# RIPPLE ENGLISH
# ACTIVE LEARNING PROGRAM

## Workbook for:
## “The Science 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にせずに、**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！

The Science of Energy

1. Energy is everywhere in our lives. If you are reading to this on your computer in an air-conditioned room and working your brain to understand the essence of energy, what powers your computer, air conditioners, and your brain is nothing else but energy. Then what is energy? This might be the most difficult question you could ever ask. Surprisingly, even Nobel Prize winners have great trouble providing a satisfactory answer to that seemingly simple question. In Physics today, there is no clear knowledge of what energy is. Though we have no ultimate and **comprehensive** definition of energy, we still can get closer to understanding the essence by breaking it down into different perspectives. Energy is at the core of challenges that humanity is facing now, and it is also the key to understanding the journey of human society up to this day. Science literacy about energy serves as a vital knowledge for deepening our insights into the world and working towards a brighter future. So, what exactly is energy?

(1) The word “comprehensive” in the passage is closest in meaning to
A. thorough
B. understandable
C. simple
D. absolute

(2) According to paragraph 1, which of the following is NOT true about energy?
A. We can comprehend it by dividing it up into several aspects.
B. Even the best and brightest scientists struggle to understand it.
C. There is no way to understand what energy is.
D. It is a significant topic for the humanity.

2. The term “energy” derives from an ancient Greek word “energeia.” An Ancient Greek philosopher Aristotle has given an abstract definition to this concept; force capable of doing work. It may appear ambiguous and **elusive**, but he seemed to have grasped the essence of energy.

3. Today, energy is commonly understood as something that serves as the source of physical or chemical changes in an object. In other words, energy is not about a specific substance or phenomenon. Rather, it is a concept that includes anything that can cause physical or chemical alteration in objects. For example, workers constructing a huge Pyramid carried massive stones by using their muscles to apply acceleration to them, which we call kinetic energy. When the water in a kettle is boiling and undergoing a physical transition from liquid to gas, that change is being caused by thermal energy. When there is a bicycle on a hilltop that is just about to gain acceleration and go down the hill, we consider the bicycle to possess gravitational potential energy.

4. From a pure scientific point of view, thermal energy and gravitational potential energy are different phenomena; the former is generally the kinetic energy of vibrating molecules or atoms in a substance, and the latter is what comes from the earth's gravitational pull. But we can find common ground in that they are sources capable of doing work, and one can be converted into another. As Aristotle suggested, energy is a concept, and it can take a variety of forms.

(3) The word “elusive” in the passage is closest in meaning to
A. concrete
B. complex
C. indifferent
D. intangible

(4) According to paragraph 3, what is energy?
A. Energy is a material substance responsible for alterations in objects.
B. Energy is a conceptual force that can induce physical or chemical transformations in objects.
C. Energy is about any source of kinetic force.
D. Energy is what derives from gravitational potential.

(5) According to paragraph 2 to 4, why was Aristotle right about defining energy?
A. Because he seemed to realize the existence of gravitational potential energy.
B. Because he seemed to understand that all these were scientifically different phenomena.
C. Because he seemed to notice that energy is useful for us.
D. Because he seemed to know that every energy could be converted into kinetic energy.

5. From a human perspective, energy can be defined as force capable of doing useful work for us, and it can take various forms. Let us trace the flow of energy that is currently lighting the light bulb in your room back to its source. Originally, it was chemical energy embedded in fossil fuel, which turned into thermal energy through combustion reactions. The thermal energy boils water, and then it was transformed into the kinetic energy of a steam turbine, creating electric energy. It travels along power lines to your home, and the electric energy is converted into light energy by the filament, lighting your room.

6. However, not all energy in petroleum is turned into light energy; the conversion efficiency is about 10%. According to the law of the conservation of energy, every form of energy can be turned into another form, and no energy is ever lost in any of these conversions. Then, where did the rest of 90% go? At each step of conversion, some proportion of energy is transformed into unintended form and scatters away. For example, some of the thermal energy within the turbine dissipates by heating the surrounding air and the cooling water. When electrical energy is transformed into light energy, a fraction of it is turned into thermal energy due to the resistance of the filament in the light bulb. No energy is ever lost in any of these conversions, but the utility of energy has diminished in the process.

