Multiple-choice exam:	**GRA 60352** Mathematics		
Examination date:	27.04.2015 09:00 – 10:00	Total no. of pages:	5 incl. attachments
		No. of attachments:	1 (1 page)
Permitted examination	A bilingual dictionary and BI-approved calculator TEXAS		
support material:	INSTRUMENTS BA II Plus		
Answer sheets:	Answer sheet for multiple-choice examinations		
	Counts 20% of GRA 6035	The questions have equal weight	
Re-take exam		Responsible department: Economics	

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 <u>one</u> 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 a linear system $A \cdot \mathbf{x} = \mathbf{b}$, where A is a 3×3 matrix with $\operatorname{rk} A = 3$ and $\mathbf{b}$ is a vector. **Which statement is true?**

    (a) The linear system has a unique solution
    (b) The linear system is inconsistent
    (c) The linear system has one degree of freedom
    (d) The number of solutions depends on the vector $\mathbf{b}$
    (e) I prefer not to answer.

QUESTION 2.

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

$$\mathbf{v}_1 = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}, \quad \mathbf{v}_2 = \begin{pmatrix} 1 \\ 2 \\ a \end{pmatrix}, \quad \mathbf{v}_3 = \begin{pmatrix} 2 \\ a-1 \\ 5 \end{pmatrix}$$

Which statement is true?

    (a) The vectors $\{\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3\}$ are linearly independent for all a
    (b) The vectors $\{\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3\}$ are linearly independent exactly when $a = 0$ or $a = 4$
    (c) The vectors $\{\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3\}$ are linearly independent exactly when $a \neq 0$ and $a \neq 4$
    (d) The vectors $\{\mathbf{v}_1, \mathbf{v}_2, \mathbf{v}_3\}$ are linearly independent exactly when $a \neq 3$
    (e) I prefer not to answer.

QUESTION 3.

Compute the rank of the matrix

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

Which statement is true?

    (a) $\operatorname{rk} A = 2$ for all h
    (b) $\operatorname{rk} A = 3$ for $h \neq 2$ and $\operatorname{rk} A = 2$ for $h = 2$
    (c) $\operatorname{rk} A = 3$ for $h \neq 2$ and $\operatorname{rk} A = 1$ for $h = 2$
    (d) $\operatorname{rk} A = 3$ for all h
    (e) I prefer not to answer.

Consider the matrix

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

Which statement is true?

(a) A has three positive eigenvalues
(b) A has two positive and one negative eigenvalue
(c) A has one positive and two negative eigenvalues
(d) A has three negative eigenvalues
(e) I prefer not to answer.

Consider the matrix A given by

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

Which statement is true?

(a) A is diagonalizable for all s
(b) A is diagonalizable exactly when $s = 1$
(c) A is diagonalizable exactly when $s \neq 1$
(d) A is not diagonalizable for any s
(e) I prefer not to answer.

Consider the quadratic form

$$f(x_1, x_2, x_3, x_4) = -x_1^2 + 4x_1x_2 + 3x_1x_3 - 5x_2^2 - 6x_3^2 - x_4^2$$

Which statement is true?

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

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

(a) f has local maximum points
(b) f has local minimum points
(c) f has stationary points, but all are saddle points
(d) f has no stationary points
(e) I prefer not to answer.

Consider the function f given by

$$f(x, y, z) = x^4 + hxy + y^4 + z^4 + z^2$$

Which statement is true?

(a) f is a convex function for all h
(b) f is a convex function for $h \geq 0$, and concave for $h < 0$
(c) f is a convex function for $h \leq 0$, and concave for $h > 0$
(d) f is a convex function for $h = 0$, and neither concave nor convex for $h \neq 0$
(e) I prefer not to answer.