

國立高雄大學九十七學年度轉學招生考試試題

科目：工程數學  
考試時間：80 分鐘

系所：  
土木與環境工程學系轉三年級  
本科原始成績：100 分

是否使用計算機：是

**Question 1**

(25%)

Matrix  $D_n$  is denoted by  $\begin{bmatrix} a_1 + b_1 & a_1 + b_2 & \cdots & a_1 + b_n \\ a_2 + b_1 & a_2 + b_2 & \cdots & a_2 + b_n \\ \vdots & \vdots & \cdots & \vdots \\ a_n + b_1 & a_n + b_2 & \cdots & a_n + b_n \end{bmatrix}$ . Find the determinant (行列式值) of  $D_n$ , if

(a)  $n=1$ , (b)  $n=2$ , and (c)  $n=3$

Hint: Decompose  $D_n$  into a product of two matrices (矩陣).

**Question 2:**

(25%)

Using (a) Gauss Elimination method (高斯消去法) and (b) the Cramer rule (克拉瑪法則) to solve a linear equation system as follows

$$\begin{cases} -x + 3y - 2z = 7 \\ 3x + 3z = -3 \\ 2x + y + 2z = -1 \end{cases}$$

**Question 3**

(20%)

$A = \begin{bmatrix} 4 & 6 & 6 \\ 1 & 3 & 2 \\ -1 & -5 & -2 \end{bmatrix}$ , find the eigenvalues (特徵值) and eigenvector (特徵向量) corresponded to

matrix A.

**Question 4**

(30%)

Determine the curvature (曲率), unit principal normal vector (單位主法線向量), unit binomial vector (單位副法線向量), and torsion (扭率) of the circular helix:

$$r(t) = [a \cos t, a \sin t, ct] = (a \cos t)i + (a \sin t)j + (ct)k$$

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答案請由左至右書寫，每五題寫在同一行。如：1. \_\_\_ 2. \_\_\_ 3. \_\_\_ 4. \_\_\_ 5. \_\_\_

I. Choose the answer that can best complete the sentence. (40%)

1. Justice Sandra Day O'Connor was ----- to serve on the U.S Supreme Court.

- (A) the woman who first
- (B) the first woman
- (C) who the first woman
- (D) the first and a woman

2. General Grant had General Lee ----- him at Appomattox to sign the official surrender of the Confederate forces.

- (A) to meet
- (B) met
- (C) meet
- (D) meeting

3. ----- small specimen of the embryonic fluid is removed from a fetus, it will be possible to determine whether the baby will be born with birth defects.

- (A) A
- (B) That a
- (C) If a
- (D) When it is

4. ----- Java Man, who lived before the first Ice Age, is the first manlike animal.

- (A) It is generally believed that
- (B) Generally believed it is
- (C) Believed generally is
- (D) That is generally believed

5. ----- 1000 species of finch have been identified.

- (A) As many as
- (B) As many
- (C) As much as
- (D) Much as

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6. The Continental United States is ----- that there are four time zones.

- (A). much big
- (B). too big
- (C). so big
- (D). very big

7. Since Elizabeth Barrett Browning father never approved of ----- Robert Browning, the couple eloped to Italy, where that lived and wrote.

- (A) her to marry
- (B) her marrying
- (C) she marrying
- (D) she to marry

8. One of the most effective vegetable protein substitutes is the soybean ----- used to manufacture imitation meat products.

- (A) which can be
- (B) it can be
- (C) who can be
- (D) can be

9. Upon hatching, -----.

- (A) young ducks know how to swim
- (B) swimming is known by young ducks
- (C) the knowledge of swimming is in young ducks
- (D) how to swim is known in young ducks

10. ----- is necessary for the development of strong bones and teeth.

- (A) It is calcium
- (B) That calcium
- (C) Calcium
- (D) Although calcium

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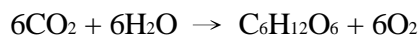
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II. Reading Comprehension (60%)

Passage A:

It has long been known that when the green parts of plants are exposed to light under suitable conditions of temperature and moisture, carbon dioxide is absorbed by the plant from the atmospheric CO<sub>2</sub>, and oxygen is released into the air. This exchange of gases in plants is the opposite of the process that occurs in respiration. In this plant process, which is called photosynthesis, carbohydrates are synthesized in the presence of light from carbon dioxide and water by specialized structures in the cytoplasm of plant cells called chloroplasts. These chloroplasts contain not only two types of light-trapping green chlorophyll but also a vast array of protein substances called enzymes. In most plants, the water required by the photosynthesis process is absorbed from soil by the roots and translocated through the xylem of the root and stem to the chlorophyll-laden leaves. Except for the usually small percentage used in respiration, the oxygen released in the process diffuses out of the leaf into the atmosphere through stomates. In simple terms, carbon dioxide is the fuel, and oxygen is the product of the chemical reaction. For each molecule of carbon dioxide used, one molecule of oxygen is released. Here is a summary chemical equation for photosynthesis:



As a result of the process, radiant energy from the sun is stored as chemical energy. In turn, the chemical energy is used to decompose carbon dioxide and water. The products of their decomposition are recombined into a new compound, which successively builds up into the more and more complex substances that comprise the plant. There organic substances, that is, the sugars, starches, and cellulose, all belong to the class of organic molecules. In other words, the process of photosynthesis can be understood as an enzyme-induced chemical change from carbon dioxide and water into the simple sugar glucose. This carbohydrate, in turn, is utilized by the plant to generate other forms of energy, such as the long chains of plant cells or polymers that comprise the cellular structures of starches or cellulose. Many intermediate steps are involved in the production of a simple sugar or starch. At the same time, a balance of gases is preserved in the atmosphere by the process of photosynthesis.

