

Name: \_\_\_\_\_  
Student ID: \_\_\_\_\_

## Test 2

No books, calculators, notes or cell phones are allowed. You must show all your work, the correct answer is worth 1 mark the remaining marks are given for the work. If you need more space for your answer use the back of the page.

**Question 1.** Given the following symbolization key:

$A$ : Alexander Berkman loves Emma Goldman

$E$ : Emma Goldman loves Alexander Berkman.

$F_1$ : Alexander Berkman buys flowers.

$F_2$ : Emma Goldman buys flowers.

$P_1$ : Alexander Berkman protests.

$P_2$ : Emma Goldman protests.

a. (1 mark) Translate the English statement into a propositional logic statement:

Emma Goldman does not love Alexander Berkman if Alexander does not buy flowers.

b. (1 mark) Rewrite the propositional logic statement of part a. into a logically equivalent statement using the logical connective 'or'.

c. (1 mark) Give the logical negation of the statement of part b. and distribute the negation using De Morgan Laws.

d. (1 mark) Translate the propositional logic statement of part c. into an English statement.

**Question 2.** (6 marks) Using a truth table: determine whether the following two statements are logically equivalent. Justify.

$$\neg A \rightarrow B$$

and

$$(\neg A \rightarrow \neg B) \wedge (B \rightarrow \neg A)$$

**Question 3.** (1 marks per correct line - no part marks) Provide a justification (rule and line number(s)) for **each line** of the following proof.

1	$(A \leftrightarrow B) \vee B$	
2	$\neg B$	
3	$\neg(\neg A \vee C)$	
4	$\neg\neg A \wedge \neg C$	
5	$A \leftrightarrow B$	
6	$A \rightarrow B$	
7	$\neg\neg A$	
8	$A$	
9	$B$	
10	$B \wedge \neg B$	
11	$\neg\neg(\neg A \vee C)$	
12	$\neg A \vee C$	
13	$\neg B \rightarrow (\neg A \vee C)$	
14	$\neg\neg B \vee (\neg A \vee C)$	
15	$(\neg\neg B \vee (\neg A \vee C)) \vee D$	

**Question 4.** (10 marks) Using only the rules of inference and the rules of replacement show that the following argument is valid using Fitch style natural deduction:

$$P \rightarrow Q, \neg P \rightarrow R, (Q \vee R) \rightarrow S, \therefore S$$

**Question 5.** (15 marks) **Choose one of the argument** and show that it is valid using only the rules of inference and the rules of replacement and Fitch style natural deduction:

$$(\neg A \vee B) \leftrightarrow C, \neg(A \wedge G) \leftrightarrow \neg D, \neg(D \wedge E), \neg(C \vee F), \therefore E \rightarrow \neg G$$

or

$$(Y \vee \neg Z) \rightarrow \neg X, X \wedge A, \neg(A \wedge (B \vee \neg C)), ((A \wedge \neg B) \vee H) \rightarrow W, \therefore W \wedge Z$$