

平成17年度大学院医学研究科（2回目）

医学・生物学一般試験（問題用紙1枚、解答用紙2枚）

以下の4問題から2問題を選択して解答しなさい。1問題につき1枚の解答用紙を使用すること。紙面不足の場合は裏面使用も可。

1. 1997年に羊のドリーさんがクローン羊として世に送り出されて以来、クローン動物作成技術は社会問題となりながらも着実に進歩しています。最近では、ベンチャービジネスとしてクローン猫の販売等が報道されています。このクローン動物作成技術とその問題点について知るところを述べて考察しなさい。
2. 最近重要な社会問題となっている人畜共通感染症について述べなさい。
3. 人類による生物毒の認識は、はじめおそらくは周囲にある動植物を食べ物として利用しようとしたとき、あるいはへビ、サソリ、毒虫などに襲われて被害をこうむった時になされたものと思われます。有毒動植物による中毒被害や咬刺被害は次第に人類にそれらを認識する知識と利用する知恵とをあたえ、毒はやがて医薬や狩猟用の矢毒などに用いられるようにさえなりました。我々の身近にあって、今日の医療に役立っている生物毒を2例挙げ、概説しなさい。
4. 「児童虐待の防止等に関する法律」について知るところを記しなさい。

次の文章を読み、下記の質問に答えなさい。

Many religious leaders find themselves at odds with science, but the head of Tibetan Buddhism is a notable exception. Jonathan Knight meets a neurologist whose audience with the Dalai Lama helped to explain why.

One of the first things people discover when they meet His Holiness the Dalai Lama is that the head of Tibetan Buddhism likes a good laugh. "He jokes all the time," says Fred Gage, a neuroscientist at the Salk Institute for Biological Studies in La Jolla, California, who met the spiritual leader for the first time in October. "He has a great sense of humour."

This is probably a good thing. The occasion for this meeting — a research conference held at the Dalai Lama's headquarters in Dharamsala, India — included a presentation of evidence that people in good spirits are better able to control their blood sugar levels. Other talks suggested that meditation can transform emotions and that daily experiences can alter the expression of genes. Gage presented his research into how the brain can remake itself throughout life.

It was the 12th time since 1987 that the Dalai Lama has convened leading psychologists and neurobiologists to hear the latest scientific thinking in fields related to the human mind. These meetings are organized by the Mind & Life Institute in Louisville, Colorado, which was established in the 1980s to promote communication between science and Buddhism. But much of the credit for this open communication goes to the Dalai Lama himself.

Spiritual links

In accordance with Tibetan tradition, the current Dalai Lama, Tenzin Gyatso, was recognized as the 14th reincarnation of the Bodhisattva of Compassion in 1937, when he was only two years old. Gyatso has long had an interest in science. When he accepted the Nobel Peace Prize in 1989, he commented: "Both science and the teachings of the Buddha tell us of the fundamental unity of all things." He once said that if he had not been a monk, he would have been an engineer.

Enthusiasm for science seems to extend beyond the spiritual leader. Tibetans, surprisingly enough, were the most strongly represented ethnic group working on the Human Genome Project: although they account for only 0.1% of the world's population, Tibetans made up about 10% of the project's workforce (see *Nature* 425, 335; 2003).

For many Buddhist monks, this interest in science is focused on an intense curiosity about the workings of the brain. Monks typically spend hours in meditation each day, a practice they say enhances their powers of concentration. Highly trained monks report being able to focus on a single object for hours without distraction and to recall complex scenes in exquisite detail. A question that deeply interests the Dalai Lama, and indeed some neuroscientists, is whether these phenomena have a biological basis.

Gage studies the ability of the mammalian brain to change and adapt in adulthood. Before the late 1990s, it was thought that adult brains were more-or-less complete. Learning involved the development of new connections — but no new neurons were born, and when these cells died they were gone forever. Now it turns out that new neurons do grow and our brains are much more flexible than was once believed. As a key component of Buddhist belief is that meditation literally transforms the mind, Buddhists are keenly interested in scientific advances that could help explain this observation.

Gage's talk on 18 October in Dharamsala — seat of the Tibetan government-in-exile since 1960 — kicked off a five-day private conference on 'neuroplasticity'. Gage gave a general primer on the complexity of the nervous system, and then launched into a two-hour presentation of his research targeted at a lay audience. Next to him, the Dalai Lama listened intently, making occasional use of two interpreters to translate into Tibetan things he didn't immediately grasp in English. Also in the audience were the six other presenters and a handful of Buddhist monks.

