

WATERFORD INSTITUTE OF TECHNOLOGY

HIGHER CERTIFICATE IN COMPUTER APPLICATIONS

EXAMINATION:

**MATHEMATICS
YEAR 1**

(SEMESTER ONE EXAM)

Spring 2006

DURATION: 2 HOURS

**EXAMINER: MS. ANN VEREKER
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INSTRUCTIONS TO CANDIDATES

1. ATTEMPT THREE QUESTIONS
2. ALL QUESTIONS CARRY EQUAL MARKS

EQUIPMENT/MATERIALS SUPPLIED

1. GRAPH PAPER.

Question 1

(a) If $A = \begin{pmatrix} 3 & -2 \\ -4 & 6 \end{pmatrix}$, $B = \begin{pmatrix} 0 & -7 \\ 5 & -1 \end{pmatrix}$ and $C = \begin{pmatrix} -9 \\ -8 \end{pmatrix}$ then calculate

- (i) $3A - 2B$
- (ii) BA
- (iii) $(A + B)C$

(10 marks)

(b) Find $\begin{pmatrix} 3 & -1 \\ 2 & 7 \end{pmatrix}^{-1}$ if it exists.

(3 marks)

(c) Solve the following set of equations by using Cramer's Rule.

$$\begin{aligned} 3x &= y - 9 \\ 2x + 7y &= 17 \end{aligned}$$

(7 marks)

(Total 20 marks)

Question 2

A computer call-centre company employs two types of employees – Sales and Service employees. The company has office space for only 50 employees but there must always be at least 10 Sales and 12 Service employees on duty at any one time to satisfy customers' needs. A Sales employee wages are €9 per hour and a Service employee earns €6 per hour. The total hourly wage bill for all employees which the company can afford is limited to €360. The profit to the company for employing a Sales employee is estimated as €300 per hour and the profit from a Service employee to the company is estimated as €210 per hour.

Using an appropriate linear programming method, find the number of each type of employee which the company should employ to maximise its profits and calculate this profit.

(20 marks)

Question 3

Use the Simplex Method to find the maximum of

$$w = 6x + 4y$$

subject to the following constraints:

$$8x + 2y \leq 32$$

$$2x + 6y \leq 30$$

$$x, y \geq 0$$

(20 marks)

Question 4

- (a) Construct a truth table to illustrate all possible truth-values for the following compound logical proposition:

$$\neg p \leftrightarrow q$$

(3 marks)

- (b) Construct a truth table to determine whether the following is a tautology, a contradiction or neither. Give a reason for your answer.

$$q \rightarrow (\neg q \wedge p)$$

(5 marks)

- (c) Construct a truth table to prove the following logical equivalence law.

$$\neg(p \wedge q) \Leftrightarrow \neg p \vee \neg q$$

(6 marks)

- (d) Determine the truth-value of each of the following statements if the universe for all variables is the set of integers \mathbf{Z} . In each case justify your answer.

- (i) $\exists x (\sqrt{x} = -5)$
- (ii) $\forall x (-x < 0)$
- (iii) $\exists x \exists y (xy < -\infty)$
- (iv) $\forall x \forall y (x + y = y + x)$
- (v) $\exists x (x > x^2)$
- (vi) $\forall x \forall y (xy > 0)$

(6 marks)

(Total 20 marks)