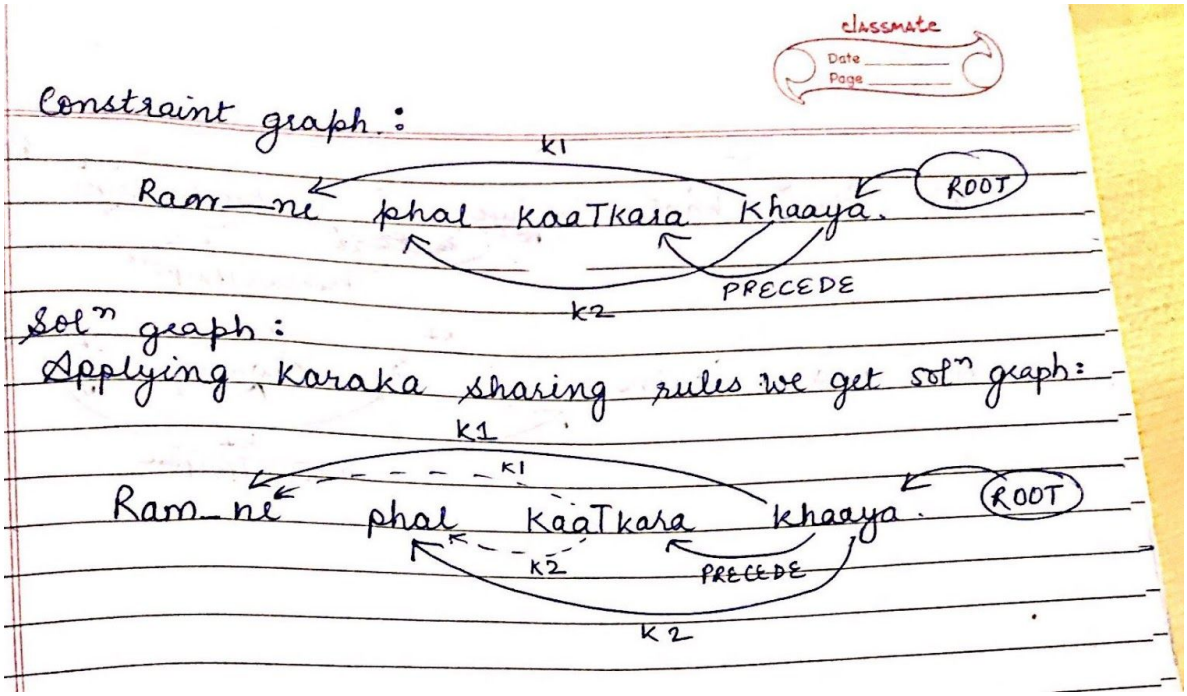


b. Raama ne phala kaaTakara khaaya.

Required karaka Charts:
I. kaaTtaa_hai -> k1(Φ), k2(ko/Φ)
II. khaataa_hai -> k1(Φ), k2(ko/Φ)

Required transformation Charts:
I. kara -> k1 must not be present; k2 is optional; add PRECEDE to parent verb(main verb)/ to the verb being modified
II. yaa -> k1(ne)

