Discrete Chapter 2 :-

* Ch 2.1 :-

Q1 :

* if all algebric expressions can be written in prefix notation, then $(a+2b)(a^2-b)$ can be written in prefix notation.
* All algebric expressions " " " " " notation.
" " " " "

Q2 : * If all prime numbers are odd, then 2 is odd.

Q3 * My mind is shot or logic is confusing.
* " " " "
* Therefore, logic is confusing.

Q4 if this function is polynomial then . . . .
if this function is diff
" " " " is cont

Q5 (a) statement (c) statement
(b) sentence (d) sentence

Q6 s: stocks are increasing
i: interest rates are steady

a) $s \wedge i$
b) $\sim s \wedge \sim i$

Q7 $m \wedge \sim c$

Q8 (a) $(h \wedge w) \wedge \sim s$
(b) $\sim w \wedge (h \wedge s)$
(c) $(\sim h \wedge \sim w) \wedge \sim s$
(d) $(\sim w \wedge \sim s) \wedge h$
(e) $w \wedge \sim (h \wedge s)$ (not $w \wedge \sim h \wedge \sim s$)

Q9 $n \vee k \wedge \sim (n \wedge k)$

Q10 p: DATBEND Flag is off
q: error equals 0
r: sum is less than 1000

(a) $p \wedge q \wedge r$
(b) $p \wedge \sim q$
(c) $p \wedge (\sim q \vee \sim r)$
(d) $(\sim p \wedge q) \vee \sim r$
(e) $\sim p \vee (q \wedge r)$

Q11 inclusive, the statement can occur together.

Q12

p	q	~p	~p ∧ q
T	T	F	F
T	F	F	F
F	T	T	T
F	F	T	F

Q13 $\sim(p \wedge q) \vee (p \vee q)$

p	q	(p ∧ q)	~(p ∧ q)	(p ∨ q)	~(p ∧ q) ∨ (p ∨ q)
T	T	T	f	T	T
T	F	F	T	T	T
F	T	F	T	T	T
F	F	F	T	F	T

Q14 $p \wedge (q \wedge r)$

p	q	r	$(q \wedge r)$	$p \wedge (q \wedge r)$
T	T	T	T	T
T	T	F	F	F
T	F	T	F	F
T	F	F	F	F
F	T	T	T	F
F	T	F	F	F
F	F	T	F	F
F	F	F	F	F

Q15 $p \wedge (\sim q \vee r)$

p	q	r	$\sim q$	$\sim q \vee r$	$p \wedge (\sim q \vee r)$
T	T	T	F	T	T
T	T	F	F	F	F
T	F	T	T	T	T
T	F	F	T	T	T
F	T	T	F	T	F
F	T	F	F	F	F
F	F	T	T	T	F
F	F	F	T	T	F

Q16 $p \vee (p \wedge q) \equiv p$

p	q	$p \wedge q$	$p \vee (p \wedge q)$
T	T	T	T
T	F	F	T
F	T	F	F
F	F	F	F

$p \vee (p \wedge q)$ & p are logically eq since they have the same truth values in the truth table.

Q17 $\sim(p \wedge q) \stackrel{?}{\equiv} \sim p \wedge \sim q$

p	q	$\sim p$	$\sim q$	$(p \wedge q)$	$\sim(p \wedge q)$	$\sim p \wedge \sim q$
T	T	F	F	T	F	F
T	F	F	T	F	T	F
F	T	T	F	F	T	F
F	F	T	T	F	T	T

$\sim(p \wedge q)$ & $\sim p \wedge \sim q$ are not logically eq since they don't have the same truth values in the truth table

Q18 $p \vee t$ and t

p	t	$p \vee t$
T	T	T
F	T	T

they are logically eq since they have the same truth values in the truth table.

Q19 $p \wedge t \stackrel{?}{\equiv} p$

p	t	$p \wedge t$
T	T	T
F	T	F

they're logically eq since they've the same truth values in the truth table

Q20 $p \wedge c$ and $p \vee c$

p	c	$p \wedge c$	$p \vee c$
T	F	F	T
F	F	F	F

↳ they're not logically eq. since they don't have the same truth values in the truth table.

Q21 $(p \wedge q) \wedge r$ and $p \wedge (q \wedge r)$

they're logically eq. since they've the same truth values in the truth table.

and Q_{22} / Q_{23} aren't logically eq & Q_{24}

Q_{25} Hal isn't a major or Hal's sister isn't a computer science major.

Q_{26} Sam isn't an orange belt or Kate isn't a red belt.

Q_{27} The connector isn't loose and the machine isn't ....

Q_{28} The units digits of 4^{67} isn't 4 and it isn't 6.

