1. Let the propositions p, q and r be defined as:

p: Matthew arrives home before six o'clock
q: Matthew cooks dinner
r: Jill washes the dishes

(a) (i) Express the following statement in logical form.

If Matthew arrives home before six o'clock then he will cook dinner.

(1)

(ii) Write the following logic statement in words.

$$\neg q \Rightarrow \neg r$$

(1)

(b) (i) Copy and complete the truth table below.

p	q	r	$p \Rightarrow q$	$q \Rightarrow r$	$\neg r$	$(p \Rightarrow q) \wedge (q \Rightarrow r) \wedge \neg r$	$\neg p$	$[(p \Rightarrow q) \wedge (q \Rightarrow r) \wedge \neg r] \Rightarrow \neg p$
T	T	T						T
T	T	F						T
T	F	T						T
T	F	F						T
F	T	T						T
F	T	F						T
F	F	T						T
F	F	F						T

(5)

(ii) Explain the significance of the truth table above.

(2)
(Total 9 marks)

2. $[(p \Leftrightarrow q) \wedge p] \Rightarrow q$

(a) Complete the truth table below for the compound statement above.

p	q	$p \Leftrightarrow q$	$(p \Leftrightarrow q) \wedge p$	$[(p \Leftrightarrow q) \wedge p] \Rightarrow q$
T	T			
T	F			
F	T			
F	F			

(b) Explain the significance of your result.

Working:

Answers:

(b) ....

....

(Total 4 marks)

3. (a) The following truth table contains two entries which are incorrect, one in column three and one in column four. Circle the two incorrect entries.

(b) Fill in the two missing values in column five.

(c)   Which **one** of the following words could you use to describe the statement represented by the values in the last column (number 6)?

   (i)   converse

   (ii)   tautology

   (iii)   inverse

   (iv)   contradiction

   (v)   contrapositive

1	2	3	4	5	6
p	q	$p \wedge q$	$\neg p$	$p \vee q$	$(p \vee q) \wedge (\neg p \wedge \neg q)$
T	T	T	F	T	F
T	F	F	F		F
F	T	F	T	T	F
F	F	T	F		F

Working:

Answer:

(c)   ....

(Total 8 marks)

4. The truth table below shows the truth-values for the proposition

$$p \underline{\vee} q \Rightarrow \neg p \underline{\vee} \neg q$$

p	q	$\neg p$	$\neg q$	$p \underline{\vee} q$	$\neg p \underline{\vee} \neg q$	$p \underline{\vee} q \Rightarrow \neg p \underline{\vee} \neg q$
T	T	F	F		F	
T	F	F		T	T	T
F	T	T	F	T	T	T
F	F	T	T	F		T

(a) Explain the distinction between the compound propositions, $p \underline{\vee} q$ and $\neg p \underline{\vee} \neg q$.

(b) Fill in the four missing truth-values on the table.

(c) State whether the proposition $p \underline{\vee} q \Rightarrow \neg p \underline{\vee} \neg q$ is a tautology, a contradiction or neither.

Working:

Answers:

(a) ....

....

....

(c) ....

(Total 6 marks)

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1. (a) (i) $p \Rightarrow q$ (A1)

(ii) If Matthew doesn't cook dinner then Jill will not wash the dishes (A1) 2

(b) (i) (A5) 5

4

p	q	r	$p \Rightarrow q$	$q \Rightarrow r$	$\neg r$	$(p \Rightarrow q) \wedge (q \Rightarrow r) \wedge \neg r$	$\neg p$	$[(p \Rightarrow q) \wedge (q \Rightarrow r) \wedge \neg r] \Rightarrow \neg p$
T	T	T	**T**	**T**	F	**F**	**F**	T
T	T	F	**T**	**F**	T	**F**	**F**	T
T	F	T	**F**	**T**	F	**F**	**F**	T
T	F	F	**F**	**T**	T	**F**	**F**	T
F	T	T	**T**	**T**	F	**F**	**T**	T
F	T	F	**T**	**F**	T	**F**	**T**	T
F	F	T	**T**	**T**	F	**F**	**T**	T
F	F	F	**T**	**T**	T	**T**	**T**	T

Note: Award (A1) for each correct bold column.

(ii) The truth table is showing that the following argument is valid. If Matthew arrives home before six o'clock he will cook dinner. If Matthew cooks dinner then Jill will wash the dishes. Jill did not wash the dishes. Therefore Matthew did not arrive before six o'clock. (R2) 2

[9]

2. (a)

p	q	$p \Leftrightarrow q$	$(p \Leftrightarrow q) \wedge p$	$[(p \Leftrightarrow q) \wedge p] \Rightarrow q$
T	T	**T**	**T**	**T**
T	F	**F**	**F**	**T**
F	T	**F**	**F**	**T**
F	F	**T**	**F**	**T**

(A3)

Note: Award (A1) for each completely correct bold column.

(b) It is a tautology (or equivalent). The statement is valid. (A1)

[4]

3. (a) and (b)

1	2	3	4	5	6
p	q	$p \wedge q$	$\neg p$	$p \vee q$	$(p \vee q) \wedge (\neg p \wedge \neg q)$
T	T	T	F	T	F
T	F	F	F	**T (A1)**	F
F	T	F	T	T	F
F	F	**(T) (A2)**	**(F) (A2)**	**F (A1)**	F

(C6)

(c) The last column is a *contradiction*. (A2) (C2)

[8]

4. (a) Both are "p or q", the first is "but not both" (A1)

(C1)

> *Note: Award mark for clear understanding if wording is poor.*

(b)

$\neg q$	$p \veebar q$	$\neg p \veebar \neg q$	$p \veebar q \Rightarrow \neg p \veebar \neg q$
	F		T
T			
		F	

(A1)(A1)(ft)

(A:

(A1) (C4)

> *Note: Follow through is for final column.*

(c) Tautology. (A1)(ft) (C1)

[6]