11. Which title best expresses the ideas in the passage?

- (A) A Chemical Equation
- (B) The Process of Photosynthesis

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- (C) The Parts of Vascular Plants
- (D) The Production of Sugar

12. The combination of carbon dioxide and water to form sugar results in an excess of

- (A) water
- (B) oxygen
- (C) carbon
- (D) chlorophyll

13. Which process is the opposite of photosynthesis?

- (A) Decomposition
- (B) Synthesization
- (C) Diffusion
- (D) Respiration

14. In photosynthesis, energy from the sun is

- (A) changed to chemical energy
- (B) conducted from the xylem to the leaves of green plants
- (C) not necessary to the process
- (D) released one to one for each molecule of carbon dioxide used

15. Besides the manufacture of food for plants, what is another benefit of photosynthesis?

- (A) It produces solar energy.
- (B) It diffuses additional carbon dioxide into the air.
- (C) It maintains a balance of gases in the atmosphere.
- (D) It removes harmful gases from the air.

16. Which of the following is NOT true of the oxygen used in photosynthesis?

- (A) Oxygen is absorbed by the roots.
- (B) Oxygen is the product of photosynthesis.
- (C) Oxygen is used in respiration.
- (D) Oxygen is released into the atmosphere through the leaves.

17. The word successively in paragraph 2 is closest in meaning to

- (A) with effect

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- (B) in a sequence
- (C) slowly
- (D) carefully

Passage B:

Organic architecture ? that is, natural architecture ? may vary in concept and form, but it is always faithful to natural principles. The architect dedicated to the promulgation of organic architecture rejects outright all rules imposed by individual preference or mere aesthetics in order to remain true to the nature of the site, the materials, the purpose of the structure, and the people who will ultimately use it. If these natural principles are upheld, then a bank cannot be built to look like a Greek temple. Form does not follow function; rather, form and function are inseparably two aspects of the same phenomenon. In other words, a building should be inspired by nature forms and constructed with materials that retain and respect the natural characteristics of the setting to create harmony between the structure and its natural environment. It should maximize people contact with the utilization of the outdoors. Furthermore, the rule of functionalism is upheld; that is, the principle of excluding everything that serves no practical purpose.

Natural principles, then, are principles of design, not style, expressed by means and modes of construction that reflect unity, balance, proportion, rhythm, and scale. Like a sculptor, the organic architect views the site and materials as an innate form that develops organically from within. Truth in architecture results in a natural, spontaneous structure in total harmony with the setting. For the most part, these structures find their geometric shapes in the contours of the land and their colors in the surrounding palette of nature.

From the outside, an organic structure is so much a part of nature that it is often obscured by it. In other words, it may not be easy, or maybe not even possible, for the human eye to separate the artificial structure from the natural terrain. Natural light, air, and view permeate the whole structure, providing a sense of communication with the outdoors. From the inside, living spaces open into one another. The number of walls for separate rooms is reduced to a minimum, allowing the functional spaces to flow together. Moreover, the interiors are sparse. Organic architecture incorporates built-in architectural features, such as benches and storage areas, to take the place of furniture.

18. According to the passage, what is another name for organic architecture?

- (A) Natural architecture
- (B) Aesthetic architecture
- (C) Principle architecture
- (D) Varied architecture

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19. The word **ultimately** in paragraph 1 could best be replaced by
- (A) fortunately
  - (B) eventually
  - (C) supposedly
  - (D) obviously
20. The word **upheld** in paragraph 1 is closest in meaning to
- (A) invalidated
  - (B) disputed
  - (C) promoted
  - (D) perceived
21. The following examples are all representative of natural architecture EXCEPT
- (A) a bank that is built to look like a Greek temple
  - (B) a bank built so that the location is important to the structure
  - (C) a bank that is built to conform to the colors of the natural surroundings
  - (D) a bank that is built to be functional rather than beautiful
22. Why does the author compare an organic architecture to a sculptor?
- (A) To emphasize aesthetics
  - (B) To give an example of natural principles
  - (C) To make a point about the development of geometry
  - (D) To demonstrate the importance of style
23. The word **obscured** in paragraph 3 is closest in meaning to
- (A) difficult to see
  - (B) in high demand
  - (C) not very attractive
  - (D) mutually beneficial
24. With which of the following statements would the author most probably agree?
- (A) Form follows function.
  - (B) Function follows form.
  - (C) Function is not important to form.

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(D) Form and function are one.

25. Which of the following statements best describes the architect's view of nature?

- (A) Nature should be conquered.
- (B) Nature should not be considered.
- (C) Nature should be respected.
- (D) Nature should be improved.