Statement Calculus & Predicate Calcul *connectivities. stouth tables, & Tautology & Contradiction (7M) * Well formed formulaes (NFF), Buality law. * Without using touth tables. } 7M * Normal forms. 1. PDNF 2. PCNF * Theory of Inferience (7M) Type-1 Tupe -2 Type-3 Type -4 Type -5. * Quantifiers (7M). Type -1 Type -2

SAGE POWERS IN CO. CREEKS Peak over

3. Name pepnes 1. Name: Negation. Touth Representation: ~,7 (mot) The P P The Tree profess bearings smooth bornois P: Ro p: Ramu is a good boy. AMAGI of Parmu is not a good boy 11109 1 q: Pa Note: (Mr) more to present to present * PUQ: PC 0 1-300 ~ (~P) (> P. 2. Name: conjuction. Tupe-2 4. No Representation: 1 (and, meet). H - 39HT Touth table: Tupe - 5. PA9 9 * Quantifica (M) T 1- sqpT Lypers T Ex! P: Roomu is a good boy q: Ravi is a bad boy. PAQ: Pamu is a good boy and Ravi is a bad boy.

Rel

Tou

P:

9.

P.

```
3 Name: Disjunction.

pepaecentation: V (8, join).

Touth table:

P 9 PV9

T T T

F T T

F T F
```

p: Ramu is good boy
q: favi is bad boy.
pyq: Ramu is good boy & Ravi is bad
boy.

Representation: -> => (If, then).

Touth table:

P: Paju is studying well.

9: Paju will pass the exam.

P->9: If Paju is studying well

them Paju will pass the exam.

Pavi

offer ye

194

7.5

5. Name: Bi-conditional.

Pep-recentation: (+) (If and only if).

Touth Tables

P 9 P→9

T T F

F T F

F T T

p: Raju is studying well.

q: Raju will pass the exam.

Perq: Raju is studying well if and only

if Raju will pass the exam.

Construction of Touth tables:

1 ~ (PAQ) \ \to \ \to PV ~ Q.

2. \((Q \Lambda(P \to Q)) \rightarrow P

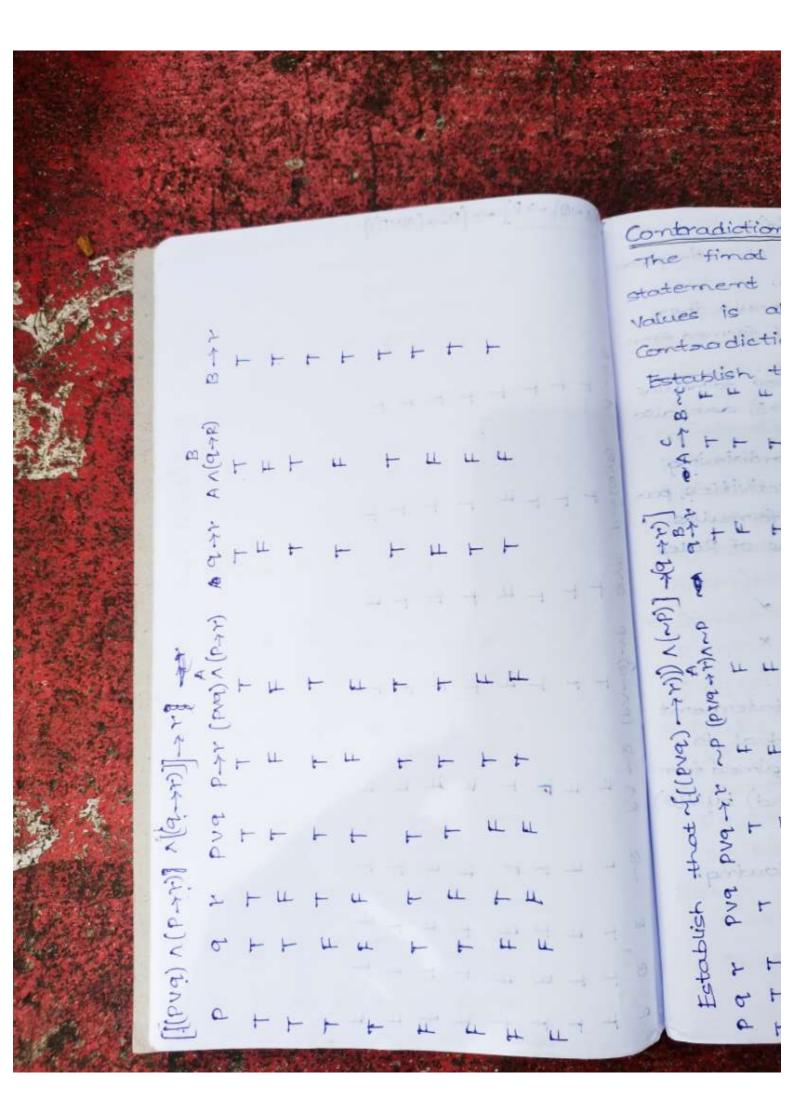
3.~[PV(9A7)] (PA9) A (PVY).