Lessons learned

Although the group did not come to any Earth-shattering conclusions about cognition, they did reach a higher understanding of each other, which was the main point of the exercise. For the monks, the sessions may help them deal with modern questions not addressed in traditional Buddhist teachings, such as the issue of the morality of stem-cell research (see page 666). Scientists in turn have plenty to learn from the monks — after centuries of inner contemplation, Buddhists claim to know a thing or two about how the mind behaves.

Richard Davidson, a psychologist at the University of Wisconsin, Madison, and the coordinator of the Dharamsala conference, has learned from the monks through study. He found that certain neural processes in the brain are more coordinated in people with extensive training in meditation, an observation that may be linked to the heightened awareness reported by meditating monks (A. Lutz *et al. Proc. Natl. Acad. Sci. USA* 101, 16369–16373; 2004).

Gage says that what particularly impressed him was the Dalai Lama's empirical approach. "At one point I asked: 'What if neuroscience comes up with information that directly contradicts Buddhist philosophy?'" says Gage. "The answer was: 'Then we would have to change the philosophy to match the science.'"

So far that hasn't been necessary. And if the reported benefits of laughter are correct, there is no need for the Dalai Lama to rein in his sense of humour either. During a discussion of how our childhoods shape who we are, he observed that he liked to play with toy guns as a child and even picked on his brother. "I was the mean one," he said, thereby stabilizing blood sugar levels throughout the room.

Jonathan Knight writes for *Nature* from San Francisco.

問1 Dalai Lama はどのような人柄をもつか、それを反映する語句あるいは文章を本文中より4つ選びだしなさい。

- 1
- 2
- 3
- 4

問2 “meditation”が体や脳に対しどのような作用をもつと考えられているか？

問3 “meditation”と同様な意味で使われている単語あるいは語句を一つ、本文中より選びだしなさい。

問4 仏教についての Dalai Lama の考え方(仏教観)を示す文章を、選びだしなさい。

以下の文を読み、設問に答えよ。

Everybody knows that liquid water is necessary for life, at least as we know it. But just why exactly is it?

Liquid water may sound redundant, but planetary scientists insist on using the qualifier [1], for solid or vaporous water won't do. The biochemical reactions that sustain life need a fluid in order to operate. In a liquid, molecules can dissolve and chemical reactions occur. And because a liquid is always in flux, it effectively conveys vital substances like metabolites and nutrients from one place to another, whether it's around a cell, an organism, an ecosystem, or a planet. Getting molecules where they need to go is difficult within a solid and all too easy within a gas—vapor-based life would go all to pieces.

And why is water the best liquid to do the job? For one thing, it dissolves just about anything. "Water is probably the best solvent in the universe," says Jeffrey Bada, a planetary scientist at the Scripps Institution of Oceanography in La Jolla, Calif. "Everything is soluble in water to some degree." Even gold is somewhat soluble in seawater. (Before you get any ideas about extracting gold from the oceans, I should add that, according to Bada, the value of dissolved gold in a metric ton of seawater comes to about \$0.0000004).

Water may be a black sheep [2] of the liquids. Water's ability to so successfully further the processes of life has a lot to do with just how unusual a fluid it is. Despite its ubiquity and molecular simplicity, H₂O is abnormal in the extreme.

For starters, while other substances form liquids, precious few do so under the conditions of temperature and pressure that prevail on our planet's surface. In fact, next to mercury and liquid ammonia, water is our only naturally occurring inorganic liquid, the only one not arising from organic growth. It is also the only chemical compound that occurs naturally on Earth's surface in all three physical states: solid, liquid, and gas. Good thing, otherwise the hydrological cycle [3] that most living things rely on to ferry water from the oceans to the land and back again would not exist. This cycle of evaporation and condensation has come to seem so perfectly natural that we never think to remark on why no other substances display such transformations [4].

Compared to most other liquids, water also has an extremely large liquid range. Pure water freezes at 0°C and boils at 100°C. Add salt and you can lower the freezing temperature; natural brines are known with freezing points below -46°C. Add pressure and you can raise the boiling temperature; deep-sea vent waters can reach over 343°C. Water also has one of the highest specific heats of any substance known, meaning it takes a lot of energy to raise the temperature of water even a few degrees.

Water's broad liquid range and high heat capacity are good things, too. They mean that temperatures on the Earth's surface, which is more than two-thirds water, can undergo extreme variations—between night and day, say, or between seasons—without its water freezing or boiling away, events that would throw a big wrench into life as we know it. As it is, the oceans serve as a powerful moderating influence on the world's climate.

Liquid water has yet another unusual property that means the difference between life and essentially no life in cold regions of the planet. Unlike most other liquids when they freeze, water expands and becomes less dense. Most other frozen liquids are denser than their melted selves and thus sink. If it sank, ice, being unable to melt because of the insulating layer of water above it, would slowly fill up lakes and oceans in cold climates, making sea life in those parts of the world a challenging prospect.

(from Life's Little Essential by Peter Tyson; NOVA Science Programming on Air and Online)

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外国語試験問題・解答用紙（日本人） $\frac{2}{2}$

設問 1. [1]の qualifier が指す語を文中から選べ。

設問 2. [2]の black sheep はどういう意味で使われているか。

設問 3. [3]の the hydrological cycle とは何を意味するか。具体的に説明せよ。

設問 4. [4]の transformations は何を意味するか。具体的に説明せよ。

設問 5. この文が述べている水の特徴を5つ挙げよ。

1)

2)

3)

4)

5)

Read the following sentences and answer the questions below either in English or Japanese.

Many religious leaders find themselves at odds with science, but the head of Tibetan Buddhism is a notable exception. Jonathan Knight meets a neurologist whose audience with the Dalai Lama helped to explain why.

One of the first things people discover when they meet His Holiness the Dalai Lama is that the head of Tibetan Buddhism likes a good laugh. "He jokes all the time," says Fred Gage, a neuroscientist at the Salk Institute for Biological Studies in La Jolla, California, who met the spiritual leader for the first time in October. "He has a great sense of humour."

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Q 1 Choose 4 phrases or sentences that reflect the personal character of Dalai Lama's.

- 1.
- 2.
- 3.
- 4.

Q 2 What kind of effects are expected to be brought by "meditation"?

Q 3 Choose a word or a phrase from the text that reflects similar meaning with "meditation".

Q 4 Choose sentences from the text that reflect Dalai Lama's viewpoint on Buddhism.

Read the following document and answer the questions below.

Everybody knows that liquid water is necessary for life, at least as we know it. But just why exactly is it?

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受験番号

外国語試験問題・解答用紙 (外国人-英語) 2/2

Q1. Indicate the word in the document that corresponds to qualifier [1]!

Q2. What is the actual meaning of the phrase black sheep [2]?

Q3. Describe the phenomenon that the phrase the hydrological cycle [3] indicates!

Q4. Explain what the word transformations [4] mean!

Q5. List up 5 characteristics of water described here.

1)

2)

3)

4)

5)

次の文章を読んで、以下の質問に答えなさい。

落ち込む出生率の謎

Nature Vol.432 (38-39)/4 November 2004

先進国全体で出生率が落ち込みつつある。これは単なる社会現象なのだろうか。それとも生物としての生殖能力低下を意味するものなのだろうか。真の理由はまだわからない。だからこそ心配だと、Declan Butlerが報告する。

現在のペースが続けば、次の世紀の中頃には日本の人口はゼロとなる。日本国内の出生率は非常に低く、人口は2006年をピークに、その後は減少に転じる。高齢者の増加により年金や健康保険制度が崩壊し、経済的な混乱が起きるのではないかと危惧されている。似たような話は、韓国、イタリア、スペイン、そして多くの東欧諸国でも聞かれる。女性1人あたりが、国の人口維持に必要な2人の子供を産んでいるのは、先進国では4か国に過ぎない。

こうした変化は、社会環境によるところが大きい。夫婦が望む子供の数は減っており、子供をもたないという選択をするカップルもいる。一方で、さらに不吉な変化が進行している可能性がある。男性あるいは女性の生殖能力を低下させる環境汚染や性感染症といった問題だ。

「問題の可能性を真剣に考える必要はありますが、心配しすぎるのは早計です」と、パリ第6大学で疫学・人口統計学・社会科学の研究室を率いるHenri Leridonは語る。

懸念すべきは、この問題についての信頼できるデータが極めて少ないことである。もしヒトの生物学的な生殖能力が実際に弱まりつつあるとしても、研究機関が関心を寄せていないのが現状だ。しかし、この問題が考えられてしかるべき理由はある。たとえば、女性の生殖能力は年齢とともに低下するので、第一子を産む時期が遅くなる傾向にあるのは問題だ。将来に目を向ければ、体外受精の普及は、両親の生殖能力上の問題を受け遅く成人集団を出現させる可能性がある。

生涯に交渉をもつ性的パートナーの数が増える傾向には、不妊に関連する別の関連リスクがある。性感染症の問題である。生殖可能年齢にある米国人の約5%は、クラミジアに感染している。しかしクラミジア感染症は明瞭な自覚症状を示さず、診断が下されることはまれである。「蔓延しているといえる状況です」と、ニュージャージー医科歯科大学(ニューアーク)の不妊治療の専門家 Peter McGovernは指摘する。

