

RIPPLE ENGLISH

ACTIVE LEARNING PROGRAM

Workbook for:
“Human History of Energy”

問題は解きっぱなしにしないで！

英語資格試験の学習は、**解いた後の復習をしなければほとんど効果はありません。**

答え合わせをしておしまいせず、**テキストの音読練習やリスニング、多読学習などのインプット学習を何度も反復して記憶に定着させましょう。**ホームページからダウンロードできる音読練習用のテキストをぜひご活用ください。

また、数日置いてから再度解き直すのも効果的です。答えを記憶してしまっているかもしれませんが、回答の根拠をなぞりながら繰り返し解くことで有効な復習になります！



Human History of Energy

1. Human history can be seen as a series of struggle and development over the acquisition and utilization of energy. Even from prehistoric times, humans have been unable to survive without the addition of external energy. Homo sapiens have exceptionally large brains, and it consumes 20 to 25 percent of all metabolic energy, compared to around 10 percent in other primates and just 3-5 percent in other mammals. In order to maintain such a huge expenditure of energy, there had to be a reduction of energy consumption in other organs. The solution was to harness the energy of fire; namely, cooking. By heating up food, it becomes easier to chew, digest, and absorb calories and nutrients. Wild chimpanzees spend six hours or more each day just chewing their food, while humans spend only about an hour a day. The high energy need of the brain was partly **offset** by a reduced energy need in digestive systems. In other words, our huge brain was possible by externalizing the energy required for food digestion. Biologically speaking, a human body cannot be maintained without external energy consumption. Beginning from the use of fire, how has humanity discovered various ways to collect, store, and utilize energy outside our own bodies more abundantly and efficiently?

- (1) The word “offset” in the passage is closest in meaning to
 - A. decreased
 - B. missed
 - C. neutralized
 - D. preserved
- (2) According to paragraph 1, which of the following is NOT true?
 - A. Humans can spare energy by reducing the energy necessary for digestion.
 - B. The use of fire freed some proportion of energy needed for survival.
 - C. Wild animals spend a lot of energy for food digestion.
 - D. Human brain is highly efficient in energy consumption.

2. The second significant breakthrough in the history of energy is agriculture. Throughout history, the sun has been the direct or indirect source of almost all human activities. Only about 0.05 percent of incoming solar energy is transformed by photosynthesis into chemical energy in plants, providing the essential foundation for all animals, including humankind. Before agriculture, all people had been living as hunter-gatherers. Our ancestors made their living by walking through woods to collect mushrooms and running across plains to hunt animals. Whether in rainforests or savannah, only a fraction of the entire biomass is edible for us, so there was an **inherent limitation** in the amount of accessible calories.
3. From 10,000 B.C. onwards, farming began sporadically around the world, which dramatically transformed human societies. In terms of the history of energy acquisition, agriculture means the exclusive use of solar energy in a specific piece of land. We drive away all wild animals and plants from the land, cultivate a single species, and constantly expel weeds and vermin. The result was remarkable. First, agricultural societies could support far higher population densities than hunter-gatherer societies. Second, farming began creating an energy surplus that allowed some members of society to engage in a range of activities other than producing food. The denser population and energy surplus eventually paved the way to highly complex and advanced hierarchical societies.
4. By the end of the 19th Century, however, yields approached a limit since the yearly amount of energy that photosynthesis can capture from the sun is finite. For example, the population in Japan reached 30 million in the middle of the 18th Century, and almost leveled off during the rest of the Edo period (-1868), which suggests that, relying solely on the efficient utilization of solar energy, this is the maximum population capacity that the Japanese Archipelago can sustain.