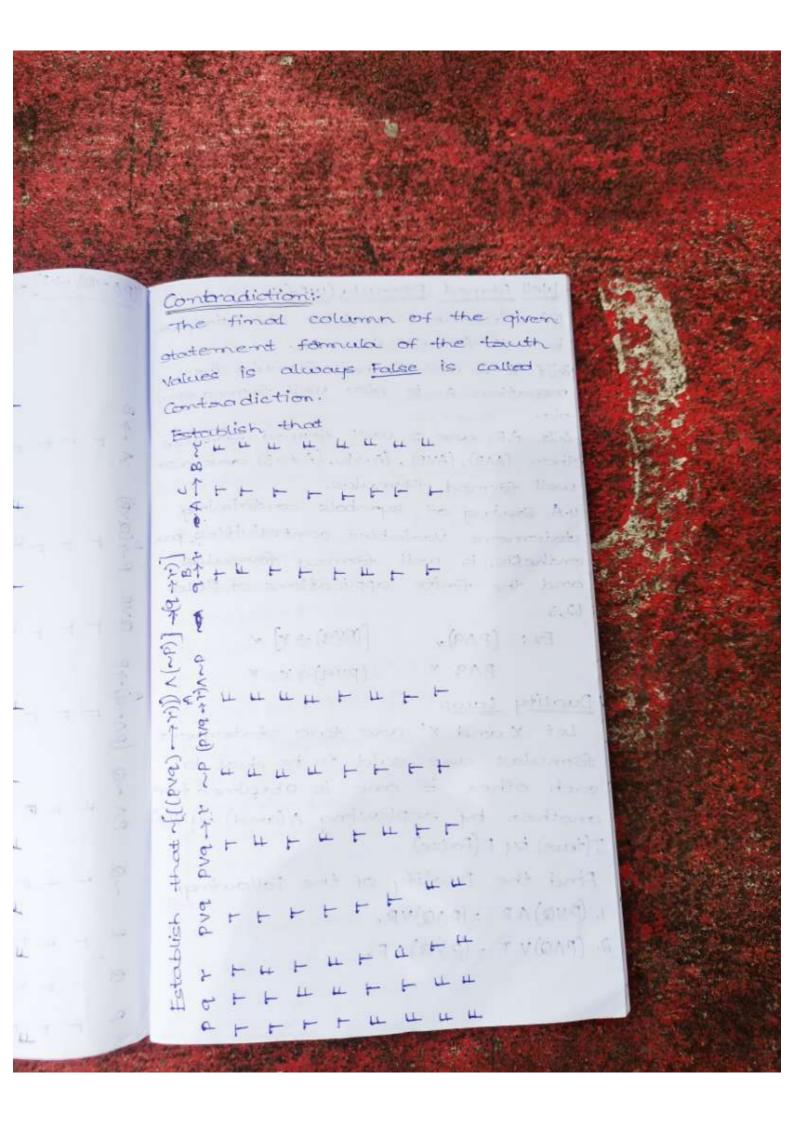
+ + H H H H H H L ~(いいり~d~)~ 444 and only m - 17 14 . PV(9Ar) 4++44 + + + + H H H H H

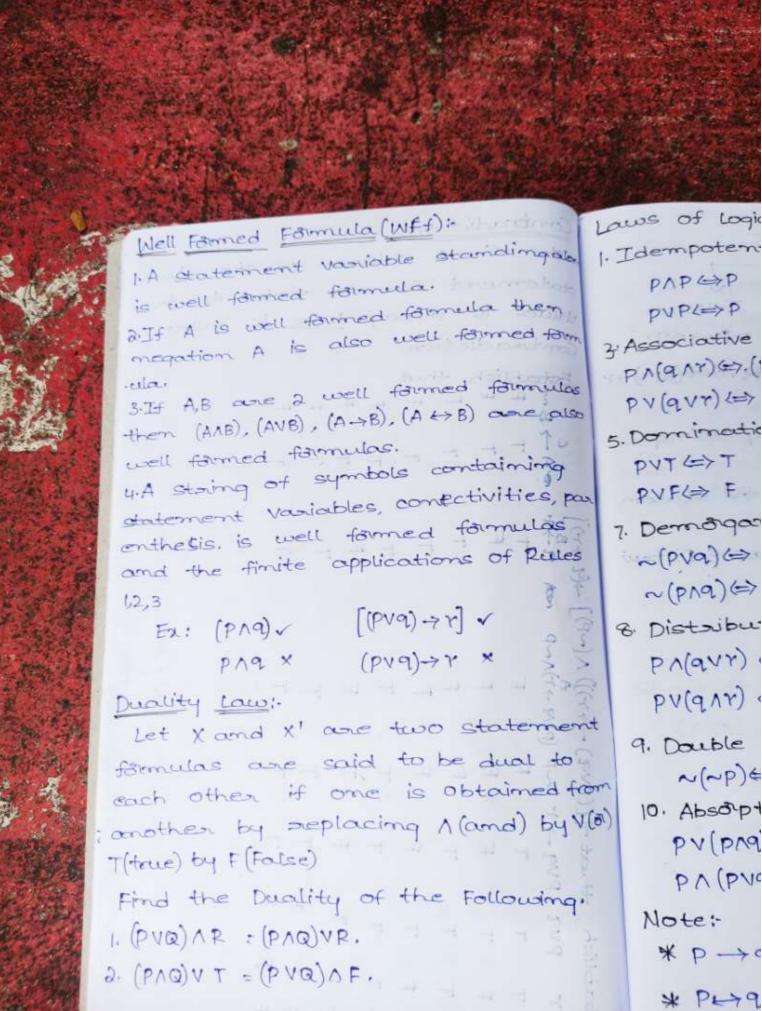
av(b-d) +b ALAB

voluces is orlunys towne is called colemn of the given gistow that [P>(QVP) (P>QV(P+P) statement formula of the truth オカームエ 7 1. エーエー F a toutology, 7 racetology. 1 F the final F 8↔A T T T Toutology: 7 1. 1 (949)V(049) 949
T T
T 1 1 0 d d

2.[(P→9)→ア)→ [(P→9)→(P→ア)] ((P1~Q) -> P) OT 4 BVR PA~Q (PA~Q) -PR

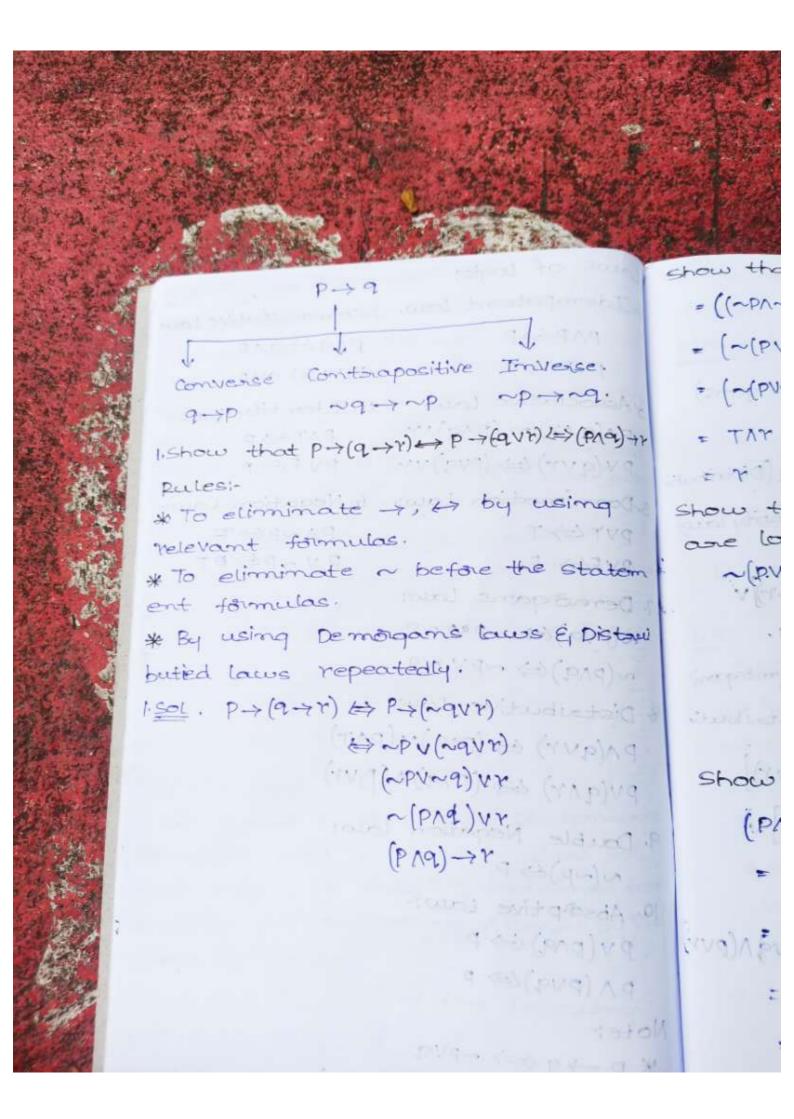






1. Idempoten PAPGP PVP (=> P 3: Associative PA(QAY) (=>.(PV(QVY) (=> 5. Dominatio PVTGT PVF⇔ F. 7. Demogar ~(pva) (=> ~ (PAQ) (=> 8 Distribu PN(QUY) pv(qnr) 9. Double ~ (~p) ¢

Laws of Logic: . Idempotent law. 2. commutative law standingalor PAPGP PAR CAP PVP(=>P neila them. pvq (=> qvp & Associative Law. 4. Identity Law: formed form PA(9AT) @. (PA9)AT PATOP d formulas pv(qvr) (=> (pvq) vr PVFAP B) are also 5. Domination Law: 6. Negation Law: P∧~P⇔ F PVTGYT ntaining PVF F. PV~PEPPT tivities, par 7. Demogans laws farmulas ~(pva) (>> ~pm ~9 s of Rules ~ (PAQ) (=> ~PV~9 & Distributive Law: PA(QUY) (PAQ), N (PAT) pv(qnr) (pva)n(pvr) 9. Double Negation law: tatement dual to ~(~P) AP aimed from 10. Absorptive Law: nd) by V(a) PV(PM) (=> P PA (PVQ) (=> P llowing. Note: * P -> q (=> ~PV9 $*P\mapsto q \Leftrightarrow (P\rightarrow q) \wedge (q\rightarrow P)$ (PAQ) V (~PRA~Q).

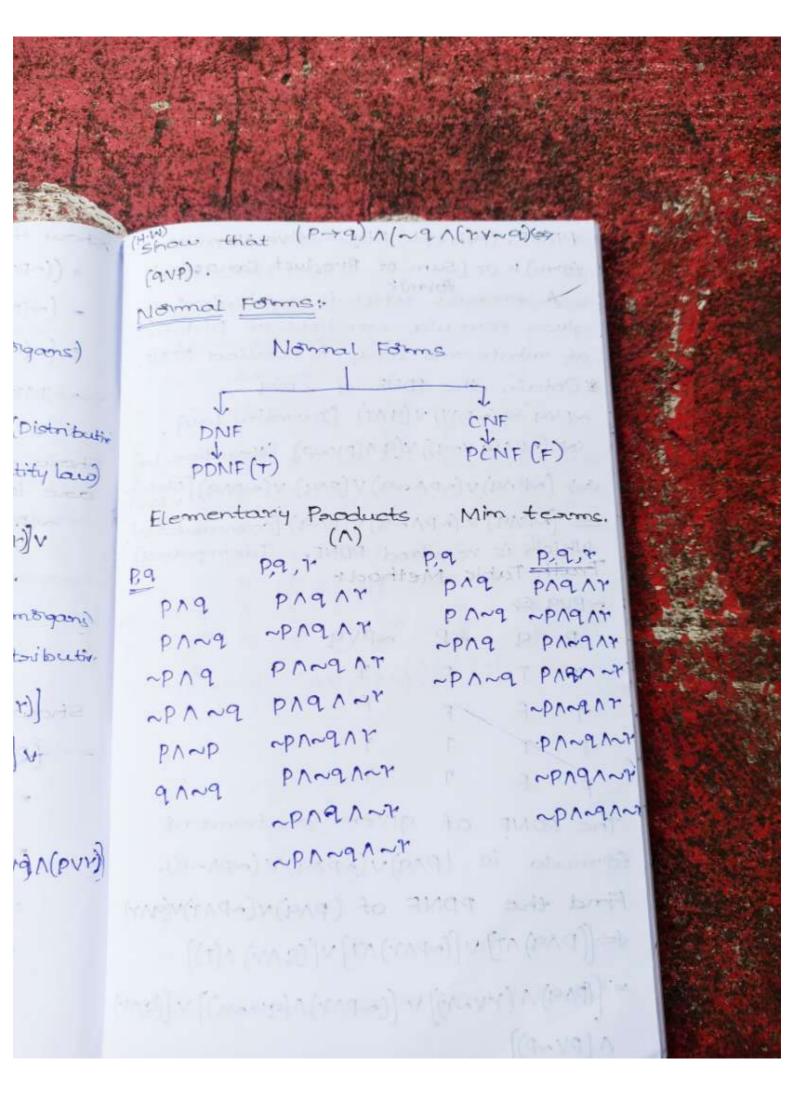


show that (-PAGAAT))V(QAH) V(PAT) +> K. = ((~PA~9) A.T) v ((QVP) A) (associative & distributive land - (~(PV9) AY) V [(PV9) AY) (Demograms law) 1 nverse. + (~(PVa) v (Pva)) Ar. (Distributive law) D->~9. * TAT (Negation Law) +) (=> (A) ++ = 7 (Identity law). using ? show that ~ (PN(~PAQ)) and (~PA~Q) are logically equivalent:-~ (DV (~PAQ)) = ~PA ~ (~PAQ) [Demoggans) e statem = ~p \(PVa) (Demograms)

