國立臺灣師範大學105學年度碩士班招生考試試題

科目：**普通生物學**　　適用系所：**科學教育研究所**

注意：1.本試題共 5 頁，請依序在答案卷上作答，並標明題號，不必抄題。2.答案必須寫在指定作答區內，否則依規定扣分。

一、大多數的感冒疫苗難以維持長時間的效力來抵禦流行性感冒病毒的侵犯。請問造成大規模流行的(pandemic)感冒病毒如何維持高度的遺傳變異而造成快速且廣泛的傳染？(3 分)

二、試描繪格蘭氏陽性(gram-positive)及革蘭氏陰性(gram-negative)菌的細胞壁結構差異。(6 分)

三、何謂演化的直接證據？何謂間接證據？請各舉一例子並解釋之。(4 分)

四、畫出細菌(Eubacteria)、古菌(Archaea)及真核生物(Eukarya)的演化關係。(3 分)

五、試描述或繪圖敘述植物次級生長時，維管束(木質部、韌皮部、形成層)發育的順序？(5 分)

六、試以生長素(auxin)及細胞分裂素(cytokinin)的分泌部位及交互作用來解釋植物頂芽優勢(apical dominance)的機制。(4 分)

七、演化學家常用 *r* 選擇策略(*r*-selected strategy)與 *K* 選擇策略(*K*-selected strategy)來描述物種適應環境變化程度所採用的生殖策略；生態學家也以描繪存活曲線(survivorship curves)來描繪物種的生殖策略。

1、請比較 *r* 選擇策略與 *K* 選擇策略的差異。(4 分)

2、在較不穩定的環境(unstable environment)的物種，族群大小常受到「非密度制約」(density independent)的因子影響。何謂「非密度制約因子」？(2 分)

3、呈上題，這些生活在不穩定環境中的物種大多採用 *r* 選擇策略或 *K* 選擇策略的生殖模式？請簡述理由。(3 分)

4、請畫出 type-I, II, III 三種生存曲線，須標示出橫軸(x 軸)及縱軸(y 軸)所代表的意義(3 分)

5、三種存活曲線中，何者屬於 *r* 選擇策略？何者屬於 *K* 選擇策略？(2 分)

八、實驗設計題：

現象描述：中國大陸西北乾旱區原有植被為稀疏的草原及灌木叢，然而由於過度放牧造成當地植被快速減少，導致土壤涵養水分的能力下降，進而造成嚴重的沙漠化現象。數十年來當地政府與居民為了降低沙漠化速度，實施大規模的造林運動，企圖增加綠林面積來強化土壤涵養水分的能力，沒想到數十年後沙漠化現象不但沒解決，反而造成更嚴重的沙塵暴，影響範圍甚至擴及華北一帶。

1、根據上述現象，請提出一個合理的科學問題。(2 分)

2、根據上題所提出的科學問題，寫出合適的研究假說。(4 分)

3、根據所提出的假說，設計實驗來驗證假說。(5 分)

九、單選題 (2.5 points each; total 40 points)

1. Many antibiotic drugs are effective against bacteria without hurting humans because the antibiotics rely upon differences in the structure of human and bacterial _____.

A) chromosomes

B) mitochondria

C) lysosomes

D) carbohydrates

E) ribosomes

2. Why would you expect tobacco smokers (and those exposed to tobacco smoke) to be at greater risk of an ectopic (tubal) pregnancy?

A) Tobacco smokers tend to get pregnant when they are younger.

B) Tobacco interferes with the functioning of the flagella propelling sperm.

C) Tobacco interferes with the transfer of oxygen to the uterus, thereby forcing the zygote to implant in a fallopian tube.

D) Tobacco interferes with the sweeping motion of cilia that aids in the movement of the egg toward the uterus.

E) Tobacco causes the cilia to grow to be very long and block movement through the fallopian tubes.

3. Enzymes increase the rate of a reaction by _____.

A) increasing the temperature of the substrates

B) decreasing activation energy

C) contributing electrons to the reaction

D) contributing water to the reaction

E) changing the pH of the substrates

4. You are adrift in the Pacific Ocean and, being thirsty, drink the surrounding seawater. As a result, _____.

A) you quench your thirst

B) your cells lyse, due to the excessive intake of salt

C) your cells become turgid

D) you dehydrate yourself

E) none of the above

5. A child is born with a rare disease in which mitochondria are missing from skeletal muscle cells. Physicians find that the muscles function. Not surprisingly, they also find that _____.

