科目名 ： 総合科目Ⅰ

問題訂正

科目名 総合科目Ⅰ

17ページ　第4問　上から2行目

（誤）　（正）

「transmtted」→「transmitted」

1 次の文章は，19世紀における微生物学の発展について述べたものである。文章を読み以下の設問に答えなさい。

By the last half of the 19th century, the existence of a diverse microbial world of bacteria, fungi, and protozoa was well established. As early as 1840, the noted German anatomist, Jacob Henle of Gottingen, hypothesized the existence of infectious agents that were too small to be observed with the light microscope and that were able to cause specific diseases. In the absence of any direct evidence for such entities, however, his ideas failed to be accepted. It was at this time that three major advances in microbiology (A) came together to set the stage for the development of the concept of a submicroscopic agent that would come to be called a [(B)] .

The first of these ideas was the demonstration that the spontaneous generation of organisms did not occur (C). This notion had a long history, with experiments both supporting and refuting it. The credit, however, for finally disproving this hypothesis is commonly given to Louis Pasteur, who employed his swan-neck flasks to strike a mortal blow to the concept of spontaneous generation. Pasteur went on to study fermentation by different microbial agents. During these studies, he made it clear that "different kinds of microbes are associated with different kinds of fermentation" and he extended this concept to disease processes. Building upon this, Robert Koch, a student of Jacob Henle and a country doctor in a small German village, demonstrated that the anthrax bacillus was the cause of this disease and that the tubercle bacillus was the cause of tuberculosis in humans. Little of this would have been possible without the third major contribution by Joseph Lister (D). Once it was clear that organisms reproduce new organisms, the importance of a sterile field, whether in surgery or for the isolation of new organisms, became clear. Lister contributed the techniques of limiting dilution to obtain pure cultures of organisms, while Koch developed solid media, the isolation of separate individual colonies of bacteria to

obtain pure cultures, and the use of stains to visualize these microorganisms. While many scientists of that day contributed to these tools and concepts, it was principally Pasteur, Lister, and Koch who put together a new experimental approach for medical science.

These studies formalized some of Jacob Henle's original ideas in what are now termed *Koch's postulates* (E) for defining whether an organism was indeed the causative agent of a disease. These postulates state that (i) the organism must be regularly found in the lesions of the disease, (ii) the organism must be isolated in pure culture, (iii) inoculation of such a pure culture of organism into a host should initiate the disease, and (iv) the organism must be recovered once again from the lesions of the host. By the end of the 19th century, these concepts became the dominant paradigm of medical microbiology. They outlined an experimental method to be used in all situations. It was only when these rules broke down and failed to yield a causative agent that the concept of a virus was born.

(*Fields Virology*, third edition, 1996 より抜粋, 一部改稿)

(注)

anthrax：炭そ病　bacillus：桿状の細菌　culture：培養；培養物
dilution：希　釈　disprove：論破する　entity：実　体
fermentation：発　酵　formalize：定式化する
fungi：真菌類　host：宿　主　hypothesis：仮　説
infectious：感染性のある　inoculation：接　種　isolation：単　離
Koch's postulates：コッホの仮説　lesions：病変組織
medium：培養培地　microbe：微生物　mortal：致命的な
organism：生　物　paradigm：学　説　protozoa：原生動物
refute：論破する　reproduce：複製する
spontaneous：自然に起こる　sterile：無菌な
submicroscopic：顕微鏡で見えない　surgery：外科手術
tubercle：結　節　tuberculosis：結　核
virus：ウイルス

設　問

(1)　下線部(A)にある3つの進歩として適切なものを下記の選択肢から3つ選びなさい。

(ア)　電子顕微鏡を用いた微生物の観察手法の開発

(イ)　微生物の純培養法の確立

(ウ)　生物の自然発生説の否定

(エ)　抗生物質の発見

(オ)　病気を引き起こす微生物の存在証明

(カ)　ワクチンを用いた微生物病の予防法の開発

(キ)　血清型別による微生物の分類法の確立

(2)　空欄(B)に入る英単語1語を本文中より抜き出しなさい。

(3)　下線部(C)に述べられている実験を行った科学者の姓名を本文中より抜き出しなさい。

(4)　下線部(D)を和訳しなさい。科学者の姓名は英語表記のままでよい。

(5)　下線部(E) *Koch's postulates* は，感染症の原因となる生物を同定するための必要条件である。ここに述べられた条件は何か。140字以内の日本語で書きなさい。

2 次の英文は，Jack S. Kilby 博士が，2000 年にノーベル賞を受賞した際の講演の抜粋である。以下の設問に答えなさい。

The innovation and development that have followed in the past 40 years have been more remarkable and far more rapid than all the developments in the prior 400 years after William Gilbert first coined the term "electricity."