Double negation

(~P\(\frac{a}{a}\) \(\frac{a}{a}\) (Distributive) E Distau FV(~PA~2) (Negation law) = (~PA~9) (Identity law) NOVE Show that (PAQ) + (PVQ) is a tautolog (Ap)Ve (PA9) -> (PV9)= . (AV9) . (AV9) . (AV9) doed of = ~ (P/a) v(PVa) = (npvia) v(pva) (Demodoms Law). : (~pvp)v(ava) (Negation Law). TAG 2 TVT (Idempotent) Hotel ε Τ.

show that (p-79)-79 (> pv9 (avp). (P-9)-9 = ~(P-79) v9. = ~ (~pva)va. , (PNA) va (Dermorgans) =-PAG(PVa)A = (pva) / (~ava) (Distribut, = (pva) AT (Identity law) = (PV9). B Show that ((PV9) 1~(np1 (~9V~1))v [PARI) V (PARI) is a tautology. i(npr(ngvnr)) = P& (arr) (D&mogan) = (pv9) (pvr) (Distribution (~PA~Q) V (~PA~T) : ~ [(PVQ) A (PVT)] (ANB) v (CVD) = [(PVQ) N (PVQ) N (PVY)] v MENS) V (BAR) = [(PV9) V (BAL)] A ~ [(BAd) V(BAL)



PDNF: (Princple Disjunctive Normal form): or (sum of Product Canonical A formula which is equivalent to given formula consists of Disjung of minterine only is dalled PDNF. * Obtain the PDNF of ~pvq ~pva ⇔(~pAT) N(aAT) [Identity iaw). (~PA(q v~q)) V(q A(pv~P)) [Negation Low (=> (~PAQ) V (~PAQ) V (PAQ) V (~PAQ) [Distributive] (~PAQ) V (~PAQ) V (PAQ) [commutative Which is required PDNF. Idempotent]
Truth Table Method: ~PV9 => ~PVq P 9 ~P EA BOUNG PAGA HEATING TOLAGE. P V P V d no 19a TATALE TAPATTA FT The PONF of given statement formula is (PA9) V (~PA9) V (~PA-9). Find the PDNF of (PAQ) v (~PAT) v (QAT) (PA9) AT) v [(~PAY) AT) v ((9AY) A(T)) = (PAQ) 1 (rv~r)) v ((~PAT) 1 (qv~q)) v ((QAM) 1 [PV~P)