A) the muscles contain large amounts of lactic acid following even mild physical exercise

B) the muscles contain large amounts of carbon dioxide following even mild physical exercise

C) the muscles require extremely high levels of oxygen to function

D) the muscle cells cannot split glucose to pyruvic acid

E) the muscles require extremely large amounts of carbon dioxide to function

6. How is photosynthesis similar in C4 plants and CAM plants?

A) In both cases, the light reactions and the Calvin cycle are separated in both time and location.

B) Both types of plants make sugar without the Calvin cycle.

C) In both cases, rubisco is not used to fix carbon initially.

D) Both types of plants make most of their sugar in the dark

E) In both cases, thylakoids are not involved in photosynthesis.

7. A plant of genotype AABbCC is crossed with an AaBbCc plant. What is the probability of an offspring having the genotype AABBCC?

A) 1/2

B) 1/4

C) 1/8

D) 1/16

E) 1/32

8. Which of the following would be considered a transgenic organism?

A) a bacterium that has received genes via conjugation

B) a rat with rabbit hemoglobin genes

C) a human given a corrected human blood-clotting gene

D) a fern grown in cell culture from a single fern root cell

E) a human treated with insulin produced by bacteria

9. A biologist isolated a gene (DNA) from a human cell, digested with appropriate restriction enzymes, attached it to a plasmid, and inserted the plasmid in to a bacterium. The bacterium did make a new protein, but it was nothing like the protein normally produced in a human cell. Why?

A) The bacterium had undergone transformation.

B) The gene did not have sticky ends.

C) The gene contained introns.

D) The gene did not come from a genomic library.

E) The biologist should have cloned the gene first.

10. Professional athletes may abuse the chemical erythropoietin because it _____.
A) increases athletic stamina by increasing the concentration of red blood cells in blood
B) increases the strength of athletes by increasing the number of skeletal muscle cells in key muscles
C) converts cartilage cells to bone cells, making bones stronger and able to perform more work
D) causes cells in the liver to release extra glucose, increasing the energy available to muscle cells
E) none of the above

11. Which of the following cells initiates an immune response by acting as an antigen-presenting cell engulfing an invader and presenting its antigens to other immune cells?
A) helper T cell
B) macrophage
C) cytotoxic T cell
D) B cell
E) All of these cells perform these functions.

12. One of your best friends loves to run long distances. You ask her what she enjoys about running. In addition to good physical fitness, she tells you that after a run she feels extra happy. You suspect that her joy might be related to increased production of _____ by the anterior pituitary gland.
A) endorphins
B) inhibiting hormones
C) releasing hormones
D) prolactin
E) ibuprofen

13. Which one of the following statements is true?
A) Meiosis in spermatogenesis produces two cells from one primary spermatocyte.
B) Meiosis in oogenesis produces four mature eggs from one primary oocyte.
C) Oogenesis begins during puberty.
D) Oogenesis in humans is completed after stimulation by sperm.
E) Spermatogenesis begins before birth.

14. The induction and maintenance of labor represents an example of which of the following types of control?
A) control of uterine events by anterior pituitary hormones
B) control of uterine events by posterior pituitary hormones
C) positive feedback involving the fetus, uterus, pituitary gland, and placenta
D) positive feedback involving uterine substances only
E) negative feedback involving pituitary hormones and uterine prostaglandins

15. Realizing that you did not study as much as you needed to for this exam, you start to take the test. However, it is difficult to concentrate because your heart is racing, your stomach seems tied in a knot, you are breathing too quickly, and your mouth is dry. Most likely, you are experiencing the effects of the _____.

A) somatic nervous system
B) sympathetic nervous system
C) parasympathetic nervous system
D) central nervous system
E) spinal cord reflexes

16. Altogether, the body secretes about 7 liters of water into the alimentary canal each day. About what percentage of this water gets reabsorbed?

A) 30%
B) 40%
C) 50%
D) 75%
E) 90%

十、問答題 (total 10 points)

1. There is a phase called cytokinesis during the mitosis of a cell. Please describe the difference between animal cells and plant cells within this cytokinesis process. (6 points)

2. Should we collect and establish a so-called big DNA database which contains whole DNA sequences of all citizens? Please express your opinion and describe any advantage and/or disadvantage regarding of your opinion? (4 points)