(6) According to paragraph 5, which of the following best describes the flow of energy from fossil fuel to the light bulb?

A. chemical energy→kinetic energy→electric energy→thermal energy→light energy
B. chemical energy→light energy→kinetic energy→thermal energy→light energy
C. chemical energy→kinetic energy→thermal energy→electric energy→light energy
D. chemical energy→thermal energy→kinetic energy→electric energy→light energy

(7) According to paragraph 6, which of the following is true?

A. The the law of the conservation of energy contradicts with the reality.
B. Energy can be lost when it's converted from one form to another.
C. Energy can be transformed into unwanted form and lost its usefulness.
D. Energy is so precious that any loss of its utility should be avoided.

7. In Japanese mythology, the supreme god Amaterasu is also the goddess of the sun. Similarly, there are **numerous** deities around the world that serve as both the highest god and the symbol of the sun, such as Quetzalcoatl in Maya and Aztec, and Ra in Egypt. Ancient people might have somehow realized that all energy on earth is derived from the sun's radiation.

8. The energy in the earth's ecosystem comes ultimately from a single source: plants. By the process of photosynthesis, they captured solar energy and packed it into organic compounds. Herbivores eat plants to gain solar energy indirectly, and **carnivores eat herbivores to do likewise**. Homo sapiens has never been the exception. We maintain our bodily functions by consuming plants and animals, and stay warm and smelt metals by cutting down trees and using them as fuel.

9. Modern industrial society has also been largely dependent on the sun. Fossil fuels are the compressed preservation of past solar energy, since they were originally the remains of ancient plants and animals which have been slowly transformed under pressure and geothermal heat. Wind and water powers are also indirect use of solar energy. Wind is the phenomenon in which air flows from high-pressure areas to low-pressure areas, and the differences in atmospheric pressure arise from the differential heating of Earth's surfaces by the sun. Water power harnesses the gravitational potential energy of water that is lifted from the ocean onto land by evaporation. With some exceptions such as nuclear power and geothermal power generation, all sources of energy eventually end up in the sun. From eating rice to burning firewood, sailing ships to building pyramids, everything we have done throughout history has been some form of direct or indirect use of solar energy.

(8) The word "numerous" in the passage is closest in meaning to
A. sacred
B. many
C. fictional
D. famous

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

**carnivores eat herbivores to do likewise.**

A. Flesh-eating animals provide energy to humans by being hunted.
B. Plant-eating animals are eaten by flesh-eating animals just like plants were eaten by plant-eating animals.
C. Energy taken by flesh-eating animals eventually goes back to plants after they die.
D. Flesh-eating animals feed on plant-eating animals to indirectly take energy originated from the sun.

(10) According to paragraph 9, which of the following is NOT true?
A. Energy in Fossil fuels was originally energy from the sun.
B. All energy on earth come from the sun, except for nuclear, hydropower generation, and so on.
C. Wind occurs when parts of Earth's surface heated differently by the sun.
D. Eating crops is one way of humanity harnessing energy from the sun.

10. If almost all the energy on earth derives from the sun’s radiation, then what is the source of the solar energy in the first place? Within the sun, hydrogen fusion reactions are constantly taking place, transforming hydrogen into helium. Throughout this nuclear fusion reaction, there is a reduction in the total mass, and this decrease in mass is released as energy. In other words, the loss of quantity becomes energy. It must sound counterintuitive, but this is part of what Einstein unveiled in the Theory of Relativity.

11. We often confuse mass with weight, but they are two separate things. Mass is actually a static form of energy that represents the 'inertia' of an object, or in other words, an object's resistance to being moved. All matter is energy at rest. As Einstein discovered, mass is equivalent to energy and they are interchangeable. Every loss of mass results in the release of energy proportional to the square of the speed of light. This principle forms the foundation of nuclear power generation. The collision of neutrons with uranium-235 triggers a chain reaction of nuclear fission. Before and after these fission reactions, again, the mass reduces in total, and the reduced mass is released as thermal energy. The rest is the same to thermal power generation; the thermal energy rotates the steam turbine to generate electricity.

