UNIVERSITY OF MANITOBA

DATE: March 10, 2010

TERM TEST 2
TITLE PAGE
TIME: 1 hour
EXAMINER: D. Kalajdzievska

DEPARTMENT & COURSE NO: MATH 1010
EXAMINATION: Applied Finite Mathematics

NAME: (Print in ink) _____

STUDENT NUMBER: _____

SIGNATURE: (in ink) _____

(I understand that cheating is a serious offense)

Please indicate your instructor and section by placing a check mark in the appropriate box below.

☐ A01 (TR 10:00)
☐ A02 (MWF 12:30)

INSTRUCTIONS TO STUDENTS:

This is a 1 hour exam.

No texts or notes are permitted. Single line display calculators are permitted. Cell phones, electronic translators, and other electronic devices are **not** permitted.

This exam has a title page and 11 pages of questions, including 2 blank pages for rough work. Please check that you have all the pages. You may remove the blank pages if you want, but be careful not to loosen the staples.

There are 24 questions.

Answer all questions on the BUBBLE SHEET PROVIDED. If you need more scrap paper, use the back of the question pages. When you are done, hand in both your bubble sheet, and this booklet.

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Questions 1, 2, and 3 refer to the following linear programming problem:

Rajah is opening a shoe factory that manufactures and sells boots and sandals. A pair of boots makes a profit of \$53, and needs 2 ft^2 of leather, 3 hours of machine power, and 7 hours of man power to be made. A pair of sandals makes \$21 profit, and needs 1 ft^2 of leather, 5 hours of machine power, and 10 hours of man power to be made. Considering Rajah only has 730 ft^2 of leather, 1000 hours of machine power, and 3500 hours of man power to use, she would like to maximize her profit. (We denote number of pairs of boots as x and sandals as y.)

1. What is the objective function of this problem?

   A. Maximize $P = 53x + 21y$

   B. Maximize $P = 21x + 53y$

   C. Minimize $P = 53x + 21y$

   D. Maximize $P = 2x + y$

   E. None of the above

2. What is the number of constraints for the problem?

   A. 3

   B. 4

   C. 5

   D. 6

   E. None of the above

3. Which of the following is a constraint of the problem?

   A. $2x + y \geq 730$

   B. $7x + 10y \leq 3500$

   C. $5x + 3y \leq 1000$

   D. $3x + 5y \geq 1000$

   E. None of the above

Questions 4 and 5 refer to the following:

A linear programming problem has a feasible set with the following corner points: $(0,0)$, $(8,0)$, $(0,10)$, and $(7,5)$:

4. Which point maximizes the objective function $R = x + 2y$?

   A. $(0,0)$

   B. $(7,5)$

   C. $(8,0)$

   D. $(0,10)$

   E. None of the above

5. Which point minimizes the objective function $C = 11 - x + 4y$?

   A. $(0,0)$

   B. $(7,5)$

   C. $(8,0)$

   D. $(0,10)$

   E. None of the above

Questions 6-15 refer to the following set of matrices:

$$A = \begin{bmatrix} 1 & 2 \\ -3 & 4 \end{bmatrix}, \qquad B = \begin{bmatrix} 0 & -1 & 7 \\ 4 & 2 & 1 \end{bmatrix}, \qquad C = \begin{bmatrix} 3 & -1 \\ 2 & 0 \\ -3 & 5 \end{bmatrix},$$

$$E = \begin{bmatrix} 2 \\ -2 \\ 0 \end{bmatrix}, \qquad F = \begin{bmatrix} 0 & 5 & 1 \end{bmatrix}.$$