- (3) According to paragraph 2, what does the highlighted “inherent limitation” mean?
 - A. Humans have to compete with other animals over food.
 - B. The amount of biomass eatable for humans is very small.
 - C. Photosynthesis is so inefficient that there is very little energy in the ecosystem to begin with.
 - D. Hunting is so unstable and unpredictable that people often underwent food shortages.
- (4) According to paragraph 3, what is the significance of farming?
 - A. Monopoly of solar energy by Homo sapiens
 - B. Expulsion of useless animals and plants
 - C. Beginning of inequality within society
 - D. Deterioration of animal welfare
- (5) According to paragraph 4, the population in Japan leveled off at around 30 million in the Edo period because
 - A. Their technology was not sophisticated as it is today.
 - B. There was a ceiling on the amount of accessible energy.
 - C. The land was too small to accommodate a larger population size.
 - D. They were not utilizing the solar energy enough.

5. Agriculture enabled humankind to monopolize the solar energy raining on the land. But utilizing the sun's radiation falling at this very moment was not enough to achieve the extraordinary population and industrial productivity of the modern times. It was the use of fossil fuels that broke through the inherent limitation of agriculture. Fossil fuels, in a literal sense, are dead remains of ancient plants and animals. They stored solar energy as chemical energy through photosynthesis. After they died and buried under the ground, earth pressure and geothermal heat gradually transformed them into substances with high energy densities. In other words, fossil fuels are a storage of solar radiation energy that fell on Earth for hundreds of millions of years.
6. Today, we are tapping into these ancient reserves of solar power to feed the expanding population by producing chemical fertilizer, travel around the world with jet planes, and operate huge shopping malls. We don't pay the whole price for any of these. **They are subsidized by ancient sunlight.** Today, the average person in Japan consumes energy at the rate of about 4500 Watts, and more than 80 percent of that comes from burning coal, oil, and gas. If you were to generate the same amount of energy by employing laborers pedaling exercise bicycles, you would need 270 slaves working eight-hour shifts each.
7. By **analogy**, we can also understand the historical dependence on forest resources in pre-modern civilizations. For example, a 40-year-old tree can be viewed as a mass of solar energy accumulated over the past 40 years on that spot. Technological development, cultural advancement, and education systems are only possible in societies with sufficient energy surplus. Forest resources have given us a temporary energy surplus until they are all cut down. Throughout history, progress of human society has been invested by nature's reservoir of past solar energy.

- (6) According to paragraph 5, what is the significance of fossil fuels?
- A. Acquisition of geothermal energy
 - B. Beginning of air pollution and climate change
 - C. Preservation of energy with high densities
 - D. Utilization of the past solar energy

- (7) Which of the following text best expresses the essential information in the highlighted sentence?

They are subsidized by ancient sunlight.

- A. We cannot provide enough energy for those activities with energy we currently receive from the Sun.
 - B. Past solar energy is as powerful as exploiting about 300 slaves.
 - C. Fossil fuels put an end to slavery.
 - D. Abundant use of energy today is due to an effort by the government to make fossil fuels inexpensive.
- (8) The word "analogy" in the passage is closest in meaning to
- A. example
 - B. parallel
 - C. anecdote
 - D. metaphor
- (9) According to paragraph 7, what is common among fossil fuels and forest resources?
- A. They are both finite resources.
 - B. They enable perpetual prosperity.
 - C. Their depletion lead to environmental issues.
 - D. They store past solar energy.

8. Whether it is building a pyramid, cultivating farmland, or weaving cloth, there has to be an input of kinetic energy. Until a certain point in history, humans had only one machine capable of converting solar energy into kinetic energy: the body. First, grain and grass fix the sun's radiation energy as chemical energy through photosynthesis. Then, in the process of metabolism, the bodies of animals, including Homo sapiens, burn these organic fuels, which we call food, and convert the chemical energy into the movement of muscles. This had been the only way to generate kinetic energy from other forms of energy, until the discovery of steam engines in the 18th Century. A steam engine burns some kind of fuel, such as coal, and use the resulting heat to boil water, producing steam. As the steam expands, it pushes a piston. The piston moves, and anything that is connected to the piston moves as well. The point is that it has successfully converted thermal energy into kinetic energy.
9. At heart, the Industrial Revolution has been a revolution in energy conversion. Previously, humans could harness energy only in the same form as it was extracted. For example, pre-modern societies used water wheels to capture the flow of rivers to grind grain, and burned firewood to smelt iron. In either case, there is no conversion of energy form. The former turns kinetic energy of water into kinetic energy of millstones, and the latter uses thermal energy in the form of thermal energy as it is. Steam engines taught humanity that any type of energy can be transformed into a useful form, if we could just invent the right machine. In particular, fossil fuels suddenly became valuable as we have discovered a way to extract useful energy from thermal energy.

