

Japanese Grant Aid for Human Resource  
Development Scholarship (JDS)  
Basic Mathematics Aptitude Test  
2020

*Solution*

Prepared by Japanese Development Service Co., Ltd.

Note:

- You have 60 minutes to complete.
- No calculators are allowed.
- Show all your work and write your answers in the designated space.
- Part I is 'Basic Math,' Part II is 'Applied Math' and Part III is 'Advanced Math.' Follow instructions which Part to be solved.
- The test result is only for the reference purpose and basically does not affect the selection procedure. However, some accepting universities may require the candidates who apply for the economics-related fields of study to have analytical and numerical skills.

Registration No.: \_\_\_\_\_

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

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

[PART I]

**Points: Syria (3/each, total:30), JDS (4/each, total:40)**

1. Calculate:

$$\begin{aligned}9 - 8 \div \frac{1}{2} \\ &= 9 - 8 \times 2 \\ &= 9 - 16 \\ &= -7\end{aligned}$$

2. Calculate:

$$\begin{aligned}\frac{1}{3} \div \left(\frac{1}{3} - 2\right) \\ &= \frac{1}{3} \div \left(\frac{1}{3} - \frac{6}{3}\right) \\ &= \frac{1}{3} \div \left(-\frac{5}{3}\right) \\ &= \frac{1}{3} \times \left(-\frac{3}{5}\right) \\ &= -\frac{1}{5}\end{aligned}$$

3. Solve:

$$\begin{aligned}\frac{1}{7} = \frac{4}{x+1} \\ \frac{x+1}{7} = 4 \\ x+1 = 4 \times 7 \\ x = 28 - 1 \\ x = 27\end{aligned}$$

4. What is the value of  $x - x^2 - x^3 + x^4$  when  $x = -1$  ?

$$\begin{aligned} & x - x^2 - x^3 + x^4 \\ &= -1 - 1 + 1 + 1 \\ &= \mathbf{0} \end{aligned}$$

5. Calculate:

$$\begin{aligned} & 3(5a - b) - (7a - 4b) \\ &= 15a - 3b - 7a + 4b \\ &= \mathbf{8a + b} \end{aligned}$$

6. Calculate:

$$\begin{aligned} & (\sqrt{7} - 1)^2 \\ &= (\sqrt{7})^2 - 2\sqrt{7} + 1 \\ &= 7 - 2\sqrt{7} + 1 \\ &= \mathbf{8 - 2\sqrt{7}} \end{aligned}$$

7. Solve:

$$\begin{aligned} & \begin{cases} 7x - 3y = 6 \\ x + y = 8 \end{cases} \\ & + \begin{cases} 7x - 3y = 6 \\ 3x + 3y = 24 \end{cases} \\ & \hline & 10x = 30 \\ & \mathbf{x = 3} \\ & \mathbf{y = 5} \end{aligned}$$

8. Solve:

$$3x^2 + 9x + 5 = 0$$

$$\begin{aligned}x &= \frac{-9 \pm \sqrt{9^2 - 4 \times 3 \times 5}}{2 \times 3} \\&= \frac{-9 \pm \sqrt{81 - 60}}{6} \\&= \frac{-9 \pm \sqrt{21}}{6}\end{aligned}$$

9. Solve:

$$-2x + 8 \geq -18$$

$$-2x \geq -18 - 8$$

$$-2x \geq -26$$

$$x \leq 13$$

10. Calculate:

$$\begin{aligned}&\left(\left(\frac{1}{3}\right)^{-1} \times \left(\frac{1}{3}\right)^4\right)^{-\frac{1}{3}} \\&= \left(\left(\frac{1}{3}\right)^{-1+4}\right)^{-\frac{1}{3}} \\&= \left(\left(\frac{1}{3}\right)^3\right)^{-\frac{1}{3}} \\&= \left(\frac{1}{3}\right)^{3 \times \left(-\frac{1}{3}\right)} \\&= \left(\frac{1}{3}\right)^{-1} \\&= 3\end{aligned}$$

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

[PART II]

**Points: Syria (3/each, total:45), JDS (4/each, total:60)**

1. Find the sum of the integers from 1 to 101.

$$\begin{aligned} & 101 \times 50 + 101 \\ & = 5050 + 101 \\ & = \mathbf{5151} \end{aligned}$$

2. Find the average of the following six values:

$$\left\{ -\frac{1}{2}, \quad \frac{1}{3}, \quad -2, \quad 0, \quad 1, \quad \frac{3}{2} \right\}$$

