平成１７年度　理学系研究科博士前期課程　入学試験問題

（分子科学専攻・秋募集）

英語

試験時間　：　10:30～12:00

配点　　：　150 点

【注意】

（１）　問題冊子（１部)、問題１の解答用紙（１枚)、問題２の解答用紙（１枚）を配布する。手元に上記３種類が所定の枚数配布されていることを確認すること。
過不足がある場合には速やかに申し出ること。

（２）　２枚の解答用紙の各々に受験番号と氏名とを必ず記入すること。

（３）　問題１、問題２の解答をそれぞれ指定された解答用紙に記入すること。なお、解答用紙の表面だけで書ききれない場合には裏面を使用すること。

1 次の文章を読んで以下の問に答えよ。

Water occurs in huge abundance on the Earth, where most of it lies in the great pools we call oceans that cover 71 per cent of the Earth's surface to an average depth of 6 kilometers.

(a) All three forms of water – ice, liquid, and vapour – are abundant on Earth, but very little is in a form suitable for human consumption: 97 per cent of it is too salty, and 75 per cent of the Earth's fresh water is solidified at the poles. The remaining 1 per cent of the total water is drinkable, but most of that is inaccessibly deep groundwater. Thus, only 0.05 per cent of the total, the water that runs through lakes and streams, is readily available. Some ancient groundwater is mined in deep wells, but that water recedes further from the surface as we use it but do not replace it.

(b) The oddest property of water is that it is a liquid at room temperature. This is surprising because so small a molecule would be expected to be a gas, like ammonia, methane, and its even closer relative hydrogen sulfide. That water is a liquid stems from the ability of its molecules to link together by forming networks of hydrogen bonds. One molecule can form these weak but important bonds to four others, and all four neighbours link to their neighbours, and so on. (c) As a result, the molecules cluster together as a mobile liquid, rather than moving independently as a gas. (d) Most solids expand when they melt, but ice contracts: ice at 0^{o}C is less dense than water at 0^{o}C. As a result, ice floats on water, giving us icebergs and a solid skin on frozen ponds. This skin insulates the liquid water beneath, protects it from the cooling winds above, and can keep it from freezing during the winter. Thus, aquatic life can survive in the liquid, even though the roof of its world is frozen. This quirk of density is again due to the presence of hydrogen bonds, for, when water freezes, its molecules are held apart, as well as held together, by the hydrogen bonds between them: each molecules grips its neighbours firmly, but holds them at arm's length. When the solid melts, this open framework-like structure partially collapses, the molecules lie closer together, and the liquid is more dense. (e) Floating icebergs are thus a sign of the strength of hydrogen bonds; indeed, it was hydrogen bonds that brought death to the Titanic.

【注】*iceberg*: a very large mass of ice floating in the ocean, most of which is under the surface of the water
odd: different from what is normal or expected
quirk: something strange that happens by chance
Titanic: name of giant passenger ship (sunk by accident at the North Atlantic Ocean in 1912 then fifteen hundred persons missed)

問１　下線部 (a) の指摘のように、水は地球上に大量に存在するにもかかわらず人類にとって飲用に適する水は、わずかしかない。その理由を数値データも使って本文の表現にもとづき簡潔に記せ。
問２　下線部 (b) を日本語に訳せ。
問３　下線部 (c) を日本語に訳せ。
問４　下線部 (d) を日本語に訳せ。
問５　下線部 (e) を日本語に訳せ。
問６　水分子間の水素結合が強い理由について、水が凍るときの様子に注目し、本文の表現にもとづき簡潔に記せ。

2 次の文章を日本語に訳せ。

Carbon-carbon bond-forming reactions are arguably the most important processes in chemistry, as they represent key steps in the building of more complex molecules from simple precursors. In the past 50-100 years, organic chemists have developed a plethora of reactions for carbon-carbon bond formation between molecules with saturated sp^3 C-atoms. However, until the discovery and development of metal-mediated cross-coupling reactions, starting 1970s, there were no simple, general *direct* methodologies known for carbon-carbon bond formation between unsaturated species such as vinyl, aryl, and alkynyl moieties. In other words, carbon-carbon bond formation between sp^2 C-atom centers was often difficult and tedious. In the inventing 30 years, a wide variety of cross-coupling methodologies have been developed and cross-coupling reactions have emerged among the most powerful and useful synthetic tools in chemistry. Metal-catalyzed cross-coupling reactions are extensively employed in a wide range of areas of preparative organic chemistry, from the synthesis of complex natural products to supramolecular chemistry and materials science. In fact, in 1990s one can hardly open a chemical journal in the broad area of organic chemistry or materials science that does not contain several examples of cross-coupling reactions.

【注】 *supramolecular chemistry*: 超分子化学