**Constraint Graph and Solution Graph:**



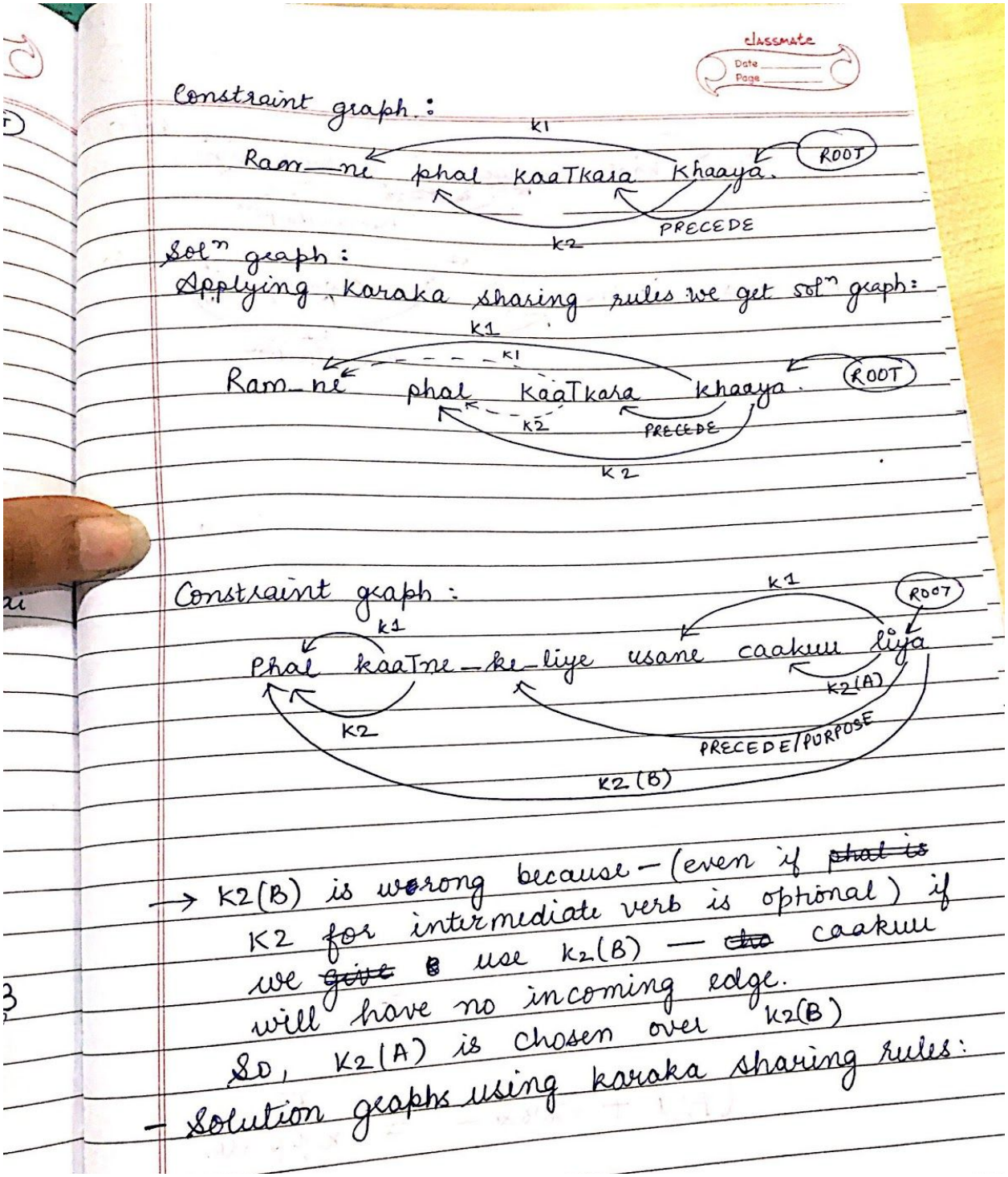

c. phala kaaTane ke liye usane caakuu liyaa

Required karaka Charts:
I. kaaTtaa_hai -> k1(Φ), k2(ko/Φ)
II. letaa_hai -> k1(Φ), k2(Φ)

