

**Mid-term examination in MA0002 Mathematical methods B**

Monday 6 March 2006 12:15–14:00

Permitted aids: Any written and printed material. One calculator.

*Mark one answer for each problem on the form overleaf. You will score one point for each right answer and zero points for each wrong answer. Multiple answers will score zero.*

*NB: There is text on both sides of the sheet. All problems have five alternative answers.*

**Problem 1.** What is the equation for the plane through  $(1, 0, 0)$  perpendicular to  $[-1 \ 0 \ 1]'$ ?

- (a)  $x - z = 1$    (b)  $x = -1$    (c)  $x = 1$    (d)  $z = 1$    (e)  $-x + z = 1$

**Problem 2.** Compute the determinant  $\begin{vmatrix} 4 & 2 & 3 \\ -2 & 7 & 1 \\ 0 & 5 & -3 \end{vmatrix}$ .

- (a)  $-85$    (b)  $-146$    (c)  $85$    (d)  $84$    (e)  $-84$

**Problem 3.** What is the inverse matrix of  $\begin{bmatrix} 1 & -3 \\ 2 & -1 \end{bmatrix}$ ?

- (a)  $\frac{1}{7} \begin{bmatrix} -1 & -3 \\ -2 & 1 \end{bmatrix}$    (b)  $\frac{1}{7} \begin{bmatrix} 1 & -3 \\ 2 & -1 \end{bmatrix}$    (c)  $\begin{bmatrix} -1 & -3 \\ -2 & 1 \end{bmatrix}$    (d)  $\begin{bmatrix} 1 & -3 \\ 2 & -1 \end{bmatrix}$    (e) The matrix is not invertible

**Problem 4.** We consider the initial-value problem  $dy/dx = x/y$ , where  $y = 3$  when  $x = 5$ . What is an approximate value of  $y$  when  $x = 6$ ?

- (a) 4,5   (b) 2,5   (c) 2   (d) 4   (e) 3,5

**Problem 5.** What is the lower-left entry of the product  $\begin{bmatrix} 1 & -3 & 0 \\ -2 & -1 & 4 \end{bmatrix} \begin{bmatrix} 2 & -1 \\ 5 & 3 \\ -4 & -5 \end{bmatrix}$ ?

- (a)  $-10$    (b)  $-8$    (c)  $-25$    (d)  $-13$    (e)  $8$

**Problem 6.** Let  $y$  be a measure of the amount of crystallizable milk fat in a sample after  $t$  hours. Then  $y$  satisfies the differential equation  $dy/dt = 8(y^5 - y)$ . Which kinds of equilibrium points does this differential equation have? (It is given that  $y^5 - y = y(y - 1)(y + 1)(y^2 + 1)$ .)

(a) One stable and four unstable   (b) Four stable and one unstable   (c) One stable and two unstable   (d) Two stable and one unstable   (e) Three stable

**Problem 7.** In a bird population with  $x_1$  hatchlings and  $x_2$  adults the number of hatchlings next year is  $0,5x_1 + 2x_2$  and the number of adults the next year is  $0,5x_1 + 0,5x_2$ . If  $\mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$  and  $L = \begin{bmatrix} 0,5 & 2 \\ 0,5 & 0,5 \end{bmatrix}$ , then the number of hatchlings and the number of adults after  $n$  years are given by  $L^n \mathbf{x}$ . What is the long-term relative growth rate of the population?

- (a) 1,0   (b) 1,5   (c) 0,8   (d) 0,6   (e) 1,2

**Problem 8.** We consider the same bird population as in the preceding problem. What is the long-term ratio of the number of hatchlings to the number of adults?

- (a) 2 : 3   (b) 3 : 2   (c) 2 : 1   (d) 1 : 2   (e) 1 : 1

**Problem 9.** Assume that  $x$ ,  $y$  and  $z$  satisfy the system  $x - 3y + 2z = -9$ ,  $3x + 2y + 5z = -3$ ,  $y + z = 0$  of equations. Which of the following is true?

- (a)  $y = -1$    (b)  $y = 5$    (c)  $y = 2$    (d) The system of equations has no solution   (e) The

system of equations has infinitely many solutions

**Problem 10.** Let  $y$  be a solution of the initial-value problem  $dy/dt - 2ty = 2t$ , where  $y = 1$  when  $t = 0$ . What is  $y$  equal to when  $t = 1$ ?

- (a)  $2e$    (b)  $e - 2$    (c)  $e$    (d)  $2e - 1$    (e)  $e - 1$

Problem	a	b	c	d	e
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Studentnummer	Student number

Studieprogram	Study program

Inspektør	Inspector