Sum of six values:

$$\begin{aligned} & -\frac{1}{2} + \frac{1}{3} - 2 + 0 + 1 + \frac{3}{2} \\ & = \frac{-3 + 2 - 12 + 0 + 6 + 9}{6} \\ & = \frac{2}{6} \\ & = \frac{1}{3} \end{aligned}$$

Average of six values are:

$$\begin{aligned} & \frac{1}{3} \div 6 \\ & = \frac{\mathbf{1}}{\mathbf{18}} \end{aligned}$$

3. Find both the maximum value and the minimum value of the six values above.

**Maximum value:**  $\frac{3}{2}$

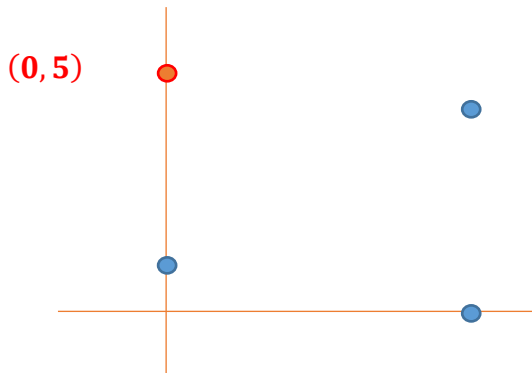
**Minimum value:**  $-2$

※Give three (3) points each (total:6 points) or four (4) points each (total: 8 points).

4. Round off 456.789 to the tens place and make a three-digit number.

**460**

5. In the  $xy$ -coordinate plane, the coordinates of three vertices of a parallelogram are  $(4, 4)$ ,  $(4, 0)$ , and  $(0, 1)$ . What are the coordinates of the fourth vertex of the parallelogram?



6. The points on a plane coordinate,  $(-3, 0)$ ,  $(5, 4)$ , and  $(7, a)$ , lie on the same line. Find the value  $a$ .

Draw a graph using dots given on a plane coordinate and find the point asked.

Or

Using 2 points,  $(-3, 0)$  and  $(5, 4)$ , the linear function of this line becomes:

$$y = \frac{1}{2}x + \frac{3}{2}$$

Assign  $x = 7$  in this function, then you can get the answer  $a = 5$

7. Mr. Smith bought a laptop for 350 dollars and sold it at a 4 percent profit. How much did he sell it?

$$350 \text{ dollars} \times 1.04 = 364 \text{ dollars}$$

8. The sum of Country A's GDP and Country C's GDP is 33 trillion dollars, and the difference between these two GDPs is 7 trillion dollars. Country A's economy is larger than Country C's economy. Find each GDP.

Assume that Country A's GDP as  $a$  and Country C's GDP as  $c$ .

$$\begin{cases} a + c = 33 \\ a - c = 7 \end{cases}$$

$$2a = 40$$

$$a = 20$$

$$c = 13$$

**GDP of Country A is 20 trillion dollars**

**GDP of Country C is 13 trillion dollars**

※**Three (3) points** or **four (4) points** are given to the case both  $a$  and  $c$  values are correct. If the case only either value is correct, give **one (1) point**.

9. After finishing an examination, a professor summarized the result as following table. Find the values of  $a$ ,  $b$ ,  $c$ , and  $d$  on the table.

Points	Number of students	Ratio
Below 20	12	30 %
20 to 39	14	$c$
40 to 59	$a$	25 %
60 to 79	3	7.5 %
80 to 100	1	$d$
<b>Total</b>	<b><math>b</math></b>	<b>100 %</b>

$$b: \frac{12 \times 100}{30} = 40 \text{ students}$$

$$a: 40 \times 0.25 = 10 \text{ students}$$

$$c: \frac{14}{40} \times 100 = 35 \%$$

$$d: \frac{1}{40} \times 100 = 2.5 \%$$

※Give **three (3) points each (total:12 points)** for Syria or **four (4) points each (total: 16 points)** for JDS.

