選擇題 (每題 2 分，36 分)

1. According to the third law of thermodynamics, _____ possible is -273.16 degrees centigrade.
(A) that temperature is lowest
(B) the temperature is lowest
(C) lowest temperature
(D) the lowest temperature

2. Muskrats generally _____ close to the edge of a bog, where their favorite plant foods grow plentifully.
(A) staying
(B) stay
(C) they are staying
(D) to stay there

3. Oliver Ellsworth, _____ of the United States Supreme Court, was the author of the bill that established the federal court system.
(A) he was the third chief justice
(B) the third chief justice was
(C) who the third chief justice
(D) the third chief justice

4. _____ Colonial period the great majority of Connecticut's settlers came from England.
(A) Since
(B) The time
(C) During the
(D) It was

5. A politician can make a legislative proposal more _____ by giving specific examples of what its effect will be.
(A) to understanding
(B) understandably
(C) understandable
(D) when understood

6. Before every presidential election in the United States, the statisticians try to guess the proportion of the population that _____ for each candidate.
(A) are voted
(B) voting
(C) to be voted
(D) will vote

7. The air inside a house or office building often has higher concentrations of contaminants _____ heavily polluted outside air.
(A) than does
(B) more

(C) as some that are
(D) like of

8. The decimal numeral system is one of the _____ ways of expressing numbers.
(A) useful most world's
(B) world's most useful
(C) useful world's most
(D) most world's useful

9. The mountains surrounding Los Angeles effectively shield the city from the hot, dry winds of the Mojave Desert, _____ the circulation of air.
(A) but they also prevent
(B) also prevented by them
(C) and also to prevent
(D) and also preventing

10. _____ the demands of aerospace, medicine, and agriculture, engineers are creating exotic new metallic substances.
(A) Meet
(B) Being met are
(C) To meet
(D) They are meeting

11. _____ no real boundary to the part of the ocean referred to as a "deep" because of changing water levels and movement in the sea floor.
(A) It is
(B) To be
(C) Being
(D) There is

12. A few animals sometimes fool their enemies _____ to be dead.
(A) appear
(B) to appear
(C) by appearing
(D) to be appearing

13. Abraham Lincoln insisted that _____ not just on mere opinion but on moral purpose.
(A) to base democracy
(B) whenever democracy is based
(C) democracy be based
(D) for democracy to be based

14. World trade patterns are indicative of the important economic issues _____ confront the world today.
(A) what
(B) that
(C) who
(D) they

15. In the symphony orchestra, bass drums are not _____ kettle drums.
(A) as prevalent
(B) that prevalent
(C) so prevalent as
(D) prevalent than

16. Most natural ports are located where the shoreline is irregular and _____.
(A) the water is deep
(B) is the water deep
(C) deep water
(D) there is the deep water

17. _____ to the reproductive rates of other small mammals, that of the bat is very low indeed.
(A) Compared
(B) It is compared
(C) To be comparing
(D) Have compared

18. _____ native to Europe, the daisy has now spread throughout most of North America.
(A) That it is
(B) If it were
(C) In spite of
(D) Although

閱讀測驗 (每題 2 分，36 分)

The owner of a computer store is planning a window display of five products. Three are to be hardware items selected from K, L, M, N, and O, and two are to be software manuals selected from R, S, T, and U. The display items are to be selected according to the following conditions:

If K is displayed, U must be displayed.
M cannot be displayed unless both L and R are also displayed.
If N is displayed, O must be displayed, and if O is displayed, N must be displayed.
If S is displayed, neither T nor U can be displayed.

1. Which of the following is an acceptable display?
(A) L, M, O, R, S
(B) K, M, N, O, R
(C) K, L, M, R, U
(D) M, N, O, T, U
(E) N, O, R, S, T

2. If K and T are the first two display items to be selected, how many acceptable groups of items are there that would complete the display?
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

