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| <b>Multiple-choice exam: GRA 60352 Mathematics</b> |  |               |   |
| Examination date:                                  | 12.10.2012   | 14:00 – 15:00 | Total no. of pages: 4 incl. attachments<br>No. of attachments: 1 (1 page) |
| Permitted examination support material:            | A bilingual dictionary and BI-approved calculator TEXAS INSTRUMENTS BA II Plus                             |               |   |
| Answer sheets:                                     | Answer sheet for multiple-choice examinations<br>Counts 20% of GRA 6035 The questions are weighted equally |               |   |
| Ordinary exam                                      | Responsible department: Economics  |               |   |

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**PLEASE READ THE FOLLOWING BEFORE YOU BEGIN!**

- Students must themselves assure that the examination papers are complete.
- Students must provide the following information on the answer sheet:
  - Examination code
  - Personal initials
  - ID-nr

The ID-nr must be recorded with both the appropriate numbers and by putting an “X” by the corresponding number in the columns below.

- Do not use pencils or pens with green ink when filling in answer sheets. Answer sheets must not be used for rough drafts.
- **All answers must be recorded with an “X” under the letter you believe corresponds with the correct answer.**
- **Cancel an “X” by filling in the box completely (boxes that are completely filled in will not be registered). “X” in two boxes for one question will be registered as a wrong answer.**
- The attached example shows you how the answer sheet would be filled in if A were the correct answer for question 1, B correct for question 2, C correct for question 3 and D correct for question 4. An “X” under E indicates that you choose not to answer question 5.
- **Your answers are to be recorded on the answer sheet. Answers written on the examination papers and not on the answer sheets will not be graded.**
- There is only one right answer for each question. Because the questions are weighted equally, it can be to your advantage to answer the easiest questions first.
- Wrong answers are given -1 point, unanswered questions get 0 points (indicated by an “X” next to E”) and correct answers are given 3 points.
- You can keep the examination papers.

## This exam has 8 questions

### QUESTION 1.

Consider the linear system with augmented matrix

$$\left( \begin{array}{cccc|c} 1 & 2 & 3 & 4 & 0 \\ 0 & 1 & 1 & 1 & 3 \\ 1 & 0 & 1 & 2 & 1 \end{array} \right)$$

Which statement is true?

- (a) The linear system is inconsistent.
- (b) The linear system has a unique solution.
- (c) The linear system has one degree of freedom
- (d) The linear system has two degrees of freedom
- (e) I prefer not to answer.

### QUESTION 2.

Consider the vectors  $\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3$ , given by

$$\mathbf{v}_1 = \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}, \quad \mathbf{v}_2 = \begin{pmatrix} 0 \\ 2 \\ 3 \end{pmatrix}, \quad \mathbf{v}_3 = \begin{pmatrix} 1 \\ 4 \\ 0 \end{pmatrix}$$

Which statement is true?

- (a) The vectors  $\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3$  are linearly independent
- (b) The vectors  $\mathbf{v}_1, \mathbf{v}_2$  are linearly independent, and  $\mathbf{v}_3$  is a linear combination of  $\mathbf{v}_1, \mathbf{v}_2$
- (c) The vectors  $\mathbf{v}_1, \mathbf{v}_3$  are linearly independent, and  $\mathbf{v}_2$  is a linear combination of  $\mathbf{v}_1, \mathbf{v}_3$
- (d) The vectors  $\mathbf{v}_2, \mathbf{v}_3$  are linearly independent, and  $\mathbf{v}_1$  is a linear combination of  $\mathbf{v}_2, \mathbf{v}_3$
- (e) I prefer not to answer.

### QUESTION 3.

Compute the rank of the matrix

$$A = \begin{pmatrix} 1 & 2 & 1 \\ 2 & 1 & 2 \\ 6 & 6 & t \end{pmatrix}$$

Which statement is true?

- (a)  $\text{rk } A = 2$  for all  $t$
- (b)  $\text{rk } A = 2$  for  $t \neq 6$  and  $\text{rk } A = 3$  for  $t = 6$
- (c)  $\text{rk } A = 3$  for  $t \neq 6$  and  $\text{rk } A = 2$  for  $t = 6$
- (d)  $\text{rk } A = 3$  for all  $t$
- (e) I prefer not to answer.

QUESTION 4.

Consider the matrix

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

**Which statement is true?**

- (a)  $A$  has eigenvalues  $\lambda = 2$  and  $\lambda = 3$
- (b)  $A$  has eigenvalues  $\lambda = 4$  and  $\lambda = 1$
- (c)  $A$  has a single eigenvalue  $\lambda = 3$
- (d)  $A$  has eigenvalues  $\lambda = 5$  and  $\lambda = 0$
- (e) I prefer not to answer.

QUESTION 5.

Consider the matrix

$$A = \begin{pmatrix} 1 & s+1 & s \\ 0 & 1 & 4 \\ 0 & 0 & 3 \end{pmatrix}$$

**Which statement is true?**

- (a)  $A$  is diagonalizable for all  $s$
- (b)  $A$  is diagonalizable when  $s = 0$ , and non-diagonalizable for all other values of  $s$
- (c)  $A$  is diagonalizable when  $s = -1$ , and non-diagonalizable for all other values of  $s$
- (d)  $A$  is non-diagonalizable for all  $s$
- (e) I prefer not to answer.

QUESTION 6.

Consider the quadratic form

$$Q(x_1, x_2, x_3) = x_1^2 - 4x_1x_2 + 2x_2^2 - 3x_3^2$$

**Which statement is true?**

- (a)  $Q$  is positive definite
- (b)  $Q$  is positive semidefinite but not positive definite
- (c)  $Q$  is indefinite
- (d)  $Q$  is negative semidefinite
- (e) I prefer not to answer.

QUESTION 7.

Consider the function  $f(x, y, z) = 2x^2 + hy^3 + 3z^4$ . **Which statement is true?**

- (a)  $f$  is a convex function for all values of  $h$ .
- (b)  $f$  is a convex function for  $h \geq 0$ , and not convex for all other values of  $h$ .
- (c)  $f$  is convex function for  $h = 0$ , and not convex for all other values of  $h$ .
- (d)  $f$  is not a convex function for any value of  $h$ .
- (e) I prefer not to answer.

QUESTION 8.

Deleted because of a misprint in the original printed problem.