

**Basic Mathematics Aptitude Test**

(Full score: 40)

**Please Note:**

- You have 60 minutes to complete.
- No calculators are allowed.
- Please show all your work and write your answers in the designated space.

*Thank you.*

**Country:** \_\_\_\_\_

**Reference Number:** \_\_\_\_\_

**Name:** \_\_\_\_\_

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**(Please show all your work here and write your answers in the designated space.)**

**[Part 1] (1 point for each question) Answer the following questions:**

1. Calculate the following.

$$\log_9 \frac{1}{6} + \log_9 18 - \log_9 4 + \log_9 108$$

Answer: \_\_\_\_\_

2. Solve for  $x$  in the following equation.

$$2x^{-0.25} = 8$$

Answer: \_\_\_\_\_

3. Solve for  $x$  in the following equation.

$$4\ln(e^{-2x}) = 32$$

Answer: \_\_\_\_\_

4. Solve for  $x$  in the following equation.

$$3x^2 + x - 1 = 0$$

Answer: \_\_\_\_\_

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**[Part 2] (2 point for each question) Answer the following questions:**

1. Find the values of  $x$  that satisfy the following inequality.

$$-(x - 3)(x + 1) < 0$$

Answer: \_\_\_\_\_

2. Find the equation of a line that is tangential to  $y = 3(x - 1)^2$  at the point  $(2,3)$ .

Answer: \_\_\_\_\_

3. Solve for  $x$  in the following equation.

$$\log_2(x + 7) + \log_2(-2x + 2) = 5$$

Answer: \_\_\_\_\_

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(Please show all your work here and write your answers in the designated space.)

[Part 3] (3 point for each question) Answer the following questions:

1. Find the first derivative of the following function.

$$y = (2x + 1)(3x^2 - x + 2)$$

Answer: \_\_\_\_\_

2. Find the second order Taylor approximation of the function below at the point (0,2).

$$f(x) = 2e^x$$

Answer: \_\_\_\_\_

3. Evaluate the following integral.

$$\int_1^5 \frac{2}{x} dx$$

Answer: \_\_\_\_\_

4. Given two matrices **A** and **B** below, find the matrix **X** that satisfies **AX = B**.

$$\mathbf{A} = \begin{bmatrix} 2 & 2 \\ 1 & 3 \end{bmatrix}, \mathbf{B} = \begin{bmatrix} 1 & 0 \\ 2 & 1 \end{bmatrix}.$$

Answer: \_\_\_\_\_

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**(Please show all your work here and write your answers in the designated space.)**

**[Part 4] (5 point for each question) Answer the following questions:**

1. Answer the following questions.

(a) **[2 points]** Evaluate the following sum.

$$\sum_{t=1}^{\infty} (0.9)^t$$

Answer: \_\_\_\_\_

(b) **[3 points]** Evaluate the following sum.

$$\sum_{t=1}^{\infty} t(0.9)^t$$

Answer: \_\_\_\_\_

2. Answer the following questions.

(c) **[2 points]** Find the values of  $x$  and  $y$  that solve the following problem.

$$\begin{aligned} &\text{maximize } x^2y \\ &\text{subject to } x + 2y = 6, \quad x \geq 0, \quad y \geq 0 \end{aligned}$$

Answer: \_\_\_\_\_

(d) **[3 points]** Find the values of  $x$  and  $y$  that solve the following problem.

$$\begin{aligned} &\text{maximize } 3\ln(x - 1) + y \\ &\text{subject to } x + y = 3, \quad x \geq 0, \quad y \geq 0 \end{aligned}$$

Answer: \_\_\_\_\_

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**(Please show all your work here and write your answers in the designated space.)**

**[Part 5] Answer the following questions:**

1. **[2 points]** When you buy four notebooks and six pencils, it costs 840 yen. When you buy three notebooks and two pencils, it becomes 480 yen. Answer the price of one notebook.

2. Let  $A = 1 \times 2 \times 3 \times 4 \times \dots \times 27 \times 28 \times 29 \times 30$ . Then answer the following questions.

(a) **[2 points]** How many times can you divide A by 11?

Answer: \_\_\_\_\_

(b) **[2 points]** How many times can you divide A by 3?

Answer: \_\_\_\_\_

(c) **[2 points]** When A is calculated, how many consecutive times does 0 appear after the first digit?

Answer: \_\_\_\_\_