Q_{29} This computer " " hasn't " " " and it isn't being

Q_{30} The dollar isn't " " or the stock market isn't " ".

Q_{31} The train isn't late and my watch isn't .. ...

Q_{32} $-2 < x < 7 \Rightarrow \sim\big((-2 < x) \wedge (x < 7)\big)$

$(-2 \geq x) \vee (x \geq 7)$

Q_{33} $-10 < x < 2 \Rightarrow \sim\big((-10 < x) \wedge (x < 2)\big)$

$\equiv (-10 \geq x) \vee (x \geq 2)$

Q_{34} $\sim(x < 2 \text{ or } x > 5) \Rightarrow x \geq 2 \wedge x \leq 5$

$\equiv 2 \leq x \leq 5$

Q_{35} $\sim(x \leq -1 \text{ or } x > 1) \Rightarrow x > -1 \wedge x \leq 1$

$\equiv -1 < x \leq 1$

Q_{36} $\sim(x \geq -3 \wedge x < 1) \Rightarrow (x < -3) \vee (x \geq 1)$

Q_{37} $\sim(x \geq -7 \wedge x < 0) \Rightarrow (x < -7) \vee (x \geq 0)$

Q38 $\sim((num\_orders > 100 \wedge num\_instock \leq 500) \vee num\_in < 200)$

(num_orders $\leq$ 100 or num_in > 500) and num_in $\geq$ 200)

Q39 (num_orders $\geq$ 50 or num_instock $\leq$ 300) and (50 > num_order $\geq$ 75 or num_instock $\leq$ 500)

Q40 - Q43 skip

Q44 $x < 2$ or it is not the case that $1 < x < 3$

$\sim(1 < x < 3)$

$\sim(1 < x \wedge x < 3)$

$(x < 2) \vee (1 \geq x \vee x \geq 3)$

$x < 2 \vee 1 \geq x \vee x \geq 3$

they are logically eq

Q45

a. Bob is a double math and computer science major and Ann is a math major, but Ann is not a double math and computer science major.

b. It is not the case that both Bob and Ann are double math and computer science majors, but it is the case that Ann is a math major and Bob is a double math and computer science major.

idk (later)

Q46 (a) $p \oplus q \equiv (p \vee q) \wedge \sim(p \wedge q)$

$p \oplus p \equiv (p \vee p) \wedge \sim(p \wedge p)$

$\equiv p \wedge \sim p$

$\equiv C$

$(p \oplus p) \oplus p = c \oplus p \equiv (c \vee p) \wedge \sim(c \wedge p)$

$\equiv p \wedge t$

$\equiv p$

(b) $(p \oplus q) \oplus r \equiv p \oplus (q \oplus r)$

$\oplus$ is associative $\Rightarrow$ then it's true

(c)

p	q	r	$p \oplus q$	$(p \oplus q) \wedge r$	$p \wedge r$	$q \wedge r$	$(p \wedge r) \oplus (q \wedge r)$
T	T	T	F	F	T	T	F
T	T	F	F	F	F	F	F
T	F	T	T	T	T	F	T
T	F	F	T	F	F	F	F
F	T	T	T	T	F	T	T
F	T	F	T	F	F	F	F
F	F	T	F	F	F	F	F
F	F	F	F	F	F	F	F

Q48 $(p \wedge \sim q) \vee (p \vee q)$

$\equiv p \wedge (\sim q \vee q)$ Distributive law

$\equiv p \wedge (q \vee \sim q)$ Commutative law

$\equiv p \wedge t$ Negation law

$\equiv p$ identity law

Q49 $(p \vee \sim q) \wedge (\sim p \vee \sim q)$

$\equiv (\sim q \vee p) \wedge (\sim q \vee \sim p)$ commutative law

$\equiv \sim q \vee (p \wedge \sim p)$ distributive law

$\equiv \sim q \vee C$ negation law

$\equiv \sim q$ identity law

Q50 $(p \wedge \sim q) \vee p \equiv p$

$\equiv p \vee (p \wedge \sim q)$ commutative law

$\equiv p$ absorption law

Q51 $p \wedge (\sim q \vee p)$

$\equiv p \wedge (p \vee \sim q)$ commutative law

$\equiv p$ absorption law

Q52 $\sim(p \vee \sim q) \vee (\sim p \wedge \sim q)$

$\equiv (\sim p \wedge \sim(\sim q)) \vee (\sim p \wedge \sim q)$ De morgan's law

$\equiv (\sim p \wedge q) \vee (\sim p \wedge \sim q)$ double negative law

$\equiv \sim p \wedge (q \vee \sim q)$ distributive law

$\equiv \sim p \wedge t \equiv \sim p$ Negation law identity law

Q53 $\sim((\sim p \wedge q) \vee (\sim p \wedge \sim q)) \vee (p \wedge q) \equiv p$