10. You deposited \$300 into own bank account at the beginning of this year. The interest rate is 5% compounded annually. How much will your savings finally become at the end of 10 years later? Use  $1.05^{10} = 1.63$  for the calculation.

$$\begin{aligned}
 & \$300 \times 1.05 \times 1.05 \times 1.05 \times 1.05 \times 1.05 \times 1.05 \times 1.05 \times 1.05 \times 1.05 \times 1.05 \\
 & = \$300 \times 1.05^{10} \\
 & = \$300 \times 1.63 \\
 & = \mathbf{\$489}
 \end{aligned}$$

11. It is known that this infected disease transmits from 1 person to 3 people. The first patient was found today. If today is day 0 of the disease, what day will the number of new patients reach over 1,000?

$$3^n \geq 1,000$$

Day	Number of <u>new</u> patients	Number of <u>total</u> patients
0	$3^0$	1
1	$3^1$	4
2	$3^2$	13
3	$3^3$	40
4	$3^4$	121
5	$3^5$	364
<u>6</u>	$3^6$	<u>1093</u>
<u>7</u>	$3^7$	<u>2178</u>

**Day seven**

※If the number of total patients are answered (Day six), give **two (2) points** for Syria or **three (3) points** for JDS.



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

[PART III]

**Points: only Syria (5/each, total:25), JDS (no need to solve)**

1. Solve the following simultaneous equations in the matrix form for x and y.

$$\begin{bmatrix} 2 & x-y \\ y & -2 \end{bmatrix} \begin{bmatrix} 1 \\ -1 \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

$$\begin{cases} 2 + (x-y) \times (-1) = 0 \\ y + (-2) \times (-1) = 1 \end{cases}$$

$$\begin{cases} 2 - x + y = 0 \\ y + 2 = 1 \end{cases}$$

$$\begin{cases} -x + y = -2 \\ y = -1 \end{cases}$$

$$\mathbf{x = 1, \quad y = -1}$$

※**Five (5) points** are given to the case both x and y values are correct. If the case only either value is correct, give **two (2) points**.

2. Find the following definite integral.

$$\int_{-1}^2 3(x^2 + 3)dx$$

$$= \int_{-1}^2 (3x^2 + 9)dx$$

$$= [x^3 + 9x]_{-1}^2$$

$$= (8 + 18) - (-1 - 9)$$

$$= 26 + 10$$

$$= \mathbf{36}$$

3. Differentiate the following function.

$$f(x) = 2x^3 + 3x^2 + 5x - 8$$

$$\mathbf{f'(x) = 6x^2 + 6x + 5}$$

4. Solve the following inequation.

$$\log_{\frac{1}{2}}(x - 3) > -2$$

$$\log_{\frac{1}{2}}(x - 3) > \log_{\frac{1}{2}}\left(\frac{1}{2}\right)^{-2}$$

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

$$x - 3 < 4$$

$$x < 7 \text{ -----(i)}$$

*On the other hand,*

$$x - 3 > 0$$

$$x > 3 \text{ -----(ii)}$$

*Due to (i) and (ii)*

$$\mathbf{3 < x < 7}$$

✳If the answer is either (i) or (ii), give **3 points**.

5. You start to deposit \$10 into own bank account at the beginning of every year. The interest rate is 5% compounded annually. How much does your saving finally become at the end of 10 years later? The answer should round off to the nearest whole number. Use the following values for the calculation if necessary.

$1.05^{10}$	1.63
$1.05^9$	1.55
$1.05^8$	1.48
$1.05^7$	1.41
$1.05^6$	1.34
$1.05^5$	1.28
$1.05^4$	1.22
$1.05^3$	1.16
$1.05^2$	1.10

$$\begin{aligned} & \$10 \times 1.05^{10} + \$10 \times 1.05^9 + \$10 \times 1.05^8 + \$10 \times 1.05^7 + \$10 \times 1.05^6 \\ & + \$10 \times 1.05^5 + \$10 \times 1.05^4 + \$10 \times 1.05^3 + \$10 \times 1.05^2 \\ & + \$10 \times 1.05^1 \end{aligned}$$

$$\begin{aligned}
&= \$10 \times (1.05^{10} + 1.05^9 + 1.05^8 + 1.05^7 + 1.05^6 + 1.05^5 + 1.05^4 + 1.05^3 \\
&\quad + 1.05^2 + 1.05^1) \\
&= \$10 \times (1.63 + 1.55 + 1.48 + 1.41 + 1.34 + 1.28 + 1.22 + 1.16 + 1.10 \\
&\quad + 1.05) \\
&= \$132.2 \\
&\approx \mathbf{\$132}
\end{aligned}$$

Or

$$\begin{aligned}
&= \$10 \times \frac{1.05(1.05^{10} - 1)}{1.05 - 1} \\
&= \$10 \times \frac{1.05(1.63 - 1)}{1.05 - 1} \\
&= \$10 \times \frac{1.05 \times 0.63}{0.05} \\
&= \mathbf{\$132}
\end{aligned}$$