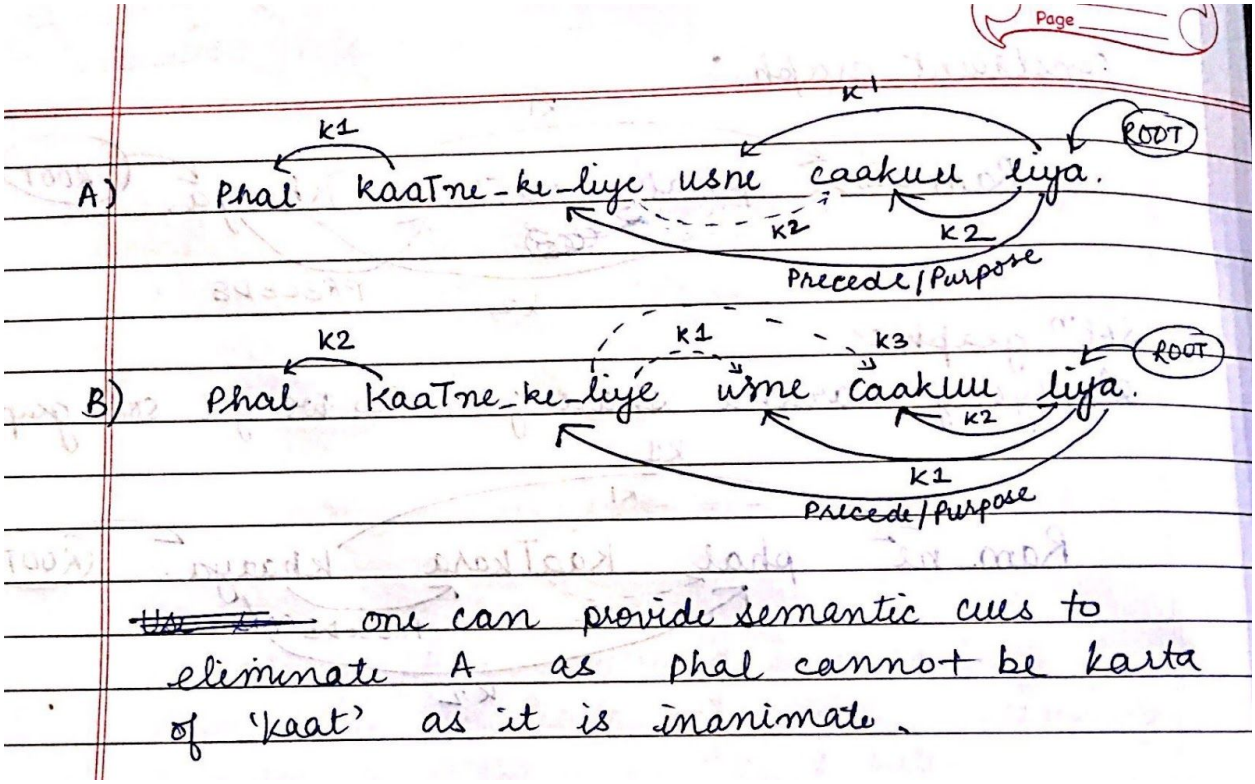
Required transformation Charts:
I. naa -> k1 is optional; k2 is optional, add PURPOSE to the verb being modified

