

國立清華大學命題紙

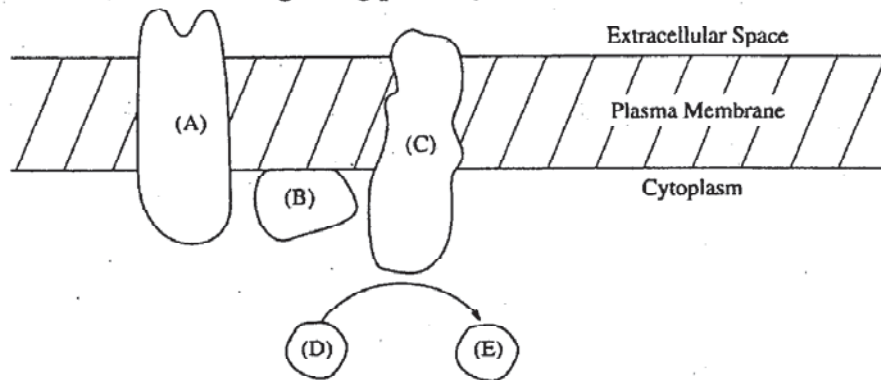
99 學年度 生醫工程與環境科學系甲組(分子生醫光電組) 碩士班入學考試

科目 普通生物學 科目代碼 2305 共 7 頁, 第 1 頁 *請在【答案卷卡】作答

I. Questions (40%; 8 points/each)

1. Consider a DNA sequence upstream of a gene. For simplicity, let's just look at one strand, and say that the "base sequence" is **abcdefghijklmnpqrstuvwxyz**. You want to explore the importance of this region in gene expression, so you make many mutants in this region. In one set of experiments, you make small deletions (say, 2-3 bases at a time). These experiments show that deletions of any bases from **d** to **w** reduce gene expression. In another set of experiments, you do extensive linker scanning tests over this region. The linker scanning results show that only changes in bases **d-i** and **r-w** reduce gene expression. Suggest a reasonable model for what this region does, based on these two sets of experiments. In particular, explain why the two experiments seem to point to different parts of the DNA as being important.

2. The diagram illustrates a member of the beta-adrenergic family of receptors and the associated proteins and small molecules involved in its signaling pathway.



- (1) Which is a heterotrimeric G protein?
- (2) What is the function of G protein?
- (3) Which is the molecule structurally and functionally related to rhodopsin?
- (4) The enzyme whose physiological substrate is ATP?

3. (1) What happens if a ribosome encounters a codon on mRNA that does not correspond to any of the amino acid-linked tRNAs?
- (2) What would happen if the different tRNAs in cells could bind to just any amino acid?

4.

When normal human fibroblasts are cultured in medium containing calf serum, they divide with an average generation time of approximately 22 hours ($M = 1$ hr, $G_1 = 10$ hr, $S = 6$ hr, $G_2 = 5$ hr). To determine the effects of serum deprivation on cell cycle distribution, cells were incubated for 48 hours in medium with or without serum. At the end of this incubation, cells were harvested and stained with propidium iodide, which binds to DNA and fluoresces when exposed to ultraviolet light. The stained cells were analyzed for DNA content (fluorescence) in a flow cytometer. The results with serum are shown in Figure 1a. If deprived of serum, the cells stop proliferating and enter a quiescent state (Figure 1b).

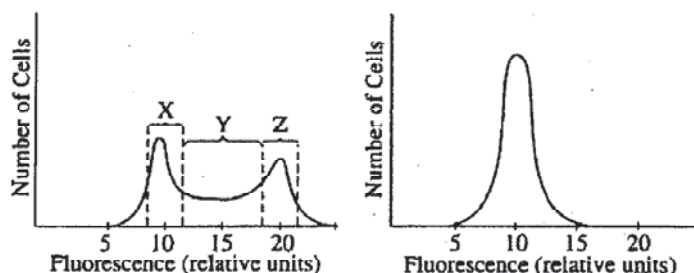


Figure 1a. With serum

Figure 1b. Without serum

- (1) In Figure 1a, the cells in the region labeled X, Y, and Z are in what stage of the cell cycle, respectively?
- (2) Cells growing in the presence of the serum were labeled for 3 hours with ^3H -thymidine and then analyzed by flow cytometry. Which regions in Figure 1a will contain radioactive cells? Why?

5.