Thanks to the work by hundreds of thousands of the world's best engineers, we've not only created new applications for integrated circuits, we've also gotten much better at making them. New manufacturing processes have been devised, better transistors have been invented, and sophisticated techniques for computer-aided design have been developed. Consequently, (A)progress in the field was rapid.

The early simple chips with a dozen (B)components grew to chips with 10,000 components by 1970 and 100 million components today. This progress has been accompanied by a rapid decrease in the cost of electronic circuitry.

In 1958, a single transistor cost about $10. Today, you can buy a chip with 100 million transistors for about that price. Costs are almost certain to continue declining in the future. This decrease in cost of 100 million to one has greatly expanded the field of electronics.

Today, powerful personal computers sell for less than $1,000. And these are far more capable than the $10 million versions of the 1960s.

(C)While integrated circuits are used for military applications, many more are used to improve the quality of life for everyone. Automobiles are safer and emit fewer pollutants because of their integrated circuit systems. Radio and TV have become nearly universal, and hundreds of millions of people are united by the networking power of the Internet. Wireless communications keep people in contact with information and other people anywhere they go on the planet.

I believe the best is yet to come.

Today, approximately 1,000 electrons are necessary to turn an individual transistor on or off. By 2010, it's estimated this will be accomplished by only 100

electrons. The 2010 projection assumes that higher dielectric constant materials will be introduced.

If they were not, then the continuation of geometrical scaling would extrapolate the reduction to a mere 10 electrons per transistor by 2010 and just one electron by 2020.

That, of course, would present a fundamental physical limitation.

Some proposed approaches around this obstacle include quantum cellular automata and molecular switches, among others. When we reach this nanometer-length scale, many people think chemically assembled configurations will begin replacing today's patterned and etched structures.

I don't really know how all that will play out. I do know that engineers in all corners of the world continue to refine integrated circuits while others are working on what might come next.

I know how they feel. In 1958, my goals were simple: to lower the cost, simplify the assembly, and make things smaller and more reliable. Although I do not consider myself responsible for all of the activity that has followed, it has been very satisfying to witness the integrated circuit's evolution.

I am pleased to have had even a small part in helping turn the potential of human creativity into (D) practical reality.

(Jack S. Kilby ノーベル賞受賞講演 "Turning Potential into Realities: The Invention of the Integrated Circuit"より抜粋, 一部改稿)

(注)

coin：造り出す　　dielectric constant：誘電率

electronic circuitry：電子回路　　extrapolate：外挿する

integrated circuit：集積回路　　innovation：革新

quantum cellular automata：量子セルオートマトン

scaling：縮尺(ここでは主に縮小)

設　問

(1)　下線部(A)の急速な進歩の理由を本文に即して100字以内の日本語で答えなさい。

(2)　下線部(B)の components は近い将来物理的な限界が予想されているが，その先の将来へ向けた提案として本文中に具体的に2例示されている。その2例を示す語句をそれぞれ抜き出して答えなさい。

(3)　下線部(C)を和訳しなさい。

(4)　下線部(D)の具体例として挙げられている製品・応用例を本文中より6つ抜き出し日本語で答えなさい。

(5)　この講演当時の chip が動作する時に流れる電流量 I [A]に関して，chip 上のトランジスタ数 N_T，ひとつのトランジスタの動作に必要な電子数 N_e を本文中より抜き出した上で，$I = N_T e N_e f_T$ 式を用いて電流量を計算しなさい。
ただし
e：電荷素量($e = 1.6 \times 10^{-19}$C)，
f_T：トランジスタの動作頻度($f_T = 1 \times 10^9$/s)
とする。

3 次の英文は，遺伝子工学(genetic engineering)の倫理的問題について論じた文章である。これを読んで以下の設問に答えなさい。

In 1975, when genetic engineering was still young, the leaders in the field called a meeting at Asilomar, a seaside conference centre in California, where they thrashed out the possible environmental and health risks of the powerful new gene-splicing techniques that they were wielding. They not only agreed important containment guidelines for certain kinds of work, but achieved something potentially more valuable: the wide press coverage they received won the public trust that scientists were behaving responsibly.