$\equiv \sim(\sim p \wedge q) \wedge \sim(\sim p \wedge \sim q) \vee (p \wedge q)$ De morgan's law

$\equiv (\sim\sim p \vee \sim q) \wedge (\sim\sim p \vee \sim\sim q) \vee (p \wedge q)$ De morgan's law (x2)

$\equiv (p \vee \sim q) \wedge (p \vee q) \vee (p \wedge q)$ double negative law

$\equiv p \vee (\sim q \wedge q) \vee (p \wedge q)$ distributive law

$\equiv p \vee (q \wedge \sim q) \vee (p \wedge q)$ commutative law

$\equiv (p \vee c) \vee (p \wedge q)$ Negation law

$\equiv p \vee (p \wedge q)$ identity law

$\equiv p$ Absorption law

Q54 $(p \wedge (\sim(\sim p \vee q))) \vee (p \wedge q) \equiv p$

$\equiv (p \wedge (\sim\sim p \wedge \sim q)) \vee (p \wedge q)$ De morgan's law

$\equiv (p \wedge (p \wedge \sim q)) \vee (p \wedge q)$ Double negative law

$\equiv ((p \wedge p) \wedge \sim q) \vee (p \wedge q)$ Associative law

$\equiv (p \wedge \sim q) \vee (p \wedge q)$ Idempotent law

$\equiv p \wedge (\sim q \vee q)$ distributive law

$\equiv p \wedge (q \vee \neg q)$ commutative law

$\equiv p \wedge (t)$ Negation law

$\equiv p$ identity law

*Ch 2.2

Q1 if the loop doesn't contain a stop or a go to, then it will repeat exactly N times.

Q2 if I catch the 8:05 bus then I am on time for work.

Q3 if you don't freeze then I'll shoot

Q4 If you don't fix my ceiling then I won't pay my rent.

Q5 $\neg p \vee q \rightarrow \neg q$

p	*q	*¬p	*¬q	*¬p ∨ q	¬p ∨ q → ¬q
T	T	F	F	T	F
T	F	F	T	F	T
F	T	T	F	T	F
F	F	T	T	T	T

Q6 $(p \vee q) \vee (\neg p \wedge q) \rightarrow q$

p	*q	*¬p	*¬q	*5 (p ∨ q)	*6 (¬p ∧ q)	*7 *5 ∨ *6	*7 → q
T	T	F	F	T	F	T	T
T	F	F	T	T	F	T	F
F	T	T	F	T	T	T	T
F	F	T	T	F	F	F	T

skipped Q7/8/9/10/11

Q12 $(p \vee q) \rightarrow r \equiv (p \rightarrow r) \wedge (q \rightarrow r)$

if $\underbrace{x > 2}_{p}$ or $\underbrace{x < -2}_{q}$, then $\underbrace{x^2 > 4}_{r}$

if $x > 2$ then $x^2 > 4$ and if $x < -2$ then $x^2 > 4$

Q13 a. $p \to q \equiv \sim p \vee q$ (Done in the slides)

b. $\sim(p \to q) \equiv p \wedge \sim q$ (Done too)

Q14 a) $p \to q \vee r$, $p \wedge \sim q \to r$ and $p \wedge \sim r \to q$

$\sim p \vee q \vee r \equiv \sim p \vee q \vee r \equiv \sim p \vee r \vee q$

they are logically eq by logical eq
(truth table ويمكن اجمع انواعهم حسب

b) if n is prime, then n is odd or n is 2

- p = n is prime
- q = n is odd
- r = n is 2

$p \wedge \sim q \to r \Rightarrow$ if n is prime and n isn't odd then n is 2

$p \wedge \sim r \to q \Rightarrow$ if n is prime and n isn't 2 then n is odd

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15 $p \to (q \to r)$ $(p \to q) \to r$

p	q	r	$q \to r$	$p \to (q \to r)$	$(p \to q)$	$(p \to q) \to r$
T	T	T	T	T	T	T
T	T	F	F	F	T	F
T	F	T	T	T	F	T
T	F	F	T	T	F	T
F	T	T	T	T	T	T
F	F	T	T	T	T	T
F	T	F	F	T	T	F
F	F	F	T	T	T	F

they are not logically equivilent, since they don't have the same truth values in the truth table

Q16 (use truth table)

* if you paid full price (p), you didn't buy it at Crown Books (q)
* You didn't buy it at Crown Books or you paid full price

$p \to q$
$q \wedge p$ they aren't logically eq

Q17 (use truth table)