- (10) According to paragraph 8, what was the major source of kinetic energy before the discovery of steam engines?
- A. muscles
 - B. coal
 - C. kettles
 - D. photosynthesis
- (11) According to paragraph 9, which of the following is NOT true?
- A. Industrial Revolution was about the development of the energy conversion.
 - B. We learned that we could get energy in a form we want from other forms of energy.
 - C. Fossil fuels were not as valuable as it is today before the invention of steam engines.
 - D. Kinetic energy is the ultimate form that any form of energy eventually ends up in.

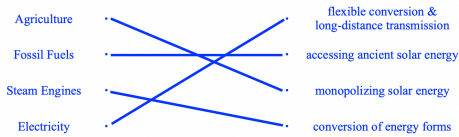
10. The last breakthrough in the history of energy is the implementation of electricity. From the mid 18th Century to the end of the 19th Century, humanity spent one and a half centuries discovering and developing a series of technologies necessary to make electric energy commercially **viable**.
11. Electricity was revolutionary in the following two aspects. First, it has dramatically increased the flexibility of energy conversion. Medieval water wheels could not turn the kinetic energy of water into thermal energy to warm their house. Steam engines could turn thermal energy into kinetic energy, but they couldn't use the kinetic energy to light their room. Electric energy can be the medium of various forms of energy. Today, we can generate electric energy at a hydroelectric power station, and it can be turned into thermal energy to heat your room. Electricity from a steam turbine can eventually be transformed into light energy by your LED. Electricity is the universal currency, so to speak. Any source of energy, once it's converted into electric energy, can be harnessed as a useful form of energy.
12. Second, electric power has enabled the long-distance transmission of energy. Before electricity, energy could only be consumed at the very place it was extracted. For example, millstones to grain wheat powered by a water wheel had to be right next to rivers. Today, in contrast, energy produced by hydro turbines at the Kurobe Dam illuminates the night in Osaka, 300 kilometers away in power transmission distance.
13. Human history can be seen as the quest for more abundant energy in more useful and versatile forms more efficiently at lower costs. With the discovery of electricity, we have achieved the freedom of conversion and transmission of energy, which marked a certain completion in the history of energy. However, there are still ongoing challenges such as the depletion of fossil fuels and climate change. How will the quest for energy unfold in the 21st Century?

- (12) The word “viable” in the passage is closest in meaning to
 A. feasible
 B. advanced
 C. accessible
 D. preferable
- (13) According to paragraph 11, what was revolutionary about electric energy?
 A. It enabled a wide variety of power generating methods.
 B. It drastically improved the conversion efficiency.
 C. It can work as an intermediary between different forms of energy.
 D. It can be a standard to measure the amount of energy consumed.
- (14) According to paragraph 12, what was revolutionary about electric energy?
 A. It increased the capacity of energy consumption.
 B. It made hydroelectric power viable.
 C. It shortened the power transmission distance.
 D. It increased flexibility in choosing power generation locations.
- (15) The word “versatile” in the passage is closest in meaning to
 A. convenient
 B. multipurpose
 C. accessible
 D. powerful
- (16) Connect each breakthrough on the left with its significance in history.

