

2020 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 (MEXT) SCHOLARSHIP 2020

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

(2020)

MATHEMATICS

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

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

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

$x =$

2) Solve the equation  $\cos 2x + 4 \cos x + 3 = 0$  ( $0 \leq x \leq 2\pi$ ).

$x =$

3) Express  $\left| \pi - \frac{20}{7} \right| + \left| \pi - \frac{23}{7} \right|$  without the absolute value symbols.

4) Solve the equation  $3^{2x+2} - 10 \cdot 3^x + 1 = 0$ .

$x =$

5) Solve the inequality  $\log_2 x + \log_2(x - 1) > \log_2(x + 3)$ .

6) Calculate the area of the triangle whose vertices are  $(1, 1, 1)$ ,  $(-1, 0, 1)$  and  $(1, -1, -1)$  in the  $xyz$ -space.

7) Let  $\alpha : x - 3y + 2z + 7 = 0$ . Let  $l$  be the line which is perpendicular to  $\alpha$  and goes through the point  $(0, 0, 0)$ . Find the intersection point  $(x, y, z)$  of  $\alpha$  and  $l$ .

  

8) Find all tangent lines to the curve  $y = x \sin x$  which goes through the point  $(0, 0)$ .

9) Calculate the infinite series  $\sum_{n=1}^{\infty} a_n$  for the sequence  $\{a_n\}$  defined as follows:

$$a_1 = 2, \quad 2a_{n+1} + a_n = 0.$$

10) Calculate  $\lim_{x \rightarrow -0} \frac{1 - \cos 4x}{x |x|}$ .

11) Let  $f(x) = \log_{\sqrt{e}} \sqrt{x+1}$ . Calculate  $f'(x)$ .

$$f'(x) =$$

12) Calculate  $\int_{-\pi}^{\pi} e^{2x} \sin x \, dx$ .

2 For real numbers  $a, b$ , ( $b > 0$ ), let  $I = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$  and  $A = \begin{pmatrix} a & b \\ -b & a \end{pmatrix}$  satisfy  $A^2 + 2A = -4I$ . Answer the following questions and write your answers in the boxes provided.

1) Find  $a$  and  $b$ .

$a =$	$b =$
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2) Calculate  $A^{-1}$ .

$A^{-1} = \begin{pmatrix} & \\ & \end{pmatrix}$
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3) Calculate  $(A^{-1})^{3n}$ .

$(A^{-1})^{3n} = \begin{pmatrix} & \\ & \end{pmatrix}$
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3 Let  $C_1 : y = x^2 + 2x$  and  $C_2 : y = x^2 - 4x + 6$ . Answer the following questions and write your answers in the boxes provided.

1) Find the intersection point  $(x, y)$  of  $C_1$  and  $C_2$ .

$x =$                        $y =$

2) Find the common tangent line  $l$  of  $C_1$  and  $C_2$ .

3) Calculate the area of the region bounded by  $C_1$ ,  $C_2$  and  $l$ .