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I. Vocabulary (30 points)
Select a word or a definition which has the closest meaning to that of the underlined word in each sentence.

1. It was American ingenuity that stood in the forefront.
   a) aggressiveness b) inventiveness c) salesmanship d) sincerity
2. The machine eliminated the cumbersome and hazardous part atop the machine.
   a) awkward b) dangerous c) fragile d) manipulative
3. The smaller ephemeral regions do not form sunspots and have a broader distribution in latitude.
   a) active. b) transient c) bright d) convective
4. The latter scheme offers simple and robust configuration.
   a) frail b) complicated c) novel. d) strong
5. He developed an elaborate scheme.
   a) detailed b) familiar c) conventional d) modern
6. The transitions increase the opacity of the matter.
   a) conductivity b) nebulousness c) randomness d) transparency
7. The stratified part becomes unstable with respect to convective motions.
   a) layered, b) frozen, c) energized, d) separated
8. It determines the conditions of the onset of the phenomenon.
   a) Occurrence b) propagation c) mitigation d) termination
9. Fluctuation in the temperature was induced by the surrounding condition.
   a) Saturation b) decrease c) increase d) variation
10. They constitute a significant and benign reservoir or repository for the available free energy of the system.
    a) Evil or harmful in nature or influence b) Pleasant and beneficial in nature or influence c) Showing the capacity for endurance d) Able to adjust readily to different conditions
11. The physics underlies the design of the instrument.
    a) Constraint b) Dismiss from consideration c) Be or form the base for d) Make it more complicated
12. This provides a spatial resolution of 10 km for the measurements.
    a) Finding a solution to a problem b) The ability of a instrument to identify the separation of measuring quantities that are close together c) A formal expression by a meeting d) A statement that solves a problem or explains how to solve the problem
13. The photon can stimulate or induce atomic emission.
    a) hasten b) alert c) energize d) de-energize
14. The signal may disorient the satellite.
    a) diagnose b) destroy c) guide d) cause to be lost
15. Filaments of plasma erupt from the surface.
    a) burst b) inject c) collapse d) disappear

(背面仍有題目,請繼續作答)

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II.

Reading comprehension (40 points):

Read the passages extracted from the article "Self-organization processes in continuous media" written by A. Hasegawa (published in ADVANCES IN PHYSICS, 1985, VOL. 34, NO. 1, 1-42) below and answer the questions that follow.

People consider Ladies Maochiang and Lichi as classic beauties. Seeing them, however, fish swim deeper, birds fly higher and deer run away. Which of the four knows the true color of the universe?
--from Chung-Tze, fourth century BC.

The world of thermodynamical equilibrium with maximized entropy is the (1)color-less, dead world of 4K. However, in the presence of a local energy source and nonlinear interactions, quasi-stationary and stable states having an ordered structure can be formed naturally (Nicolis and Prigogine 1977). The formation of life may be regarded as one example of such a process where the local decrease of entropy is [A] by an increase of entropy in the environment; here the ordered structure can be formed without violating the global entropy law.

The self-organization processes described in this review take a rather different perspective of this view. It is a perspective which is best described by the sentence in the classic Chinese philosophy Chung-Tze quoted above. What this sentence says is that 'beauty' [B] is subjective.

In familiar physical systems where the energy is the only quadratic quantity which is conserved, entropy is defined as the measure of disorder in the quality of the energy. However, if one or more other quantities are conserved, the system can in principle form an ordered structure in one physical quantity (2)by letting other physical quantities take care of the increase of entropy. One well-known example is the two-dimensional incompressible fluid in which the squared vorticity (called enstrophy) is conserved as well as the energy. In such a system, the quality of energy increases (entropy decreases) by virtue of the quality of the enstrophy decreasing at a faster rate. Since we discuss a non-conservative system, we cannot define Boltzmann's entropy or prove the H theorem. Thus the entropy is defined here in a conceptual sense.

The system we consider is primarily global; that is, we consider the formation of ordered structure in some

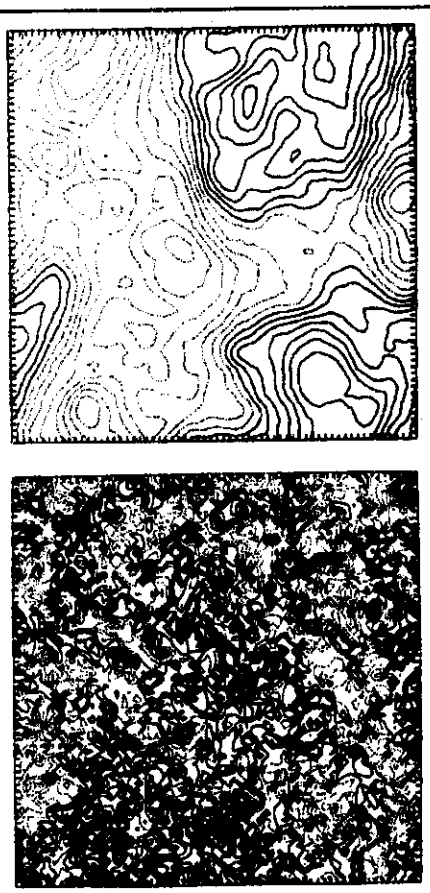

Figure (a) The stream function and (b) the vorticity at the 2360th time-step of simulated Navier-Stokes turbulence (Lilly 1969).

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physical quantity in the global (non-local) sense. Thus the self-organization concept here differs from that used by Nicolis and Prigogine (1977). Ordered structure appears when one observes a particular physical quantity and ignores the other(s). In this respect the self-organization discussed here is subjective and relative to the observer, as with the beauty of Maochiang and Lichi.

snip

The stream function and vorticity at the 2360th time-step of simulated Navier-Stokes turbulence are shown in figures (a) and (b), respectively. The smooth structure of the stream function apparent from figure (a) is a consequence of the inverse cascade of the energy to larger wavelengths, while the chaotic state of the vorticity is a result of the enstrophy cascading to smaller wavelengths. The figure clearly demonstrates the subjective aspect of self-organization as described in this review: to an observer who sees only [C] the turbulence looks organized, while to another observer who sees only [D] the same state looks chaotic--a perfect analogue of Chung-Tze's philosophy.

* omit the rest *

1. What are quasi-stationary and stable states that have an ordered structure produced by, according to Nicolis and Prigogine picture ?

2. Fill in blank [A] with the most appropriate word from a)- d) to complete the sentence.

   a) accompanied b) smoothened c) ignored d) compensated

3. What does the word underlined (1) mean ? Choose the most suitable answer from a)-d).

   a) chilly b) dark c) ordered d) disordered

4. What is likened to "beauty" in this review ? That is the word which was originally placed at the location of [B].

5. As to the underlined sentence (2). What physical quantity does take care of increase in the entropy in the simulation of the figures (a) and (b) ?

6. What is "enstrophy" ? Describe with two words being used in the review.

7. Fill in each blank [C] and [D] with the most appropriate words that are used in this review to complete the sentence.

8. Explain the difference mentioned in this text between Nicolis-Prigogine picture of "self-organization" and the author's. (within 50 words)

III. Essay (30 points)

Write a short English essay about your purpose in entering the graduate school and the means for accomplishing that. (within 250 words)