注意：考試開始鈴響前，不得翻閱試題，並不得書寫、畫記、作答。

國立清華大學 108 學年度碩士班考試入學試題

系所班組別：**分析與環境科學研究所**

考試科目(代碼)：**普通生物學**(2906)

－作答注意事項－

1. 請核對答案卷（卡）上之准考證號、科目名稱是否正確。
2. 作答中如有發現試題印刷不清，得舉手請監試人員處理，但不得要求解釋題意。
3. 考生限在答案卷上標記「由此開始作答」區內作答，且不可書寫姓名、准考證號或與作答無關之其他文字或符號。
4. 答案卷用盡不得要求加頁。
5. 答案卷可用任何書寫工具作答，惟為方便閱卷辨識，請儘量使用藍色或黑色書寫；答案卡限用 2B 鉛筆畫記；如畫記不清（含未依範例畫記）致光學閱讀機無法辨識答案者，其後果一律由考生自行負責。
6. 其他應考規則、違規處理及扣分方式，請自行詳閱准考證明上「**國立清華大學試場規則及違規處理辦法**」，無法因本試題封面作答注意事項中未列明而稱未知悉。

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Part 1 單選題 (每題二分，共三十分，答錯不倒扣。請在【答案卡】作答)

1) The main source of energy for producers in an ecosystem is
A) light energy.
B) kinetic energy.
C) thermal energy.
D) chemical energy.
E) ATP.

2) One mole (mol) of glucose (molecular mass = 180 daltons) is
A) 180×10^{23} molecules of glucose.
B) 1 kg of glucose dissolved in 1 L of solution.
C) the largest amount of glucose that can be dissolved in 1 L of solution.
D) 180 kilograms of glucose.
E) both 180 grams of glucose and 6.02×10^{23} molecules of glucose.

3) Which of the following statements correctly describes *cis-trans* isomers?
A) They have variations in arrangement around a double bond.
B) They have an asymmetric carbon that makes them mirror images.
C) They have the same chemical properties.
D) They have different molecular formulas.
E) Their atoms and bonds are arranged in different sequences.

4) Which of the following is a characteristic feature of a carrier protein in a plasma membrane?
A) It is a peripheral membrane protein.
B) It exhibits a specificity for a particular type of molecule.
C) It requires the expenditure of cellular energy to function.
D) It works against diffusion.
E) It has few, if any, hydrophobic amino acids.

5) Green fluorescent protein (GFP) can be used to fluorescently label a specific protein in cells by genetically engineering cells to synthesize the target protein fused to GFP. What is the advantage of using GFP fusions to visualize specific proteins, instead of staining cells with fluorescently labeled probes that bind to the target protein?

A) GFP fusions enable one to track changes in the location of the protein in living cells; staining usually requires preserved cells.

B) GFP fusions enable higher resolution than staining with fluorescent probes.

C) GFP permits the position of the protein in the cell more precisely than fluorescent probes.

D) GFP permits visualization of protein-protein interactions; fluorescent probes do not.

E) GFP fusions are not subject to artifacts; fluorescent probes may introduce background artifacts.

6) The mathematical expression for the change in free energy of a system is $\Delta G = \Delta H - T\Delta S$. Which of the following is (are) correct?

A) ΔS is the change in enthalpy, a measure of randomness.

B) ΔH is the change in entropy, the energy available to do work.

C) ΔG is the change in free energy.

D) T is the temperature in degrees Celsius.

7) The ATP made during glycolysis is generated by

A) substrate-level phosphorylation.

B) electron transport.

C) photophosphorylation.

D) chemiosmosis.

E) oxidation of NADH to NAD^+.

8) What does the chemiosmotic process in chloroplasts involve?
A) establishment of a proton gradient across the thylakoid membrane
B) diffusion of electrons through the thylakoid membrane
C) reduction of water to produce ATP energy
D) movement of water by osmosis into the thylakoid space from the stroma
E) formation of glucose, using carbon dioxide, NADPH, and ATP

9) Receptor tyrosine kinases (RTKs) are found at high levels on various cancer cells. A protein, Herceptin, has been found to bind to an RTK known as HER2. This information can now be utilized in breast cancer treatment if which of the following is true?
A) If Herceptin is found in the breast lymph nodes of the patient.
B) If HER2, administered by injection, is in sufficient concentration.
C) If the patient's cancer cells have detectable HER2.
D) If the patient's genome codes for the HER2 receptor.
E) If the patient's genome codes for the manufacture of Herceptin.

10) A lack of which molecule would result in the cell's inability to "turn off" genes?
A) operon
B) inducer
C) promoter
D) ubiquitin
E) corepressor

11) The major advantage of using artificial chromosomes such as YACs and BACs for cloning genes is that

A) plasmids are unable to replicate in cells.

B) only one copy of a plasmid can be present in any given cell, whereas many copies of a YAC or BAC can coexist in a single cell.

C) YACs and BACs can carry much larger DNA fragments than ordinary plasmids can.

D) YACs and BACs can be used to express proteins encoded by inserted genes, but plasmids cannot.

E) All of these are correct.

12) Which of the following is the correct sequence of events in the origin of life?

I. formation of protobionts

II. synthesis of organic monomers

III. synthesis of organic polymers

IV. formation of DNA-based genetic systems

A) I, II, III, IV

B) I, III, II, IV

C) II, III, I, IV

D) II, III, IV, I

13) To increase the effectiveness of exchange surfaces lining the lungs and the intestines, evolutionary pressures have

A) increased the exchange surface area with folds and branches.

B) increased the thickness of the membranes in these linings.

C) increased the number of cell layers in these linings.

D) decreased the metabolic rate of the cells in these linings.

E) increased the volume of the cells in these linings.

14) Which of the following were probably factors that permitted early plants to successfully colonize land?

1. the relative number of potential predators (herbivores)
2. the relative number of competitors
3. the relative availability of symbiotic partners
4. air's relative lack of support, compared to water's support

A) 1 and 2
B) 2 and 3
C) 3 and 4
D) 1, 2, and 3
E) 1, 2, and 4

15) Acidity in human urine is an example of

A) cell-mediated immune responses.
B) antibody activation.
C) acquired immunity.
D) adaptive immunity.
E) innate immunity.

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Part 2 簡答題 (每題五分，共三十分。請在【答案卷】作答)

1) Please explain the reasons for different body cells can respond differently to the same peptide hormones.

2) In close comparisons, external fertilization often yields more offspring than does internal fertilization. Why internal fertilization offers the advantage to ensure the survival of the species?

3) Please correctly display the sequence of developmental milestones.

4) Please explain what the two ways to terminate the neurotransmitter activity are after its release.

5) Please image how climate might change if Earth was 75% land and 25% water?
B) Earth's daytime temperatures would be higher and nighttime temperatures lower.

6) Please demonstrate the age-dependent changes of collagens and elastin.

Part 3 問答題 (每題十分，共四十分。請在【答案卷】作答)

1) Please explain the free radical's role in the physiological control of cell functions.
2) How have the Human Genome Project and the 1000 Genomes Project (abbreviated as 1KGP) affected biological research?
3) What will the next 50 years of medical science look like?
4) Please describe the definition of following constants: $K_{eq}/K_m/K_d/K_{cat}/\triangle G$.