Japanese Grant Aid for Human Resource Development Scholarship (JDS)

Basic Mathematics Aptitude Test

2022

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' and Part II and III are 'Applied Math.'
- 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]   **3 points/each (total 60 points)**
1.   Calculate the followings.

$\dfrac{18}{3} + 1.5 = 7.5$

$8 - (-11) = 19$

$-\dfrac{1}{8} + \dfrac{3}{2} = \dfrac{-2 + 24}{16} = \dfrac{22}{16} = \dfrac{11}{8}$

$\dfrac{1}{7} - \dfrac{4}{3} + \dfrac{5}{21} = \dfrac{3 - 28 + 5}{21} = -\dfrac{20}{21}$

$9.3 + (-3.5) = 5.8$

$$\frac{2}{5} \div \left(\frac{8}{3} - 3\right) = \frac{2}{5} \div \left(\frac{8-9}{3}\right) = \frac{2}{5} \times -\frac{3}{1} = -\frac{6}{5} \quad or -1.2$$

$$(x+3)(x+1) = x^2 + 4x + 3$$

$$4(3a-b) - (4a-6b) = 12a - 4b - 4a + 6b = 8a + 2b$$

$$\left(-2+\sqrt{3}\right)^2 = 4 - 4\sqrt{3} + 3 = 7 - 4\sqrt{3}$$

$$\left(\left(\frac{1}{3}\right)^3 \times 3^{-5}\right)^{-\frac{1}{4}} \times 3^{\frac{1}{2}}$$

$$= (3^{-3} \times 3^{-5})^{-\frac{1}{4}} \times 3^{\frac{1}{2}} = (3^{-8})^{-\frac{1}{4}} \times 3^{\frac{1}{2}} = 3^2 \times 3^{\frac{1}{2}} = 3^{\frac{5}{2}} = 9\sqrt{3}$$

2. Solve the followings.

$2x - 3 = \dfrac{x}{3} + 4$

$6x - 9 = x + 12$

$5x = 21$

$x = \dfrac{21}{5}$ or 4.2

$\dfrac{3}{x + 1} = \dfrac{2}{7}$

$\dfrac{3}{1} = \dfrac{2(x + 1)}{7}$

$3 \times 7 = 2(x + 1)$

$21 = 2x + 2$

$2x = 21 - 2 = 19$

$x = \dfrac{19}{2}$

$\dfrac{x}{6} = -\dfrac{x}{3} + 2$

$x = -2x + 12$

$3x = 12$

$x = 4$

$\begin{cases} x - 3 = 6 \\ 7x + 2y = 9 \end{cases}$

$x = 9$

$63 + 2y = 9$

$2y = -54$

$y = -27$

$$\begin{cases} 3x + 2y = 5 \\ 2x - 7y = 5 \end{cases}$$

$$\begin{cases} 6x + 4y = 10 \\ 6x - 21y = 15 \end{cases}$$

$$25y = -5$$

$$y = -\frac{5}{25} = -\frac{1}{5}$$

$$x = \frac{9}{5}$$

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

$$x = \frac{2 \pm \sqrt{2 \times 2 - 4 \times -3 \times 1}}{2 \times -3}$$

$$x = \frac{2 \pm \sqrt{4 + 12}}{-6}$$

$$x = \frac{2 \pm \sqrt{16}}{-6}$$

$$x = \frac{2 \pm 4}{-6}$$

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

$$-3x - 12 > 0$$

$$-3x > 12$$
$$x < -4$$

$$(x - 6)(x - 2) < 0$$
$$2 < x < 6$$

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

$$-2x + x^2 - x^3 + x^4 = -6 + 9 - 27 + 81 = 57$$

4. What is the value of $-2ab + a^2 - b^3 + a^4$ when $a = -2, \ b = -3$?

$$-2ab + a^2 - b^3 + a^4 = -12 + 4 + 27 + 16 = 35$$

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

[PART II]

5. The table below shows the time spent using the Internet per day for 20 people. Answer the following questions. **(1 point/each, total 4 points)**

Time spent (min.)	Class value	Number of people	%
65 ~ 75	70	1	
75 ~ 85	80	3	
85 ~ 95	90	4	
95 ~ 105	100	5	
105 ~ 115	110	3	
115 ~ 125	120	2	
125 ~ 135	130	2	
Total		**20**	

(1) How many people spent less than 95 minutes on the Internet?

