令和３年度入学試験問題(前期)

総　合　問　題

(医学部医学科)

【注意事項】

1. 試験開始の合図があるまで，この問題冊子を開いて見てはならない。
2. 本冊子には，[1]から[2]までの２問題が印刷されていて，12ページある。
   落丁，乱丁，印刷の不鮮明な箇所等がある場合には，申し出ること。
3. 解答用紙と計算用紙を別に配付している。解答は，解答用紙の指定された箇所に記入すること。所定の箇所以外に記入したものは無効である。
4. 解答用紙の指定された欄に，学部名および受験番号を記入すること。
5. 解答用紙の一つのます目に一文字ずつ入れること。数字・アルファベットの場合も同様とする。
6. 提出した解答用紙以外は，すべて持ち帰ること。

1 以下の文章を読み，各問いに答えなさい。

Microplastics, as the name implies*, are tiny plastic particles. Officially, they are defined as plastics less than five millimeters (0.2 inches) in diameter*-smaller in diameter than the standard pearl used in jewelry. There are two categories of microplastics: primary and secondary. Primary microplastics are tiny particles designed for commercial use, such as cosmetics, as well as microfibers shed from clothing and other textiles, such as fishing nets. Secondary microplastics are particles that result from the breakdown of larger plastic items, such as water bottles. This breakdown is caused by exposure to ① environmental factors.

The problem with microplastics is that -like plastic items of any size- they do not readily break down into harmless molecules. Plastics can take hundreds or thousands of years to decompose* -and in the meantime, wreak havoc* on the environment. On beaches, microplastics are visible as tiny multicolored plastic bits in sand. In the oceans, microplastic pollution* is often consumed by marine animals. Some of this environmental pollution is from littering*, but much is the result of storms, water runoff, and winds that carry plastic -both intact objects and microplastics- into our oceans. Single-use plastics, such as a straw -plastic items meant to be used just once and then discarded*- are the primary source of secondary plastics in the environment.

In the oceans, microplastics are colonized by microorganisms, such as algae*, bacteria and fungi*, and formed biofilm*. ② The growth of biofilm can increase the density of microplastics and may affect the distribution* of microplastics in the ocean column. Microplastics have been detected in marine organisms from plankton to whales, in commercial seafood, and ③ even in table salt and drinking water. Alarmingly, standard water treatment facilities* cannot remove all traces of microplastics. To further complicate matters, microplastics in the ocean can bind with other harmful chemicals before being

ingested* by marine organisms.

Scientists are still unsure whether consumed microplastics are harmful to human or animal health -and if so, what specific dangers they may pose. Even so, many countries (A) to reduce microplastics in the environment. A 2017 United Nations resolution* discussed microplastics and the need for regulations to reduce this hazard to our oceans, their wildlife, and human health. Some companies are starting to replace single-use plastic items with biodegradable* alternatives. Traditional plastics are made from petroleum, biodegradable plastics such as polylactic acids (PLA), in contrast, are made from biological materials like sugarcane* and corn stalks*. ④ These materials decay* when microbes feed on them, breaking big molecules into smaller, simpler ones (such as carbon dioxide and water). Other living things can then feed on these breakdown products to grow.

出典 https://www.nationalgeographic.org/encyclopedia/microplastic,
https://www.sciencenewsforstudents.org/article/help-for-a-world-drowning-in-microplastics
(一部改変)

*訳注

imply	示す
diameter	直径
decompose	分解する
wreak havoc	大惨事をもたらす
pollution	汚染
litter	捨てる
discard	捨てる
algae	藻類
fungi	菌類
biofilm	生物膜
distribution	分布
facility	設備
ingest	摂取する
United Nations resolution	国連決議
biodegradable	生分解性の
sugarcane	サトウキビ
stalk	茎
decay	崩壊

問 1　マイクロプラスチックが問題視される理由を日本語で3つ挙げなさい。

問 2　下線部①の environmental factors に相当するものを考え，日本語ですべて挙げなさい。

問 3　下線部②のように，マイクロプラスチックはバイオフィルムの付着により密度が変化する。下記の図 1 のような球状のマイクロプラスチック(半径(R_0) 0.90 mm，密度 1.00 g/cm^3)の表面にバイオフィルム(厚さ(d) 0.10 mm，密度 1.30 g/cm^3)が一様に形成されたときのバイオフィルムが付着したマイクロプラスチック全体の粒子の密度を求めなさい。計算の過程を示し，答えは小数点第 2 位まで求めなさい。

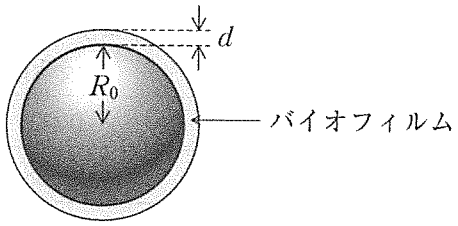


図 1

問 4　図 1 のように，球状のマイクロプラスチックにバイオフィルムが付着するときの密度変化について正しく記述してあるものを，ア)からウ)の選択肢から選びなさい。