6. What is the $(3,2)$ entry of C?

   A. -3

   B. 2

   C. 0

   D. 5

   E. None of the above

7. What is the size of the matrix E?

   A. 3x3

   B. 1x1

   C. 3x1

   D. 1x3

   E. None of the above

8. What is the matrix $-\frac{1}{2}B$?

   A. $\begin{bmatrix} 0 & -1/2 & 7/2 \\ 2 & 1 & 1/2 \end{bmatrix}$

   B. $\begin{bmatrix} 0 & 1/2 & -7/2 \\ -2 & -1 & -1/2 \end{bmatrix}$

   C. $\begin{bmatrix} 0 & -2 & 14 \\ 8 & 4 & 2 \end{bmatrix}$

   D. $\begin{bmatrix} 0 & 2 & -14 \\ -8 & -4 & -2 \end{bmatrix}$

   E. None of the above

9. What is the matrix BC+2A?

   A. $\begin{bmatrix} -22 & 37 \\ 10 & 13 \end{bmatrix}$

   B. $\begin{bmatrix} -21 & 39 \\ 7 & 9 \end{bmatrix}$

   C. $\begin{bmatrix} -21 & 39 \\ 7 & 17 \end{bmatrix}$

   D. $\begin{bmatrix} 21 & 37 \\ 19 & 17 \end{bmatrix}$

   E. None of the above

10. What is the matrix A-3C?

A. $\begin{bmatrix} 8 & -5 \\ 9 & -4 \\ -9 & 15 \end{bmatrix}$

B. $\begin{bmatrix} 8 & -5 \\ 9 & -4 \end{bmatrix}$

C. $\begin{bmatrix} -8 & 5 \\ -9 & 4 \\ -9 & 15 \end{bmatrix}$

D. $\begin{bmatrix} -8 & 5 \\ -9 & 4 \end{bmatrix}$

E. None of the above

11. What is the (2,2) entry of AC?

A. 4

B. -6

C. 2

D. 3

E. None of the above

12. What is the matrix A^2?

A. $\begin{bmatrix} 1 & 4 \\ 9 & 16 \end{bmatrix}$

B. $\begin{bmatrix} 1 & 4 \\ -9 & 16 \end{bmatrix}$

C. $\begin{bmatrix} 5 & 15 \\ 13 & 10 \end{bmatrix}$

D. $\begin{bmatrix} -5 & 10 \\ -15 & 10 \end{bmatrix}$

E. None of the above

13. What is the (3,1) entry of B^T?

A. 1

B. 2

C. 7

D. -1

E. None of the above

14. What is the size of the matrix $(EF)^T C - B^T A$?

A. 3x3

B. 1x1

C. 3x1

D. 1x3

E. None of the above

15. What single elementary row operation would simplify the accompanying augmented matrix to row echelon form? $\left[\begin{array}{ccc|c} 1 & 0 & -2 & 5 \\ 0 & 1 & 2 & 3 \\ 0 & 3 & 7 & 6 \end{array}\right]$

A. Divide the third row by 3

B. Add a -2 times the third row to the second

C. Add a -2 times the second row to the third

D. This cannot be done in a single operation

E. None of the above

16. The augmented matrix associated with the system of equations

$x - 6y + 8z = 12$

$3x - 2y + z = -1$

$4y + 2z - 4 = 0$

is:

A. $\left[\begin{array}{ccc|c} 1 & -6 & 8 & 12 \\ 3 & -2 & 1 & -1 \\ 0 & 4 & 2 & 0 \end{array}\right]$

B. $\left[\begin{array}{ccc|c} 1 & -6 & 8 & 12 \\ 3 & -2 & 1 & -1 \\ 0 & 4 & 2 & -4 \end{array}\right]$

C. $\left[\begin{array}{ccc|c} 1 & -6 & 8 & 12 \\ 3 & -2 & 1 & -1 \\ 4 & 2 & -4 & 0 \end{array}\right]$

D. $\left[\begin{array}{ccc|c} 1 & -6 & 8 & 12 \\ 3 & -2 & 1 & -1 \\ 0 & 4 & 2 & 4 \end{array}\right]$

E. None of the above

17. When the augmented matrix for a system of 3 equations in 3 unknowns is partially simplified, the following matrix is obtained: $\left[\begin{array}{ccc|c} 1 & 2 & 3 & 4 \\ 0 & 1 & -3 & 4 \\ 0 & 1 & -3 & 2 \end{array}\right]$ What do you conclude about the number of solutions of the system.