Today that trust is on shaky ground. Controversies over genetically engineered crops and embryo research are leading people to question how carefully scientists consider the possible consequences of their work before barrelling ahead. This is no small concern for science, as it has already led to restrictions.

At the same time, biologists have come to feel increasingly secure in the belief that some ecological nightmare (A) is not likely to spring out of a graduate student's Petri dish. Every day for decades they have been transferring modified genes into microbes, nematodes and mice. At least some of the results — the errant fruitfly or the culture tube spilled in the sink — have no doubt escaped into the environment, without producing a biological Chernobyl.

Is that confidence in step with the technology? The tools now available to the molecular biologist have the potential to provide a stunning array of benefits, for both biomedicine and basic biology. Researchers are learning to understand and manipulate the genetic circuits that control cells. They can transfer entire synthetic pathways to bacteria to make drugs that must otherwise be extracted from rare plants at great cost. Viral genomes can be synthesized chemically in weeks, and bacterial genomes will soon be within reach.

Through such technologies, a new field of synthetic biology is emerging.

(B) Bacteria and yeast have been engineered to build proteins impossible in nature, and with novel properties, by the addition of synthetic amino acids. Several groups are even working on assembling simple cells from basic components. This is no longer a matter just of moving genes around. This is shaping life like clay.

Members of the synthetic-biology community have begun to discuss the possible risks, and ethical implications, of their work. But there is no plan as yet for anything like another Asilomar. In one sense, it may be too soon. The scope of these tools is much broader than that of recombinant DNA, and it is certain to be more difficult to foresee what the actual risks are.

But perhaps such discussions can't come soon enough. What will happen if biologists announce that (C) they have made the first living cells from scratch without having demonstrated to the public any concern for the implications? Researchers must do more than talk among themselves. They must demonstrate publicly that they are willing to consult and reflect carefully about risk — both perceived and genuine — and to moderate their actions accordingly. The need for [(D)], significant in 1975, is all the greater today.

(Nature 2004 年 10 月 7 日号より，一部改変)

(注)

array：おびただしい数　　barrel ahead：猛スピードで進む

Chernobyl：チェルノブイリ(旧ソ連・ウクライナにあった原子力発電所。1986年に大規模な爆発事故を生じ，周辺地域を大量の放射能で汚染した。)

containment：封じ込め　　coverage：報道

embryo：胚　　errant：道からそれた

foresee：予見する　　from scratch：無(ゼロ)から

fruitfly：ミバエ　　gene-splicing：遺伝子操作

genome：ゲノム　　manipulate：操作する

microbe：微生物　　nematode：線虫

recombinant：組換えの　　scratch：(from scratch を見よ)

shaky：不安定な　　stunning：すごい

synthesize：合成する　　thrash out：徹底的に論議する

viral：ウイルスの　　wield：用いる

yeast：酵母

設　問

(1)　下線部(A)の「生態学的な悪夢」とはどのような事態を指すのか。60字以内の日本語で説明しなさい。

(2)　下線部(B)を和訳しなさい。

(3)　下線部(C)は，どのような研究を指すのか。他の段落でこの研究について述べた文を参考にして，30字以内の日本語で説明しなさい。

(4)　空欄(D)に入る単語2つからなる語句を，文章の最初の段落(In 1975 から responsibly まで)から抜き出して答えなさい。さらにその語句の内容を，本文全体の趣旨にもとづいて，60字以内の日本語で説明しなさい。

4 次の英文は，情報伝送路の伝送能力について論じた文章の一部である。これを読んで以下の設問に答えなさい。

Teletype and telegraphy are two simple examples of a discrete channel for transmitting information. Generally, a discrete channel will mean a system whereby a sequence of choices from a finite set of elementary symbols $S_1,...,S_n$ can be transmitted from one point to another. Each of the symbols S_i is assumed to have a certain duration in time t_i seconds (not necessarily the same for different S_i, for example the dots and dashes in telegraphy). It is not required that all possible sequences of the S_i be capable of transmission on the system; certain sequences only may be allowed. These will be possible signals for the channel. (A) Thus in telegraphy suppose the symbols are: A dot, consisting of line closure for a unit of time and then line open for a unit of time; A dash, consisting of three time units of closure and one unit open; A letter space consisting of three units of line open; A word space of six units of line open. We might place the restriction on allowable sequences that no spaces follow each other (for if two letter spaces are adjacent, it is identical with a word space). The question we now consider is how one can measure the capacity of such a channel to transmit information.

