# Japan-IMF Scholarship Program for Asia 2025-26

## Basic Mathematics Aptitude Test

**Test A** (Answer sheet)

**Please Note:**

- You have 60 minutes to complete
- Calculators are not allowed
- Please show all your work and write your answers in the designated space

*Thank you*

**Country**:_____

**Reference Number**:_____

**Name**:_____

**Problem 1.** Compute the following

$$\frac{100}{2} + 5$$

Answer:

**Problem 2.** Suppose that

$$Y = K^{\alpha} L^{1-\alpha}$$

Which of the following is true?

Answer:

**Problem 3.** Suppose that

$$y = x^2 - 2ax$$

Which of the following is equivalent to this equation:

Answer:

**Problem 4.** Solve for $x$:

$$\frac{1}{x} = \frac{3}{1-x}$$

Answer:

**Problem 5.** Note that $e$ is Euler's constant. Solve for $x$:

$$\frac{e^{6x-10}}{e^x} = 1$$

Answer:

**Problem 6.** Solve for $x$:

$$\frac{(1+x)^2}{1+x} = 3$$

Answer:

**Problem 7.** Solve for $x$:

$$2\ln(1+x) - \ln(1+x) = \ln(3)$$

Answer:

**Problem 8.** Find a first order Taylor expansion (nearby $x = 0$) of

$$f(x) = \ln(1+x)$$

Using this, approximate $\ln(1 + .02)$

Answer:

**Problem 9.** Suppose there is a box containing 50 red balls and 50 green balls. A ball is removed and then set aside (and not returned to the box). Which of the following is true?

Answer:

**Problem 10.** Suppose that we have the set of numbers:

$$X = [87, 63, 40, 76, 2, 28, 6, 30, 25, 49]$$

The average value of this set of numbers is $\bar{x} = 40.6$. Compute the following, where $x_i \in X$,

$$\sum_{i=1}^{10} x_i.$$

Answer:

**Problem 11.** Suppose that we have the set of numbers:

$$X = [87, 63, 40, 76, 2, 28, 6, 30, 25, 49]$$

The average value of this set of numbers is $\bar{x} = 40.6$. Compute the following, where $x_i \in X$,

$$\sum_{i=1}^{10} (x_i - \bar{x})$$

Answer:

**Problem 12.** Compute the derivative of the function

$$f(x) = x\ln(x) + 1$$

Answer:

**Problem 13.** Suppose that

$$y(t) = \frac{x(t)}{z(t)}$$

where $x(t)$ and $z(t)$ are functions of time

$$x(t) = x_0 e^{g_x t}, \;\; z(t) = z_0 e^{g_z t}$$

where $g_x$ and $g_z$ are constants. Compute

$$g_y \equiv \frac{d \ln y(t)}{dt}$$

Answer:

**Problem 14.** Suppose that

$$\int_{-\infty}^{\infty} f(x)dx = 1$$

$$\int_{-\infty}^{0} f(x)dx = 0.2$$

Compute

$$\int_{0}^{\infty} f(x)dx$$

Answer:

**Problem 15.** Note that

$$\Phi(X) \equiv \int_{-\infty}^{X} \frac{1}{\sqrt{2\pi}} e^{\frac{-1}{2}\left(z^2\right)} dz.$$

Evaluate the following integral:

$$Y \equiv \int_{-\infty}^{X} \frac{1}{\sqrt{2\pi}} \frac{1}{\sigma} e^{\frac{-1}{2}\left(\frac{x-\mu}{\sigma}\right)^2} dx \tag{1}$$

Answer:

**Problem 16.** Find the value of $x$ in which

$$\phi(x) = \frac{1}{\sqrt{2\pi}} \frac{1}{\sigma} e^{\frac{-1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}, \quad \sigma > 0$$

is maximized:

Answer:

**Problem 17.** Suppose that $A = \begin{bmatrix} 1 & 2 & 3 \end{bmatrix}$. Compute $AA^T$:

Answer:

**Problem 18.** Suppose that

$$\begin{bmatrix} y_1 \\ y_2 \end{bmatrix} = \begin{bmatrix} 1 & 2 \\ 3 & 5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}.$$

Write $y_1$ as a function of and $x_1$ and $x_2$:

Answer:

**Problem 19.** If possible, solve for the values of $x_1$, $x_2$, and $x_3$ in which

$$\begin{bmatrix} 1 & 5 & 10 \\ 2 & 10 & 20 \\ 3 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 1 \\ 3 \\ 5 \end{bmatrix}$$

Answer:

**Problem 20.** Evaluate the limit (use L'Hôpital's rule)

$$\lim_{x\to\infty} x\ln\left(1+\frac{1}{x}\right)$$

Answer: