

University of Ottawa
Department of Mathematics and Statistics

MAT 1302B: Mathematical Methods II
Professor: Alistair Savage

First Midterm Test
February 5, 2010

Surname _____ First Name _____

Student # _____ DGD (1-4) _____

Instructions:

- (a) You have 80 minutes to complete this exam.
- (b) The number of points available for each question is indicated in square brackets.
- (c) Unless otherwise indicated, you must justify your answers to receive full marks.
- (d) All work to be considered for grading should be written in the space provided. The reverse side of pages is for scrap work. If you find that you need extra space in order to answer a particular question, you should continue on the reverse side of the page and indicate this **clearly**. Otherwise, the work written on the reverse side of pages will not be considered for marks.
- (e) Write your student number at the top of each page in the space provided.
- (f) No notes, books, scrap paper, calculators or other electronic devices are allowed.
- (g) You should write in **pen**, not pencil
- (h) You may use the last page of the exam as scrap paper.

Good luck!

Please do not write in the table below.

Question	1	2	3	4	5	6	Total
Maximum	5	3	5	4	4	4	25
Grade							

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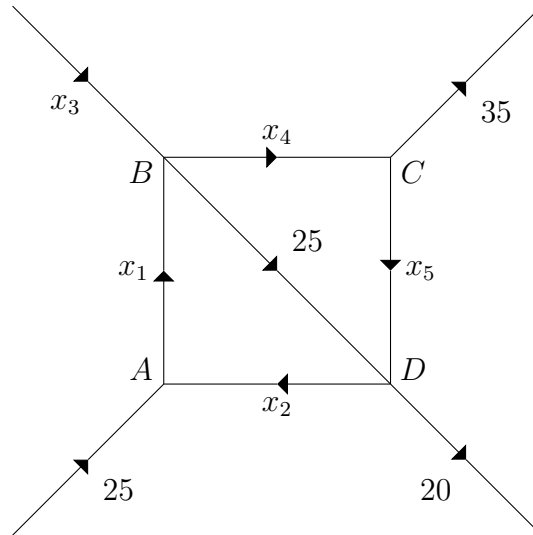
1. [5 pts] Is the following linear system consistent or inconsistent? If it is consistent, find the general solution.

$$x_1 + 2x_3 + 5x_4 + 7x_5 = x_2 + 1$$

$$-x_1 + 2x_2 = x_2 + x_4 + x_5 - 3$$

$$x_1 - x_2 + x_3 + 6x_4 + 5x_5 - 5 = -x_1 + x_2 + 2x_4$$

2. [3 pts] Write down a system of equations describing the following traffic flow problem. The letters *A* through *D* label intersections and numerical values indicate flow in cars per minute. The arrows indicate the direction of flow (all roads are one-way). You do **not** need to solve the system.



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3. [5 pts] Find the general solution to the matrix-vector equation

$$\begin{bmatrix} 1 & -1 & 2 & 3 & -2 \\ 2 & -2 & 6 & 6 & 4 \end{bmatrix} \vec{x} = \begin{bmatrix} 1 \\ 2 \end{bmatrix}.$$

Write your answer in **vector parametric form**.

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4. [4 pts] Are the vectors $(1, 2, 3)$, $(-1, 1, 1)$ and $(1, 5, 7)$ linearly independent or linearly dependent?

5. [4 pts] Consider the vectors

$$\vec{a}_1 = \begin{bmatrix} 0 \\ 1 \\ 2 \\ 1 \end{bmatrix}, \quad \vec{a}_2 = \begin{bmatrix} 3 \\ -2 \\ -1 \\ -2 \end{bmatrix}, \quad \vec{a}_3 = \begin{bmatrix} -1 \\ 4 \\ 7 \\ 4 \end{bmatrix}, \quad \vec{b} = \begin{bmatrix} 2 \\ 1 \\ 5 \\ 1 \end{bmatrix}.$$

Is \vec{b} in $\text{Span}\{\vec{a}_1, \vec{a}_2, \vec{a}_3\}$?

6. [4 pts] Suppose a linear system has augmented matrix

$$\left[\begin{array}{cc|c} 1 & 3 & 2 \\ 3 & p+5 & q+9 \end{array} \right]$$

for some real numbers p and q . For which values of p and q does the system have:

- (a) No solution?
- (b) Exactly one solution?
- (c) Infinitely many solutions?

Your answers should include all possibilities for the values of p and q . Write your final answer in the spaces at the bottom of the page.

Final Answer: (a)

(b)

(c)

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