ア）バイオフィルム形成が密度変化に与える影響は，球状マイクロプラスチックの半径が大きいほど大きい。

イ）バイオフィルム形成が密度変化に与える影響は，球状マイクロプラスチックの半径が大きくても小さくても同じである。

ウ）バイオフィルム形成が密度変化に与える影響は，球状マイクロプラスチックの半径が小さいほど大きい。

問 5　下線部③のように，海産物や食塩に含まれるマイクロプラスチックは人間の健康に影響を与える可能性がある。表 1 は世界各地の海塩を基に生産された食塩 1 kg 当たりに含まれているマイクロプラスチック量を調べたものである。食塩に含まれるマイクロプラスチック量の生産地差を生み出す要因として何が考えられるか日本語で記しなさい。

表 1.　食塩に含まれるマイクロプラスチック量

海水採取地	マイクロプラスチック量 (mg/kg)
韓国	0.99
中国	12.88
台湾	25.86
タイ	13.08
インド	3.43
ベトナム	1.19
フランス	0.00
イタリア	2.35
イギリス	1.89
オーストラリア	0.11
ブルガリア	3.70
アメリカ	0.23
ブラジル	0.50
セネガル	0.62

Kim JS, et al. *Environ. Sci. Technol.* 2018; 52(21):12819-12828 より抜粋

問 6　文章中の(　A　)に入る最もふさわしい語句をア)からエ)の選択肢から選びなさい。

ア）have a doubt

イ）are blinded

ウ）are taking action

エ）are refusing

問 7　下線部④の生分解性プラスチックであるポリ乳酸は，微生物の作用により最終的には水と二酸化炭素に分解される。ポリ乳酸のみからなるプラスチック 132 g が全て水と二酸化炭素に分解されたとき，何 g の二酸化炭素が生じるか求めなさい。計算の過程を示し，答は整数で記しなさい。但し，ポリ乳酸は下記の図 2 で示される繰り返し単位だけからなるとし，原子量は H = 1.0，C = 12，O = 16 とする。

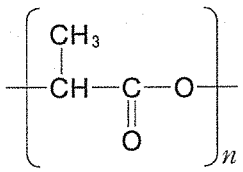


図 2

問 8　以下の日本語を英語に訳しなさい。

社会のあらゆるレベル(政府，公衆，個人)の関与と教育は，マイクロプラスチック問題に対する意識向上や積極的な行動変化を起こすために必要である。

2 以下の文章を読み，各問いに答えなさい。

① The human body is getting colder. Since the nineteenth century, normal body temperatures have dropped by a fraction of a degree, according to a provocative* study of more than 677,000 thermometer measurements taken from people in the United States since 1860. People's bodies are now, on average, cooler than the textbook figure of 37 ℃, having fallen by a few hundredths of a degree per decade, estimates a team led by Julie Parsonnet, an infectious-disease epidemiologist* at Stanford University in California. "If you ask a room of physicians, 'What's the normal temperature?', they'll tell you it's 37," says Parsonnet. She suspects that falling rates of chronic infections explain our cooler bodies. The 37 ℃ figure for normal body temperature was first determined in 1851 by Carl Reinhold August Wunderlich, a German physician who took millions of measurements from some 25,000 people and reported a range of 36.2 to 37.5 ℃. "It became just the standard. It was adopted in textbooks, and it was just what people believed," Parsonnet says.

Nobody rigorously challenged Wunderlich's figure until 1992, when a team at the University of Maryland in Baltimore tested 148 people participating in a vaccine trial and found that their temperatures averaged 36.8 ℃. A 2017 study of more than 35,000 people in the United Kingdom found an average of 36.6 ℃. The 1992 study's lead author, infectious-disease physician Philip Mackowiak, suspected that the rudimentary* thermometers available to Wunderlich explained ② the discrepancy*. He later tested one of Wunderlich's thermometers — in the collection at the Mütter Museum in Philadelphia, Pennsylvania — and found that its reading was too high by more than 1 ℃. Mackowiak concluded that measurement error was behind Wunderlich's 37 ℃ average.

But Parsonnet says her team's data suggest ③ body temperatures really are cooling. The team looked at three data sets. In the earliest one, a

database of 83,900 temperatures collected between 1860 and 1940 from veterans* of the American Civil War*, the researchers found that people born earlier tended to have higher temperatures than those born in later years, even when body temperatures were measured in the same period — presumably, with the same technology. This suggests that improvements in thermometer technology were not behind the trend, Parsonnet says. "If it's just the thermometers changing, the year that the temperature was taken should make the difference." Using the Civil War data, along with hundreds of thousands of measurements collected in the 1970s and between 2007 and 2017, Parsonnet's team modelled changes in body temperature. Women born in the first decade of the nineteenth century had temperatures 0.32 ℃ higher than those of women born in the late 1990s; for men, the difference was 0.59 ℃. Overall, temperatures dropped at a rate of 0.03 ℃ per decade.

