2023 年度
大学院理工学研究科【生命/環境】専攻 博士前期課程
一般選抜試験(第Ⅰ期) 問題

英　　語

開始時刻　午前 10 時 30 分
終了時刻　午前 11 時 30 分

【注意事項】

１．答案用紙には受験番号、氏名を必ず記入してください。
２．問題番号を明記された答案用紙を使用して解答してください。
３．配布された答案用紙は試験が終了したら、必ず提出してください。
（問題用紙は提出しなくてよい）

問１：次の英文を読み，下の問い（１）～（３）に答えなさい。

(ア)When scientists develop methods to help them see things that were once invisible, research always takes a great leap forward. For example, when Anton van Leeuwenhoek invented the microscope in the 17th century a new world opened up. Scientists could suddenly see bacteria, sperm and blood cells. Things they previously did not know even existed.

The green fluorescent protein, GFP, rewards a similar effect on science. It has functioned in the past decade as a guiding star for biochemists, biologists, medical scientists and other researchers. The strong green color of this protein appears under blue and ultraviolet light. It can, for example, illuminate growing cancer tumors*; show the development of Alzheimer's disease in the brain or the growth of pathogenic bacteria.

An even more interesting use of GFP means that researchers can actually follow processes *inside* individual cells. The body consists of billions of cells, from pumping heart muscle cells and insulin-producing beta cells to macrophages that destroy unwelcome bacteria. (A)The more researchers know about a cell type – how it develops and functions – the greater the chance that they can develop effective drugs with minimal side-effects.

Studying the machinery of these 0.02 millimeter sized cells is not easy. Observing the building blocks of a cell: proteins, fatty acids, carbohydrates and other molecules is beyond the power of an ordinary microscope. And it is even more difficult to follow chemical processes within a cell, but (イ)it is at this detailed level that scientists must work. When researchers understand how cells start building new blood vessels*, for example, they might be able to stop cancer tumors from acquiring a nourishing and oxygenating vessel system. This will prevent their growth.

The chemical processes of cells are usually regulated by proteins. There are tens of thousands of different proteins, each with different functions. By connecting GFP to one of these proteins, researchers can obtain vital information. (ウ)They can see which cells a particular protein inhabits; they can follow its movements and watch its interactions with other proteins. Thanks to GFP's green light scientists can now track a single protein under the microscope.

What is revolutionary about GFP is that the protein does not need any additives to glow, in contrast to other bioluminescent proteins, which require a continuous supply of energy rich molecules. It is enough to radiate GFP with UV light or blue light. The light enters the cells and meets GFP, which glows green. If the researchers had needed to add a chemical, they would have had to inject it into the cell – a process which can both disturb the cell and is difficult to carry out at such microscopic scales.

(Taken with modification from "Information for the Public: The Nobel Prize in Chemistry 2008", The Royal Swedish Academy of Sciences.)

* tumor: 腫瘍，blood vessel: 血管

（1）この英文中の記述ともっともよく一致しているものを次の(a)〜(e)から一つ選び，記号で答えなさい。

(a) 細菌の存在は 17 世紀に顕微鏡が発明される前から知られていた。
(b) GFP の発見は悪性腫瘍の研究には役立ったが，アルツハイマー病の研究にはあまり役に立たなかった。
(c) 大きさが 0.02 mm しかない細胞が働くしくみを研究するのは容易ではない。
(d) 細胞の中にあるタンパク質は一万種類より少ない。
(e) GFP を光らせるには緑色の光を照射するだけでよい。

（2）文中の下線部 (A) の内容ともっともよく一致するものを次の(a)〜(e)から一つ選び，記号で答えなさい。

(a) 多くの研究者が細胞についてよくわかっているので，副作用が少なくて有効な薬を開発できる機会が増えた。
(b) 細胞についてわかっていることが多ければ多いほど，研究者は副作用が少なくて有効な薬を開発できる機会が増える。
(c) 細胞についてわかっている研究者が多ければ多いほど，副作用が少なくて有効な薬を開発できる機会が増える。
(d) 細胞についてわかっていることが多いからといって，研究者は副作用が少なくて有効な薬を開発できる機会が増えるわけではない。
(e) 細胞のことがわかっている研究者が多いからといって，副作用が少なくて有効な薬を開発できる機会が増えるわけではない。

