Graded for Honest Effort

1.1.2 c) $n \lor m$.

used disjunction to express "nausea or migraines"

e) $t \land n$

used conjunction to express "despite t, n"

f) $\neg t$

Used negation to express "no way that t"

1.2.7 c) $B \lor (D \land M)$

Use conjunction to express "Both D and M"

then use disjunction to express "either B or 'Both D and M'"

1.3.3 b) If $\overset{p}{7 < 5}$, then $\overset{q}{5 < 3}$

Inverse: If $\overset{\neg p}{7 > 5}$, then $\overset{\neg q}{5 > 3}$. True

the inverse of if p, then q is

if not p, then not q

Contrapositive: If $\overset{\neg q}{5 > 3}$, then $\overset{\neg p}{7 > 5}$. True

The contrapositive of if p, then q is

if not q, then not p

Converse: If $\overset{q}{5 < 3}$, then $\overset{p}{7 < 5}$. True

The converse of if p, then q is

if q, then p

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1.3.7 a) $p \to (s \wedge y)$

use conjunction to express "s and y"
then use conditional statement to express
"p only if s and y"

c) $p \to y$

use conditional statement to express
"y is a necessary condition to p"

1.3.10 $p: T$, $q: F$, $r: U$

b) $(p \vee r) \to r$

$(T \vee U) \to U$

$T \to U$

U

$\boxed{\text{Unknown}}$

since the hypothesis is true and the conclusion is unknown, therefore the truth value is unknown

c) $(p \vee r) \longleftrightarrow (q \wedge r)$

$(T \vee U) \longleftrightarrow (F \wedge U)$

$T \longleftrightarrow F$

F

$\boxed{\text{False}}$

since the hypothesis is true and the conclusion is false, therefore the truth value is false

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e) $p \rightarrow (r \vee q)$

$T \rightarrow (U \vee F)$

$T \rightarrow U$

U

$\boxed{\text{Unknown}}$

Since the hypothesis is true and the conclusion is unknown, therefore the truth value is unknown

f) $(p \wedge q) \rightarrow r$

$(T \wedge F) \rightarrow U$

$F \rightarrow U$

T

$\boxed{\text{True}}$

Since the hypothesis is false, the truth value is true regardless the conclusion is true or not.

1.4.4 a) $\neg(p \vee \neg q)$ and $\neg p \wedge q$

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

The truth table shows that the two expressions are logically equivalent

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c) $p \wedge (p \to q)$ and $p \to q$

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

p : F , q : T

The truth table shows that the two expressions are not logically equivalent when p is false and q is true

1.5.1 c) $r \vee (\neg r \to p)$

$r \vee (\neg\neg r \vee p)$ Conditional identity

$r \vee (r \vee p)$ Double negation law

$(r \vee r) \vee p$ Associative law

$r \vee p$ Idempotent law

Justifications are provided for each steps which shows the two expressions are logically equivalent

Graded for Honest Effort and Feedback Given

1.2.4 d) $(r \vee p) \wedge (\neg r \vee \neg q)$

p	q	r	¬q	¬r	r ∨ p	¬r ∨ ¬q	result
T	T	T	F	F	T	F	F
T	T	F	F	T	T	T	T
T	F	T	T	F	T	T	T
T	F	F	T	T	T	T	T
F	T	T	F	F	T	F	F
F	T	F	F	T	F	T	F
F	F	T	T	F	T	T	T
F	F	F	T	T	F	T	F

All the intermediate columns are shown in the truth table

Graded for Honest Effort and Feedback Given

1.4.5 b) $\neg j \rightarrow (l \vee r)$

$(r \wedge \neg l) \rightarrow j$

j	l	r	$\neg j$	$l \vee r$	$\neg j \rightarrow (l \vee r)$	$\neg l$	$r \wedge \neg l$	$(r \wedge \neg l) \rightarrow j$
T	T	T	F	T	T	F	F	T
T	T	F	F	T	T	F	F	T
T	F	T	F	T	T	T	T	T
T	F	F	F	F	T	T	F	T
F	T	T	T	T	T	F	F	T
F	T	F	T	T	T	F	F	T
F	F	T	T	T	T	T	T	F
F	F	F	T	F	F	T	F	T

I turn each of English sentences into logical expressions, the I use truth table show that they are not logically equivalent.

Graded for Honest Effort and Feeback Given

1.4.5 d) $(r \vee \neg l) \rightarrow j$

$j \rightarrow (r \wedge \neg l)$

j	l	r	$\neg l$	$r \vee \neg l$	$(r \vee \neg l) \rightarrow j$	$r \wedge \neg l$	$j \rightarrow (r \wedge \neg l)$
T	T	T	F	T	T	F	F
T	T	F	F	F	T	F	F
T	F	T	T	T	T	T	T
T	F	F	T	T	T	F	F
F	T	T	F	T	F	F	T
F	T	F	F	F	T	F	T
F	F	T	T	T	F	T	T
F	F	F	T	T	F	F	T

I turn each of English sentences into logical expressions, the I use truth table show that they are not logically equivalent.

1.5.2 c) $(p \rightarrow q) \wedge (p \rightarrow r) \equiv p \rightarrow (q \wedge r)$

$(p \rightarrow q) \wedge (p \rightarrow r)$	start
$(\neg p \vee q) \wedge (p \rightarrow r)$	Conditional identity
$(\neg p \vee q) \wedge (\neg p \vee r)$	Conditional identity
$\neg p \vee (q \wedge r)$	Distributive identity
$p \rightarrow (q \wedge r)$	Conditional identity

Justifications are provided for each steps which shows the two expressions are logically equivalent

Graded for Honest Effort and Feedback Given

1.5.2 f) $\neg(p \vee (\neg p \wedge q)) \equiv \neg p \wedge \neg q$

$\neg(p \vee (\neg p \wedge q))$	Start
$\neg((p \vee \neg p) \wedge (p \vee q))$	Distributive law
$\neg(T \wedge (p \vee q))$	Complement law
$\neg((p \vee q) \wedge T)$	Commutative law
$\neg(p \vee q)$	Identity law
$\neg p \wedge \neg q$	De Morgan's law

Justifications are provided for each steps which shows the two expressions are logically equivalent

1.5.4 b) A conditional statement is not logically equivalent to its inverse

$p \to q$, inverse: $\neg p \to \neg q$

p	q	$\neg p$	$\neg q$	$p \to q$	$\neg p \to \neg q$
T	T	F	F	T	T
T	F	F	T	F	T
F	T	T	F	T	F
F	F	T	T	T	T

The truth table shows that $p \to q$ and $\neg p \to \neg q$ are not logically equivalent

Graded for Honest Effort and Feedback Given

1.5.4 c) A conditional statement is logically equivalent to its contrapositive

$p \to q$, contrapositive : $\neg q \to \neg p$

$p \to q$	start
$\neg p \lor q$	conditional identity
$q \lor \neg p$	commutative law
$\neg q \to \neg p$	conditional identity

$p \to q \equiv \neg q \to \neg p$

p	q	$\neg q$	$\neg p$	$p \to q$	$\neg q \to \neg p$
T	T	F	F	T	T
T	F	T	F	F	F
F	T	F	T	T	T
F	F	T	T	T	T

Justifications are provided for each steps which shows the two expressions are logically equivalent. Also a truth table is provided to show that they are logically equivalent.