12. Thus, we can understand energy differently from various aspects. In terms of human life and society, energy can be defined as any force capable of doing useful work for us. Speaking scientifically but limitedly within the Earth's atmosphere, energy is about the transformation or preservation of solar radiation. Ultimately, on a cosmic scale, atoms that make up our bodies and things around us are essentially masses of energy. But the exact details still remain unsolved. Physicists around the world are still in the midst of a relentless pursuit of the essence of energy.

(11) According to paragraph 11, what is mass?

A. how heavy the object is
B. the quantity of the object
C. how resistant the object is against being moved
D. the amount of power it derived from the earth’s gravitational pull

(12) According to paragraph 10 and 11, what is common among solar radiation and nuclear power generation?

A. Loss of mass is released as energy.
B. They are both beyond human’s control.
C. No greenhouse gas is emitted.
D. They are both infinite sources of energy.

(13) Within the whole passage, all of the following were mentioned, EXCEPT

A. Energy is a concept that includes everything capable of causing alteration in an object.
B. Almost all sources of energy on Earth come from the sun’s radiation.
C. Solar energy is the result of nuclear fission reactions of hydrogen.
D. Ne energy is lost in conversions of energy forms.

## Answers

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

(1) 文中の “comprehensive”（包括的な） と意味が最も近いのは
**A. thorough（完全な、やり残しのない、取りこぼしのない）**
B. understandable（理解できる）
C. simple（単純な）
D. absolute（絶対的な）

(2) 1段落によると、エネルギーに関して正しくないのは？
According to paragraph 1, which of the following is NOT true about energy?
A. We can comprehend it by dividing it up into several aspects.（いくつかの側面に分けて理解することができる）
B. Even the best and brightest scientists struggle to understand it.（最も優れた科学者でさえ、それを理解するのに苦労している）
**C. There is no way to understand what energy is.（エネルギーとは何かを理解する方法はない）**
D. It is a significant topic for the humanity.（それは人類にとって重要なテーマだ）
究極的かつ包括的な理解はいまのところ存在しないが、複数の観点に切り分けて理解しようというのが本文の趣旨なのでCが誤り。

(3) 文中の “elusive”（とらえどころのない）と意味が最も近いのは
A. concrete（具体的な）
B. complex（複雑な）
C. indifferent（無関心な）
**D. intangible（つかみどころのない）**

(4) 3段落によれば、エネルギーとは何か？
A. Energy is a material substance responsible for alterations in objects.（エネルギーは、物体の変化を引き起こす物質だ）
**B. Energy is a conceptual force that can induce physical or chemical transformations in objects.（エネルギーは、物体に物理的または化学的変化を引き起こすことができる概念的な力だ）**
C. Energy is about any source of kinetic force.（エネルギーとは、あらゆる運動の源のことだ）
D. Energy is what derives from gravitational potential.（エネルギーは重力ポテンシャルから得られるものだ）

(5) 2段落から4段落によれば、アリストテレスのエネルギーの定義が正しかったのはなぜ？
According to paragraph 2 to 4, why was Aristotle right about defining energy?
A. Because he seemed to realize the existence of gravitational potential energy.（重力ポテンシャルエネルギーの存在に気づいていたようだから）
**B. Because he seemed to understand that all these were scientifically different phenomena.（これらすべてが科学的に異なる現象であることを彼は理解しているようだったから）**
C. Because he seemed to notice that energy is useful for us.（エネルギーが私たちにとって有益であることに彼は気づいたようだから）
D. Because he seemed to know that every energy could be converted into kinetic energy.（あらゆるエネルギーが運動エネルギーに変換できることを知っているようだったから）

(6) 5段落によれば、化石燃料から電球までのエネルギーの流れとして最も適切なのは？
A. chemical energy→kinetic energy→electric energy→thermal energy→light energy
B. chemical energy→light energy→kinetic energy→thermal energy→light energy
C. chemical energy→kinetic energy→thermal energy→electric energy→light energy
**D. chemical energy→thermal energy→kinetic energy→electric energy→light energy**