* if 2 is a factor of n and 3 is a factor of n, then 6 is a factor of n.
2 is not a factor of n or 3 is not a factor of n or 6 is a factor of n.

p: 2 is a factor of n
q: 3 is a factor of n
r: 6 is a factor of n

$(p \wedge q) \to r \stackrel{?}{\equiv} \sim p \vee \sim q \vee r$

$\equiv \sim(p \wedge q) \vee r$

$\equiv \sim p \vee \sim q \vee r \equiv \sim p \vee \sim q \vee r$

then they are logically eq

Q18 (use truth table)

p: walks like a duck
q: talks like a duck
r: it is a duck

(1) $\Rightarrow (p \wedge q) \to r \Longrightarrow \sim(p \wedge q) \vee r \equiv \sim p \vee \sim q \vee r$

(2) $\Rightarrow \sim p \vee \sim q \vee r$ ← then they're logically eq

(3) $\Rightarrow (\sim p \wedge \sim q) \to \sim r$

$\sim(p \wedge \sim q) \vee \sim r$

$\sim p \vee \sim \sim q \vee \sim r$ ← then they're not logically eq.

Q19 false ⇒ the negation ⇒ Sue is Luiz's mother and Ali isn't his cousin.

Q20 a. P is a square and P isn't a rectangle.

b. today is New Year's eve and tmw isn't january.

c. the decimal expansion of r is terminating and r isn't rational.

d. n is prime and n isn't odd and n isn't 2.

e. x is nonnegative (and) could be replaced with(,) x isn't positive and x isn't 0

f. Tom is Ann's father and either Jim isn't her uncle or Sue isn't her aunt.

g. n is divisible by 6 and either n isn't divisible by 2 or n isn't divisible by 3.

Q21 $p \to q$ false

∴ p true
q false

(a) $\sim p \to q \Rightarrow$ true
(b) $p \vee q \Rightarrow$ true
(c) $q \to p \Rightarrow$ true

Q22 (a) if P isn't a rectangle, then P isn't a square.

(b) if tmw isn't January, then today isn't New Year's Eve.

(c) if r isn't rational, then the decimal expansion of r isn't terminating

(d) if n is not odd and n isn't 2 then n isn't prime.

(e) if x isn't positive and x isn't zero then x isn't nonnegative

(f) if either Jim isn't Ann's uncle or Sue isn't her aunt then Tom isn't her father.

(g) if n isn't divisible by 2 or n isn't divisible by 3 then n is not divisible by 6.

Q23 (skip)

Q24 $p \to q \stackrel{?}{\equiv} q \to p$ (24 is true)

p	q	$p \to q$	$q \to p$
T	T	T	T
T	F	F	T
F	T	T	F
F	F	T	T

they aren't logically eq since they don't have the same truth values

Q25

p	q	$p \to q$	$\sim p$ *	$\sim q$ *	$\sim p \to \sim q$
T	T	T	F	F	T
T	F	F	F	T	T
F	T	T	T	F	F
F	F	T	T	T	T

they're not logically eq since they don't have the same truth values

Q26

p	q	$p \to q$	$\sim p$	$\sim q$	$\sim q \to \sim p$
T	T	T	F	F	T
T	F	F	F	T	F
F	T	T	T	F	T
F	F	T	T	T	T

they are logically eq since they have the same truth values

Q27

p	q	$\sim p$	$\sim q$	$q \to p$	$\sim p \to \sim q$
T	T	F	F	T	T
T	F	F	T	T	T
F	T	T	F	F	F
F	F	T	T	T	T

they are logically eq since they have the same truth values

Q29 $p \to (q \vee r) \equiv (p \wedge \neg q) \to r$

(tautology)

p	q	r	¬q	(q ∨ r)	(p ∧ ¬q)	p → (q ∨ r)	(p ∧ ¬q) → r	p → (q ∨ r) ↔ (p ∧ ¬q) → r
T	T	T	F	T	F	T	T	T
T	T	F	F	T	F	T	T	T
T	F	T	T	T	T	T	T	T
T	F	F	T	F	T	F	F	T
F	T	T	F	T	F	T	T	T
F	F	T	T	T	F	T	T	T
F	T	F	F	T	F	T	T	T
F	F	F	T	F	F	T	T	T

they are logically eq since they have the same truth values

Q30 (بنى التمرين)

Q31 $p \to (q \to r) \equiv (p \wedge q) \to r$

tautology

p	q	r	p ∧ q	(q → r)	p → (q → r)	(p ∧ q) → r	p → (q → r) ↔ (p ∧ q) → r
T	T	T	T	T	T	T	T
T	T	F	T	F	F	F	T
T	F	T	F	T	T	T	T
T	F	F	F	T	T	T	T
F	T	T	F	T	T	T	T
F	F	T	F	T	T	T	T
F	T	F	F	F	T	T	T
F	F	F	F	T	T	T	T

they're logically eq since they've the same truth values

Q32 if This quadratic eq has two distinct real roots then its discriminant is greater than zero and if this quadratic eq's discriminant is greater than zero then it has two distinct real roots.

