1) .a.

```
example (A B C : Prop ) :

 (A ∧ C) ∨ (B ∧ C)   → (A ∨ B) ∧ C :=

  assume h : (A ∧ C) ∨ (B ∧ C),

    and.intro

        (or.elim h

        (assume k : A ∧ C, or.intro_left B (and.elim_left k))

        (assume l : B ∧ C, or.intro_right A (and.elim_left l))

    )

    (or.elim h

    (assume k : A ∧ C,and.elim_right k)

    (assume l : B ∧ C,and.elim_right l)

    )
```

b.

1.b.

$$
\dfrac{
\dfrac{
(A \wedge C) \vee (B \wedge C)^h
\qquad
\dfrac{
\dfrac{
\dfrac{\dfrac{A \wedge C^k}{A}}{A \vee B}\,[\vee I\ \text{left}]
\qquad
\dfrac{A \wedge C^k}{C}\,[\wedge E\ \text{right}]
}{(A \vee B) \wedge C}\,[\wedge I]
}{A \wedge C \to (A \vee B) \wedge C}\,k.
\qquad
\dfrac{
\dfrac{
\dfrac{\dfrac{B \wedge C^k}{B}\,[\wedge E\ \text{right}]}{A \vee B}
\qquad
\dfrac{B \wedge C^k}{C}\,[\wedge E\ \text{right}]
}{(A \vee B) \wedge C}
}{B \wedge C \to (A \vee B) \wedge C}\,k
}{(A \vee B) \wedge C}\,[\vee E].
}{(A \wedge C) \vee (B \wedge C) \to (A \vee B) \wedge C}\,h.
$$

2)”

¬R) 2.

A	B	C	$(A\land C)\lor(B\land C)$	$(A\lor B)\land C$	$(A\land C)\lor(B\land C)\to(A\lor B)\land C$
T	T	T	T	T	T
T	T	F	F	F	T
T	F	T	T	T	T
T	F	F	F	F	T
F	T	T	T	T	T
F	T	F	F	F	T
F	F	T	F	F	T
F	F	F	F	F	F·T.

And. $(A\lor B)\land C \to (A\lor B)\land C$

T
T
T
T
T
T
T
T

* so the ~~logically~~ logical equivalence $(A\land C)\lor(B\land C)\Leftrightarrow(A\lor B)\land C$ is value!

3)'a.

3.a. $(A\land B)\lor(A\land\neg B)^5$

$$\frac{(A\land B)\lor(A\land\neg B)^5}{\therefore (A\land B)\lor(A\land\neg B)^5,\ (A\land B).}\ [\lor/\text{left}].$$