3. If T and U are displayed, which of the following must also be displayed?
(A) K (B) L (C) M (D) N (E) R

4. If N and O are not displayed, all of the following must be displayed EXCEPT
(A) K (B) M (C) R (D) T (E) U

The molecules of carbon dioxide in the Earth's atmosphere affect the heat balance of the Earth by acting as a one-way screen. Although these molecules allow radiation at visible wavelengths, where most of the energy of sunlight is concentrated, to pass through, they absorb some of the longer-wavelength, infrared emissions radiated from the Earth's surface, radiation that would otherwise be transmitted back into space. For the Earth to maintain a constant average temperature, such emissions from the planet must balance incoming solar radiation. If there were no car-bon dioxide in the atmosphere, heat would escape from the Earth much more easily. The surface temperature would be so much lower that the oceans might be a solid mass of ice. Today, however, the potential problem is too much carbon dioxide. The burning of fossil fuels and the clearing of forests have increased atmospheric carbon dioxide by about 15 percent in the last hundred years, and we continue to add carbon dioxide to the atmosphere. Could the increase in carbon dioxide cause a global rise in average temperature, and could such a rise have serious consequences for human society? Mathematical models that allow us to calculate the rise in temperature as a function of the increase indicate that the answer is probably yes. Under present conditions a temperature-of--18℃ can be observed at an altitude of 5 to 6 kilometers above the Earth. Below this altitude (called the radiating level), the temperature increases by about 6℃ per kilometer approaching the Earth's surface, where the average temperature is about 15℃. An increase in the amount of carbon dioxide means that there are more molecules of carbon dioxide to absorb infrared radiation. As the capacity of the atmosphere to absorb infrared radiation increases, the radiating level and the temperature of the surface must rise. One mathematical model predicts that doubling the atmospheric carbon dioxide would raise the global mean surface temperature by 2.5℃. This model assumes that the atmosphere's relative humidity remains constant and the temperature decreases with altitude at a rate of 6.5℃ per kilometer. The assumption of constant relative humidity is important, because water vapor in the atmosphere is another efficient absorber of radiation at infrared wavelengths. Because warm air can hold more moisture than cool air, the relative humidity will be constant only if the amount of water vapor in the atmosphere increases as the temperature rises. Therefore, more infrared radiation would be absorbed and reradiated back to the Earth's surface. The resultant warming at the surface could be expected to melt snow and ice, reducing the Earth's reflectivity. More solar radiation would then be absorbed, leading to a further increase in temperature.

5. The primary purpose of the passage is to
(A) warn of the dangers of continued burning of fossil fuels
(B) discuss the significance of increasing the amount of carbon dioxide in the atmosphere
(C) explain how a constant temperature is maintained on the Earth's surface
(D) describe the ways in which various atmospheric and climatic conditions contribute to the Earth's weather
(E) demonstrate the usefulness of mathematical models in predicting long-range climatic change

6. According to the passage, the greatest part of the solar energy that reaches the Earth is
(A) concentrated in the infrared spectrum
(B) concentrated at visible wavelengths
(C) absorbed by carbon dioxide molecules

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(D) absorbed by atmospheric water vapor
(E) reflected back to space by snow and ice

7. According to the passage, atmospheric carbon dioxide performs all of the following functions EXCEPT
(A) absorbing outgoing radiation from the Earth
(B) absorbing infrared radiation
(C) absorbing radiation at visible wavelengths
(D) helping to retain heat near the Earth's surface
(E) helping to maintain a constant average temperature on the Earth's surface

8. Which of the following best describes the author's attitude toward the increasing amount of carbon dioxide in the atmosphere and its consequences?
(A) Incredulous
(B) Completely detached
(C) Interested but skeptical
(D) Angry yet resigned
(E) Objective yet concerned

9. It can be concluded from information contained in the passage that the average temperature at an altitude of 1 kilometer above the Earth is about
(A) 15°C (B) 9°C (C) 2.5°C (D) -12°C (E) -18°C

10. It can be inferred from the passage that the construction of the mathematical model mentioned in the passage involved the formulation of which of the following?
(A) An assumption that the amount of carbon dioxide added to the atmosphere would in reality steadily increase
(B) An assumption that human activities are the only agencies by which carbon dioxide is added to the atmosphere
(C) Assumptions about the social and political consequences of any curtailment of the use of fossil fuels
(D) Assumptions about the physical conditions that are likely to prevail during the period for which the model was made
(E) Assumptions about the differential behavior of carbon dioxide molecules at the various levels of temperature calculated in the model

11. According to the passage, which of the following is true of the last hundred years?
(A) Fossil fuels were burned for the first time.
(B) Greater amounts of land were cleared than at any time before.
(C) The average temperature at the Earth's surface has become 2°C cooler.
(D) The amount of carbon dioxide in the atmosphere has increased measurably.
(E) The amount of farmland worldwide has doubled.

Our visual perception depends on the reception of energy reflecting or radiating from that which we wish to perceive. If our eyes could receive and measure infinitely delicate sense-data, we could perceive the world with infinite precision. The natural limits of our eyes have, of course, been extended by mechanical instruments; telescopes and microscopes, for example, expand our capabilities greatly. There is, however, an ultimate limit beyond which no instrument can take us; this limit is

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imposed by our inability to receive sense-data smaller than those conveyed by an individual quantum of energy. Since these quanta are believed to be indivisible packages of energy and so cannot be further refined, we reach a point beyond which further resolution of the world is not possible. It is like a drawing a child might make by sticking indivisible discs of color onto a canvas. We might think that we could avoid this limitation by using quanta with extremely long wavelengths; such quanta would be sufficiently

sensitive to convey extremely delicate sense-data. And these quanta would be useful, as long as we only wanted to measure energy, but a completely accurate perception of the world will depend also on the exact measurement of the lengths and positions of what we wish to perceive. For this, quanta of extremely long wavelengths are useless. To measure a length accurately to within a millionth of an inch, we must have a measure graduate in millionths of an inch; a yardstick graduated in inches is useless. Quanta with a wavelength of one inch would be, in a sense, measures that are graduated in inches. Quanta of extremely long wavelength are useless in measuring anything except extremely large dimensions. Despite these difficulties, quanta have important theoretical implications for physics. It used to be supposed that, in the observation of nature, the universe could be divided into two distinct parts, a perceiving subject and a perceived object. In physics, subject and object were supposed to be entirely distinct, so that a description of any part of the universe would be independent of the observer. The quantum theory, however, suggests otherwise, for every observation involves the passage of a complete quantum from the object to the subject, and it now appears that this passage constitutes an important coupling between observer and observed. We can no longer make a sharp division between the two in an effort to observe nature objectively. Such an attempt at objectivity would distort the crucial interrelationship of observer and observed as parts of a single whole. But, even for scientists, it is only in the world of atoms that this new development makes any appreciable difference in the explanation of observations.

