

THE UNIVERSITY OF MANITOBA

DATE: October 25, 2004

**Midterm Examination**

DEPARTMENT & COURSE NO. 136.130

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EXAMINATION: Vector Geometry & Linear Algebra

TIME: 1 Hour

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**(10)** 1. Solve, by Gauss-Jordan elimination, the system:

$$2x_1 + x_2 + x_3 = 7,$$

$$x_1 + x_2 - x_3 = 0,$$

$$3x_1 + x_2 + 3x_3 = 14.$$

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(7) 2. Evaluate  $\det \begin{bmatrix} 2 & 0 & 11 \\ 1 & 2 & 3 \\ -3 & -2 & -8 \end{bmatrix}$  by row reduction to the determinant of an upper

triangular matrix. No other method will be awarded marks. Show all your work.

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(10) 3. Evaluate  $\det \begin{bmatrix} 5 & 2 & 6 \\ 7 & 3 & 0 \\ 1 & 4 & 8 \end{bmatrix}$  by expansion using column 2. No other method will be

awarded marks. Show all your work.

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(9) 4. Let  $A = \begin{bmatrix} -40 & 16 & 9 \\ 13 & -5 & -3 \\ 5 & -2 & -1 \end{bmatrix}$ .

a) Find  $A^{-1}$ . Note:  $A^{-1}$  has only integer entries.

b) Use  $A^{-1}$  to solve  $AX = \begin{bmatrix} 1 \\ -2 \\ -1 \end{bmatrix}$ .

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(10) 5. Let  $A = \begin{bmatrix} 1 & 2 \\ 3 & 0 \end{bmatrix}$ ,  $B = \begin{bmatrix} 3 & -1 & 2 \\ 1 & 0 & 4 \end{bmatrix}$ ,  $C = \begin{bmatrix} 1 & -1 \\ 2 & 1 \\ -2 & 3 \end{bmatrix}$ ,  $D = \begin{bmatrix} 1 & 2 & -1 \\ 1 & 0 & 2 \\ -2 & -3 & 1 \end{bmatrix}$ .

Calculate defined expressions; write "undefined" beside undefined expressions.

a)  $CA + DB^T =$

b)  $A^2 =$

c)  $B^2 =$

d)  $AB - 3C =$

e)  $B^T B =$

(14) 6. Let  $A = \begin{bmatrix} 0 & 1 \\ 2 & 4 \end{bmatrix}$ .

a) Using only elementary row operations, transform  $A$  into  $I_2$ . Use suitable notation (or words) to explain what each elementary row operation is.

b) Find elementary matrices  $E_1, E_2, \dots, E_n$ , such that  $E_n \dots E_2 E_1 A = I_2$ .

c) For each  $E_i$  found in b), give the inverse  $E_i^{-1}$ .

d) Using the above results, express  $A$  as an explicit product of elementary matrices.