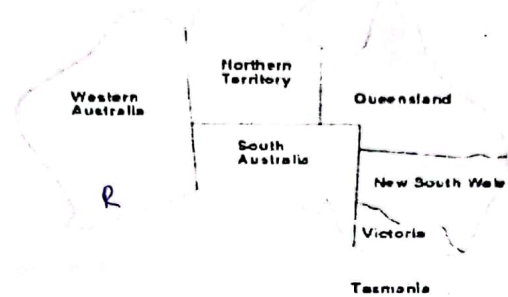**Question No 01:** Assign the colors to each area keeping in view the remaining legal values for the unassigned variables and maintaining arc consistency.

	WA	NT	Q	NSW	V	SA	T
	RGB	RGB	RGB	RGB	RGB	RGB	RGB
After WA = red	R	GB	RGB	RGB	RGB	GB	RGB
After Q =Green	R	B	G	RB	RGB	B	RGB
After V= Blue	R	B	G	R	B		RGB

Question No 02: Identify the types of constraints based on the given data:

1) $A \neq 0$

$\Rightarrow$ Unary constraint
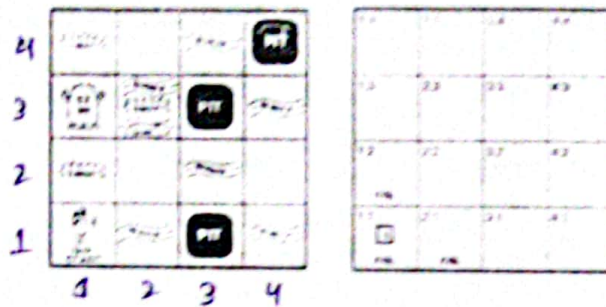
2) $A \neq B$

$\Rightarrow$ Binary constraint

3) $E = A + B$

High order

=> ~~Algorithm~~ constraint

Question No 03: : Consider the Wumpus world problem as described in the figures below:
[5 x 2 = 10]

Given: A: agent, B: breeze, G: Gold, OK: Safe, P: Pit, S: Stench, W: Wumpus

Using preposition logic, write the expressions to represent the following conditions:

1) If there is a stench in square (1, 2), then there is a Wumpus in an adjacent square.

$$(S_{1,2}) \rightarrow (W_{1,3}) \vee (W_{2,2})$$

2) If there is gold in square (2, 3), then there is a breeze and a stench in square (2, 3).

$$(G_{2,3}) \rightarrow (B_{2,3}) \wedge (S_{2,3})$$

3) There is a breeze in square (3, 2) or there is no pit in square (1, 3).

$$(B_{3,2}) \vee (\sim P_{1,3})$$

4) The agent perceives a stench in square (1, 2) if and only if there may be a Wumpus in an adjacent square.

$$(S_{1,2}) \leftrightarrow (W_{2,2}) \vee (W_{1,3})$$

5) If there is a breeze in square (4, 1), then there is a Pit in an adjacent square.

$$(B_{4,1}) \longrightarrow (P_{4,2}) \vee (P_{3,1})$$

Question No 04: Consider the following sentence in propositional logic.

$$P \wedge \neg Q \wedge (P \Rightarrow R) \wedge (\neg Q \vee W) \wedge (W \Rightarrow P) \wedge (\neg R \vee W)$$

Show W using resolution. Also mention each step. Also mention the rule of resolution.

Apply resolution theorem (convert to CNF)

$$P \wedge \neg Q \wedge (P \rightarrow R) \wedge (\neg Q \vee W) \wedge (W \rightarrow P) \wedge (\neg R \vee W)$$

$$P \wedge \neg Q \wedge (\neg P \vee R) \wedge (\neg Q \vee W) \wedge (\neg W \vee P) \wedge (\neg R \vee W)$$

Formula	Steps	Derivations
P	1	Given
¬Q	2	Given
¬P ∨ R	3	Given
¬Q ∨ W	4	Given
¬W ∨ P	5	Given
¬R ∨ W	6	Given
R	7	1, 3
W	8	6, 7

Question no 05: For each of the sentences below, indicate whether it is satisfiable, unsatisfiable, or valid. (Give Reason)

i. $P \Rightarrow P$

Solution:

Valid

($P \rightarrow P$ means that both the values will be same. Implication is wrong only one when the first one is True and the second one is false which is not possible in this case since both the variables must have be same.)

ii. $P \Rightarrow \neg P$

Solution:

Satisfiable

(It will give false when $P = $ True and gives True when $P = $ False).

P	$\neg P$	$P \rightarrow$
T	F	F
F	T	T

iii. $P \Leftrightarrow \neg P$

Solution:

Unsatisfiable. (P and $\sim P$ are complement of each other. Biconditional is true only when both of them will be same either False or True), i.e.;

P	$\sim P$	$P \leftrightarrow \sim P$
T	F	F
F	T	F

iv. $(P \Rightarrow Q) \Rightarrow ((P \wedge R) \Rightarrow Q)$

Solution:

Valid (as shown by the truth table).

P	Q	R	$P \rightarrow q$ ①	$P \wedge r$ ④	$②\rightarrow q$	$①\rightarrow③$
F	F	F	T	F	T	T
F	F	T	T	F	T	T
F	T	F	T	F	T	T
F	T	T	T	F	T	T
T	F	F	F	F	T	T
T	F	T	F	T	F	T
T	T	F	T	F	T	T
T	T	T	T	T	T	T

Question No 06: Convert $\neg ([(P \wedge \neg Q) \Rightarrow (R \vee S)] \wedge T)$ to CNF.

$= \sim ([P \wedge \sim q) \rightarrow (R \vee S)] \wedge T)$

$= \sim ([\sim (p \wedge \sim q) \vee (r \vee s)] \wedge T)$ $\therefore p \rightarrow q = \sim p \vee q$

$= \sim ([(\sim p \vee q) \vee (r \vee s)] \wedge T)$

$= \sim [(\sim p \vee q) \vee (r \vee s)] \vee \sim T$ $\therefore \sim (p \wedge q) = \sim p \vee \sim q$
By De Morgan's

$= [(p \wedge \sim q)] \wedge [(\sim r \wedge \sim s) \vee \sim T]$