TFFTFT

(PAC

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= [(PAGAT)V(PAGA-T)V(~PATAG)V[~PATAG
mal
        V(QATAP)V(QATA~P))
opical
         · (PARAY) V(PARAWY) V(~PATAR) V(~PATAR)
lent to
risjunction
        Truth table Method:
& PDNF.
         PQ 7 PAQ NPAT A
                      ~ PAQ ~PAT QAT
aw
tion law
1) [Distributive]
nutative
potent]
             T T F F F F
        (PAQ) V(~PAQ) AV (QAT)
nt
-9).
r)v(9112)
         (PAQAY) V (PAQA~Y) V (~PAQAY) V (~PA~QAY)
v ((21r)
```

Find the Princple Disjunctive Normal form of P->((P->Q)1~(~QV~P)] By comos truth tables. P>[(~PVQ) A~(~QV~P)]. P -> [(~PVQ) A (QAP)] · ~PV [(~PVQ) A(QAP)] (~PAT) V [(~PVQ) A (QAP)] (~PA(QV~Q)) v[(~PVQ) A(QAP)] [(~PAQ) V(~PA~Q)] V[(~PVQ) A(QAP)] (~PAQ) V(~PA~Q) V [(~PVQAP) A (QAP)] (~PAQ) V (~PA~Q) V [(FAQ) A (QAP)] (~PAQ) V (~PA~Q) V (PAQ).

PONES Principle (Impediate Clares) from a faceback to Diffe Concess 00 - (- PV) & (- PV) & (- PV) -JON JON Mary a prop (PNB)V (~PNB)V (~PNA). 0

PCNF: Princple Conjuctive Normal Form & Product of sum Canonical A Farmula Which is equivalent to form i given formula and consists of Product of Mast teams is called PCNE (v) A(v). Find the PCNF of (pag) = ~PA~9 = (~PVF) A (~9VF) = (~PV(91~9)) 1 (~9V(P1~P)) = [(~PV9) / (~PV~9)] / [(~9VP) / (~9V~P) = (~PV9) 1 (~PV~9) 1 (PV~9). Which is required PCNF. Truth Table Method: P 9 PV9 ~ (PV9) F ~ = (P 19) = ~ PV ~9 Fr ~(PN ~q) = ~PVa Fra(npna) = pv~a (~PV~q) 1 (~P 119) 1 (PV~q).

The can old the co

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Rul

Theory of Inference: ical The word Inference means we

CNF.

P)

can desive new statement from old Statement. The inference is of the form conjuction of

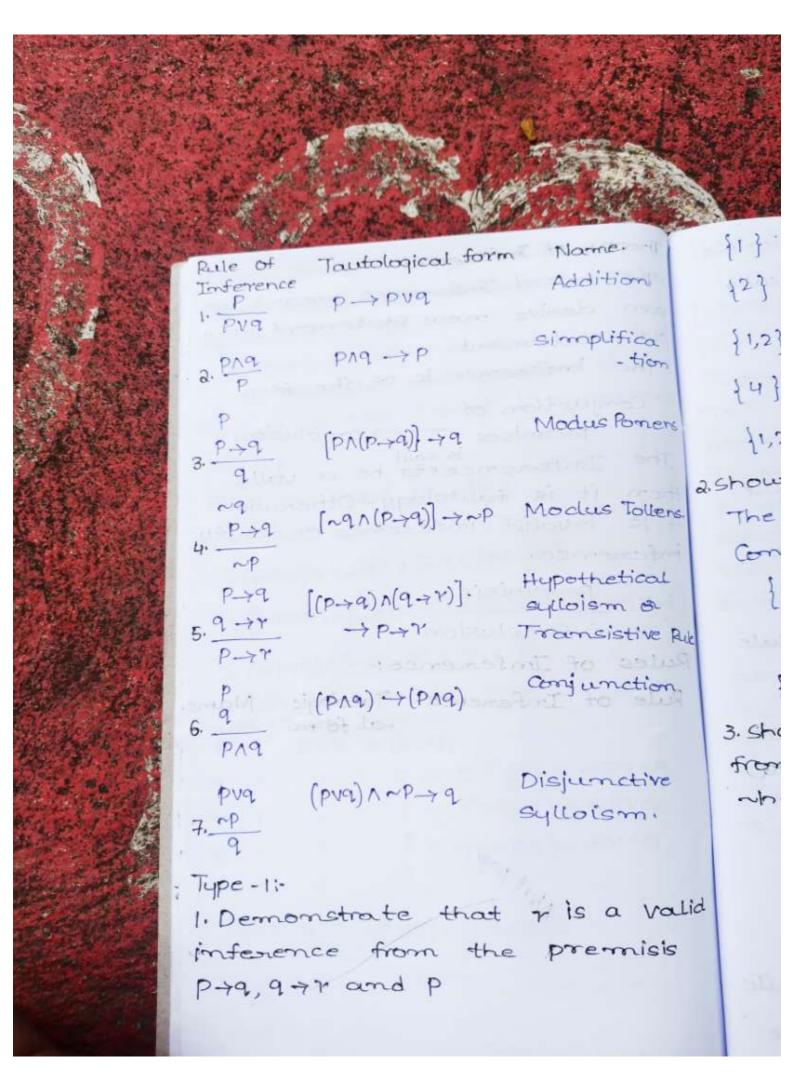
The Inference rto be a valid then it is tautology. Otherwise it is invalid inference or faulty inferience.

paremisis ...

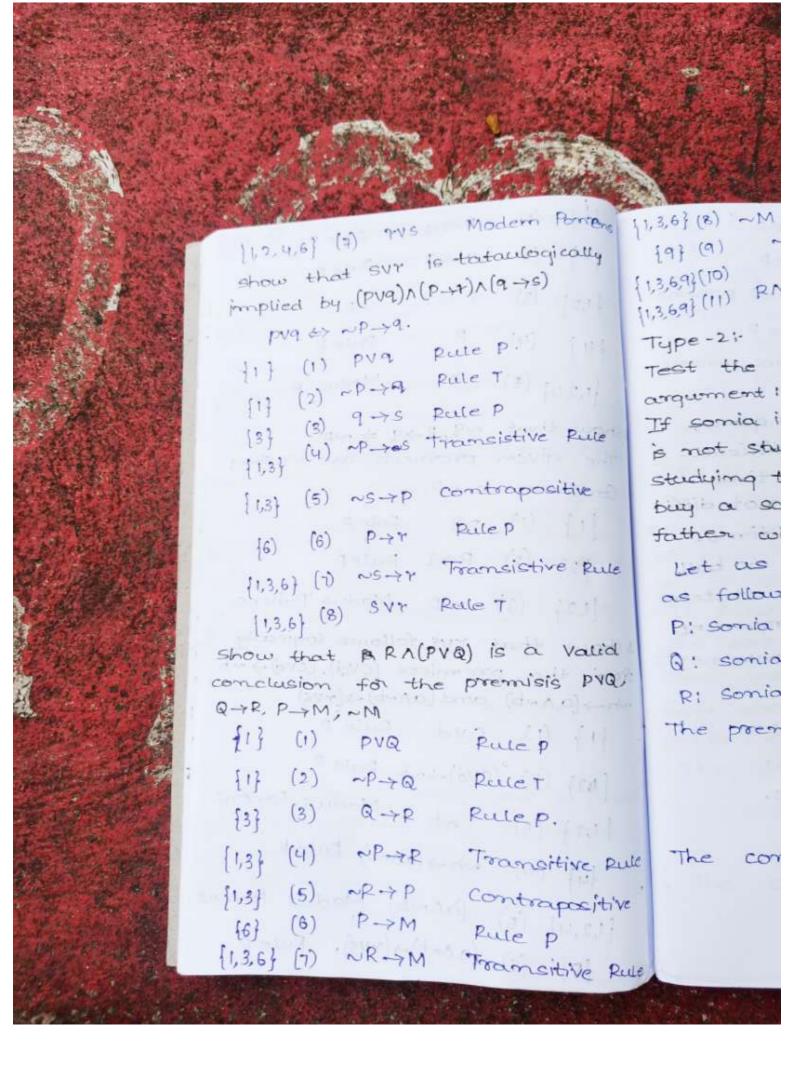
... Conclusion.

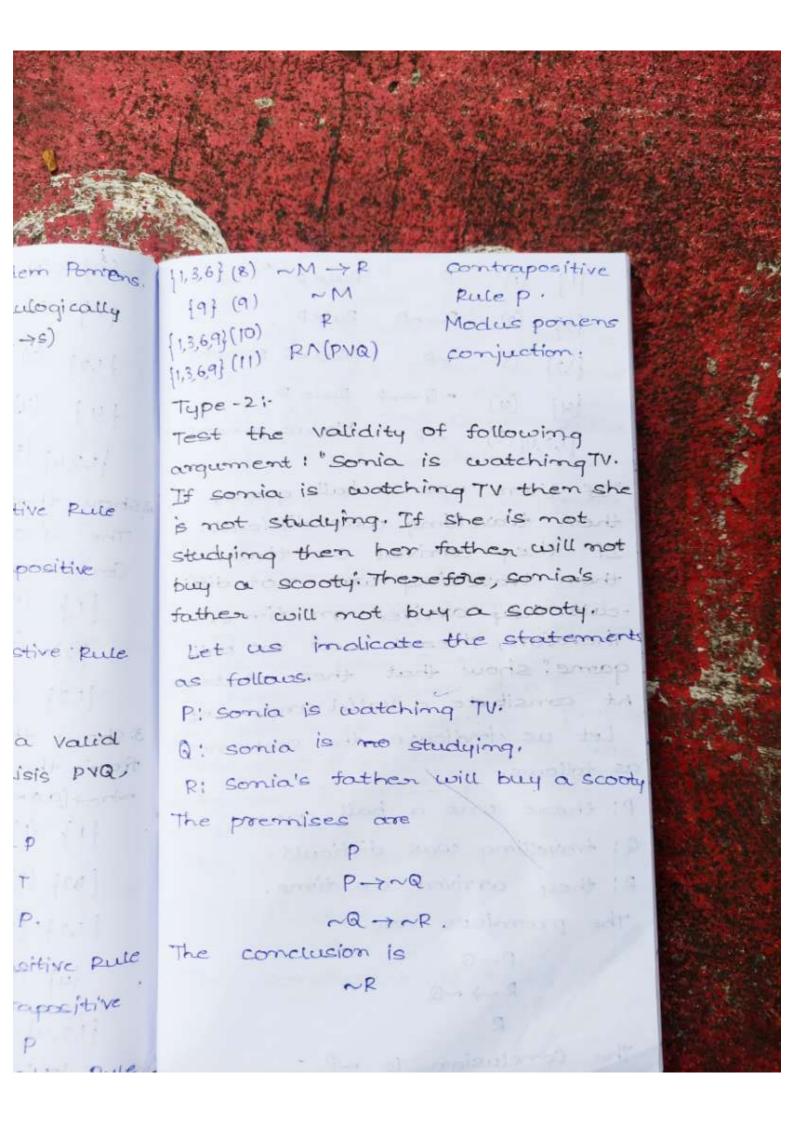
Rules of Inference; Rule of Inference: Tatologic Mame -al form

PATRA (PV)



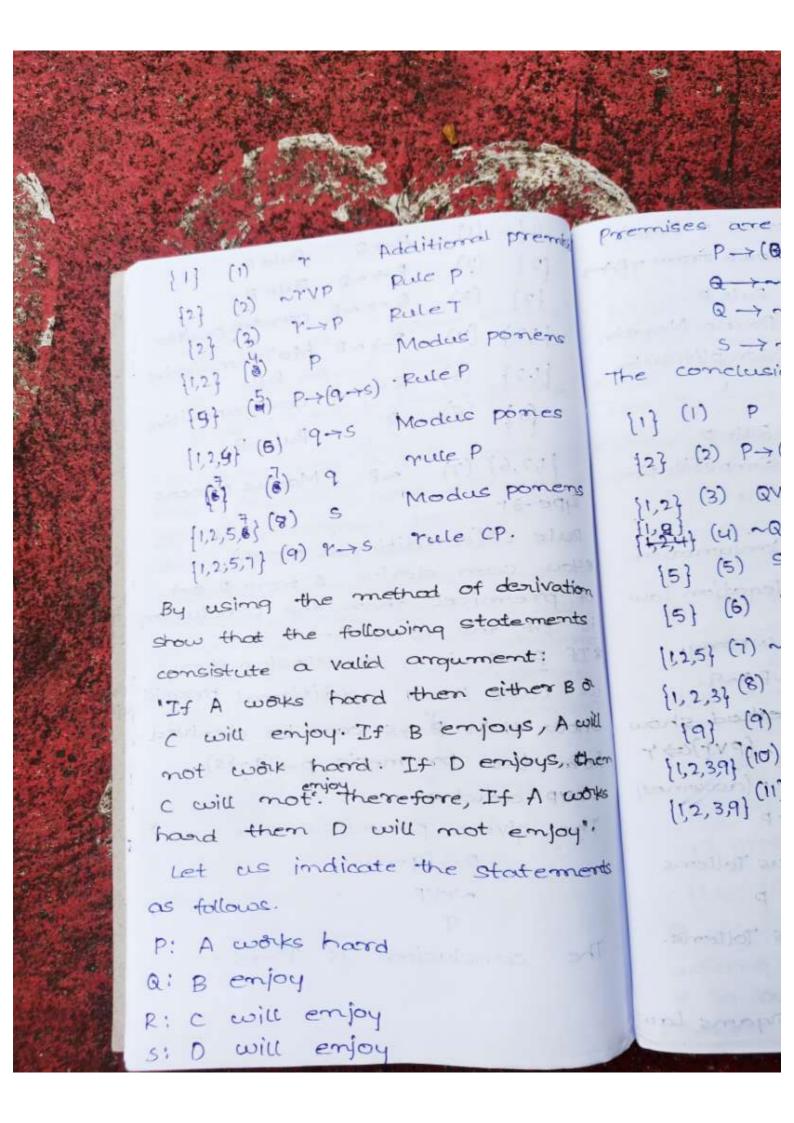
fif (1) Pag Pule P Name. Addition 127 (2) 9-77 Rule P {1,2} (3) P-77 T.R implifica - tion {4} (4) P Rule P 11,247 (5) 7 Modus p odus Pomens ashow that ~9, P >9 = ~P The given premesis are ~9, p-79 dus Tollers. Conclusion is NP. [1] (1) ~9 Pule P thetical ism or 124 (2) P-79 RuleP nsistive Rue [1,2] (3) ~P Modus Pottens unction. 3. Show that rvs. follows logically from the premises (cvd), (cvd) + ~h metive ~h -> (an -b) and (an -b) -> (rvs) ism. 113 (1) CVd Pale P [82] (2) (CVd) -> ~ h Peule P {1,2} (3) ~h Modus Pomens. a valid misis (4) (4) wh → (anob) Rule P {1,2,4} (5) (annb) Modus Pomens (6) (a ∧~b) → (rvs) Rule p





PuleP {1} (1) fif (i) {2} (2) P.y~a Rule P (2) {1,2} (3) RR Modus pomen {2} (3) [4] (4) ~Q -> ~R Rule P. {1,2} (4) (1,2,4) (5) ~P Modus pomens {1,2} (5 (e) (e "If there was a ball game, 11,2,6} (then travelling was difficult. Type -31 If they arrived on time. Rule CP(then travelling was not diffi * you can -cult . They arrived on time. of brew Therefore, There was no ball is of the game! show that these stateme *If PAQ nt consitute a valid argument we take Let us indicate the statement show th as follows. from th P: there was a ball game + wrup a Q: travelling was difficult. The gi R: they arrived on time. The premises are P->Q The R->~Q The conclusion is NP