Agriculture	•	•	flexible conversion & long-distance transmission
Fossil Fuels	•	•	accessing ancient solar energy
Steam Engines	•	•	monopolizing solar energy
Electricity	•	•	conversion of energy forms

Answers

- (1) C
- (2) D
- (3) B
- (4) A
- (5) B
- (6) D
- (7) A
- (8) B
- (9) D
- (10) A
- (11) D
- (12) A
- (13) C
- (14) D
- (15) B
- (16)



(1) 文中の“offset（相殺された）”と意味が最も近いのは

- A. decreased（減少した）
- B. missed（逃した）
- C. neutralized（中和された、相殺された）**
- D. preserved（保全された）

(2) 1段落の内容に合致しないのは？

- A. Humans can spare energy by reducing the energy necessary for digestion.（人間は消化に必要なエネルギーを減らすことでエネルギーを節約できる）
 - B. The use of fire freed some proportion of energy needed for survival.（火の使用により、生存に必要なエネルギーの一部が解放された）
 - C. Wild animals spend a lot of energy for food digestion.（野生動物は食物の消化に大量のエネルギーを費やす）
 - D. Human brain is highly efficient in energy consumption.（人間の脳はエネルギー消費効率が非常に高い）**
- エネルギー消費量は膨大だが、効率が良いとは言っていないのでDが誤り。

(3) 2段落によると、下線部「inherent limitation（固有の限界）」は何を意味しているか？

- A. Humans have to compete with other animals over food.（人間は食べ物をめぐって他の動物と競争しなければならない）
- B. The amount of biomass edible for humans is very small.（人間が食べられるバイオマスの量は非常に少ない）**

- C. Photosynthesis is so inefficient that there is very little energy in the ecosystem to begin with.（光合成は非常に非効率であるため、生態系にはそもそもエネルギーがほとんどない）
 - D. Hunting is so unstable and unpredictable that people often underwent food shortages.（狩猟は非常に不安定で予測不可能であるため、人々はしばしば食糧不足に陥った）
- 本文中の“only a fraction of the entire biomass is edible for us”（バイオマス全体のうち我々が食べられるのは一部だ）の内容を言い換えているBが正解。

(4) 3段落によると、農業の意義とは

- A. Monopoly of solar energy by Homo sapiens（ホモ・サピエンスによる太陽エネルギーの独占）**
- B. Expulsion of useless animals and plants（無用な動植物の排除）
- C. Beginning of inequality within society（社会における不平等の始まり）
- D. Deterioration of animal welfare（動物福祉の悪化）

エネルギーの文脈で言うところの要点はA。本文ではBについても言及されているが、太陽エネルギーの独占の一要素として述べられている。

(5) 4段落によると、日本の人口は江戸時代には約3,000万人で横ばいとなった理由は

- According to paragraph 4, the population in Japan leveled off at around 30 million in the Edo period because
- A. Their technology was not sophisticated as it is today.（彼らの技術は今日のように洗練されていなかった）
 - B. There was a ceiling on the amount of accessible energy.（利用可能なエネルギーの量には上限があった）**
 - C. The land was too small to accommodate a larger population size.（土地が狭すぎて、より大きな人口を収容できなかった）
 - D. They were not utilizing the solar energy enough.（太陽エネルギーを十分に利用できていなかった）
- 本文の“yields approached a limit since the yearly amount of energy that photosynthesis can capture from the sun is finite.”（光合成が太陽から獲得できる年間エネルギー量は有限であるため、収量は限界に近づいた）を言い換えているBが正解。Aも内容としては正しい可能性があるが本文中では言及されていない。

(6) 5段落によると、化石燃料の意義は？

- A. Acquisition of geothermal energy（地熱エネルギーの獲得）
- B. Beginning of air pollution and climate change（大気汚染と気候変動の始まり）
- C. Preservation of energy with high densities（高密度でのエネルギーの保存）
- D. Utilization of the past solar energy（過去の太陽エネルギーの活用）**

