

2012年度日本政府(文部科学省)奨学金留学生選考試験

QUALIFYING EXAMINATION FOR APPLICANTS FOR JAPANESE  
GOVERNMENT (MONBUKAGAKUSHO) SCHOLARSHIPS 2012

学科試験 問題

EXAMINATION QUESTIONS

(高等専門学校留学生)

COLLEGE OF TECHNOLOGY STUDENTS

数 学

MATHEMATICS

注意 ☆試験時間は60分

PLEASE NOTE : THE TEST PERIOD IS 60 MINUTES.

## MATHEMATICS

Nationality		No.		Marks
Name	(Please print full name, underlining family name)			

1 Answer all questions and write your answers in the boxes provided.

1) Solve the equation  $2x^3 + 3x^2 - 8x + 3 = 0$ .

$x =$

2) Solve the equation  $4 \sin x \cos x - 1 = 0$  for  $0 \leq x \leq \frac{\pi}{2}$ .

$x =$

3) Solve the inequality  $4^x - 2^{x+1} > 48$ .

4) Solve the inequality  $\log_4(2 - x) > \log_2 x$ .

5) Let  $\vec{a} = (2, 5)$  and  $\vec{b} = (1, -1)$ . Find the value of the constant  $t$  which minimizes  $|\vec{a} + t\vec{b}|$ .

$t =$

- 6) Find the angle  $\theta$  between the two lines  $x - 2y = 3$  and  $3x - y = 2$ , where the range of values of  $\theta$  is  $0 \leq \theta \leq \frac{\pi}{2}$ .

$\theta =$

- 7) Calculate  $\sum_{k=1}^{100} \frac{1}{k(k+1)}$ .

- 8) Calculate  $\lim_{x \rightarrow \infty} \frac{\sqrt{x+1} - \sqrt{x}}{\sqrt{3x+5} - \sqrt{3x+1}}$ .

- 9) Calculate  $\lim_{x \rightarrow 0} \frac{\log(1+3x)}{x}$ .

- 10) A single dice is thrown four times. Find the probability of getting a 5 twice.

- 11) Find the derivative  $\frac{dy}{dx}$  of  $y = \log \sqrt{\frac{1+\sin x}{1-\sin x}}$ .

- 12) Calculate  $\int_0^{\frac{\pi}{6}} \cos^3 x dx$ .

2 Let  $A = \begin{pmatrix} 1 & 3 \\ 2 & 4 \end{pmatrix}$  and  $I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ .

1) Calculate  $A^2 - 5A$ .

2) Calculate  $A^3 - 5A^2 + A + I$ .

3) Calculate  $A^4 - 3A^3 - 10A^2 + A + I$ .

3 Let  $l$  be the tangent line to the curve  $y = 4 - x^2$  at the point  $(a, 4 - a^2)$ , where  $a > 0$ . Denote by  $S(a)$  the area of the triangle enclosed by the  $x$ -axis, the  $y$ -axis and  $l$ .

1) Find the equation of  $l$ .

2) Find  $S(a)$ .

3) Find the minimum value of  $S(a)$ .