(7) 6段落の内容に合致するのは？
A. The the law of the conservation of energy contradicts with the reality.（エネルギー保存則は現実と矛盾する）
B. Energy can be lost when it’s converted from one form to another.（エネルギーは、ある形から別の形に変換されるときに失われることがある）
**C. Energy can be transformed into unwanted form and lost its usefulness.（エネルギーは望まない形に変換され、その有用性を失うことがある）**
D. Energy is so precious that any loss of its utility should be avoided.（エネルギーは非常に貴重であるため、その有用性のいかなる損失も避けるべきだ）

(8) 文中の “numerous”（多数の）と意味が最も近いのは
A. sacred（神聖な）
**B. many（多くの）**
C. fictional（虚構の、想像上の）
D. famous（有名な）

(9) ハイライトされた文の重要な情報を最もよく表現しているものは？
carnivores eat herbivores to do likewise.（肉食動物は草食動物を食べることで同様のことを行う）
A. Flesh-eating animals provide energy to humans by being hunted.（肉食動物は狩猟されることで人間にエネルギーを供給する）
B. Plant-eating animals are eaten by flesh-eating animals just like plants were eaten by plant-eating animals.（植物が草食動物に食べられるのと同じように、草食動物は肉を食べる動物に食べられる）

C. Energy taken by flesh-eating animals eventually goes back to plants after they die.（肉食動物が摂取したエネルギーは、動物が死んだ後に最終的に植物に戻る）
**D. Flesh-eating animals feed on plant-eating animals to indirectly take energy originated from the sun.（肉食動物は草食動物を食べて、太陽からのエネルギーを間接的に摂取する）**

(10) 9段落の内容に合致しないのは？
A. Energy in Fossil fuels was originally energy from the sun.（化石燃料のエネルギーはもともと太陽からのエネルギーだ）
**B. All energy on earth come from the sun, except for nuclear, hydropower generation, and so on.（原子力発電や水力発電などを除いて、地球上のすべてのエネルギーは太陽から来ている）**
C. Wind occurs when parts of Earth's surface heated differently by the sun.（風は、地球の表面の一部が太陽による温度の上昇が異なると発生する）
D. Eating crops is one way of humanity harnessing energy from the sun.（作物を食べることは、人類が太陽からのエネルギーを利用する形態の 1 つだ）
水力は、太陽によって熱せられ蒸発した海水が陸地に持ち上げられることで水が得た位置エネルギーを利用しているので、これも太陽エネルギーの間接利用である。

(11) 11段落によると、質量（mass）とは何か
A. how heavy the object is（物体の重さ）
B. the quantity of the object（物体の量）
**C. how resistant the object is against being moved（物体が動かされることに対する抵抗力）**
D. the amount of power it derived from the earth's gravitational pull（地球の引力から得られる力）

(12) 10段落と11段落によれば、太陽放射と原子力発電の共通点は？
**A. Loss of mass is released as energy.（質量の損失がエネルギーとして放出される）**
B. They are both beyond human's control.（どちらも人間の制御できるものではない）
C. No greenhouse gas is emitted.（温室効果ガスが排出されない）
D. They are both infinite sources of energy.（どちらも無限のエネルギー源だ）

(13) 全本文中で言及されていないのは
A. Energy is a concept that includes everything capable of causing alteration in an object.（エネルギーとは、物体に変化を引き起こす可能性のあるすべてのものを含む概念だ）
B. Almost all sources of energy on Earth come from the sun's radiation.（地球上のほぼすべてのエネルギー源は太陽の放射線から来ている）
**C. Solar energy is the result of nuclear fission reactions of hydrogen.（太陽エネルギーは水素の核分裂反応の結果だ）**
D. Ne energy is lost in conversions of energy forms.（エネルギー形態の変換時にエネルギーが失われることはない）
太陽エネルギーは水素の核融合反応（nuclear fusion reaction）によって生まれる。核分裂反応ではないので誤り。