

試験日：2025 年 10 月 12 日（日）  
試験時間：9 時 20 分～11 時 00 分（100 分）

英語論述問題

An essay will be evaluated based on the following criteria.

(a) Reading comprehension

As to an answer to the question: Based on what the text says, say how much electricity was generated by renewable power in Japan around 1950, 2010 and 2023; make sure to explain your answer briefly for each year. How does this answer change if we consider nuclear power also to be a renewable energy?

A very good answer will explain that since almost all power was generated by hydropower in 1950, around 100% of electricity was renewable in 1950 (nuclear power does not matter here). It will proceed to explain that the text says that by 2010, almost all energy came from hydro, nuclear and fossil fuels. Since hydropower was around 8% at the time and nuclear power was around 30%, if we consider nuclear not a renewable, then around 8% was renewable in 2010, but if we consider nuclear to be renewable, then around 38% was.

Finally, in 2023, solar was 10%, hydro remained at 8%, other renewables were 6% and nuclear 6%. So either  $10+8+6=24\%$  or  $10+8+6+6=30\%$ .

As to an answer to the question: “The text cites two non-complacency problems, choose one and explain briefly what it is. Choose either hydropower or solar power and then briefly explain one reason Japan uses this energy source a lot and one problem, past or present, it faces or faced using it.”

Students can discuss the following for hydropower and why Japan uses it:

1. Japan has a lot of mountains and rivers making it relatively easy to build dams.
2. Japan has traditional civil engineering strengths.

For one problem, past or present, it faces or faced using it.

1. There are not a lot of good places to build dams any more without destroying nature.
2. There was rapid growth in the need for electricity generation in the 1960s.

For solar power and why it uses it:

1. Solar panels' costs have fallen a lot and is expected to continue falling.

For one problem, past or present, it faces or faced using it.

1. Japan has relatively low sunshine, meaning solar power is relatively expensive.
2. Solar panels need batteries to work well and Japan doesn't have so much expertise in batteries.

(b) Argument

An exemplary answer to the question: Finally, assume that Japan will increase the amount of renewable energy it uses. Discuss how you think Japan should accomplish this increase; you may include relevant facts not mentioned in the main text for this part, but this is not a requirement.

Candidates can present any number of arguments, but must focus on how to increase the amount of renewable energy in electricity generation, not on whether Japan should do this. They can choose to focus on just one source or multiple sources and should present developed arguments like below.

- Students could focus on how solar panel costs are expected to keep falling. Thus, logically, this is a good way to accomplish an increase in renewable energy in the future, as cost get lower. Good additions to this discussion would include the issue of the cost

and sunshine (e.g., Japan could install more solar panels in areas with high sunshine and improve transmission from there) and the issues of batteries (e.g., the government could focus research and development and the development of expertise in batteries to make Japan more of world leader).

- Students could also argue that nuclear power is a form of renewable (e.g., they produce very little CO<sub>2</sub>) and from there discuss how restarting/building more nuclear power plants would accomplish this goal (e.g., Japan has many idle nuclear power plant stations). Discussions of issues pertaining to restarting and building, particularly safety concerns, would be important additions (e.g., one can argue that Tepco has improved its management and safety culture).
- Students could discuss how to try to develop more hydropower plants and the trade-offs between local environmental damage vs the potential benefits of lower CO<sub>2</sub> emissions. Additions outside the text, like how hydropower is a relatively stable source of energy, would be welcome.
- Any other convincing/logical argument pertaining other sources should be evaluated highly. Logically, these should pertain to wind power (both on and off shore), geothermal or biomass.

(c) Writing expressions

数 学

I

[1]

$$10x^2 - 19x - 15 = (2x - 5)(5x + 3) = 0 \text{ より } x = \frac{5}{2}, x = -\frac{3}{5}$$

[2]

$x = 0.20\bar{7}$ と置く。  $1000x = 207.20\bar{7}$ より、辺々引いて  $999x = 207$ となる。

$$\text{従って } x = \frac{207}{999} = \frac{23}{111}$$

[3]

方程式  $x^2 + (a + 1)x + a + 4 = 0$  の判別式を  $D$  とする。

$$D = (a + 1)^2 - 4(a + 4) = a^2 - 2a - 15 = (a + 3)(a - 5)$$

$D < 0$  より  $-3 < a < 5$

[4]