Q33 if This integer is even, then it equals twice some integer and if this integer equals twice some integer then it is even.

Q34+35+36 skip

Q37 if a new hearing isn't granted then payment will be made on the fifth

Q 38 if it doesn't rain, then Anna 'll go

Q39 If a security code isn't entered, then this door will not open.

Q40 if we catch the 8:05 bus, then we are on time for work

Q41 if a triangle has two 45° angles, then this triang. is a right angle

Q42 if this num isn't divisible by 3 then it isn't divisible by 9
if this num is divisible by 9 then it's divisible by 3.

Q43 if Jim doesn't do his hw regularly then he won't pass the course.

or If Jim passes the course then he did his hw regularly

Q44 if John's team win the rest of the championship's games then they will win the championship.

Q45 if the computer program doesn't produce error messages during translation then this comp-prog is correct.

Q46 if compound x is boiling (p), then its temp must be at least 150°C (q).

(a) $q \to p$ (false) or not necessarily true

(b) $\sim q \to \sim p$ (contrapositive) true

(c) $p \to q$ (true)

(d) $\sim p \to \sim q$ (false) or not necessarily true

(e) $\sim q \to \sim p$ (true)

(f) $q \to p$ (false) or not necessarily true

$p \to q \equiv \sim p \vee q$ / $p \leftrightarrow q \equiv (p \to q) \wedge (q \to p)$

$(\sim p \vee q) \wedge (\sim q \vee p)$

Q_{47} $p \wedge \sim q \to r$

$\equiv \sim(p \wedge \sim q) \vee r$

(a) $\equiv \sim p \vee q \vee r \overset{(b)}{\Longrightarrow} \sim(p \wedge \sim q \wedge \sim r)$

Q_{48} $(p \vee \sim q) \to r \vee q$

(a) $\sim(p \vee \sim q) \vee (r \vee q)$

$\sim(\sim(\sim p \wedge q) \vee \sim(\sim r \wedge \sim q))$

(b) $\sim(\sim(\sim p \wedge q) \wedge (\sim r \wedge \sim q))$

Q_{49} $(p \to r) \leftrightarrow (q \to r)$

$(\sim p \vee r) \leftrightarrow (\sim q \vee r)$

$(\sim p \vee r) \to (\sim q \vee r) \wedge (\sim q \vee r) \to (\sim p \vee r)$

(a) $(\sim(\sim p \vee r) \vee (\sim q \vee r)) \wedge (\sim(\sim q \vee r) \vee (\sim p \vee r))$

$((p \wedge \sim r) \vee (\sim q \vee r)) \wedge ((q \wedge r) \vee (\sim p \vee r))$

Q_{50} $(p \to (q \to r)) \leftrightarrow ((p \wedge q) \to r)$

$(p \to (\sim q \vee r)) \leftrightarrow (\sim(p \wedge q) \vee r)$

$\sim p \vee (\sim q \vee r) \leftrightarrow (\sim p \vee \sim q \vee r)$

$(\sim p \vee \sim q \vee r) \leftrightarrow (\sim p \vee \sim q \vee r)$

$(\sim p \vee \sim q \vee r) \to (\sim p \vee \sim q \vee r) \wedge (\sim p \vee \sim q \vee r) \to (\sim p \vee \sim q \vee r)$

(a) $\sim(\sim p \vee \sim q \vee r) \vee (\sim p \vee \sim q \vee r) \wedge \sim(\sim p \vee \sim q \vee r) \vee (\sim p \vee \sim q \vee r)$

(6) $\sim(\sim(\sim p \wedge q \wedge \sim r) \wedge (p \wedge q \wedge \sim r)) \wedge \sim(\sim(p \wedge q \wedge \sim r) \wedge (p \wedge q \wedge \sim r))$

