2007 千葉大学医学部医学科後期試験

次の英文を読んで，設問に答えなさい。なお．一部の語句には文末に注を付してあります。

For the past 50 years, scientists have attacked the question of how life began. Some approach it from the present, (1)moving backward in time from life today to its simpler ancestors. Others march forward from the formation of Earth 4.55 billion years ago, exploring how lifeless chemicals might have become organized into living matter.

Working backward, paleontologists have found fossils of microbes dating back at least 3.4 billion years. Chemical analysis of even older rocks suggests that photosynthetic organisms were already well established on Earth by (a) billion years ago. Researchers suspect that the organisms that left these traces shared the same basic traits found in all life today. All living organisms encode genetic information in DNA and catalyze chemical reactions using proteins. Because DNA and proteins depend on each other for their survival, it's hard to imagine one of them having evolved first. But it's implausible for them to have emerged simultaneously out of a prebiotic soup.

Experiments now suggest that earlier forms of life could have been based on a third kind of molecule found in today's organisms* RNA. Once considered nothing more than a cellular courier, RNA turns out to be astonishingly versatile, not only encoding genetic information but also acting like a protein. Some RNA molecules switch genes on and off, for example, whereas others bind to proteins and other molecules. Laboratory experiments suggest that RNA could have replicated itself and carried out the other functions required to keep a primitive cell alive.

Only after life passed through this "RNA world," many scientists now agree, (2)did it take on a more familiar cast. Proteins are thousands of times more efficient as a catalyst than RNA is, and so once they emerged they would have been favored by natural selection. Likewise, genetic information can be replicated from DNA with far fewer errors than it can from RNA.

Other scientists have focused their efforts on figuring out how the lifeless chemistry of a prebiotic Earth could have given rise to an RNA world. In 1953, working at the University of Chicago, Stanley Miller and Harold Urey demonstrated that experiments could shed light on this question. They ran an electric current through a mix of ammonia, methane, and (3)other gases believed at the time to have been present on early Earth. They found that they could produce amino acids and other important building blocks of life.

Today, many scientists argue that the early atmosphere was dominated by other gases, such as carbon dioxide. But experiments in recent years have shown that under these conditions, many building blocks of life can be formed. In addition, comets and meteorites may have delivered organic compounds from space.

Just where on Earth these building blocks came together as primitive life forms is a subject of debate. Starting in the 1980s, many scientists argued that life got its start in hot, mineral-rich waters streaming out of deep-sea hydrothermal vents. But the hypothesis has

cooled off a bit. Recent studies suggest that heat-loving microbes are not living fossils. Instead, they may have descended from less hardy species and evolved new defenses against heat. Some skeptics also wonder how delicate RNA molecules could have survived in boiling water.

Research projects now under way may shed more light on how life began. Scientists are running experiments in which (4)RNA-based cells may be able to reproduce and evolve. NASA and the European Space Agency have launched probes that will visit comets, narrowing down the possible ingredients that might have been showered on early Earth.
[Science309m(2000)より抜粋,一部改変]

[語注]
amino acid アミノ酸
carbon dioxide :二酸化炭素
catalyst :触媒
catalyze :触媒作用を及ぼす
cellular :細胞内の
courier :運び屋
encode : (情報などを)符号化する
fossil :化石
genetic :遺伝子の
hydrothermal :熱水の
implausible :本当らしくない
ingredient :成分
lifeless: 生きている
meteorite: 隕石
microbe: 微生物
molecule:分子
paleontologist: 古生物学者
photosynthetic: 光合成をする
prebiotic: 生命が生まれる前の
probe: 探査機
replicate: 複製する
skeptic: 懐疑的な人
vent: 噴出口
versatile: いろいろな働きをする

問 1 下線部(1)を40字以内の日本語で訳しなさい。

問 2　下線部（a）にもっともふさわしい数字を次の中から一つ選んで記号で答えなさい。
(A) 1.9　　(B)2.8　　(C)3.7　　(D)4.6

問 3　下線部（2）のitは何を指すか。英語で答えなさい。

問 4　下線部（3）を30字以内の日本語で訳しなさい。

問 5　　下線部（4）の RNA-based cells が現在の地球上で一般的でないのはなぜか。100字以内の日本語で答えなさい。