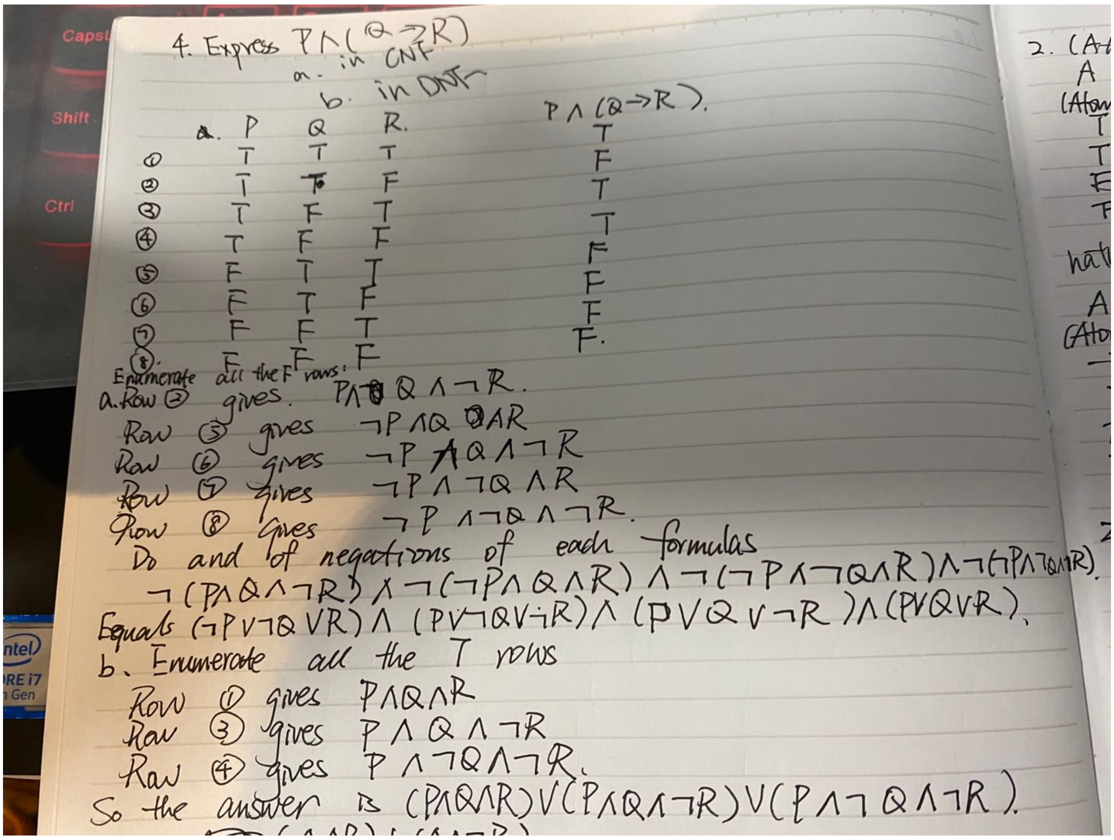
$$\frac{(A\land B)\lor(A\land\neg B)\to A\land B,\ (A\land B)\lor(A\land\neg B)^5.}{}$$

$$\frac{\dfrac{A\land B}{(A\land B)\lor(A\land\neg B)}\ [\lor/\text{left}).\qquad A^{10}}{A\to(A\land B)\lor(A\land\neg B)}\ 10.$$

b.

```
open classical

example (A B : Prop) : A → ( A ∧ B) ∨ ( A∧ ¬ B ) :=

assume a : A,

or.elim (em B)

(assume b :B, or.intro_left ( A ∧ ¬ B) (and.intro a b ))

(assume nb: ¬ B, or.intro_right( A ∧ B)(and.intro a nb ) )
```

4).



4. Express $P \wedge (Q \to R)$
a. in CNF
b. in DNF

	P	Q	R	$P \wedge (Q \to R)$
①	T	T	T	T
②	T	T	F	F
③	T	F	T	T
④	T	F	F	T
⑤	F	T	T	F
⑥	F	T	F	F
⑦	F	F	T	F
⑧	F	F	F	F.

Enumerate all the F rows:
a. Row ② gives $P \wedge Q \wedge \neg R$.
Row ⑤ gives $\neg P \wedge Q \wedge R$
Row ⑥ gives $\neg P \wedge Q \wedge \neg R$
Row ⑦ gives $\neg P \wedge \neg Q \wedge R$
Row ⑧ gives $\neg P \wedge \neg Q \wedge \neg R$.
Do and of negations of each formulas
$\neg(P \wedge Q \wedge \neg R) \wedge \neg(\neg P \wedge Q \wedge R) \wedge \neg(\neg P \wedge \neg Q \wedge R) \wedge \neg(\neg P \wedge \neg Q \wedge R)$.
Equals $(\neg P \vee \neg Q \vee R) \wedge (P \vee \neg Q \vee \neg R) \wedge (P \vee Q \vee \neg R) \wedge (P \vee Q \vee R)$.
b. Enumerate all the T rows
Row ① gives $P \wedge Q \wedge R$
Row ③ gives $P \wedge Q \wedge \neg R$
Row ④ gives $P \wedge \neg Q \wedge \neg R$.
So the answer is $(P \wedge Q \wedge R) \vee (P \wedge Q \wedge \neg R) \vee (P \wedge \neg Q \wedge \neg R)$.