$1 + 3 + 4 = 8$

(2) What percentage of the people spent 105 minutes or more browsing the Internet?

$3 + 2 + 2 = 7$
$7 / 20 = 35 \%$

(3) Find the average amount of time spent browsing the Internet.

Average $= (70 \times 1 + 80 \times 3 + 90 \times 4 + 100 \times 5 + 110 \times 3 + 120 \times 2 + 130 \times 2) / 20$
$= 2000 / 20 = 100$ min.

(4) Round off 24.95 to the first decimal place.

25.0

[PART III]   **4 points/each question (total 36 points)**

6. There are 2 groups, A and B. Group A consists of 12 people and Group B consists of 8 people. The average score of monthly salary of Group A was $1000 and Group B was $800. Calculate the average salary of the whole people.

$(12 \times \$1000 + 8 \times \$800) \div 20$
$= (\$12000 + \$6400) \div 20$
$= (\$12000 + \$6400) \div 20$
$= \$920$

7. Find definite integral of

$$\int_0^2 (8x - 4)\, dx$$

$[4x^2 - 4x]_0^2 = 16 - 8 = 8$

8. The points on a plane coordinate, $(-3, 1)$, $(5, -9)$, and $(2, \boldsymbol{a})$, lie on the same line. Find the value $\boldsymbol{a}$.

$y = -\dfrac{5}{4}x - \dfrac{11}{4}$

$a = -\dfrac{21}{4}$

9. The total number of infected people last month was 1200, this month was 1000. What is the growth rate of infected people? Round off the answer.

$$\frac{1000 - 1200}{1200} = -17\,\%$$

10. Determine the first derivative of
$f(x) = 2x^3 + 3x^2 - x + 1$

$f(x)' = 6x^2 + 6x - 1$

11. The annual amount of your National Health Insurance premiums, which cover one fiscal year from April to March of the following year, is notified to you by the beginning of June. You must pay it divided into 10 payment periods starting from June (1st payment period) to March (10th payment period). If your annual payment is ¥24000, how much do you have to pay for each period?

¥24000 / 10 = ¥2400

12. Country Y's GDP last year was 950. Economic growth rate is 15 %. What is this year's GDP?

$$\frac{x - 950}{950} = 15\,\%$$
$$x - 950 = 950 \times 0.15$$
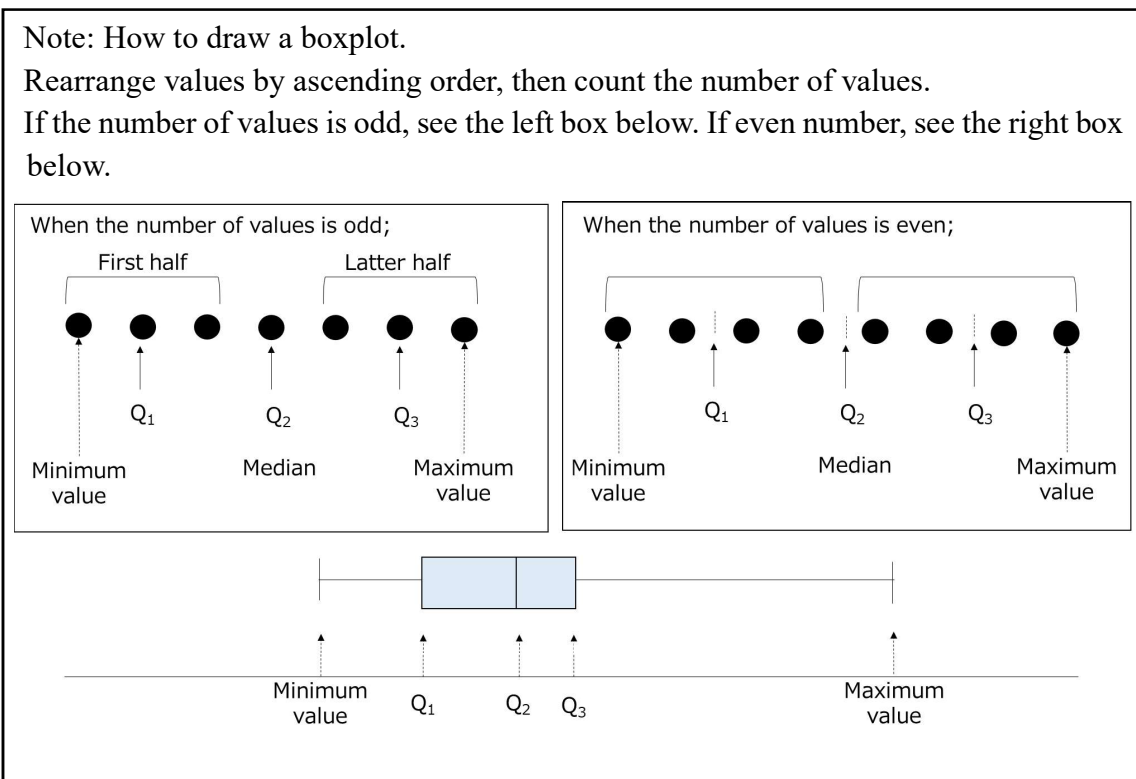$$x = 950 \times 0.15 + 950$$
$$x = 1092.5$$