Parsonnet thinks that ④ lower rates of infection are probably the best explanation for the falling temperatures. Inflammatory* immune responses* to long-term infections such as tuberculosis* and gum disease* can elevate body temperature, she notes. "If you looked at the great majority of people back in the nineteenth century, I'm sure literally all of them had a chronic inflammatory condition," she says. "They lived to be 40 years old or less. They all had terrible dentition*." A small 2008 study of healthy volunteers in Pakistan, where tuberculosis is still relatively common, reported average body temperatures of 36.9 ℃. That explanation is "intriguing* and plausible*", says Jill Waalen, an epidemiologist at the Scripps Research Translational Institute in La Jolla, California. None of the temperature measurements the researchers relied on spanned the period beginning in the 1940s, when antibiotics* were introduced. Waalen says that a marked drop in body temperatures during this period would support the theory that infections explained the cooling trend.

Makowiak, though, isn't convinced that body temperatures are falling. "I'm concerned because there are so many variables that are unaccounted for,"

he says. For instance, the Civil War data do not indicate whether temperatures were taken orally or in the armpit (which can differ in the same person), nor the time of day they were collected (bodies tend to warm through the day). "There's no biological explanation that I find convincing," Makowiak adds. ⑤"We're talking about 200 years, which in the evolution of life is just a blink of the eye." But human physiology has changed in other ways, so it should be no surprise if our bodies are a bit cooler, says Parsonnet. "We've also grown taller, we've grown fatter. We've changed since the 1850s. Temperature is just another marker of that change."

出典 Callaway E. Nature NEWS 14 JANUARY 2020
https://www.nature.com/articles/d41586-020-00074-9
Callaway E. Nature. 2020; 577:306
Protsiv, M.,et al. eLife. 2020; 9: e49555
(一部改変)

*訳注

provocative	挑戦的な
epidemiologist	疫学者
rudimentary	原始的な，未発達の
discrepancy	矛盾
veterans	退役軍人
American Civil War	南北戦争
Inflammatory	炎症性の
immune response	免疫応答
tuberculosis	結核
gum disease	歯周病
dentition	歯並び
intriguing	好奇心をそそる
plausible	もっともらしい
antibiotics	抗生物質

問 1　下線部①を和訳しなさい。

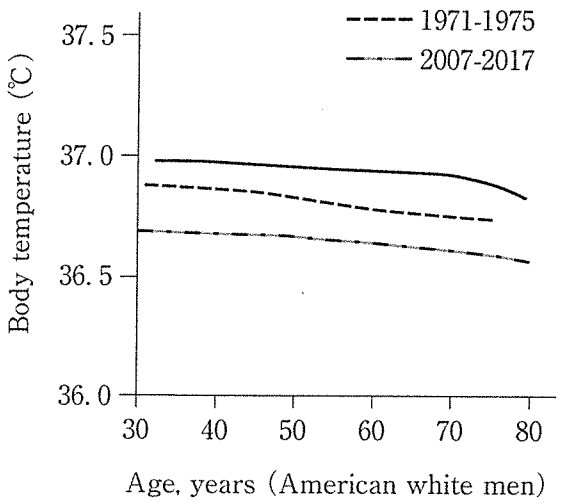
問 2　下線部② the discrepancy についての Philip Mackowiak による主張を日本語で 75 字以内で説明しなさい。

問 3　Julie Parsonnet が主張する下線部③ body temperatures really are cooling について，下のグラフ 1，グラフ 2 を用いて日本語で 150 字以内で説明しなさい。

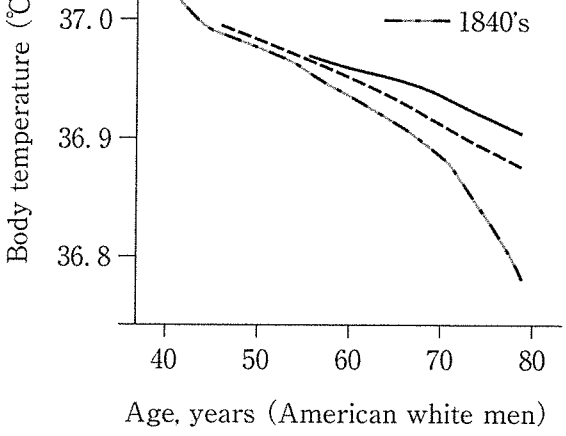
グラフ 2 は 1862-1940 の調査である。

補足：ヒトの平均体温は加齢に伴い低下する。

グラフ 1



グラフ 2



問 4　Julie Parsonnet の下線部④ lower rates of infection による平均体温低下の説について a ～ g の記述を読み，正しいと考えられる場合は○，正しいとはいえない場合は×を記しなさい。

a：　高い平均体温は短い平均寿命の要因である。

b：　1940 年代に平均体温の顕著な低下が認められた。

c：　長期に渡る感染症は平均体温の上昇をもたらす。

d：　抗生物質には直接的に体温を低下させる作用がある。

e：　全ての発展途上国では国民の平均体温が高い。

f：　19 世紀の人々の多くは慢性的に炎症を患っていた。

g：　低い医療水準は高い平均体温に関連する。

問 5　下線部⑤の Philip Mackowiak による反論を日本語で 75 字以内で説明しなさい。

問 6　上記の "The human body is getting colder." を検証する為，さらにどのような研究を加えるべきかを考察し，日本語で 100 字以内で記述しなさい。