(7) 下線部の箇所の伝えたいメッセージを最もよく表現しているのは？

They are subsidized by ancient sunlight.（これらは太古の太陽光による助成金を受けているのだ）

- A. We cannot provide enough energy for those activities with energy we currently receive from the Sun.（現在私たちが太陽から受け取っているエネルギーだけでは、それらの活動に十分なエネルギーを供給することができない）**
- B. Past solar energy is as powerful as exploiting about 300 slaves.（過去の太陽エネルギーは、約300人の奴隷を搾取するのと同じくらい強力だ）
- C. Fossil fuels put an end to slavery.（化石燃料は奴隷制に終止符を打った）

D. Abundant use of energy today is due to an effort by the government to make fossil fuels inexpensive. (今日のエネルギーの豊富な使用は、化石燃料を安価にするための政府の努力によるものだ)
下線部はまさにAの内容を比喩的に述べたものなのでAが正解。

(8) 文中の“analogy (類比、共通点)”と意味が最も近いのは

- A. example (例)
- B. parallel (類似点、関連性)**
- C. anecdote (逸話)
- D. metaphor (比喩)

(9) 7段落によると、化石燃料と森林資源の共通点は？

- A. They are both finite resources. (どちらも有限の資源だ)
 - B. They enable perpetual prosperity. (永続的な繁栄を可能にする)
 - C. Their depletion lead to environmental issues. (枯渇によって環境問題が引き起こされる)
 - D. They store past solar energy. (過去の太陽エネルギーを貯蔵している)**
- Cも内容として正しいように思えるが、この段落では言及されていない。

(10) 8段落によると、蒸気機関の発明以前は、運動エネルギーの主要な源は何だったか？

- A. muscles (筋肉)**
- B. coal (石炭)
- C. kettles (やかん)
- D. photosynthesis (光合成)

(11) 9段落の内容に合致しないのは？

- A. Industrial Revolution was about the development of the energy conversion. (産業革命はエネルギー変換の発展で)
- B. We learned that we could get energy in a form we want from other forms of energy. (他の形態のエネルギーから、望む形でエネルギーを得ることができることを学んだ)
- C. Fossil fuels were not as valuable as it is today before the invention of steam engines. (蒸気エンジンが発明されるまで、化石燃料は今日ほど価値がなかった)
- D. Kinetic energy is the ultimate form that any form of energy eventually ends up in. (運動エネルギーは、あらゆる形態のエネルギーが最終的に最終的に到達する究極の形態だ)**

(12) 文中の“viable”と意味が最も近いのは

- A. feasible (実現可能な)**
- B. advanced (先進的な)
- C. accessible (利用可能な)
- D. preferable (好ましい)

(13) 11段落によると、電気エネルギーは何において革新的だったか？

- A. It enabled a wide variety of power generating methods. (多種多様な発電方法が可能になった)
- B. It drastically improved the conversion efficiency. (変換効率が大幅に向上した)

C. It can work as an intermediary between different forms of energy. (異なる形態のエネルギー間の仲介者として機能する)

D. It can be a standard to measure the amount of energy consumed. (エネルギー消費量を測る基準となる)

(14) 12段落によると、電気エネルギーは何において革新的だったか？

- A. It increased the capacity of energy consumption. (エネルギー消費量を増加させた)
- B. It made hydroelectric power viable. (水力発電が可能になった)
- C. It shortened the power transmission distance. (送電距離が短くなった)

D. It increased flexibility in choosing power generation locations. (発電場所の選択における柔軟性が向上した)

長距離のエネルギー輸送が可能になった＝発電場所の選択肢の自由度が増したと考えられるのでDが正解。

たとえば、長距離送電が可能なおかげで、大阪で必要な電力を必ずしも大阪近郊で発電する必要がなくなっている。

(15) 文中の“versatile”と意味が最も近いのは

- A. convenient (便利な)
- B. multipurpose (多目的、多用途な)**
- C. accessible (入手可能な)
- D. powerful (強力な)

(16) エネルギー史における各躍進を、その歴史的意義とつなぎ合わせると？

