1. S.T

i) $(P \wedge Q) \vee (P \wedge \neg Q)$

P	Q	¬Q	P∧Q	P∧¬Q	(P∧Q)∨(P∧¬Q)
T	T	F	T	F	T
T	T	T	F	T	T
T	F	F	F	F	F
F	T	F	F	F	F
F	F	T	F	F	F

$$\therefore \; P \longleftrightarrow (P \wedge Q) \vee (P \wedge \neg Q)$$

ii) $P \wedge (P \vee Q)$ $\quad P \wedge (P \vee Q)$

P	Q	P∨Q	P∧(P∨Q)
T	T	T	T
T	F	T	T
F	T	T	F
F	F	F	F

$$\therefore \; P \longleftrightarrow P \wedge (P \vee Q)$$

iii) $P \wedge (P \vee Q) \wedge (P \vee \neg Q)$

P	Q	¬Q	P∨Q	P∨¬Q	(P∨Q)∧(P∨¬Q)
T	T	F	T	T	T
T	F	T	T	T	T
F	T	F	T	F	F
F	F	T	F	T	F

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

i) $P \lor (P \land Q)$

P	Q	$P \land Q$	$P \lor (P \land Q)$
T	T	T	T
F	T	F	F
F	F	F	F

$\therefore P \iff P \lor (P \land Q)$

---

2) $\neg [P \lor (\neg P \land Q)] \iff \neg P \land \neg Q$

$\iff \neg [P \lor (\neg P \land Q)]$ De-Morgen's Law

$\iff \neg P \land \neg (\neg P \land Q)$ DeMorgan's Law

$\iff \neg P \land (\neg (\neg P) \lor \neg Q)$ Double Negation

$\iff (\neg P \land P) \lor (\neg P \land \neg Q)$ Distribution

$\iff F \lor (\neg P \land \neg Q)$ Negation

$\iff \neg P \land \neg Q$ Identity

A)   i) $P \wedge (Q \to R)$

P	Q	R	$Q \to R$	$P \wedge (Q \to R)$
T	T	T	T	(T)
T	T	F	F	F
T	F	T	T	(T)
T	F	F	T	(T)
F	T	T	T	F
F	T	F	F	F
F	F	T	T	F
F	F	F	T	F

Minterms

$P \wedge Q \wedge R$

$P \wedge \neg Q \wedge R$

$P \wedge Q \wedge \neg R$

Maxterms

$\neg P \vee \neg Q \vee \neg R$

$\neg P \vee Q \vee R$

$\neg P \vee Q \vee \neg R$

$\neg P \vee \neg Q \vee R$

$\neg P \vee \neg Q \vee \neg R$

DDNF $= (P \wedge Q \wedge R) \vee (P \wedge \neg Q \wedge R) \vee (P \wedge \neg Q \wedge \neg R)$

PCNF $= (P \vee Q \vee \neg R) \wedge (\neg P \vee Q \vee R) \wedge (\neg P \vee Q \vee R)$
$\wedge (\neg P \vee \neg Q \vee R) \wedge (\neg P \vee \neg Q \vee \neg R)$

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

P	Q	R	$P \wedge Q$	$\neg R$	$P \wedge \neg Q$	$Q \wedge R$	$(P \wedge Q)$ $\vee$ $(P \wedge \neg R)$
T	T	T	T	F	T	T	T
T	T	F	T	T	T	F	T
T	F	T	F	F	T	F	T
T	F	F	F	T	T	T	T
F	T	T	T	F	F	T	F
F	T	F	T	F	T	F	F
F	F	T	T	F	F	F	F
F	F	F	F	T	F	R	R

Minterms | Maxterms

Minterms	Maxterms
$P \wedge Q \wedge R$	$P \vee Q \vee R$
$P \wedge Q \wedge \neg R$	$\neg P \vee Q \vee \neg R$
$P \wedge \neg Q \wedge \neg R$	$\neg P \vee \neg Q \vee R$
$\neg P \wedge Q \wedge R$	$\neg P \vee \neg Q \vee \neg R$

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

(T)
(T)
R
(T)
(T)
F
F
F

$PDNF = (P \wedge Q \wedge R) \vee (P \wedge Q \wedge \neg R) \vee (P \wedge \neg Q \wedge \neg R)$
$\vee (\neg P \wedge Q \wedge R)$

$PCNF = (P \vee \neg Q \wedge R) \wedge (\neg P \vee Q \vee \neg R) \wedge (\neg P \vee Q \vee \neg R)$
$\wedge (\neg P \vee \neg Q \vee R)$

3) i) H: $\neg P$

H2: $R \to Q$

$$(P \land q \to r) \lor (\neg r \land \neg q) \iff 2$$

i) $\neg P \land (R \to Q)$

P	Q	$\neg P$	$P \to Q$	$\neg P \land (R \to Q)$
T	T	F	T	F
T	F	F	F	
T	F	F		
F				
F				

$$\neg P \land (R \to Q)$$

$$P \lor Q \qquad \neg(P \land Q) \qquad \neg P \land (R \to Q) \to P \land Q$$

$$[(P \land q \land r) \land \neg(P \land q \land \neg q)] \iff (2 \land \neg) \quad T$$

$$(P \land q \land r) \land \neg(P \land q \land \neg q) \iff 2 \qquad T$$

$$((P \land r) \lor (q \land r) \land r) \land (((P \land r) \land r \land q \land r)) \iff 2 \quad T$$

$$(P \land q) \land (P \lor q \land r) \iff 2$$

∴ Yes (#) follows

ii) H: $P \to Q$ ∴

H2: $\neg P$

P	Q	$\neg P$	$P \to Q$	$\neg P \land (P \to Q)$	$\neg P \land (P \to Q) \to Q$
T	T	F	T	F	T
T	F	F	F	F	T
T	T	F	T	F	T
F	F	T	T	T	T
F	F	T	T	T	F

∴ Yes it does not follow

5.

$$S \iff (P \land Q) \lor (\neg P \land Q)$$

i) Negation of $\neg S \rightarrow$ disjunction of the product

$$P \land Q \qquad \neg P \land Q \qquad P \land \neg Q \qquad \neg P \land \neg Q$$

$$\neg S \iff (P \land \neg Q) \lor (\neg P \land \neg Q)$$

ii) Negation of $\neg S$ (DNR) applying du Morgan

$$\neg(\neg S) \iff [(P \land \neg Q) \lor (\neg P \land \neg Q)]$$

$$S \iff \neg(P \land \neg Q) \land \neg(\neg P \land \neg Q)$$

$$S \iff (\neg P \land \neg(\neg Q)) \land (\neg(\neg P) \lor \neg(\neg Q))$$

$$S \iff (\neg P \lor Q) \land (P \lor Q) \qquad P(NF$$

$P \iff (P \iff q) \land r$	$(P \iff q) \land r$	$P \iff q$	r
T		T	
T			
T		T	
		T	

collof ton sab ti rar