Section 1.2

1. Write $\neg(r \vee (q \wedge (\neg r \rightarrow \neg p)))$ in disjunctive normal form.

Solution Begin by giving the truth table for the statement:

p	q	r	$\neg r \rightarrow \neg p$	$q \wedge (\neg r \rightarrow \neg p)$	$r \vee (q \wedge (\neg r \rightarrow \neg p))$	$\neg(r \vee (q \wedge (\neg r \rightarrow \neg p)))$
T	T	T	T	T	T	F
T	T	F	F	F	F	T
T	F	T	T	F	T	F
T	F	F	F	F	F	T
F	T	T	T	T	T	F
F	T	F	T	T	T	F
F	F	T	T	F	T	F
F	F	F	T	F	F	T

For each of the three true cases, form the conjunction that gives a T value only in that case: $p \wedge q \wedge \neg r$
$p \wedge \neg q \wedge \neg r$ $\neg p \wedge \neg q \wedge \neg r$.
Then form the disjunction of these three conjunctions to obtain the answer: $(p \wedge q \wedge \neg r) \vee (p \wedge \neg q \wedge \neg r) \vee (\neg p \wedge \neg q \wedge \neg r)$.