An *in vitro* system is used to study replication of a viral DNA genome that is a double-stranded, covalently closed circle. The location of the sites for the restriction endonuclease *Mbol* on this DNA are shown in Figure 1. Replication reactions are carried out using viral DNA as a template, extracts of infected cells as a source of enzymes, and other exogenous nucleotides (dGTP, dCTP, dATP, dTTP, and ATP), all of which are labeled with ^{32}P . The reaction products are digested with *Mbol*, analyzed by agarose gel electrophoresis, and visualized by autoradiography, producing the results shown in lane 1 of Figure 2. The same reaction is carried out in the presence of increasing concentrations of nonradioactive 2', 3'-dideoxyGTP (ddGTP), and the results are shown in lanes 2-4. (Note: only full-length restriction fragments are shown.)

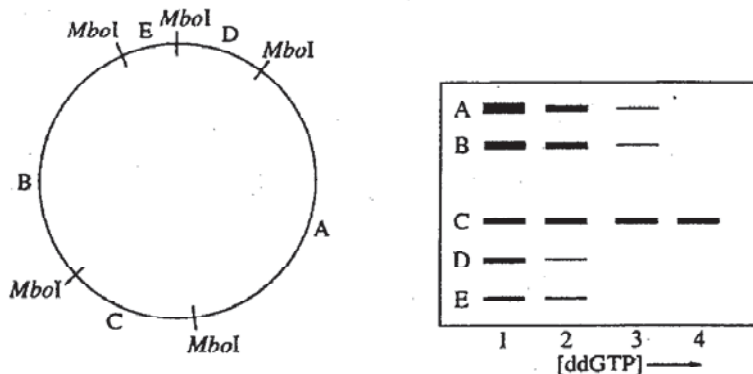


Figure 1

Figure 2

- (1) Which fragment in Figure 2 indicates the origin of replication of this DNA? Why?
- (2) Explain what type of replication of this DNA? (hint: uni-direction, bi-direction, rolling circle, semiconservation?)

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II. Multiple choice (Only one best answer for each question) (60%; 3 points/each) 無倒扣

1. A cell from heart muscle would *probably* have an unusually high proportion of?
 - (A) lysosomes
 - (B) mitochondria
 - (C) mRNA
 - (D) Golgi bodies

2. In aerobic respiration, the Krebs cycle (citric acid cycle) takes place in?
 - (A) chloroplasts
 - (B) nuclei
 - (C) lysosomes
 - (D) mitochondria

3. The first stage of photosynthesis in a chloroplast is?
 - (A) light-dependent
 - (B) temperature-dependent
 - (C) glucose-driven
 - (D) ATP-driven

4. Which of the following *best* describes meiosis?
 - (A) It is carried out in all tissues that require cell replacement.
 - (B) It occurs only in cells in the reproductive structures of the organism.
 - (C) It happens in all tissues except the brain and spinal cord.
 - (D) It is the first stage of mitosis.

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5. In certain breeds of dogs, deafness is due to a recessive allele (d) of a particular gene, and normal hearing is due to its dominant allele (D). What percentage of the offspring of a normal heterozygous (Dd) dog and a deaf dog (dd) would be expected to have normal hearing?
(A) 0% (B) 25% (C) 50% (D) 100%
6. A scientist puts nucleotide chains of UUUUUU in a test tube under conditions allowing protein synthesis. Soon the test tube is full of polypeptide chains composed of only the amino acid phenylalanine. What does this experiment indicate?
(A) The amino acid phenylalanine is composed of uracil.
(B) UUU codes for the amino acid phenylalanine.
(C) Protein synthesis malfunctions in test tubes.
(D) Most proteins contain only one type of amino acid.
7. Although there are a limited number of amino acids, many different types of proteins exist because the?
(A) size of a given amino acid can vary.
(B) chemical composition of a given amino acid can vary.
(C) sequence and number of amino acids is different.
(D) same amino acid can have many different properties.
8. How do human diseases caused by bacteria and diseases caused by viruses react to antibiotics?
(A) Neither responds to antibiotics.
(B) Both respond to antibiotics.
(C) Viral diseases respond to antibiotics; bacterial diseases do not.
(D) Bacterial diseases respond to antibiotics; viral diseases do not.
9. Individuals with HIV sometimes contract a pneumonia infection that is rare in the rest of the population because people with HIV?
(A) are unable to fight off these pneumonia-causing organisms.
(B) are more often exposed to these pneumonia-causing organisms.
(C) release pheromones that attract the pneumonia-causing organisms.
(D) release substances that increase the strength of the pneumonia-causing organisms.

