Japan-IMF Scholarship Program for Asia 2017-2018

Basic Mathematics Aptitude Test
(Full score: 40)

Please Note:

■ You have 60 minutes to complete

■ No calculator are allowed

■ Please show all your work and write your answers in the designated space

Thank you

Country:

Reference Number:

Name:

Reference Number: _____ **Country:** _____

Name: _____

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

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

■ <u>Example questions 1:</u>

Solve the following expression:

$$\frac{1}{2} + \frac{4}{2}$$

Answer: 2.5 or 5/2

■ <u>Example questions 2:</u>

Simplify the following expression:

$$a \times 10 + \frac{a^2}{a}$$

Answer: $11a$

■ <u>Now answer the questions below:</u>

1. Solve the following equation

$$\frac{1}{4} \times 10 + \frac{5}{4} \div \frac{25}{2}$$

Answer:_____

2. Given constant a, simplify the expression below:

$$\frac{a^x \left(a^x\right)^{1/2}}{3a^{1-x}}$$

Answer:_____

3. Simplify the expression below

$$\ln\left(\frac{x+1}{x-1}\right) + \ln\left(\frac{1}{x+1}\right)$$

Answer:_____

4. Solve for x when

$$e^x e^x = e^{4+x}$$

Answer:_____

5. Simplify the expression below

$$\frac{4x^2(5+x)}{20x+4x^2}$$

Answer:_____

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

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

1. Deduce the equation of a line whose slope is 1.2 and which passes through the point $(2, 5)$.

   Answer:_____

2. Find what values of x satisfy the inequalities below

$$\begin{cases} 4x - 7 & > 3x - 3 \\ 4 - 6x & < 12 - 7x \end{cases}$$

   Answer:_____

3. Solve the following equation

$$\ln(x + 6) = 0$$

   Answer:_____

4. Find x satisfying the following equation:

$$\sum_{i=1}^{2} ix^{i-1} = 1$$

   Answer:_____

5. Given constant a $(a > 0)$, find x satisfying the following equation:

$$a = (x^a)^2$$

   Answer:_____

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

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

1. Given constants a, b, and c, find the first derivative of the function below:

   $$f(x) = 2x^b x^{\frac{a}{2}} + \log c$$

   Answer:_____

2. Find the second order derivative of the function below:

   $$f(x) = \frac{6x - 7}{8x - 5}. \qquad (x \neq \frac{5}{8})$$

   Answer:_____

3. Find the partial derivative $\frac{\partial^2 f}{\partial x \partial y}$ when $f(x, y) = (8x - 4y)^5$.

   Answer:_____

4. Evaluate the following definite integral.

   $$\int_0^2 (3e^x + 5)\, dx.$$

   Answer:_____

5. Given constants a b, and c, find $\frac{\partial f}{\partial x}$ when

   $$f(x, y) = (ax + by)^b + \ln (xy + 1)^c$$

   Answer:_____

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

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

1. Given $A = \begin{bmatrix} 4 & 1 \\ 9 & 0 \end{bmatrix}$, $B = \begin{bmatrix} 2 & 0 \\ 7 & 1 \end{bmatrix}$, and $C = \begin{bmatrix} 2 & 0 & 1 \\ 1 & 0 & -1 \\ 1 & 2 & 0 \end{bmatrix}$, answer the following two sub-questions.

   (a) **[2 points]** Find $(AB)'$

   Answer:_____

   (b) **[3 points]** Find the determinant of C.

   Answer:_____

2. Answer the following questions:

   (a) **[2 points]** Find the local maximum and minimum of the function.

   $$f(x) = x^3 - 12x^2 + 36x + 8$$

   Answer:_____

   (b) **[3 points]** Given the function below

   $$f(x) = bx^2 - x - c$$

   i. Specify "the condition of the parameter b" that this function has a local minimum.

   ii. Find this point.

   Answer:_____