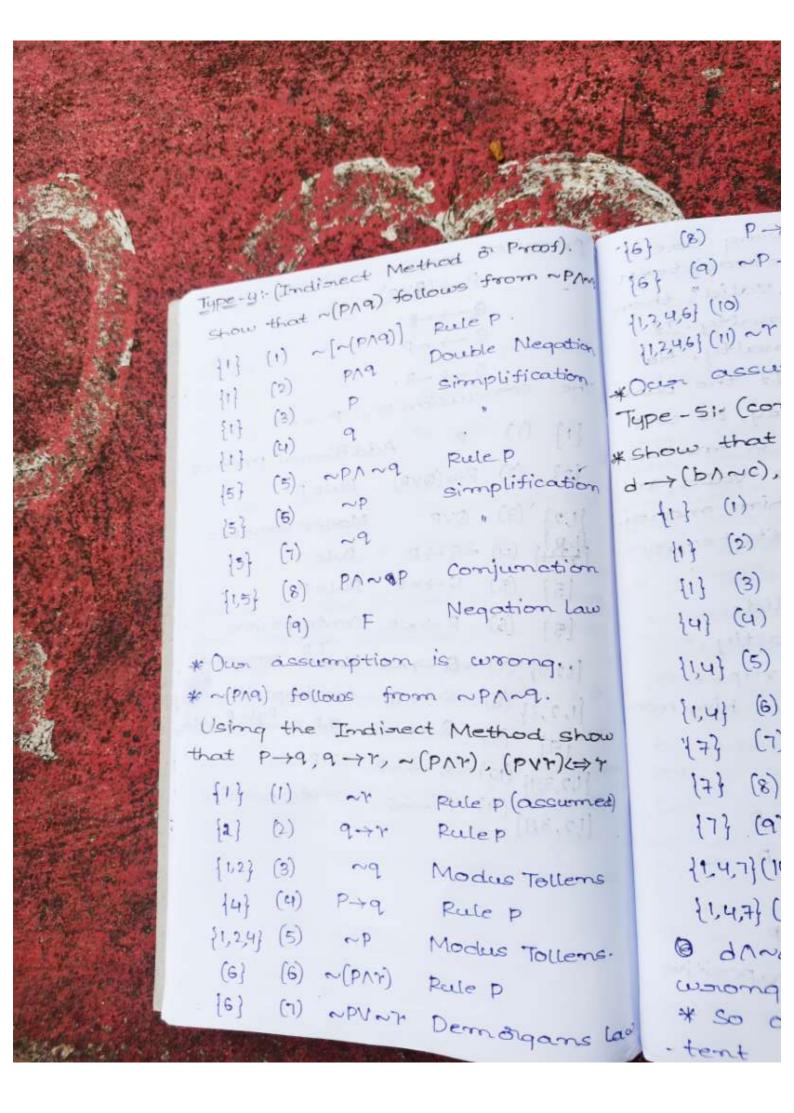
117 (1) P+Q Rule P. (2) (2) R->~Q Rule P 12} (3) Q -> ~P contrapositive 1,2) (4) P->~R MoTransistive Rule. (1,2) (5) R->~P contrapositive (6) (6) R Rule P... [1,2,6] (7) ~P Modus pomens. ame, ficult. Type - 3 1ime Rule CP (conditional proof). ot diffi * you can derive s from P set ime. of premises then the conclusion is of the form R->s no ball * If P-7Q is a conclusion then stateme we take P as additional premisi ument. show that Rays can be desired stements from the premesis p-> (9->s). NYVP and 9. The given premesis are $p \rightarrow (9 \rightarrow s)$ ~rup conclusion is 7-75



premises are P->(QVR) Q->--PS SUBJECT S->~R. the conclusion is: P-> ~s. [1] (1) P Additional priemes; nes (2) P-> (QVR) Pale P 11,27 (3) QVR Modes ponesses. onens 124) (4) ~Q -> P Pule T [5] (5) S→~R Rule P. [5] (6) R->~s contrapositive. rivation [12,5] (7) ~Q -> ~S Modus ponemus ments (1,2,3) (8) S -> Q contrapositive

[1,2,3] (8) S -> Q contrapositive

[1,2,3] (9) Q -> ~P T-R contrapositive : 1 12 EN B OF {1,2,3,9} (10) S→~P T·R , A will [12,39] (11) P ->-s contrapositive ys, then works 104". ments



(6) (8) P-> -7 Pule T & Proof). 16} (9) ~P->> Invence law from ~PMg 113,4,6] (10) 1 Modes poliens. [12,46] (11) ~ r ~ r conjunction. ble Negation *Our accumption is wrong. aplification Type-51- (consistency of Premesis): * show that the premesis *a-1(b-) e P d->(bn~c), and plification (1) (1) and Dule P (1) (2) a simplification {1} (3) d junction (4) (4) a->(b->c) kulep ation law {1,4} (5) birc Modus pornens rong ... [1,4] (6) ~bvc Rule T 1~9. 173 (7) d-> (bnoc) Rule P rod show (7) (8) ~ (b/~c) ->0 contrapositive (PVT) C=> T [7] (9) NOVC -> Nd Demorgans (assumed) {1,4,7}(10) and Modus pamens {1,4,7} (11) dhad conjunction Tollens @ dand= F. Our assumption is Tollens. · proces * so own premesis are inconsis jans law - tent

show that the following are set of premesis are incosistent. " If the contract is valid, then john is liable for penalty. If john is liable for penalty, He will go blank supt. If the bank will loan him money, He will not go banknipt. As a matter offact, the contract is valid and the bank will loan him money. Let us indicate the Statement as follows: p: The contract is valid. 9: John liable for penaltly r: John will go bankrupt. s: The bank will toan him mor The premesis are p+q,q+r,s+~r,PAS (1) (1) P->9 Rule P 127 (2) 9-7 Rule p [1,2] (y) P-7.7 T.R (4) (4) Soor Rule P (4) (5) P-TNS contrapositive [12,4] (6) P+NS TIR S: Jack

{1,2,4) f1,2,4} @ 197 11,2,4,9} (PNS) 1~(1 The prem show the are inc i, If Jack because High sch ii, If Job uneda ili. If Jo them iv, Jack because lot of Let us as follo P: Jack ause 9: He 7: Jack