Q5) Yes

Ch 2.3

Q1 $\sqrt{2}$ is not rational

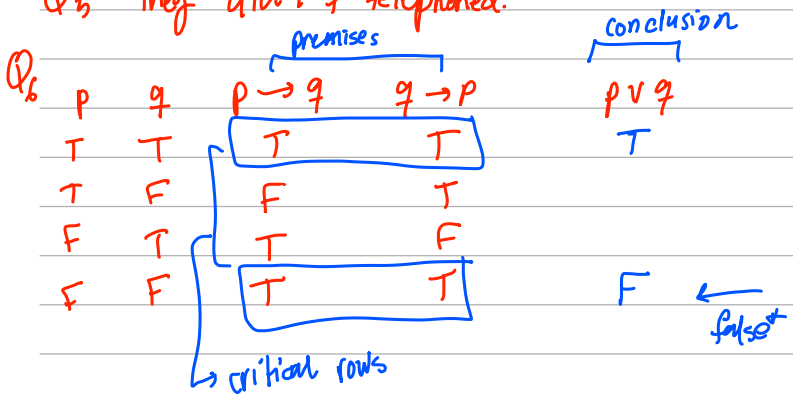
Q2 1-0.99999... is less than every positive real num

Q3 logic isn't easy.

Q4 This figure is a quadrilateral.

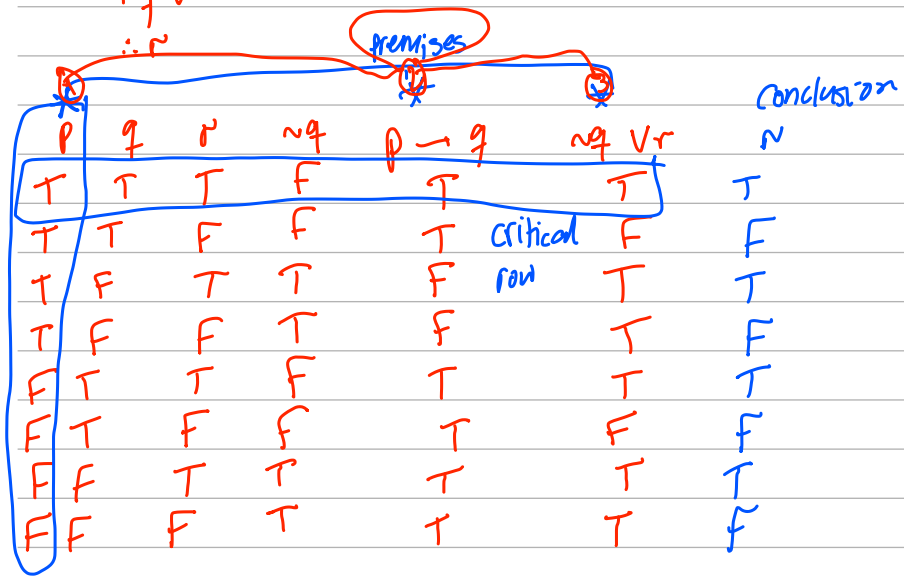
Q5 They didn't telephoned.

Q6



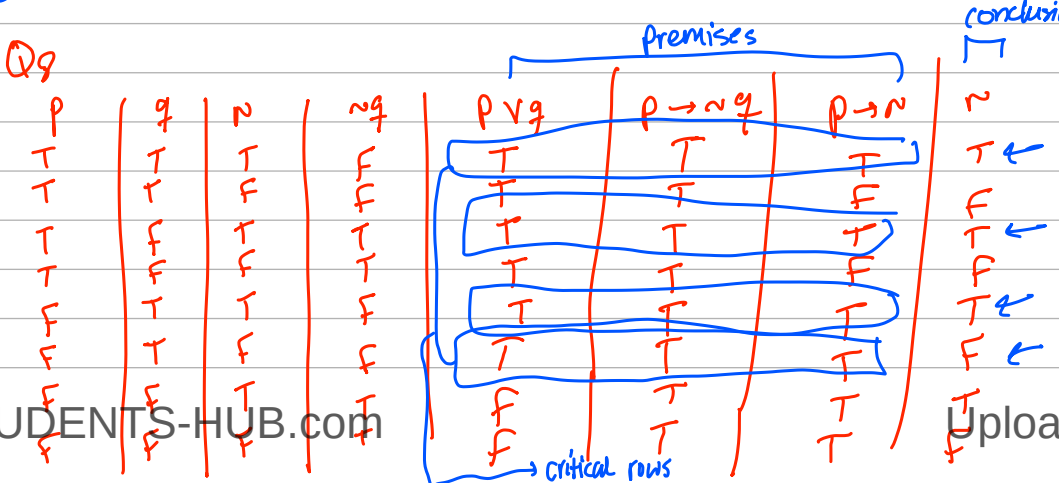
this argument form is invalid since the conclusion is false at one critical row

Q7



this argument form is valid since the conclusion is true for the critical row

Q8



this argument form is invalid since it has a fals conclusion for one critical row.

