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12) ⓑ If you don't miss the final exam, then you pass the course and conversely

ⓒ If you miss the final exam, then you don't pass the course

ⓑ ~~If~~ ~~you~~ have the flu and miss the exam, or you don't miss the final exam and pass the course

15) ⓐ $r \wedge \neg p$

ⓑ $\neg p \wedge q \wedge r$

ⓒ $r \rightarrow (q \leftrightarrow \neg p)$

ⓓ $\neg q \wedge \neg p \wedge r$

ⓔ $(\neg r \wedge \neg p) \rightarrow q$

ⓕ $(p \wedge r) \rightarrow \neg q$

28) ⓐ Converse: If I stay at home, it ~~won't~~ will snow tonight.
Contrapositive: If I don't stay at home, it won't snow tonight.
Inverse: If it doesn't snow tonight, I won't stay at home.

ⓑ Converse: If it is a sunny summer day, I ~~will~~ go to the beach.
Contrapositive: If it isn't a sunny summer day, I don't go to the beach.
Inverse: ~~If~~ I don't go to the beach whenever it isn't a sunny summer day.

ⓒ Converse: It is necessary that I sleep until noon if I stay up late.
Inverse~~Contrapositive~~: If I don't stay up late, it isn't necessary that I sleep until noon
Contrapositive: It isn't necessary that I sleep until noon if I don't stay up late.

34) ⓔ

p	q	$\neg q$	$p \oplus q$	$p \oplus \neg q$	$(p \oplus q) \vee (p \oplus \neg q)$
T	T	F	F	T	T
T	F	T	T	F	T
F	T	F	T	F	T
F	F	T	F	T	T

35) ⓓ

p	¬p	q	(p→q)	(¬p→¬q)	(p→q)∧(¬p→q)
T	F	T	T	T	T
T	F	F	F	T	F
F	T	T	T	T	T
F	T	F	F	F	F

ⓑ

p	¬p	q	¬q	(¬p↔¬q)	(p↔q)	(¬p↔¬q)↔(p↔q)
T	F	T	F	T	T	T
T	F	F	T	F	F	T
F	T	T	F	F	F	T
F	T	F	T	T	T	T

44)

@ 0 1011
1 1011
OR: 1 1011
1 1000
AND: 1 1000

@ 0 1111
1 0101
AND: 0 0101
0 1000
OR: 0 1101

@ 0 1010
1 1011
XOR: 1 0001
0 1000
XOR: 1 1001

ⓓ

@ 1 1011
0 1010
OR: 1 1011

10001
11011
OR: 11011

11011
11011
AND: 11011
~~AND:~~

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8) @ Kwame won't take a job in industry and won't go to graduate school
ⓑ Yoshiko doesn't know Java or doesn't know calculus
ⓒ ~~&~~ James isn't young or isn't strong
ⓓ Rita will not move to Oregon and will not move to Washington

ID: 2159003

) ⓑ

p	q	r	$(p \to q)$	$(q \to r)$	$(p \to q) \wedge (q \to r)$	$(p \to r)$	$[(p \to q) \wedge (q \to r)] \to (p \to r)$
T	T	T	T	T	T	T	T
T	T	F	T	F	F	F	T
T	F	T	F	T	F	T	T
T	F	F	F	T	F	F	T
F	T	T	T	T	T	T	T
F	T	F	T	F	F	T	T
F	F	T	T	T	T	T	T
F	F	F	T	T	T	T	T

Therefore $[(p \to q) \wedge (q \to r)] \to (p \to r)$ is a tautology

©

p	q	$p \to q$	$p \wedge (p \to q)$	$[p \wedge (p \to q)] \to q$
T	T	T	T	T
T	F	F	F	T
F	T	T	F	T
F	F	T	F	T

Therefore $[p \wedge (p \to q)] \to q$ is a tautology

12) @ $[p \wedge (p \to q)] \to q \equiv \neg [p \wedge (p \to q)] \vee q$

$\equiv \neg p \vee \neg (p \to q) \vee q$

$\equiv (\neg p \vee q) \vee \neg (p \to q)$

$\equiv (\neg p \vee q) \vee \neg (\neg p \vee q) \equiv T$

Therefore $[p \wedge (p \to q)] \to q$ is a tautology

ⓓ $[(p \vee q) \wedge (p \to r) \wedge (q \to r)] \to r$

LHS $\equiv (p \vee q) \wedge (\neg p \vee r) \wedge (\neg q \vee r)$ ~~$\equiv (p \vee q) \wedge [illegible] \neg$~~

$\equiv (p \vee q) \wedge [r \vee (\neg p \wedge \neg q)] \equiv (p \vee q) \wedge [\neg (p \vee q) \vee r]$

$\Rightarrow (p \vee q) \wedge [\neg (p \vee q) \vee r] \to r \equiv \neg (p \vee q) \vee \neg [\neg (p \vee q) \vee r] \vee r$

$\equiv [\neg (p \vee q) \vee r] \vee \neg [\neg (p \vee q) \vee r] \equiv T$

Therefore $[(p \vee q) \wedge (p \to r) \wedge (q \to r)]$ is a tautology

26) Proof: $\neg p \to (q \to r) \equiv q \to (p \vee r)$

$LHS \equiv \neg\neg p \vee (\neg q \to r) \equiv p \vee \neg q \vee r$

$\equiv \neg q \vee (p \vee r) \equiv q \to (p \vee r) \equiv RHS$

Therefore $\neg p \to (q \to r) \equiv q \to (p \vee r)$

30) $(p \vee q) \wedge (\neg p \vee r) \to (q \vee r)$

$\equiv \neg(p \vee q) \vee \neg(\neg p \vee r) \vee (q \vee r)$

$\equiv \neg(p \vee q) \vee p \vee \neg r \vee q \vee r \equiv \neg(p \vee q) \vee (p \vee q) \equiv T$

Therefore $(p \vee q) \wedge (\neg p \vee r) \to (q \vee r)$ is a tautology

31) Proof: $(p \to q) \to r \not\equiv p \to (q \to r)$

$LHS \equiv \neg(\neg p \vee q) \vee r \equiv (p \wedge \neg q) \vee r$

$RHS \equiv \neg p \vee (\neg q \vee r) \equiv \neg(p \wedge q) \vee r$

~~Since $(p \wedge$~~ Suppose p, q, r ~~at~~ are false

$\Rightarrow LHS \equiv (F \wedge \neg F) \vee F \equiv F \vee F \equiv F$

$RHS \equiv \neg(F \wedge F) \vee F \equiv T \vee F \equiv T$

Therefore $(p \to q) \to r \not\equiv p \to (q \to r)$