13. The interest rate of bank has been 10 % compounded annually. Beginning of last year, you deposited $10 into your bank account. You did the same this year. If you do the same next year, how much will your savings finally become at the end of next year? Use $1.1^2 = 1.21, \ 1.1^3 = 1.331$ for the calculation.

$S = \$10 \times (1 + 0.1) + \$10 \times (1 + 0.1)^2 + \$10 \times (1 + 0.1)^3$
$= \$10 \times 1.1 + \$10 \times 1.21 + \$10 \times 1.331$
$= \$11 + \$12.1 + \$13.31$
$= \$36.41$

14. The following data is the annual income of 10 employees of Company C and 9 employees of Company D. Draw a boxplot for each and compare the degree of dispersion.
Company C: 51, 40, 43, 63, 52, 45, 42, 58, 54, 52 (thousand dollar)
Company D: 43, 50, 52, 45, 45, 38, 37, 100, 40 (thousand dollar)

Note: How to draw a boxplot.
Rearrange values by ascending order, then count the number of values.
If the number of values is odd, see the left box below. If even number, see the right box below.

Rearrange values of Company C by ascending order:

40, 42, 43, 45, 51, 52, 52, 54, 58, 63

Minimum value of Company C = 40

Q1 = 43

Q2 = (51 + 52) / 2 = 51.5

Q3 = 54

and Maximum value = 63 (thousand dollar)

Rearrange values of Company D by ascending order:

37, 38, 40, 43, 45, 45, 50, 52, 100
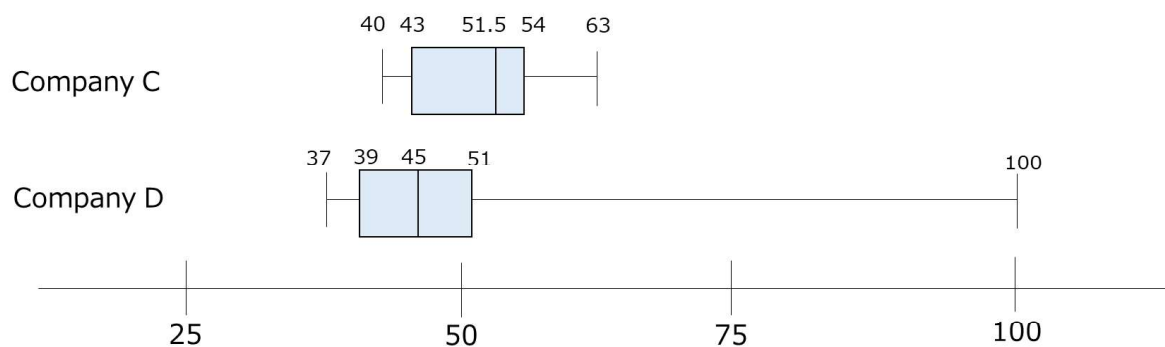
Minimum value of Company D = 37

Q1 = (38 + 40) / 2 = 39

Q2 = 45

Q3 = (50 + 52) / 2 = 51

and Maximum value = 100 (thousand dollar)

Sample answer:

From the range and interquartile range that can be read from the boxplot, **the income data of Company C have a smaller degree of dispersion than those of Company D..**