1. $P \rightarrow -Q$

a) $Q \rightarrow -P$

This is a substitution instance by replacing the variable 'P' by 'Q' and the variable 'Q' by 'P'

b) $P \rightarrow R$

This is not a substitution instance because substitution can only be performed on propositional variables, and not, for example, on negated variables. Thus to make this a substitution instance it would have to be changed to $P \rightarrow -- R$ by replacing the variable 'Q' by '$-R$' and leaving P.

c) $(P \rightarrow -Q) \rightarrow -(P \rightarrow -Q)$

This is a substitution instance by replacing the variable 'P' by the wff '$(P \rightarrow -Q)$' and the variable 'Q' by the wff '$(P \rightarrow -Q)$'

2.

P	Q	R	—	(P	v	R)	**&**	(—	Q	→	(P	&	R))
T	T	T	F	T	T	T	F	F	T	T	T	T	T
T	T	F	F	T	T	F	F	F	T	T	T	F	F
T	F	T	F	T	T	T	F	T	F	T	T	T	T
T	F	F	F	T	T	F	F	T	F	F	T	F	F
F	T	T	F	F	T	T	F	F	T	T	F	F	T
F	T	F	T	F	F	F	T	F	T	T	F	F	F
F	F	T	F	F	T	T	F	T	F	F	F	F	T
F	F	F	T	F	F	F	F	T	F	F	F	F	F

3.

a) The argument is invalid as the following truth assignment shows

P	Q	R	(P	→	Q)	**v**	(Q	→	R)	— R	**→**	— (P	&	Q)	Q	**→**	— P
T	T	T	T	T	T	T	T	T	T	F T	T	F T	T	T	T	F	F T

b) The argument is invalid as the following truth assignment shows

P	Q	R	S	(P	v	Q)	→	(R	v	S)	P	↔	— (R	&	S)	Q	↔	— (P	&	R)	(S	&	P)	→	— (P	v	R)
T	T	F	T	T	T	T	T	F	T	T	T	T	T	F	T	T	T	T	F	F	T	T	T	F	F	T	T	F

4.

a)

P	Q	R	(P	v	—	Q)	**→**	(P	↔	(Q	&	R))
T	T	T	T	T	F	T	T	T	T	T	T	T
T	T	F	T	T	F	T	F	T	F	T	F	F
T	F	T	T	T	T	F	F	T	F	F	F	T
T	F	F	T	T	T	F	F	T	F	F	F	F
F	T	T	F	F	F	T	T	F	F	T	T	T
F	T	F	F	F	F	T	T	F	T	T	F	F
F	F	T	F	T	T	F	T	F	T	F	F	T
F	F	F	F	T	T	F	T	F	T	F	F	F

b)

P	Q	R	(	–	P	v	(	–	Q	→	R	)	)	→	(	(	P	&	R	)	→	–	Q	)
T	T	T		F	T	T		F	T	T	T			F			T	T	T		F	F	T	
T	T	F		F	T	T		F	T	T	F			T			T	F	F		T	F	T	
T	F	T		F	T	T		T	F	T	T			T			T	T	T		T	T	F	
T	F	F		F	T	F		T	F	F	F			T			T	F	F		T	T	F	
F	T	T		T	F	T		F	T	T	T			T			F	F	T		T	F	T	
F	T	F		T	F	T		F	T	T	F			T			F	F	F		T	F	T	
F	F	T		T	F	T		T	F	T	T			T			F	F	T		T	T	F	
F	F	F		T	F	T		T	F	F	F			T			F	F	F		T	T	F	

5.

a) The first sentence does not imply the second as the third row of the truth table shows:

P	Q	R	(	P	&	Q	)	↔	(	Q	&	R	)	P	↔	Q
T	T	T		T	T	T		T		T	T	T		T	T	T
T	T	F		T	T	T		F		T	F	F		T	T	T
T	F	T		T	F	F		T		F	F	T		T	F	F
T	F	F		T	F	F		T		F	F	F		T	F	F
F	T	T		F	F	T		F		T	T	T		F	F	T
F	T	F		F	F	T		T		T	F	F		F	F	T
F	F	T		F	F	F		T		F	F	T		F	T	F
F	F	F		F	F	F		T		F	F	F		F	T	F

b) The first sentence does indeed imply the second as the truth table shows:

P	Q	R	P	↔	(	Q	v	R	)	–	P	→	(	Q	↔	R	)
T	T	T	T	T		T	T	T		F	T	T		T	T	T	
T	T	F	T	T		T	T	F		F	T	T		T	F	F	
T	F	T	T	T		F	T	T		F	T	T		F	F	T	
T	F	F	T	F		F	F	F		F	T	T		F	T	F	
F	T	T	F	F		T	T	T		T	F	T		T	T	T	
F	T	F	F	F		T	T	F		T	F	F		T	F	F	
F	F	T	F	F		F	T	T		T	F	F		F	F	T	
F	F	F	F	T		F	F	F		T	F	T		F	T	F	

6.

P	Q	P	#	Q	(	–	P	&	Q	)	v	(	P	&	–	Q	)
T	T	T	F	T		F	T	F	T		F		T	F	F	T	
T	F	T	T	F		F	T	F	F		T		T	T	T	F	
F	T	F	T	T		T	F	T	T		T		F	F	F	T	
F	F	F	F	F		T	F	F	F		F		F	F	T	F	