In the teletype case where all symbols are of the same duration, and any sequence of the symbols is allowed, the answer is easy. Each symbol represents five bits of information. If the system transmits n symbols per second it is natural to say that the channel has a capacity of $5n$ bits per second. (B) This does not mean that the teletype channel will always be transmitting information at this rate. This is the maximum possible rate and whether or not the actual rate reaches this maximum depends on the source of information which feeds the channel.

(中　略)

A very general type of restriction which may be placed on allowed sequences

is the following: We imagine a number of possible states $a_1,a_2,...,a_m$. For each state only certain symbols from the set $S_1,...,S_n$ can be transmtted (different subsets for the different states). When one of these has been transmitted the state changes to a new state depending both on the old state and the particular symbol transmitted. The telegraph case is a simple example of this. There are two states depending on whether or not a space was the last symbol transmitted. If so, then only a dot or a dash can be sent next and the state always changes. If not, any symbol can be transmitted and the state changes if a space is sent, otherwise it returns to the same state. The conditions can be indicated in a graph as shown in Figure 1. The junction points correspond to the states and the arrows indicate the symbols possible in a state and the resulting state.

(C. E. Shannon, A Mathematical Theory of Communication より抜粋, 一部改稿)

(注)

bit：ビット(情報量の単位)
channel：伝送路
discrete：離散的な(連続的でない)
duration：長さ
feed：データ・情報などを送り込む
finite：有限の
junction point：接合点
letter space：文字区切り記号
line closure：有音区間
line open：無音区間
state：状態
subset：部分集合
symbol：(伝送される情報の単位となる)記号
telegraphy：テレグラフ
teletype：テレタイプ
transmit：伝送する
word space：単語区切り記号

設　問

(1)　この文章ではテレタイプとテレグラフが伝送路の例として取り上げられている。以下の(ア)～(エ)のうち，テレタイプについて説明したものを１つ選びなさい。

(ア)　個々の記号の長さはすべて等しく，記号の伝送順序に関して制限がある。

(イ)　個々の記号の長さはすべて等しく，記号の伝送順序に関して制限はない。

(ウ)　個々の記号の長さはそれぞれ異なり，記号の伝送順序に関して制限がある。

(エ)　個々の記号の長さはそれぞれ異なり，記号の伝送順序に関して制限はない。

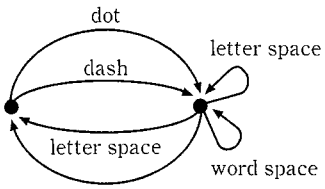
(2)　下線部(A)で説明されているテレグラフにおける４つの記号(dot，dash，letter space，word space)の信号パターンを例にならって図示しなさい(○は有音区間，×は無音区間を表す)。

例)　○○×

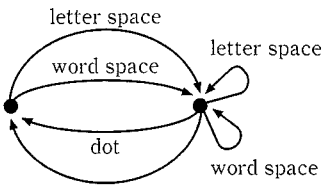
(3)　下線部(B)を和訳しなさい。

(4) 下線部(C)の Figure 1 として適切なものを以下のア～カから1つ選びなさい。

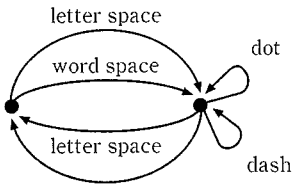
ア.



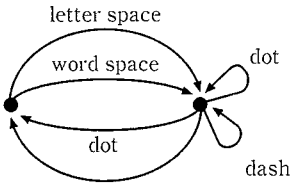
イ.



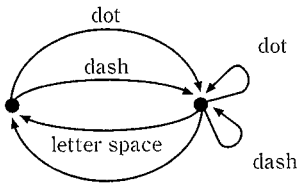
ウ.



エ.



オ.



カ.