

Application number: _____ Name: _____

Entrance examination – Question sheet (Mathematics)
Department of Space and Astronautical Science,
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Question 1-1

Find the indefinite integral of the following function:

$$\frac{1}{\sqrt{(x-\beta)(\alpha-x)}} \quad (\beta < x < \alpha)$$

You can use the following parameter: $t = \sqrt{(\alpha-x)/(x-\beta)}$

Question 1-2

Answer the following questions about the following function:

$$y = x^2 e^x$$

- (1) Find the second derivative.
- (2) Find the n -th derivative, where n is a positive integer.

Application number: _____ Name: _____

Question 1–3

Solve the following partial differential equation. You can let $u(t, x) = T(t)X(x)$.

$$\frac{\partial u(t, x)}{\partial t} = \frac{\partial^2 u(t, x)}{\partial x^2} \quad (t \geq 0, \quad 0 \leq x \leq 1)$$

$$u(t = 0, x) = \sin^2 \pi x$$

where the boundary conditions are as follows:

$$\frac{\partial u(t, 1)}{\partial x} = 0, \quad u(t, x = 0) = 0$$

Application number: _____ Name: _____

Question 2-1

Answer the following questions. Write the answer as well as the process of derivation.

(1) Answer whether the inverse matrix of the following matrix exists or not. If it exists, show the inverse matrix.

i) $A = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix}$

ii) $B = \begin{pmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 2 & 3 & 0 \end{pmatrix}$

(2) Solve the following system of equations:

$$\begin{aligned} 2y + z &= 4 \\ x + 3y + 2z &= 2 \\ 2x + 3z &= 4 \end{aligned}$$

Question 2-2

Show the conditions where the following set of vectors is linearly independent.

$$b_1 = \begin{pmatrix} m-1 \\ 1 \\ 1 \end{pmatrix}, \quad b_2 = \begin{pmatrix} 1 \\ m-1 \\ 1 \end{pmatrix}, \quad b_3 = \begin{pmatrix} 1 \\ 1 \\ m-1 \end{pmatrix}$$

(* This material is collected after the exam.)