

令和2年度 入学試験問題

医学部（Ⅱ期）

英語・数学

注意事項

1. 試験時間 令和2年3月10日、午前9時30分から11時50分まで
2. 配付した試験問題(冊子)、解答用紙の種類はつぎのとおりです。
 - (1) 試験問題(冊子、左折り)(表紙・下書き用紙付)
英語
数学(その1、その2)
 - (2) 解答用紙
英語 1枚(上端黄色)(右肩落し)
数学(その1) 1枚(上端茶色)(右肩落し)
" (その2) 1枚(上端茶色)(左肩落し)
3. 下書きが下書き用紙で足りなかったときは、試験問題(冊子)の余白を使用して下さい。
4. 試験開始2時間以降は退場を許可します。但し、試験終了10分前からの退場は許可しません。
5. 受験中にやむなく途中退室(手洗い等)を望むものは挙手し、監督者の指示に従って下さい。
6. 休憩のための途中退室は認めません。
7. 退場の際は、この試験問題(冊子)を一番上へのせ、挙手し、監督者の許可を得てから、試験問題(冊子)、受験票、下書き用紙および所持品を携行の上、退場して下さい。
8. 試験終了のチャイムが鳴ったら、直ちに筆記をやめ、おもてのまま上から解答用紙(英語、数学(その1)、数学(その2))、試験問題(冊子)の順にそろえて確認して下さい。確認が終っても、指示があるまでは席を立たないで下さい。
9. 試験問題(冊子)はお持ち帰り下さい。
10. 監督者退場後、試験場で昼食をとることは差支えありません。ゴミ入れは場外に設置してあります。
11. 午後の集合は1時です。

英 語

1 次の各文の()に入れるのに最も適切な表現を1つ選び、記号で答えなさい。

1. Due to the changes in people's shopping habits, () than five department stores were forced to close down.
A. no longer B. no higher C. no smaller D. no fewer
2. My lazy son does not so () as walk his dog every morning.
A. less B. many C. much D. few
3. How often do you () out at the fitness club?
A. go B. figure C. train D. work
4. She was very hungry. She put () a big plate of salad immediately.
A. on B. off C. in D. away
5. She is on very good () with her mother-in-law.
A. terms B. relationship C. friendship D. bond
6. My mother left the memo on the table () in order that her son would see it.
A. mistakenly B. accidentally C. definitely D. deliberately
7. My friend asked me to eat out in the heavy rain, so I tried to talk her () it.
A. off B. against C. out of D. away from
8. () a flower to flourish, it must have a good supply of light, water, and minerals.
A. Of B. For C. If D. On
9. My teacher () me to study more.
A. said B. suggested C. informed D. advised
10. The students will move into their new school building next year if it () by then.
A. complete B. completed C. is completed D. will be completed

11. Don't let any flowers in my garden ().
A. pick up B. to pick up C. picking up D. be picked up

12. The last person () will have to lock this room.
A. to leave B. for leaving C. to be left D. who leave

13. A : Could you put me through to Dr. Tanaka?

B : I'm afraid he's out now. (ア)

A : Yes, please. Could you ask him to call me back when he comes back?

B : OK. Oh, (イ)

(ア) A. Could you call again?

B. Can I take a message for him?

C. What would you like me to do?

D. What is your problem?

(イ) A. please call him anytime you want.

B. what's his phone number?

C. you've got the wrong number.

D. who's calling please?

14. A : Excuse me, but do you mind if I open the window?

B : () It's very hot here.

A. No, go ahead.

B. Yes, I don't care.

C. Yes, here it is.

D. Oh, do you?

2 著作権処理許諾が得られなかったため未収録

3 次の文章を読んで以下の設問に答えなさい。

[1] Americans don't have the guts for sushi. At least that's the implication of a new study, which finds that Japanese people harbor enzymes in their intestinal bacteria that help them digest seaweed — enzymes that North Americans lack. What's more, Japanese may have first acquired these enzymes by eating bacteria that thrive on seaweed in the open ocean.

[2] Mirjam Czjzek didn't set out to compare cross-cultural eating habits. Instead, the chemist at the Station Biologique de Roscoff*, on the coast of Brittany in France, was interested in 一片の海藻を消化するには何が必要なのか. Unlike inland plants, the carbohydrates that make up seaweed are spangled with* molecules of sulfur, so special enzymes are needed to break them down.