Q9 $p \wedge q \rightarrow \sim r$

$p \vee \sim q$

$\sim q \rightarrow p$

$\sim r$

p	q	r	~q	~r	p∧q	p∧q → ~r	p ∨ ~q	~q → p	r
T	T	T	F	F	T	F	T	T	F
T	T	F	F	T	T	T	T	T	T
T	F	T	T	F	F	T	T	T	F
T	F	F	T	T	F	T	T	T	T
F	T	T	F	F	F	T	F	F	F
F	T	F	F	T	F	T	F	T	T
F	F	T	T	F	F	T	T	F	F
F	F	F	T	T	F	T	T	T	T

premises

conclusion

critical rows

This argument form is invalid since the conclusion is false for one critical row

Q10 $p \rightarrow r$

$q \rightarrow r$

$p \vee q \rightarrow r$

p	q	r	p∨q	p → r	q → r	(p∨q) → r
T	T	T	T	T	T	T ✓
T	T	F	T	F	F	F
T	F	T	T	T	T	T ✓
T	F	F	T	F	T	F
F	T	T	T	T	T	T ✓
F	T	F	T	F	F	F
F	F	T	F	T	T	T ✓
F	F	F	F	T	T	T ✓

premises

conclusion

critical rows

this argument form is valid since the conclusion is true for all critical rows

Q11

p	q	r	~q	~r	~p	q ∨ r	p → q ∨ r	~q ∨ ~r	~p ∨ ~r
T	T	T	F	F	F	T	T	F	F
T	T	F	F	T	F	T	T	T ✓	T
T	F	T	T	F	F	T	T	T	F ✗
T	F	F	T	T	F	F	F	T	T
F	T	T	F	F	T	T	T	T	T ✓
F	T	F	F	T	T	T	T	T	T ✓
F	F	T	T	F	T	T	T	T	T ✓
F	F	F	T	T	T	F	T	T	T ✓

premises: p → q ∨ r, ~q ∨ ~r; conclusion: ~p ∨ ~r

critical rows

This argument is invalid since the conclusion is false for one critical row

Q12 to Q21 skip (in the notes)
↳ check (converse & inverse error)

Q22 Tom on team A: TA
Huey on team B: HB

~TA → HB
~HB → TA
~TA ∨ ~HB

TA	HB	~TA	~HB	~TA → HB	~HB → TA	~TA ∨ ~HB
T	T	F	F	T	T	F ✗
T	F	F	T	T	T	T ✓
F	T	T	F	T	T	T ✓
F	F	T	T	F	F	T

premises: ~TA → HB, ~HB → TA; conclusion: ~TA ∨ ~HB

critical row

This argument is invalid since the conclusion is false for one critical row

Q23 Oleg is math major: OM
Oleg is an economics major: OE
Oleg is required to take Math362: OR

argument form:-
OM ∨ OE
OM → OR
∴ OE ∨ ~OR

⇒ (Do the truth table / it's valid)

Q24 Jules solved $\Rightarrow p$
Jules obtained answ 2 $\Rightarrow q$

$p \rightarrow q$
q
$\therefore p$

This is argument is invalid (converse error)

Q25 real num is rational : p
" " " irrational : q

argument form: $p \vee q$
$\sim p$
q

valid argument (elimination)

Q26 go to movis : M
Finish hw : HW
do well on exam : E

$M \rightarrow \sim HW$
$\sim HW \rightarrow \sim E$
$\therefore M \rightarrow \sim E$

This argument form is valid (Transitivity)

Q27 num > 2 : N
$(num)^2 > 4$: S

$N \rightarrow S$
$\sim N$
$\therefore \sim S$

(invalid argument) (inverse error)

Q28

there are many rational ... .. RN
the set of irrational num is infinite : II

$RN \rightarrow II$
II
RN

(invalid argument)
(converse error)

Q29 2 num divisible by 6 $\Rightarrow N6$
product of two " " 6 $\Rightarrow p6$

$N6 \rightarrow p6$
$\sim N6$
$\sim p6$

(invalid argument)
(inverse error)

Q30 Computer prog is correct : CC
produce correct output : CO

$CC \rightarrow CO$
CO
$\therefore CC$

this is invalid argument form (converse error)

Q31 Sandra knows Java : SJ
Sandra knows C++ : SC

$SJ \wedge SC$
$\therefore SC$

(valid argument)
(specialization)

Q32 Christmas Bonus : CB
Buy Stereo : BS
Sell motorcycle: SM

CB → BS
SM → BS
∴ (CB ∨ SM) → BS

(valid argument (proof by division into cases)

Q33 – Q35 (skip)

Q36 Undeclared variable ⇒ UV
Three syntax error ⇒ SE
missing semi colon ⇒ MS
misspelled variable Name ⇒ MV