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科目 普通生物學 科目代碼 2305 共 7 頁, 第 5 頁 *請在【答案卷卡】作答

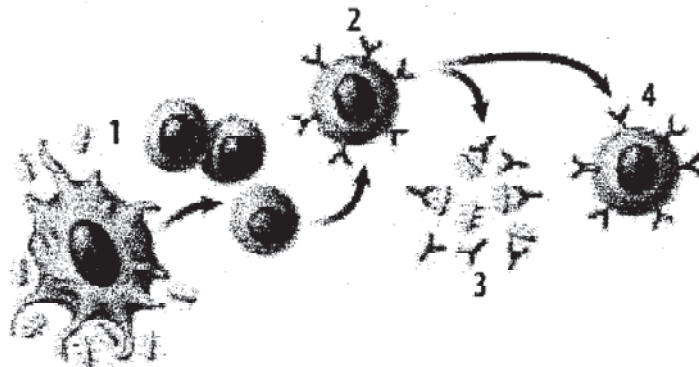
10. What is the *greatest* danger to a patient who has had damage to the skin?
- (A) loss of oils produced by the skin
 - (B) excessive muscle contractions in the damaged area
 - (C) infections in uncovered tissues
 - (D) damaged tissue entering the blood stream
11. Injecting a person with a killed-bacteria vaccine can protect that individual from a disease because the proteins of the killed bacteria?
- (A) remain in the body, and live bacteria later prey on them instead of live tissues.
 - (B) bind with receptors in the body, so that live bacteria cannot bind with them later.
 - (C) stimulate the production of antibodies which can be manufactured later in response to infection.
 - (D) give the person a mild form of the disease, which conditions the body not to respond to later infection.
12. Which of the following is a function of the nervous system?
- (A) releasing ATP into contracting muscle tissues
 - (B) signaling muscle tissues to contract
 - (C) producing lactic acid in fatigued muscle tissues
 - (D) increasing cellular respiration in muscle tissues
13. The respiratory system depends on the nervous system for signals to?
- (A) enhance the amount of available oxygen in the lungs.
 - (B) coordinate muscles controlling breathing.
 - (C) release enzymes to increase the exchange of gases.
 - (D) exchange gases with the circulatory system.
14. In carrier pigeons there is a rare inherited condition that causes the death of the chicks before hatching. In order for this disease to be passed from generation to generation there must be parent birds that?
- (A) are heterozygous for the disease.
 - (B) have the disease themselves.
 - (C) produce new mutations for this disease.
 - (D) are closely interbred.

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15. The bacterium *Agrobacterium tumefaciens* infects plants, and a portion of its DNA is inserted into the plant's chromosomes. This causes the plant to produce gall cells, which manufacture amino acids that the bacterium uses as food. This process is a natural example of?
(A) polyploidy (B) genetic manipulation (C) grafting (D) hybridization
16. Genetic engineering has produced goats whose milk contains proteins that can be used as medicines. This effect was produced by?
(A) mixing foreign genes into the milk.
(B) injecting foreign genes into the goats' udders.
(C) inserting foreign genes into fertilized goat eggs.
(D) genetically modifying the nutritional needs of the goats' offspring.
17. Which of these would *most* likely cause a mutation?
(A) the placement of ribosomes on the endoplasmic reticulum
(B) the insertion of a nucleotide into DNA
(C) the movement of transfer RNA out of the nucleus
(D) the release of messenger RNA from DNA
18. Which step in the diagram corresponds to immunity?
(A) 4 (B) 1 (C) 2 (D) 3

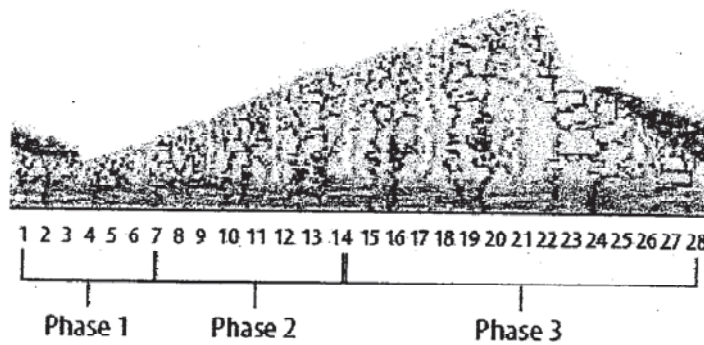


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19. What does the illustration show?
 (A) the stages of implantation
 (B) the stages of development
 (C) the stages of fertilization
 (D) the stages of the menstrual cycle



20. A person with type AB blood can donate blood to a person with
 (A) type A blood. (B) type AB blood. (C) type B blood. (D) type O blood.

Blood Type	Antigen	Antibody
A	A	Anti-B
B	B	Anti-A
AB	A, B	None
O	None	Anti-A, Anti-B

~End~