$y = -x + 3$  とすると、  $y \geq 0$  だから  $-x + 3 \geq 0$  より  $3 \geq x$

よって  $3 \geq x \geq 0$

このとき  $2x^2 - y^2 + 3 = 2x^2 - (-x + 3)^2 + 3 = x^2 + 6x - 6 = (x + 3)^2 - 15$  となるから

$x = 0, y = 3$  のとき最小となり、最小値  $-6$

$x = 3, y = 0$  のとき最大となり、最大値  $21$

II

(1) 中央値 = 55

(2) 平均値 = 60

$$(3) \text{ 分散} = \frac{(20-60)^2 + (40-60)^2 + \dots + (90-60)^2}{8} = 550$$

$$\text{標準偏差} = \sqrt{550} = 5\sqrt{22}$$

## III

[1]

廃棄物量を確率変数  $X$  として、 $X=3$  に対応する  $z$ -score は  $\frac{3-2.43}{0.88} = 0.65$ . 正規分布表から  $P(Z \leq 0.65)$  は 0.7422 であるため、 $P(Z \geq 0.65) = 0.2578$  (25.8%)。

[2]

4 の倍数であるという事象を  $A$ 、5 の倍数であるという事象を  $B$  とすると

$$P(A) = \frac{125}{500}, P(B) = \frac{100}{500}, P(A \cap B) = \frac{25}{500}$$

$$\text{よって } P(A \cup B) = P(A) + P(B) - P(A \cap B) = \frac{125}{500} + \frac{100}{500} - \frac{25}{500} = \frac{200}{500} = \frac{2}{5}$$

## IV

[1]

$$\log_4(5x+24) = \frac{\log_2(5x+24)}{\log_2 4} = \frac{\log_2(5x+24)}{2} \text{ より}$$

方程式は  $\log_2(x+2) = \frac{\log_2(5x+24)}{2}$  すなわち  $2 \log_2(x+2) = \log_2(5x+24)$ 、よって

$$\log_2(x+2)^2 = \log_2(5x+24)$$

$$\text{従って } (x+2)^2 = 5x+24$$

$$\text{ゆえに } (x+4)(x-5) = 0$$

真数条件より  $x > -2$ ,  $-4.8$  なので  $x = 5$

[2]

$$(1) \log_{10} 24 = \log_{10} 2^3 + \log_{10} 3 = 3 \times 0.3010 + 0.4771 = 1.3801$$

(2)  $3^n$  が 10 桁であることより  $10^9 \leq 3^n < 10^{10}$  より  $9 \leq \log_{10} 3^n < 10$ 、従って  $9 \leq n(\log_{10} 3) < 10$

$$9 \leq 0.4771n < 10, \frac{9}{0.4771} \leq n < \frac{10}{0.4771}, \text{ すなわち } 18.863... \leq n < 20.959...$$

従って  $n$  は 19、20

## V

[1]

$$y' = -3x^2 + 18x = -3x(x-6)$$

$$y' = 0 \text{ とすると } x = 0, 6$$

$x=0$  のとき極小値 10  $x=6$  のとき極大値 118

[2]

$$y' = 6x^2 + 6x - 35$$

接点の  $x$  座標を  $a$  とおくと、接線の傾きは  $6a^2 + 6a - 35 = 1$

これを解くと  $6a^2 + 6a - 36 = 6(a+3)(a-2) = 0$  より  $a = 2, -3$

$a = 2$  のとき接点の座標は  $(2, -37)$ 、従って接線は  $y = x - 39$

$a = -3$  のとき接点の座標は  $(-3, 83)$ 、従って接線は  $y = x + 86$

VI

[1]

初項を  $a$ 、公比を  $r$  とし、第  $n$  項を  $a_n$  とする。

$$a_3 = ar^2 = 28 \text{ 及び } a_7 = ar^6 = 448 \text{ より、 } r^4 = 16 \text{ すなわち } r = \pm 2, a=7。$$

$$a_5 = ar^4 = 7 \times (\pm 2)^4 = 112$$

[2]

$$S_{10} = \sum_{n=1}^{10} a_n \text{ とおくと、}$$

$$S_{10} = 2 + 2 \times 3 + \dots + 2 \times 3^9$$

$$3S_{10} = 2 \times 3 + 2 \times 3^2 + \dots + 2 \times 3^{10}$$

$$\text{片々引いて } 2S_{10} = 2 \times 3^{10} - 2 = 2 \times 59049 - 2 = 118096$$

$$S_{10} = 59048$$