

THE UNIVERSITY OF QUEENSLAND  
Department of Mathematics  
MATH1061: Discrete Mathematics First Exam  
September 2002.

Exam Time: 50 minutes; Perusal Time: 5 minutes.

**Question 1.** Consider the following truth table.

- (a) Construct a Boolean expression having this table as its truth table. Simplify this expression. (2 marks)
- (b) Construct a circuit having the given table as its input/output table. (2 marks)

$P$	$Q$	$R$	$S$
1	1	1	0
1	1	0	0
1	0	1	1
1	0	0	1
0	1	1	0
0	1	0	1
0	0	1	0
0	0	0	0

**Question 2.** The Peirce arrow  $\downarrow$  (NOR) is a logical binary operation which is defined as follows:

$$p \downarrow q \equiv \sim (p \vee q).$$

- (a) Prove that  $\sim p \equiv p \downarrow p$ . (1 marks)
- (b) Prove that  $p \wedge q \equiv (p \downarrow p) \downarrow (q \downarrow q)$ . (2 marks)
- (c) Write  $p \rightarrow q$  using Peirce arrows only. (2 marks)

**Question 3.** Write a negation for each of the following statement.

- (a)  $\forall x, \forall y \in \mathbb{R}, \exists z \in \mathbb{R}$  such that  $x = y + z$ . (1 marks)
- (b)  $\exists$  a book  $b$  such that  $\forall$  people  $p$ ,  $p$  has read  $b$ . (1 marks)

**Question 4.** Prove or disprove: For all real numbers  $x$ ,  $\lfloor x^2 \rfloor = (\lfloor x \rfloor)^2$ . (2 marks)

**Question 5** Solve the following Linear Diophantine Equation. (4 marks)

$$330x + 156y = -6.$$