

UNIVERSITY OF MANITOBA

DATE: June 9, 2009

MIDTERM II

TITLE PAGE

COURSE: MATH 1210

TIME: 50 minutes

EXAMINATION: Classical and Linear Algebra

EXAMINER: M. Davidson

FAMILY NAME: (Print in ink) _____

GIVEN NAME(S): (Print in ink) _____

STUDENT NUMBER: _____

SIGNATURE: (in ink) _____
(I understand that cheating is a serious offense)

INSTRUCTIONS TO STUDENTS:

This is a 50 minute exam. **Please show your work clearly.**

No texts, notes, or other aids are permitted. There are no calculators, cellphones or electronic translators permitted.

This exam has a title page, 5 pages of questions and also 1 blank page for rough work. Please check that you have all the pages. You may remove the blank page if you want, but be careful not to loosen the staple.

The value of each question is indicated in the lefthand margin beside the statement of the question. The total value of all questions is 50 points.

Question	Points	Score
1	6	
2	4	
3	8	
4	10	
5	10	
6	12	
Total:	50	

Answer all questions on the exam paper in the space provided beneath the question. If you need more room, you may continue your work on the reverse side of the page, but **CLEARLY INDICATE** that your work is continued.

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- [6] 1. For each of the following pairs \vec{u} , \vec{v} , find $\vec{u} \cdot \vec{v}$. If the vectors are orthogonal, indicate so by writing 'ORTHO', else write 'NOT ORTHO'.

(a) $\vec{u} = \begin{bmatrix} 1 \\ -3 \end{bmatrix}$ $\vec{v} = \begin{bmatrix} 7 \\ 4 \end{bmatrix}$

(b) $\vec{u} = \begin{bmatrix} 2 \\ 5 \\ -3 \end{bmatrix}$ $\vec{v} = \begin{bmatrix} 7 \\ -4 \\ -2 \end{bmatrix}$

(c) $\vec{u} = \begin{bmatrix} 3 \\ -2 \\ -11 \end{bmatrix}$ $\vec{v} = \begin{bmatrix} 5 \\ 4 \\ -1 \end{bmatrix}$

- [4] 2. Find the determinant of the matrix $A = \begin{pmatrix} -1 & 3 & 4 \\ 1 & 6 & -5 \\ -2 & 2 & 7 \end{pmatrix}$ by expansion along the second column. Show your steps carefully.

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- [8] 3. Find, in standard form, an equation of the plane that contains the point $(3, 4, -1)$ and the line $[x, y, z] = [1, 3, 2] + t[-1, 1, -1]$.
(Hint: Can you use the information given to find two vectors in the plane? How would you use that information to find the plane normal?)

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[10] 4. Let $A = \begin{pmatrix} 4 & -1 & 5 \\ 3 & 0 & 6 \end{pmatrix}$, $B = \begin{pmatrix} 3 & -1 \\ 2 & 0 \\ -3 & 5 \end{pmatrix}$, $C = \begin{pmatrix} 3 & -4 \\ 2 & 7 \end{pmatrix}$, $D = \begin{pmatrix} 2 & 3 & -5 \\ 1 & 0 & -1 \\ -4 & 2 & 5 \end{pmatrix}$,
 $E = (-1 \ 3 \ 2)$ and $F = \begin{pmatrix} 5 \\ 2 \\ -3 \end{pmatrix}$.

Evaluate the expression if it is defined. If it is undefined, *clearly* explain why.

(a) $AB + C + I_2$

(b) $BC + AD$

(c) $2E^T - 3DF$

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- [10] 5. For each of the following matrices, do ALL of the following:
- (a) Decide if the matrix is in row echelon form. If it is, write 'REF' beside or below, else write 'NOT REF'.
 - (b) Decide if the matrix is in reduced row echelon form. If it is, write 'RREF' beside or below, else write 'NOT RREF'.
 - (c) Interpret the matrix as row equivalent to the augmented matrix of a system of equations (having variables x_1, x_2 , etc.). Find the solution to that system.

$$A = \begin{pmatrix} 1 & 5 & 0 & 0 & 7 & 0 & 7 \\ 0 & 0 & 1 & 0 & -2 & 0 & 4 \\ 0 & 0 & 0 & 1 & 3 & 0 & -2 \\ 0 & 0 & 0 & 0 & 0 & 1 & 6 \end{pmatrix}$$

$$B = \begin{pmatrix} 1 & -3 & 4 & 4 \\ 0 & 1 & -2 & -4 \\ 0 & 0 & 1 & -3 \end{pmatrix}$$

$$C = \begin{pmatrix} 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 2 & 0 & 0 \\ 0 & 1 & 3 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix}$$

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[12] 6. Solve the following system using Gauss-Jordan elimination:

$$3x + 5y + z = 5$$

$$2x + 3y + 2z = 8$$

$$4x + 10y - z = 4$$