(1,2,4) (7) NPV~S RuleT ane 1,2,4} (8) ~ (PAS) Demorgans sistent. (9) PNS Rule p d' then 11,2,4,9} (10) (PAS) M(PAS) conjunction y. If 4, He (PAS) A~(PAS) ↔ F. he bank The premesis are inconsistent. te will show that the following premes are inconsistent: matter III Jack misses many classes alid and because of illness, then he fails money. terment High school. il. It Josh fails His, then he is uned ucated. III. If Jack reads a lot of book then he is not uneducated iv, Jack misses many classes him mon because of illness and readsa lot of books. Let us imdicate the statement as follows: P: Jack misses many classes bec ause of illness. 9! He fails High school. 7: Jack is uneducated s: Jack reads a lot of books

The premesis are: アナタ、タナア、ダインア、PAS· Rule P (1) Rule P (2) T.P. 127 (3) (4) (4) 5 -> ~Y PaleP {u} (5) 7->~5 contrapositive [1,2,4] (7) ~PV~S Pule T [1,2,4] (8) ~ (PAS) Derroogans (9) (9) PAS Rule P (PA) (10) (PA) A~(PAS) conjunction * (PAS) A~ (PAS) (F. Our priemesis is inconsistent. Linek anissess security to somest 2) Pc

Quar Quan * It m tity " *These 1. (2. 1) mives * ALL * Eve * Eve * att * The Exist * 50 * 90 * +6 * The Rule 1) Ru

Quantifiers: * It means to measure the quan tity of the statement. * these are 2 types: 1. Uni Versal Quantifiers. à Exestential Quantifiers. Universal Quantifiers: * Everyone (2) (1) = (00) = (10) * Everything * atteast 100 - 100 * These are denoted by (x). Existential Quantifiers: junction * something mesis * someone * fasome, atmost: * These are demoted by (7x) Rules of Quantifiers: 1) Rule universal specification $(x)A(x) \Rightarrow A(y)$ 2) Rule Existential specification $(\exists z) A(z) \rightarrow A(y)$ Pule Universal Genalisation: $A(y) \Rightarrow (x) A(x)$

(3) (4) H(4) Perce ES {4}	Note: Note: $A(4) \Rightarrow (\exists A) P(A) \lor (\exists A) Q(A)$ $A(4) \Rightarrow (\exists A) P(A) \lor (\exists A) Q(A)$ $A(4) \Rightarrow (\exists A) P(A) \lor (A) P(A) \lor (A) Q(A)$ $A(4) P(A) \Rightarrow (\exists A) P(A) \lor (A) P(A) \lor (A) P(A) \lor (A) P(A) \lor (A) P(A) \to P($	1,3] (5) 1,3] (6) 1,3] (6) 1,3] (6) 1,3] (6) 1,3] (6) 1,3] (7) 1,3] (8) 1,3] (9) 1,3] (1) 1,3
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11,3] (5) " M(4) " Modes pornes.
Jon!
         [1,3] (6) (00 M(00) Pale EG
         show that (Fa) (P(a) A Q(a)) => (Fa) (P(a)
EX) Q(XE
         V (3x)Ø(x)
          [] (1) (=x)(p(x) n (0)) . Rule P
Q(x)
        113 (2) P(4) 1 Q(4) Rule ES
                                 simplifica
        117 (3) P(4) 114
                                 simplificat
          f+) (4) Q(4)
Q(21) 1 (2)
                                 Rule EG
        (x) ((x)) (1)
                               simplifica
lep
          {1} (5) Q(4)
                                Pelle E Gi.
le Us .
           (1) (6) (AX) Q(X)
           (1) (3x) P(x) V(3x) Q(x) conjuncti
Lep x
e Us.
        "S.T from (∃x)[F(x) NS(x)] → (4)[M(4) →
        W(4)] and (74) [M(4) 1 ~ (W)(4)) the
e UGu
        conclusion & (x)[F(x)->~(s)) follows
ogi cally
         {1} (1) -(34)[M(4) ~~ M(4)) Pule P
- M(a)
                     M(z) A ~ MW(z) PULCES
         {1} (2)
                    ~ [M(z) .-> W(z)] Pule T
          [1] (3)
                  (Fa)[F(a) AS(a)] ->(4) Rule P
e US
          143 (4)
                    [M(4) -> W(4)] (10) (8.1)
          (4) (5) F(Z) AS(Z) → [M(Z) → pule US
e Es
                     W(z)
```