（3）文中の下線部 (ア)〜(ウ) を日本語に訳しなさい。

問２：次の文章を読んで，下の問い（１）～（５）に答えなさい。

Most vaccines, from measles* to Covid-19*, require a series of multiple shots before the recipient is considered fully vaccinated. To make that easier to achieve, MIT* researchers have developed microparticles that can be tuned to deliver their payload at different time points, which could be used to create (a)"self-boosting" vaccines.

(b)In a new study, the researchers describe how these particles degrade over time, and how they can be tuned to release their contents at different time points. The study also offers insights into how the contents can be protected from losing their stability as they wait to be released.

Using these particles, which resemble tiny coffee cups sealed with a lid, researchers could design vaccines that would need to be given just once, and would then "self-boost" at a specified point in the future. The particles can remain under the skin until the vaccine is released and then break down, just like [c] sutures*.

This type of vaccine delivery could be (d)particularly useful for administering childhood vaccinations in regions where people don't have frequent access to medical care, the researchers say.

"This is a platform that can be broadly applicable to all types of vaccines, including recombinant protein-based vaccines, DNA-based vaccines, even RNA-based vaccines," says Ana Jaklenec, a research scientist at MIT's Koch Institute for Integrative Cancer Research. "Understanding the process of how the vaccines are released, which is what we described in this paper, has allowed us to work on formulations that address some of the instability that could be induced over time."

This approach could also be used to deliver a range of other therapeutics, including cancer drugs, hormone therapy, and biologic drugs, the researchers say.

(Source: Modified from Anne Trafton | MIT News Office, "Microparticles could be used to deliver "self-boosting" vaccines", Life Science Network, July 14, 2022)

* measles：麻疹（はしか），Covid-19：新型コロナウィルス感染症，MIT：マサチューセッツ工科大学，sutures：縫合糸

（１）下線部(a)の"self-boosting" vaccines とはどういうワクチンのことか日本語で説明しなさい。

（２）下線部(b)の In a new study が明からにした３つのこととは何か，日本語で説明しなさい。

（３）文章中の[c]に入る最も適切な語句を，次の i.～iv.のうちから一つ選びなさい。

i. usable　　ii. resorbable　　iii. applicable　　iv. unbelievable

（４）下線部(d)で particularly useful と書かれている理由を日本語で説明しなさい。

（５）この文章中で報告されている microparticles の長所で，上記の問いで答えた以外のものを答えなさい。

問３：次の(1)～(4) の４つの和文のうち２つを選んで英訳しなさい。(3)および(4)では，必要に応じて前後の英文を参考にしてよい。

(1) タンパク質はアミノ酸同士がペプチド結合によりつながってできており，その分子の形から球状と繊維状に分けることができる。

(2) 微生物は普通目に見えないところで人々の生活に影響を与えている生き物である。

Basic science is supported by government and other funds in a modern society. Although there is some support by private institutions established for that purpose and also some industrial investment in generally product-oriented basic research, the greatest amount of support by far comes from public funds.

(3)人々がその支援の見返りを受ける方法の一つは，基礎研究が生み出す科学技術を通じてである。

(4)科学技術からの経済的な見返りだけで，基礎研究の努力全部に費やされる金を埋め合わせるのに十分以上である。

I have no estimate, however, of whether this is true or not. It should be noted that the public gains much more than the economic value of technology. It gains culture, comfort, convenience, security, recreation, health and the extension of life. What monetary value can be put on the triumphs of health over debilitating or fatal disease? The monetary value has to be higher than the purely economic savings.

語彙
(3) 見返りを受ける：be repaid
(4) 見返り：return，埋め合わせる：compensate