[3] To figure out exactly (1) enzymes are necessary, Czjzek and colleagues embarked on what she calls “treasure-hunting in the marine bacterial genome.” The researchers focused on *Zobellia galactanivorans*, a marine bacterium known to munch* on seaweed. The hunt turned up five genes in *Z. galactanivorans* that seemed to code for enzymes that could break down the particular carbohydrates found in the marine algae*. When the researchers transferred these genes to another bacterium (2) to eat seaweed carbohydrates, they found that two genes were particularly active.

[4] Czjzek wondered where else these genes might be lurking*. So she used a computational method known as BLAST* to scan vast banks of metagenomic data — the genomes of bacteria (3) from the environment — for sequences that matched up with the two *Z. galactanivorans* genes. That's when the surprise came.

[5] “They were all, except one, from marine bacteria,” Czjzek says. “The one exception... came from human gut samples.” The bacterium in question is known as *Bacteroides plebeius*, and it has been found only in Japanese people. Wondering whether the enzymes were unique to Japanese individuals, Czjzek's team compared the microbial genomes* of 13 Japanese people with those of 18 North Americans. Five of the Japanese subjects harbored the enzyme, but among the North Americans, “we didn't find a single one,” says Czjzek, (4) team reports its findings tomorrow in *Nature*.

[6] Where would bacteria inside the human gut get ahold of* a seaweed-digesting enzyme? Czjzek speculates that they could have grabbed it from bacteria that live on the seaweed. She notes, for example, that according to tax records dating back to the 8th century C.E., seaweed was used as a form of payment in Japanese society. “That shows the importance of this type of good,” Czjzek says. With *nori*, the seaweed used to wrap sushi or *wakame*,

a green seaweed often served in miso soup, being consumed day after day, the bacteria in the gut would have a chance to incorporate genetic material from their marine-dwelling cousins. “Traditionally, [the Japanese] eat [seaweed] raw, not sterile*,” says Czjzek. “This makes the contact possible.”

[7] The ability to munch on (5) extra carbohydrates might have given these gut bacteria a leg up over* their thousands of competitors, says Czjzek. It also may help their human hosts. Because gut bacteria can squeeze energy from carbohydrates that human enzymes can't break down, these adapted microbes might help Japanese who dine on seaweed get more nutrition from their meal than do North Americans, she says.

[8] Scientists have thought that gut bacteria might pick up genes from other microbes, a process known as lateral gene transfer*, “but there hasn't been an example this clear before,” says Ruth Ley, a microbiologist at Cornell University. “I think it's the first demonstration of how people's culture has impacted the [bacteria in the] gut.”

(5)

(From “Japanese Guts Are Made for Sushi” by Lauren Schenkman SCIENCE Apr. 7, 2010.
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(注)

the Station Biologique de Roscoff ロスコフ海洋生物研究所

be spangled with ～がちりばめられている munch ムシヤムシヤ食べる

algae 藻 lurk 潜む BLAST Basic Local Alignment Search Tool の略

microbial genome 微生物ゲノム get ahold of ～を手に入れる

sterile 殺菌した leg up over ～に対する優位

lateral gene transfer 遺伝子の水平伝播：母細胞(細胞分裂する前の細胞)から娘細胞(細胞分裂の結果として生じる2つ以上の細胞)への遺伝ではなく、個体間や他生物間においておこる遺伝子の取り込みのこと。

1. (1)～(5)に入れるのに最も適切な語(句)を次から1つ選び記号で答えなさい。

(1) A. whose B. which C. when D. where

(2) A. invented B. kept C. asked D. forced

(3) A. gather B. gathers C. gathering D. gathered

(4) A. what B. which C. whose D. whom

(5) A. few B. a few C. little D. a little

2. [2]の下線部(あ)を以下の語を使って英訳する際、3番目と7番目にくる語を1つ選び記号で答えなさい。

- A. of B. a C. it D. seaweed E. digest
F. what G. takes H. to I. piece

3. [6]の下線部(い)の語の意味を表す英語を本文中から探して書きなさい。

4. [8]の下線部(う)が指している内容を15字以内の日本語で説明しなさい。

5. 次の中から本文の内容に合っているものを3つ選び、記号で答えなさい。

- A. Mirjam Czjzek's original interest was to compare cross-cultural eating habits.
- B. The gut bacteria which North Americans have cannot break down the carbohydrates contained in seaweed.
- C. Microbes that dwell in the guts of Japanese people but not in North Americans have some of the same seaweed-digesting enzymes as the marine bacterium *Zobellia galactanivorans*.
- D. Five *Zobellia galactanivorans* genes were found to be able to break down carbohydrates when they were transferred to another bacterium.
- E. Two particular genes are responsible for actively breaking down carbohydrates that contain sulfur.
- F. The researchers were surprised to find genome sequences similar to *Zobellia galactanivorans*' genes in North Americans' gut bacteria.
- G. After comparing the genomes of Japanese and North Americans, the enzyme was found in 13 Japanese, and in none of the 18 North Americans.
- H. Mirjam Czjzek infers that short history of eating seaweed in Japan made it possible for Japanese to get ahold of a seaweed-digesting enzyme.
- I. Mirjam Czjzek was not the first researcher who clearly showed that the example of lateral gene transfer in gut bacteria was observed in humans.