A. There is no solution

B. There is exactly one solution

C. There are infinitely many solutions

D. There is not enough information to conclude how many solutions the system has

E. None of the above

18. You are given that the REF for the augmented matrix associated with a certain system of equations in x, y, and z is $\left[\begin{array}{ccc|c} 1 & -3 & 4 & -11 \\ 0 & 1 & 15 & 3 \\ 0 & 0 & 1 & 0 \end{array}\right]$. Therefore the solution of the system is:

A. $x = -20, y = 18, z = 0$

B. $x = -23 + 63z, y = 3 - 15z, z$ is arbitrary

C. $x = -2, y = 3, z = 0$

D. There is no solution

E. None of the above

19. You are given that the RREF for the augmented matrix associated with a certain system of equations is $\left[\begin{array}{ccc|c} 1 & 3 & 0 & 2 \\ 0 & 0 & 1 & 4 \\ 0 & 0 & 0 & 0 \end{array}\right]$. Therefore the solution of the system is:

A. x is arbitrary, $y = 2 - x, z = 4$

B. $x = 2 - 3y, y$ is arbitrary, $z = 4$

C. $x = 2 - 3z, y = -2 - 3z, y = 0, z$ is arbitrary

D. There is no solution

E. None of the above

20. Which of the following accurately describes the difference between Gaussian and Gauss-Jordan elimination:

A. Gauss-Jordan elimination always results in 0's above and below leading 1's

B. Gaussian elimination always results in 0's above and below leading 1's

C. Gaussian elimination results in less leading 1's

D. Gauss-Jordan elimination results in less leading 1's

E. None of the above

21. Which of these is in row echelon form

A. $\left[\begin{array}{ccc|c} 2 & -1 & 3 & 5 \\ 0 & 1 & -1 & 4 \\ 0 & 0 & 1 & 3 \end{array}\right]$

B. $\left[\begin{array}{ccc|c} 1 & -2 & 2 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 7 \end{array}\right]$

C. $\left[\begin{array}{ccc|c} 1 & -5 & 1 & 18 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & -15 \end{array}\right]$

D. $\left[\begin{array}{ccc|c} 1 & 1 & 10 & 0 \\ 0 & 0 & 1 & -6 \\ 0 & 1 & 0 & 9 \end{array}\right]$

E. None of the above

22. Which of these is in reduced row echelon form

A. $\left[\begin{array}{cccc|c} 1 & 2 & 0 & 0 & 4 \\ 0 & 0 & 0 & 1 & 3 \\ 0 & 0 & 1 & 0 & -2 \\ 0 & 0 & 0 & 0 & 1 \end{array}\right]$

B. $\left[\begin{array}{cccc|c} 1 & 2 & 0 & 0 & 4 \\ 0 & 0 & 1 & 0 & -2 \\ 0 & 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 0 & 2 \end{array}\right]$

C. $\left[\begin{array}{cccc|c} 1 & 2 & 1 & 0 & 4 \\ 0 & 0 & 1 & 0 & -2 \\ 0 & 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 0 & 1 \end{array}\right]$

D. $\left[\begin{array}{cccc|c} 1 & 2 & 0 & 0 & 4 \\ 0 & 0 & 1 & 0 & -2 \\ 0 & 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 0 & 1 \end{array}\right]$

E. None of the above

23. Given the matrix $A = \begin{bmatrix} 2 & 0 \\ 1 & -1 \end{bmatrix}$, A^{-1}=?

A. $\begin{bmatrix} \frac{1}{2} & 0 \\ \frac{1}{2} & \frac{-1}{2} \end{bmatrix}$

B. $\begin{bmatrix} 1 & 0 \\ \frac{1}{2} & \frac{-1}{2} \end{bmatrix}$

C. $\begin{bmatrix} \frac{1}{2} & 0 \\ \frac{1}{2} & 1 \end{bmatrix}$

D. $\begin{bmatrix} \frac{1}{2} & 0 \\ \frac{1}{2} & -1 \end{bmatrix}$

E. None of the above

24. Given the following system of equations:

$3x - y + 2z = 1$

$2x + z = 0$

$4x + 7y - z = -1$

(where A is the coefficient matrix for the system), and given that $A^{-1} = \begin{bmatrix} -7 & 13 & -1 \\ 6 & -11 & 1 \\ 14 & -25 & 2 \end{bmatrix}$, the solution to the system is:

A. $x = 1 - z, y = z, z$ is arbitrary

B. $x = -6, y = 5, z = 12$

C. $x = -6, y = 3, z = 17$

D. There is no solution

E. None of the above