(14) (7) ~ [F(z) N S(z)] Modes Tollers

(14) (7) ~ [F(z) V-S(z) Dermorgans Law (1,4) (8) [F(2) ->~5(2)] (1) (1) (8) (9) (x)[F(x): 11 Type-21- Venify the Validity for follows arguments! " All men are montal. socraties is a man. Therefore, socraties is moltal: Socraties is moltal: Let us imdicate the statement as follows:

A(x): a is a man. M(x): x is a mortal ele si socraties : / 1 The premesis are.

(a) [A(a) -> M(a)], A(s) The conclusion is M(s) fig. (1) (a)[A(a) -> M(a)] RuleP Rule US. (1) (2) - A(S) -> M(S) Pule P Moders por (13) (4) M(s) ens (4) (3) F(2) AG(2)-5 (M(8)-) COLO C

Verify the asquiment is a plan Goldfish a plant. Therefore heart Let us as follow b(x); x A(x): x H(X): X 于便); 英 The Gi (30) [P(The co {1} (1) C [1] (2) {1}- (3) 144 (a 14} [1,4] {7}

11,4,7

Verify the Validity of the following s Tollens aguments: "Every living thing is a plant or an animal. Joe's gams Law goldfish is alive and it is not a plant. All animals has hearts Therefore Joe's Gold fish has a Let us imdicate the statements or follows as follows: I was a file iontal. p(x): x is a plant : 0.160 fore, A(d): It is an animal H(x): I has a heart. f(2): * is Toe's Goldfish. The Given premiesis $(x)[P(x) \lor A(x)], \sim P(f), (x)[A(x) \rightarrow H(x)]$ The conclusion: H(f): (1) (1) (0) (P(X) V A(X) Pule P [1] (2) P(f) VA(f) Rule US (1) (3) . ~ P(f) -> A(f) Rice 1 (4) (4) (2) [A(2) -> H(2)] Rale P eP (4) (5) A(f) -> H(f) · Reve (US e us e P [! (6) ~P(f) -> H(f) T.R us pon [7] (7) ~P(f) Rate P [1,4,7] (8) H(f) B. Modus polens 5 5,13 Establish the validity of the following argument: "All integers are rational numbers. some integers are powers of 2. Therefore some rational numbers are powers of 2. sel Let us indicate the Statement as Follows I(x): & is an integer R(X); & is a rational numbers P(SU): x is a powers of 2 The given premises are (x) (I(x) = R(x)) (Ja) (Jas) Ap(xs) THE conclusion is (3x) (RCX) & PCOW) Rulef Rule P (1) $(x)(I(x) \rightarrow R(x))$ 213 Rule Us {1} (2) · I(4) -> R(4) RUP US 147e 7 100 {33 (3) (3x) (I(x) 1 p(x)) Ruje P dus pont I(A) U b(A) Rule Es { 3} (4) ule p Simplification (5) I (4) Simplification P(4) £33 (6) modes ponens RCYJ {1.3} (7) RCY) APCY) Conjunction {1,3} (8) {1,3} (9) (32) (RCE) A PCE) Rule EG