

---

**Multiple-choice examination in: GRA 60352 Mathematics**

Examination date:	30.09.2011, 14:00 – 15:00
Permitted examination aids:	Bilingual dictionary BI-approved exam calculator: Texas Instruments BA II Plus™
Answer sheets:	Answer sheet for multiple choice examinations
Total number of pages:	5
Number of attachments:	1 (example of how to use the answer sheet)

---

**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 number

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

- Pens with green ink and pencils cannot be used in filling in answer sheets. Answer sheets must not be used for writing 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 simplest 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.

**Good luck!**

## This exam has 8 questions

### QUESTION 1.

Consider the linear system with augmented matrix

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

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

$$\mathbf{v}_1 = \begin{pmatrix} 1 \\ 3 \\ 7 \end{pmatrix}, \quad \mathbf{v}_2 = \begin{pmatrix} 2 \\ -1 \\ 3 \end{pmatrix}, \quad \mathbf{v}_3 = \begin{pmatrix} 3 \\ 16 \\ 32 \end{pmatrix}$$

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  $\mathbf{v}_1, \mathbf{v}_2$  are linearly independent, but  $\mathbf{v}_3$  is not a linear combination of  $\mathbf{v}_1, \mathbf{v}_2$
- (D) The vectors  $\mathbf{v}_1, \mathbf{v}_2$  are linearly dependent
- (E) I prefer not to answer.

### QUESTION 3.

Compute the rank of the matrix

$$A = \begin{pmatrix} 1 & 2 & -2 & 1 \\ 2 & 1 & -1 & 2 \\ 7 & 8 & -8 & h \end{pmatrix}$$

Which statement is true?

- (A)  $\text{rk } A = 2$  for all  $h$
- (B)  $\text{rk } A = 2$  for  $h \neq 7$  and  $\text{rk } A = 3$  for  $h = 7$
- (C)  $\text{rk } A = 3$  for  $h \neq 7$  and  $\text{rk } A = 2$  for  $h = 7$
- (D)  $\text{rk } A = 3$  for all  $h$
- (E) I prefer not to answer.

QUESTION 4.

Consider the matrix

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

Which statement is true?

- (A)  $A$  has eigenvalues  $\lambda = 4$  and  $\lambda = 6$
- (B)  $A$  has eigenvalues  $\lambda = 2$  and  $\lambda = 8$
- (C)  $A$  has a single eigenvalue  $\lambda = 3$
- (D)  $A$  has eigenvalues  $\lambda = 3$  and  $\lambda = 7$
- (E) I prefer not to answer.

QUESTION 5.

Consider the matrix

$$A = \begin{pmatrix} 1 & h & h^2 \\ 0 & 1 & h+4 \\ 0 & 0 & 2 \end{pmatrix}$$

Which statement is true?

- (A)  $A$  is diagonalizable for all  $h$
- (B)  $A$  is diagonalizable if  $h = -4$ , and non-diagonalizable for  $h \neq -4$
- (C)  $A$  is diagonalizable if  $h = 0$ , and non-diagonalizable for  $h \neq 0$
- (D)  $A$  is non-diagonalizable for all  $h$
- (E) I prefer not to answer.

QUESTION 6.

Consider the quadratic form

$$Q(x_1, x_2) = 3x_1^2 - 24x_1x_2 + 48x_2^2$$

Which statement is true?

- (A)  $Q$  is positive semidefinite but not positive definite
- (B)  $Q$  is negative semidefinite but not negative definite
- (C)  $Q$  is indefinite
- (D)  $Q$  is positive definite
- (E) I prefer not to answer.

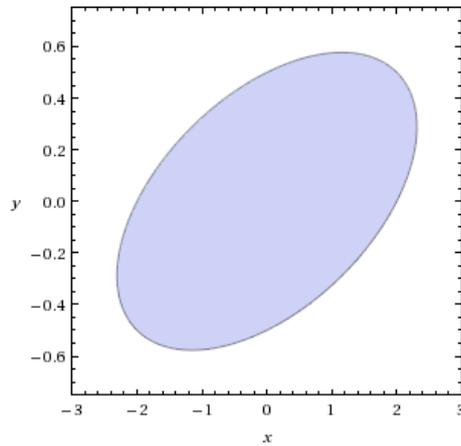
QUESTION 7.

Consider the function  $f$  defined on  $\mathbb{R}^3$ , given by

$$f(x_1, x_2, x_3) = x_1x_2x_3$$

Which statement is true?

- (A)  $f$  is a convex function but not a concave function
- (B)  $f$  is a convex function and a concave function
- (C)  $f$  is not a convex function but a concave function
- (D)  $f$  is neither a convex nor a concave function
- (E) I prefer not to answer.



QUESTION 8.

Consider the subset  $S = \{(x, y) : 3x^2 - 12xy + 48y^2 \leq 12\}$  of  $\mathbb{R}^2$ , which is shown as the shaded region in the figure.

**Which statement is true?**

- (A)  $S$  is a convex set that is closed and bounded
- (B)  $S$  is not a convex set, but it is closed and bounded
- (C)  $S$  is a convex set that is closed but not bounded
- (D)  $S$  is a convex set that is bounded but not closed
- (E) I prefer not to answer.