12. The primary purpose of the passage is to
(A) discuss a problem that hinders precise perception of the world
(B) point out the inadequacies of accepted units of measurement
(C) criticize attempts to distinguish between perceiving subjects and perceived objects
(D) compare and contrast rival scientific hypotheses about how the world should be measured and observed
(E) suggest the limited function of sensory observation

13. According to the passage, quanta with an extremely long wavelength cannot be used to give complete information about the physical world because they
(A) exist independently of sense-data
(B) are graduated only in inches
(C) have an insignificant amount of energy
(D) cannot, with present-day instruments, be isolated from quanta of shorter wavelength
(E) provide an insufficiently precise means of measuring length and position

14. Which of the following describes a situation most analogous to the situation discussed in lines 5-7?
(A) A mathematician can only solve problems the solution of which can be deduced from known axioms.
(B) An animal can respond to no command that is more complicated syntactically than any it has previously received.
(C) A viewer who has not learned, at least intuitively, the conventions of painting, cannot

understand perspective in a drawing.
(D) A sensitized film will record no detail on a scale that is smaller than the grain of the film.
(E) A shadow cast on a screen by an opaque object will have a sharp edge only if the light source is small or very distant.

15. The author uses the analogy of the child's drawing (lines 9-10) primarily in order to
(A) illustrate the ultimate limitation in the precision of sense-data conveyed by quanta
(B) show the sense of helplessness scientists feel in the face of significant observational problems
(C) anticipate the objections of those scientists who believe that no instrumental aid to observation is entirely reliable
(D) exemplify the similarities between packages of energy and varieties of color
(E) disparage those scientists who believe that measurement by means of quanta offers an accurate picture of the world

16. The author implies that making a sharp division between subject and object in physics is
(A) possible in a measurement of an object's length and position, but not in a measurement of its energy
(B) still theoretically possible in the small-scale world of atoms and electrons
(C) possible in the case of observations involving the passage of a complete quantum
(D) no longer an entirely accurate way to describe observation of the universe
(E) a goal at which scientists still aim

17. The author's use of the phrase "in a sense" (line 17) implies which of the following?
(A) Quanta of extremely long wavelength are essentially graduated in inches.
(B) Quanta of one-inch wavelength are not precisely analogous to yardsticks graduated in inches.
(C) Quanta of extremely long wavelength, in at lest one respect, resemble quanta of shorter wavelength.
(D) Quanta of one-inch wavelength and quanta of extremely long wavelength do not differ only in their wavelengths.
(E) Quanta of one-inch wavelength must be measured by different standards than quanta of extremely long wavelength.

18. According to the passage, the quantum theory can be distinguished from previous theories of physics by its
(A) insistence on scrupulously precise mathematical formulations
(B) understanding of the inherent interrelationship of perceiver and perceived
(C) recognition of the need for sophisticated instruments of measurement
(D) emphasis on small-scale rather than on large-scale phenomena
(E) regard for philosophical issues as well as for strictly scientific ones

III、寫作 (28 分)
Some people believe that a college or university education should be available to all students. Others believe that higher education should be available only to good students. Discuss these views. Which view do you agree with? Explain why.

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1. 求下列方程式之一般解

   (a) $y' + \dfrac{1}{x}y = 3x^2, \quad (x \neq 0)$ (10%)

   (b) $y'' - y' - 6y = 12xe^x$ (10%)

   (c) $y'' + 10y' + 24y = 1,\ y(2) = -3,\ y'(2) = 5$ (10%)

2. 使用拉氏變換(Laplace transformation), 求下列方程式之解

$$y'' + 4y = f(t), \quad f(t) = \begin{cases} 1, & 0 \leq t < 1 \\ 0, & t \geq 1 \end{cases}, \quad y(0) = 0, \quad y'(0) = -1 \qquad (15\%)$$

3. $f(t) = te^{-2t}\cos(3t)$，求函數 $f(t)$ 的拉氏變換(Laplace transformation)？

                                       (10%)

4. $F(s) = \dfrac{e^{-2s}}{s^2(s-1)}$，求函數 $F(s)$ 的反拉氏變換(inverse Laplace transformation)？   (10%)

5. 求解下列線性微分方程組   (20%)

$$\begin{cases} y_1' = 3y_1 + 2y_2 \\ y_2' = 6y_1 - y_2 \end{cases}$$

6. 求解下列線性方程組之所有解集合   (15%)

$$\begin{cases} x_1 \quad\quad\ -2x_3 + x_4 = 5 \\ 3x_1 + x_2 - 5x_3 \quad\quad = 8 \\ x_1 + 2x_2 \quad\quad - 5x_4 = -9 \end{cases}$$