II. yaa -> k1(ne)

**Constraint Graph:**




**Solution Graph:**



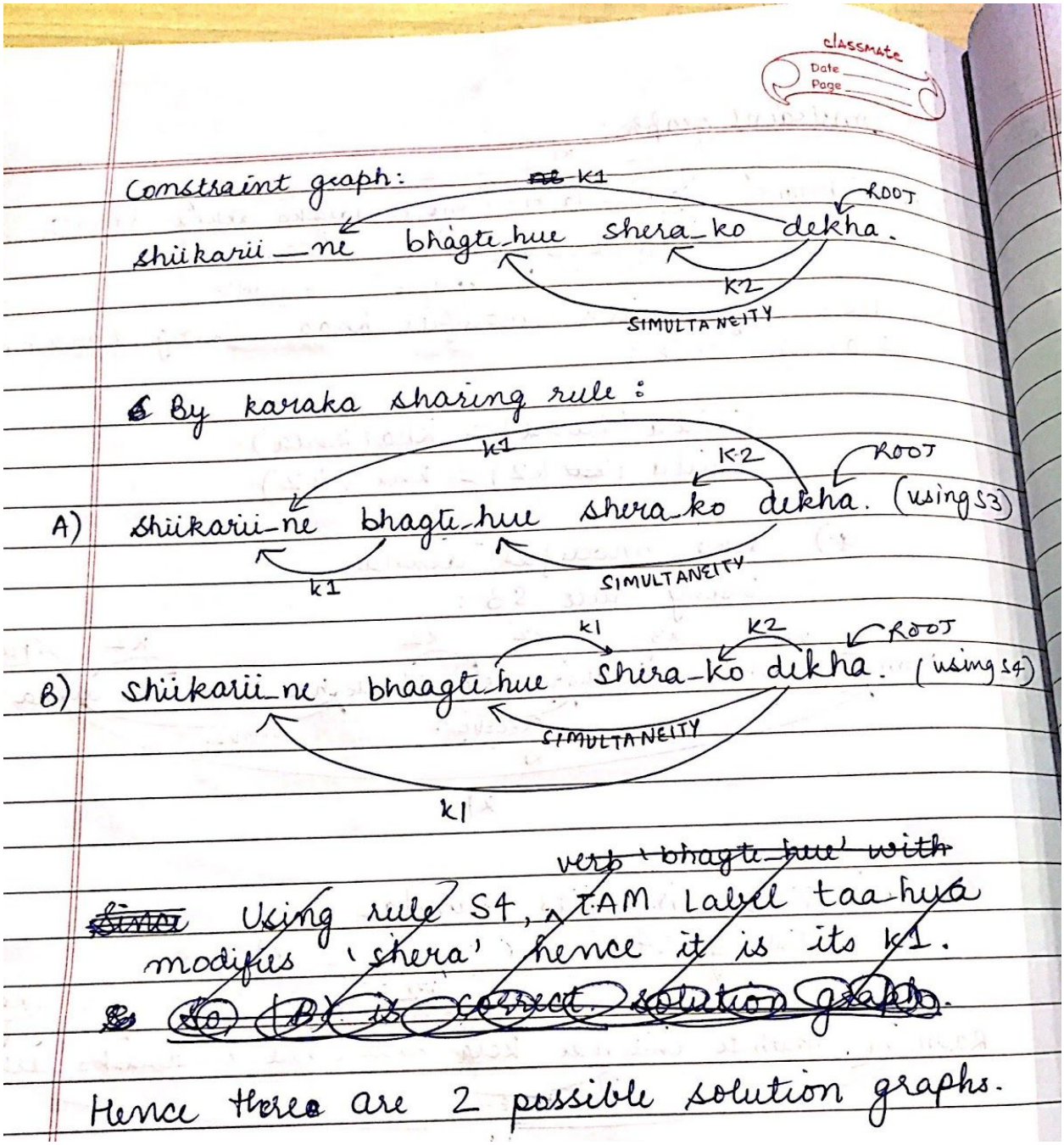

2. **Show the constraint graph and solution graph(s) for each of the following sentences in Hindi.**

   a. shikaarii ne bhaagaate hue shera ko dekhaa

   Required karaka Charts:
   I. bhaagtaa_hai -> k1(Φ)
   II. dekhtaa_hai -> k1(Φ), k2(ko/Φ)

   Required transformation Charts:
   I. taa_hua -> k1 is optional; k2 is optional; add SIMULTANEITY to the verb being modified
   II. yaa -> k1(ne)

   **Constraint Graph and Solution Graph:**




b. raama ne haatha se chiilkara kelaa khaate hue bandara ko dekhaa

Required karaka Charts:

I. dekhata_hai -> k1(Φ), k2(ko/Φ)

II. khaataa_hai -> k1(Φ), k2(ko/Φ)

III. chilltaa_hai -> k1(Φ), k2(ko/Φ)

Required transformation Charts:

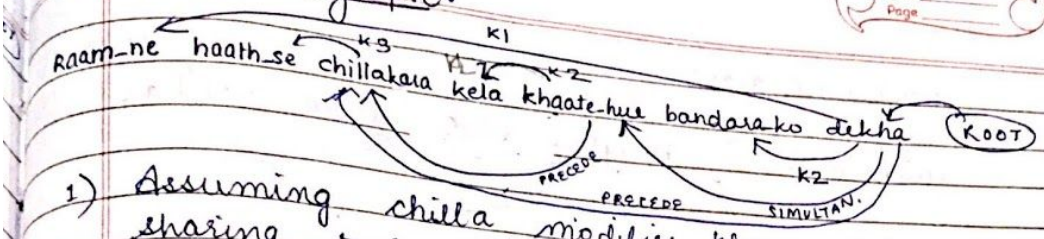
I. kara -> k1 must not be present; k2 is optional; add PRECEDE to verb being modified