専門家は、不妊症の原因となる恐れのあるもう一つの流行についても懸念している。肥満だ。重度の肥満女性は、月経周期が規則的であっても排卵できない。肥満は、多嚢卵性卵巣症候群との関連が指摘されており、卵胞が成熟できないことを特徴とするこの疾患は、不妊の重要な原因の1つである。米国人女性の最大10%に、この症状がみられると推定されている。ただし、診断をめぐる統一見解が得られていないことから、この数字を正確に求めることは難しい。「この症候群は肥満に関連するので、今後増えると予想されます」と McGovernは推測している。

子宮の中で

喫煙、アルコール摂取、他のさまざまな生活習慣因子はいずれも、男女の受胎能力を低下させる場合がある。そして影響は一般に男性より女性で深刻だ。因子の多くはホルモン経路を介して作用するので、その相互作用を解明することが、内分泌学者にとって大きな課題の1つである。

しかし、研究者の前に立ちはだかる最大の障害は、生殖能力は主に子宮内環境の影響を受けるということだ。女性が生涯に準備する卵の総数は、本人がまだ胎児の状態であったときの卵胞の数と成熟度によって決まる。胎児における正常な卵胞の発達は、母親の食生活や曝されてきた化学物質などの生活習慣因子の影響を受ける。

成人男性の精子の数と質は主に、胚の精巣内で精子を育てるセルトリ細胞の発達によって決まる。これは子宮内における性ホルモン暴露に大きく依存する。つまりこちらもまた、母親の生活習慣や他の環境要因の影響を受けるということである。

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外国語試験問題・解答用紙（外国人-日本語） $\frac{2}{2}$

問1 予測される今年以降の日本の人口動態を、横軸を西暦にして、図示しなさい。

問2 人口の減少はどのような混乱を招くと考えられますか？

問3 少子化社会を進行させる要因と考えられるものを列挙しなさい。

- 1.
- 2.
- 3.
- 4.
- 5.

問4 先進国では人口が減少する傾向にある。これについての貴方の考えを述べなさい。

以下の文を読み、設問に答えなさい。

生命活動の基本は、活動とそれによる疲労、そして休息による回復というサイクルの定常性にある。もとの状態に回復できる心理的・身体的負担は、例え①過酷なものであっても、その回復まで含めたサイクルの時間的スパンで見ると限りストレスとはならない。回復不能の、または、その[1]怖れのある疲労をもたらす負担は強いストレスとなり、実際に回復できなければ②疾病や障害となる。ストレスが健康に及ぼす影響は、休息による疲労回復過程を含めて考える必要がある。

近年、夜間高血圧、睡眠時無呼吸など睡眠に関連した病的現象が、現代人の生活習慣との③関わりの中で④蔓延しており、様々な疾患のリスクとなっていることが分かってきた。睡眠はわれわれにとって最も重要な疲労回復機能である。睡眠中には身体に備わっている様々な休息機能が発動し、それによって身体各器官の健全性が維持されている。循環系では、交感神経活動の抑制と副交感神経活動の⑤賦活により、心拍数、血圧、心拍出量が減少するが、動物実験で高い心拍数を長期間持続すると心不全が⑥惹起され、また夜間の血圧が低下しない人では左心室の肥大が起こりやすい。夜間高血圧や睡眠時無呼吸では、睡眠中の休息機能の発現が妨げられ、その結果、心臓や血管に疲労が日々⑦蓄積して疾患の発症に⑧整がるものと考えられる。

[A]ストレスに対する耐性や健康維持における疲労回復能力の重要性を考えると、現代の社会や生活習慣が、過去の時代では[2]当たり前で確保されていた休息機能に与える影響が⑨懸念される。最近の研究によれば、喫煙者や深酒をする人では、夜間の副交感神経活動の増加が妨げられている。また、通常の勤務者では週末に比べて週日の夜間の副交感神経活動の増加が少ない。現代社会は、われわれの[B]睡眠中の休息をも⑩蝕んでいる可能性がある。われわれは、休息不全の時代を生きているのかも知れない。

設問1 漢字の部分にふりがなを付け、その意味を書きなさい。

	ふりがな	意味
①過酷な	()な	
②疾病	()	
③関わり	()わり	
④蔓延	()	
⑤賦活	()	
⑥惹起	()	
⑦蓄積	()	
⑧整がる	()がる	
⑨懸念	()	
⑩蝕んで	()んで	

設問2 [1] 怖れの意味に最も近いものに○をつけなさい。

- 可能性
 現実性
 妥当性
 必然性
 予測性

設問3 [2] 当たり前の意味に最も近いものに○をつけなさい。

- 忽然
 自然
 必然
 平然
 未然

設問4 [A] ストレスに対する耐性とは、どのような事を意味するか述べなさい。

設問5 [B] 睡眠中の休息をも蝕んでいるとは、どのようなことを意味するか述べなさい。