UV ∨ SE (UV: true, SE: false)
SE → (MS ∨ MV)
~MS (false)
~MV (false)
∴ UV

Q37

HL → ~KT (true)
TFY (false) → KT (false)
HL → true
TFY (false) ∨ TB (true) → true
TBY → TG
↳ ~TFY

HL → ~KT
HL
∴ ~KT modus ponens

TFY → KT
~KT
∴ ~TFY modus tollens

TBY → TG
~TFY
∴ TG modus tollens

41. a. $\sim p \vee q \rightarrow r$
b. $s \vee \sim q$
c. $\sim t$
d. $p \rightarrow t$
e. $\sim p \wedge r \rightarrow \sim s$
f. $\therefore \sim q$

42. a. $p \vee q$
b. $q \rightarrow r$
c. $p \wedge s \rightarrow t$
d. $\sim r$
e. $\sim q \rightarrow u \wedge s$
f. $\therefore t$

43. a. $\sim p \rightarrow r \wedge \sim s$
b. $t \rightarrow s$
c. $u \rightarrow \sim p$
d. $\sim w$
e. $u \vee w$
f. $\therefore \sim t$

44. a. $p \rightarrow q$
b. $r \vee s$
c. $\sim s \rightarrow \sim t$
d. $\sim q \vee s$
e. $\sim s$
f. $\sim p \wedge r \rightarrow u$
g. $w \vee t$
h. $\therefore u \wedge w$

Q41 ~p ∨ q → r
s ∨ ~q
~t
p → t
~p ∧ w → ~s

① p → t
~t
∴ ~p
modus tollens

② ~p
∴ ~p ∨ q
Generalization
~p ∨ q → r

③ ~p ∨ q
∴ r
modus ponens

④ $\sim p$
r
$\therefore r \wedge \sim p \Rightarrow$ conjunction rule

⑤ $r \wedge \sim p \rightarrow \sim s$
$r \wedge \sim p$
$\therefore \sim s$

⑥ $s \vee \sim q$ elimination Rule
$\sim s$
$\therefore \sim q \Rightarrow$ وهاكطلوي

42. a. ~~$p \vee q$~~
b. ~~$q \rightarrow r$~~
c. $p \wedge s \rightarrow t$
d. ~~$\sim r$~~
e. ~~$\sim q \rightarrow u \wedge s$~~
f. $\therefore t$

① $q \rightarrow r$
$\sim r$
$\therefore \sim q$ modus tollens

② $\sim q \rightarrow u \wedge s$
$\sim q$
$\therefore u \wedge s$ modus ponens

③ $u \wedge s$
$\therefore s$ specialization

④ $p \vee q$
$\sim q$
$\therefore p$ elimination

⑤ s
p conjunction
$\therefore p \wedge s$

⑥ $p \wedge s \rightarrow t$
$p \wedge s$
$\therefore t$ modus ponens

43. a. ~~$\sim p \rightarrow r \wedge \sim s$~~
b. $t \rightarrow s$
c. ~~$u \rightarrow \sim p$~~
d. ~~$\sim w$~~
e. ~~$u \vee w$~~
f. $\therefore \sim t$

① $u \vee w$
$\sim w$
$\therefore u$ by elimination Rule

② $u \rightarrow \sim p$
u
$\therefore \sim p$ by modus ponens

③ $\sim p \rightarrow r \wedge \sim s$
$\sim p$
$\therefore r \wedge \sim s$ modus ponens

④ $r \wedge \sim s$
$\therefore \sim s$ by specialization rule

⑤ $t \rightarrow s$
$\sim s$
$\therefore \sim t$ by modus tollens

44. a. $p \to q$
b. $r \vee s$
c. $\sim s \to \sim t$
d. $\sim q \vee s$
e. $\sim s$
f. $\sim p \wedge r \to u$
g. $w \vee t$
h. $\therefore u \wedge w$

① $\sim s \to \sim t$
$\sim s$
$\therefore \sim t$ modus ponens

② $w \vee t$
$\sim t$
$\therefore w$ elimination Rule

③ $r \vee s$
$\sim s$
$\therefore r$ elimination Rule

④ $\sim q \vee s$
$\sim s$
$\therefore \sim q$ elimination Rule

⑤ $p \to q$
$\sim q$
$\therefore \sim p$ modus tollens

⑥ $\sim p$
r
$\therefore \sim p \wedge r$ conjunction

⑦ $\sim p \wedge r \to u$
$\sim p \wedge r$
$\therefore u$ modus ponens

⑧ u
w
$\therefore u \wedge w$ conjunction Rule