II. yaa -> k1(ne)

III. taa_hua -> k1 is optional; k2 is optional; add SIMULTANEITY to verb being modified

**Constraint Graph and Solution Graph:**

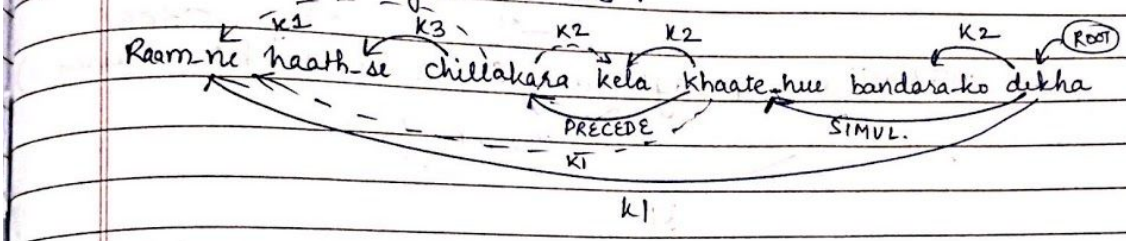
Constraint graph:



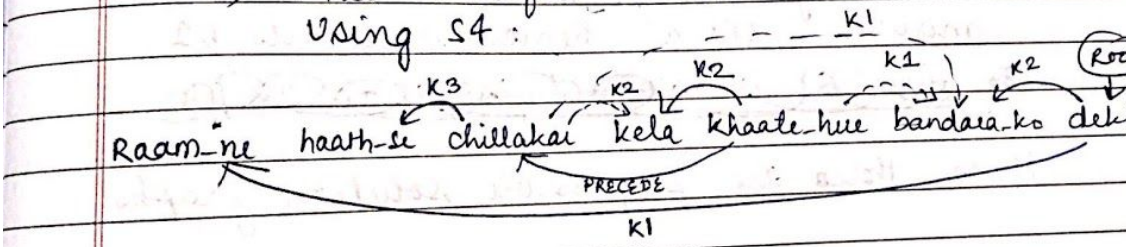

1) Assuming chilla modifies khaa Using karaka sharing rule:

Chilla (karta) = kha (karta)
Chilla (~~kar~~ k2) = kha (k2)

a) kha modifies dekha
Using rule S3:



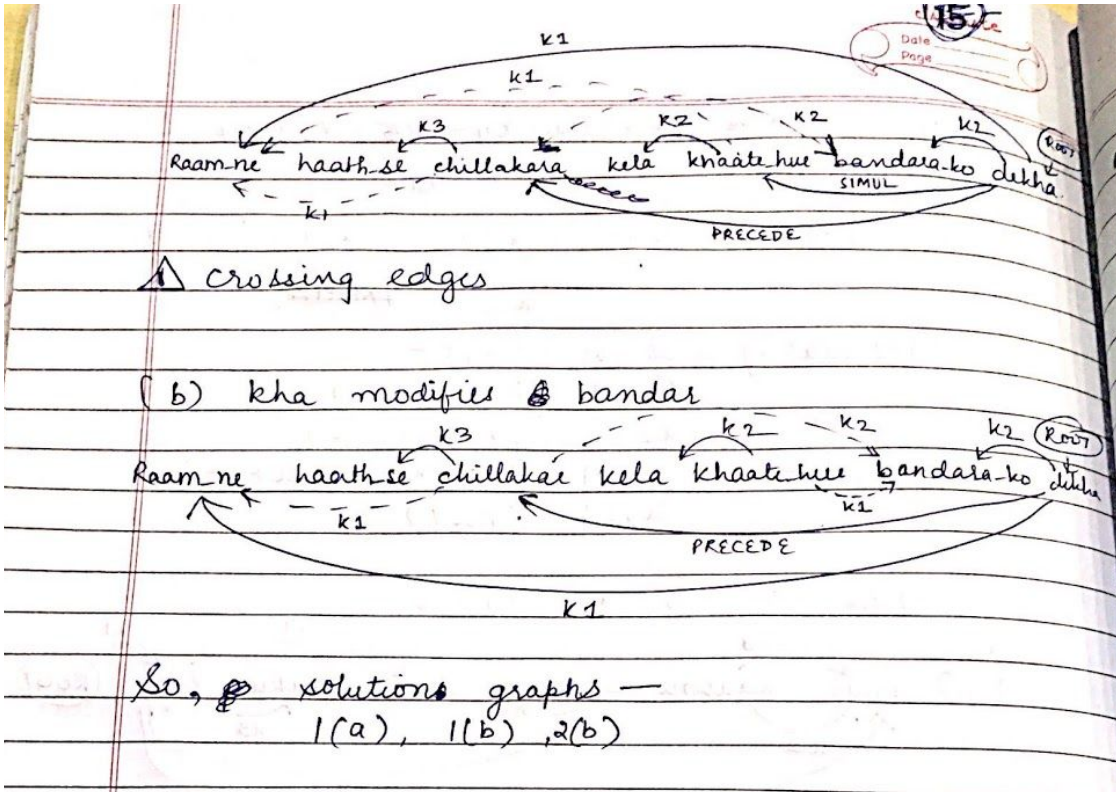

b) Kha modifies bandar
Using S4:




2) Assuming chilla modifies dekha.

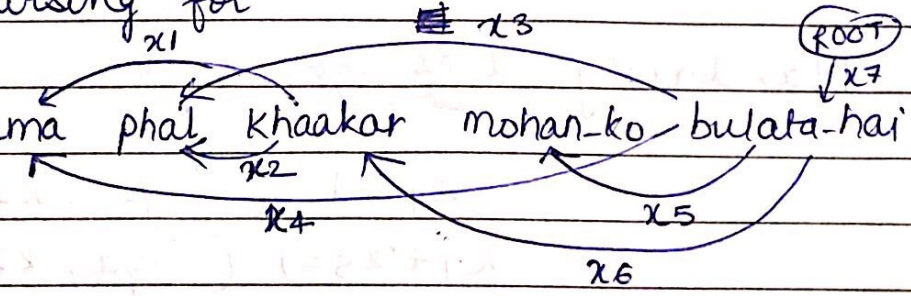
chilla (k1) = dekha (k1)
chilla (k2) = dekha (k2)

a) kha modifies dekh


15
Date
Page
k1
k1
k3
k2
k2
k2
Raam_ne haath_se chillakara kela khaate_hue bandara_ko dukha.
ROOT
SIMUL
k1
PRECEDE
⚠ crossing edges
(b) kha modifies bandar
k3
k2
k2
k2
Raam_ne haath_se chillakar kela khaate_hue bandara_ko dukha
ROOT
k1
k1
PRECEDE
k1
So, solutions graphs —
1(a), 1(b), 2(b)

Q3 and Q4: PTO

3. Integer parsing for —




Mandatory arcs for 'bula' — $x_5$, $x_4$, $x_3$

$x_4 + x_3 = 1$ (bula, k1)

$x_5 = 1$ (bula, k2)

Arcs for 'kha' — $x_1$ and $x_2$ and $x_6$

$x_2 + x_1 = 1$ (kata, k2)

$x_6 = 1$ (kata, PRECEDE)

For nodes —

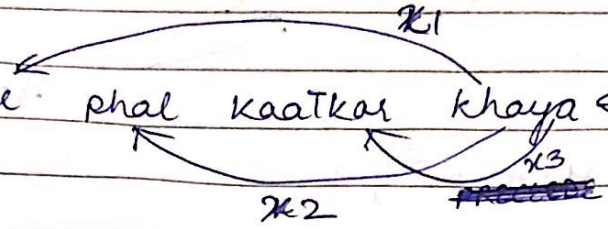
bachcha → $x_4 + x_6 = 1$ .

phala → $x_3 + x_5 = 1$

bula → $x_7 = 1$

Max. $U = x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7$

1(b) Raam_ne phal kaatkar khaya (ROOT)




Mandatory arcs for khaaya –

$x_1 = 1$ (kaaya, k1)