数 学 (その1)

1 次の各問いに答えよ。ただし、答えは結果のみを解答欄に記入せよ。

(1) xyz 空間において、原点 O を中心とする半径 1 の球面 $S: x^2 + y^2 + z^2 = 1$ 、および S 上の点 $A(0, 0, 1)$ を考える。 S 上の A と異なる点 $P(x_0, y_0, z_0)$ に対して、 2 点 A, P を通る直線と xy 平面の交点を Q とする。次の問いに答えよ。

(1-1) $\overrightarrow{AQ} = t\overrightarrow{AP}$ (t は実数) とおくと、 \overrightarrow{OQ} を $\overrightarrow{OP}, \overrightarrow{OA}$ および t を用いて表せ。

(1-2) \overrightarrow{OQ} の成分表示を x_0, y_0, z_0 を用いて表せ。

(1-3) 球面 S と平面 $x = \frac{1}{2}$ の共通部分が表す図形を C とする。点 P が C 上を動くとき、 xy 平面における点 Q の軌跡を求めよ。

(2) xy 平面において、点 $A(a, 0)$ を中心とする半径 r の円を C とする。ただし、 $0 < r \leq a$ とする。円 C の周上に、 y 座標が正である点 P と、点 $E(a + r, 0)$ をとる。さらに、点 P における円 C の接線と y 軸との交点を Q 、 2 点 E, P を通る直線と y 軸との交点を R 、 $\angle AEP$ を θ とする。このとき、 3 点 P, Q, R を頂点とする $\triangle PQR$ について、次の問いに答えよ。

(2-1) $QP:QR$ の比を求めよ。また、 $\triangle PQR$ が正三角形となる場合の θ の値を求めよ。

(2-2) $\triangle PQR$ が正三角形となり、さらに頂点の 1 つが原点と一致する場合の、 a と r の関係式を求めよ。

2

(1) 方程式 $4x^4 - 8x^3 + 11x^2 - 8x + 4 = 0$ を解け。

(2) $x^{2020} + x + 1$ を $x^2 + x + 1$ で割ったときの余りを求めよ。

(3) 3次方程式 $x^3 - x^2 - x - 1 = 0$ の3つの解を α, β, γ とする。 $\frac{1}{(\alpha - 2)(\beta - 2)}$,
 $\frac{1}{(\beta - 2)(\gamma - 2)}$, $\frac{1}{(\gamma - 2)(\alpha - 2)}$ を解とする3次方程式を求めよ。ただし、 x^3 の係数は
1とする。

数 学 (その2)

3 次の各問いに答えよ。ただし、答えは結果のみを解答欄に記入せよ。

(1)

$$\sin^3 \theta + \cos^3 \theta = \frac{11}{16} \quad (90^\circ < \theta < 180^\circ)$$

のとき、 $\sin \theta$ および $\cos \theta$ の値を求めよ。

(2) 座標平面上に2点 $A(-2, 0)$, $B(2, 0)$ がある。円 $(x-4)^2 + (y-3)^2 = 4$ 上に点 P をとって、 $\overline{AP}^2 + \overline{BP}^2$ を最小にするような点 P の座標を求めよ。

(3) 1 から 55 までの整数のどれか 1 つを同じ大きさのカードに書いて、1 を書いたカードを 1 枚、2 を書いたカードを 2 枚、以下同様に 55 を書いたカードを 55 枚作り、これらを箱に入れる。箱の中をよく混ぜてから 1 枚のカードを取り出し、それに書いてある数を X とする。

(3-1) $X = 28$ となる確率を求めよ。

(3-2) X の期待値(平均値)を求めよ。

4 次の各問いに答えよ。ただし、(1)、(2)は結果のみを解答欄に記入せよ。

(1)

$$\lim_{x \rightarrow 0} \frac{\sin^2 5x}{1 - \cos x}$$

を求めよ。

(2) 半径 3 の球に内接する直円柱の体積の最大値を求めよ。

(3) xy 平面上で $x \geq 0$, $y \leq 0$ のとき、

$$\int_y^x (1 - |t|) dt \geq 0$$

を満たす点 (x, y) の存在する部分を図示せよ。