

**You may not use calculators, cell phones, or PDAs during the exam. Partial credit is possible. Please read the entire test over before starting. Please put a box around your solutions so that the grader can find them easily.**

Print your name clearly:

Print your student number clearly:

Please sign here:

Problem 1

Problem 2

Problem 3

Problem 4

Problem 5

Problem 6

Total

1. (5 points) Consider the following linear programming problem:

Maximize  $4x_2 + x_3$

Subject to

$$\begin{array}{rcll} x_1 & +x_2 & +x_3 & \leq & 1 \\ x_1 & & & \leq & 9 \\ & -x_2 & +3x_3 & \leq & -2 \\ x_1 & & -x_3 & \leq & -2 \end{array}$$

where  $x_1, x_2, x_3 \geq 0$ .

What is the dual problem?

$$A = \begin{pmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & -1 & 3 \\ 1 & 0 & -1 \end{pmatrix} \quad \vec{b} = \begin{pmatrix} 1 \\ 9 \\ -2 \\ -2 \end{pmatrix} \quad \vec{c} = \begin{pmatrix} 0 \\ 4 \\ 1 \end{pmatrix}$$

dual problem:

minimize  $w_1 + 9w_2 - 2w_3 - 2w_4$

subject to

$$w_1 + w_2 + w_4 \geq 0$$

$$w_1 - w_3 \geq 4$$

$$w_1 + 3w_3 - w_4 \geq 1$$

$$w_1, w_2, w_3, w_4 \geq 0$$