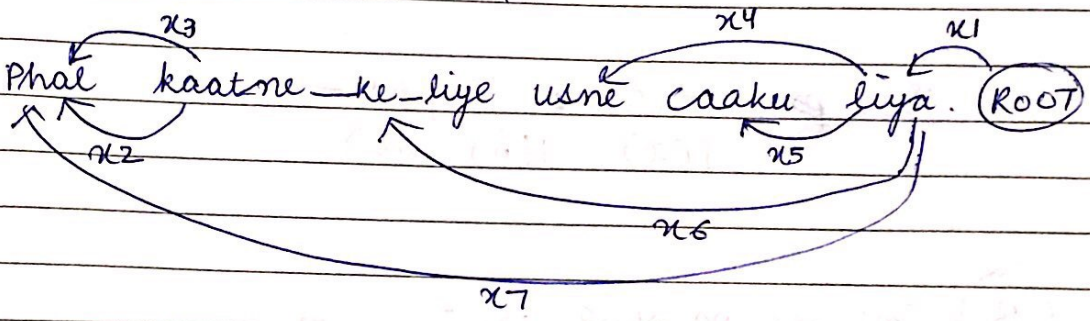
$x_2 = 1$ (khaaya, k2)

Nodes – $x_3 = 1$ (kaatkar, PRECEDE)

$x_4 = 1$ (ROOT)

Max. $x_1 + x_2 + x_3 + x_4 = U$

1(c) Phal kaatne ke_liye usne caaku liya. (ROOT)




Mandatory arcs for liya:

$x_4 = 1$ (liya, k1)

$x_7 + x_5 = 1$ (liya, k2)

~~Mandatory arcs~~

For nodes –

$x_7 + x_2 + x_3 = 1$ (Phala)

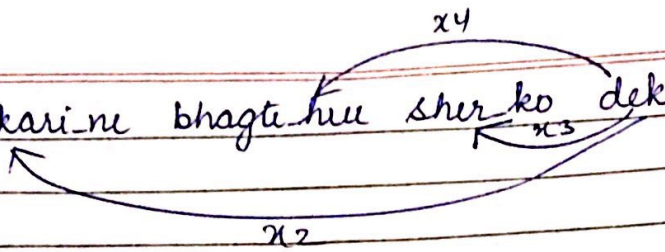
$x_1 = 1$ (Root)

$x_6 = 1$ (~~Precede~~ Purpose ~~simultaneous~~)

Max $x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 = U$

4.

2(a) shikari_ne bhagta_hua sher_ko dekha (ROOT)




Mandatory arcs for dekha –

$x_2 = 1$ (dekha, k1)

$x_3 = 1$ (dekha, k2)

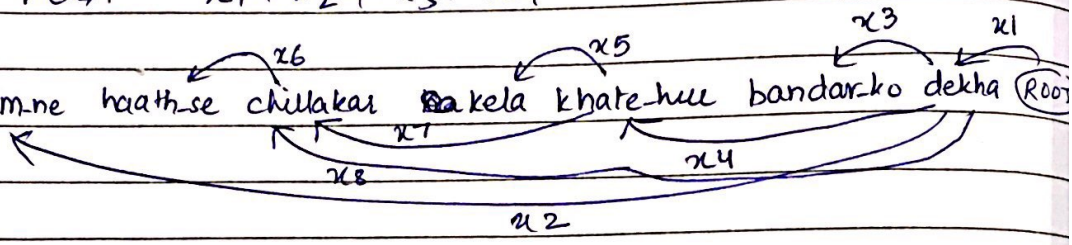
Nodes –

$x_1 = 1$ (ROOT)

$x_4 = 1$ (SIMUL)

Max. $x_1 + x_2 + x_3 + x_4 = U$

2(b). Raam_ne haath_se chillakar kela khate_hue bandar_ko dekha (ROOT)




Mandatory arcs for dekha –

$x_2 = 1$ (dekh, k1)

$x_3 = 1$ (dekh, k2)

Arcs for khate_hue –

$x_4 = 1$ (Simultaneity)

$x_5 = 1$ (khate_hue, k2)

Arcs for chillkar

$x_6 = 1$ (child, k3)

Nodes –

$x_7 + x_8 = 1$ (chillkar)

$x_1 = 1$ (ROOT)

Max. $x_1 + x_2 + x_3 + x_4 + x_5 + x_6 + x_7 + x_8 = U$