

# 國立中興大學101學年度碩士班招生考試試題

科目：生物化學

系所：生物科技學研究所

本科目試題共9頁

- 一、
1. A portion of a polypeptide produced by bacteriophage T4 was found to have the following sequence of amino acids: (10%)  
 .....Lys-Ser-Pro-Ser-Leu-Asn-Ala.....  
 Deletion of a single nucleotide from one location in the T4 DNA template strand with subsequent insertion of a different nucleotide nearby changed the sequence to:  
 .....Lys-Val-His-His-Leu-Met-Ala.....
- (a) What was the nucleotide sequence of the mRNA segment that encoded this portion of the original polypeptide?  
 (b) What was the nucleotide sequence of the mRNA encoding this portion of the mutant polypeptide?  
 (c) Can you determine which nucleotide was deleted and which was inserted? Explain your answer.

First Position 5'	Second Position				Third Position 3'
	U	C	A	G	
U	UUU F UUC F UUA L UUG L	UCU S UCC S UCA S UCG S	UAU Y UAC Y UAA stop UAG stop	UGU C UGC C UGA stop UGG W	U C A G
C	CUU L CUC L CUA L CUG L	CCU P CCC P CCA P CCG P	CAU H CAC H CAA Q CAG Q	CGU R CGC R CGA R CGG R	U C A G
A	AUU I AUC I AUA I AUG M	ACU T ACC T ACA T ACG T	AAU N AAC N AAA K AAG K	AGU S AGC S AGA R AGG R	U C A G
G	GUU V GUC V GUA V GUG V	GCU A GCC A GCA A GCG A	GAU D GAC D GAA E GAG E	GGU G GGC G GGA G GGG G	U C A G

2. If a frog egg is exposed to an inhibitor of RNA synthesis during the early stages of embryonic development, protein synthesis is not inhibited and development continues. However, if the same inhibitor is added later during embryonic development, protein synthesis is severely depressed and normal embryonic development halts. How might you explain these observations? (10%)

二、選擇題(單選，每題1分，答錯倒扣0.5分)

1. In eukaryotes, RNA splicing occurs in \_\_\_\_\_.  
 (A) Cytoplasm; (B) RER; (C) Nucleolus; (D) Mitochondria
2. Please rearrange the four steps of transcription  
 a initiation of RNA synthesis

國立中興大學101學年度碩士班招生考試試題

科目：生物化學

系所：生物科技學研究所

本科目試題共9頁

b binding of RNA polymerase to promoter

c elongation of the RNA chain

d termination

(A) abcd      (B) bacd      (C) acbd      (D) cabd

3. Which step is NOT included in the processing the mature tRNA?  
(A) Removal of leader sequence  
(B) Replacement of two nt at the 3' end of primary transcript of tRNA  
(C) Adding a phosphate group at the 3' end of primary transcript of tRNA  
(D) Excision of an intron
4. What is "second-site suppression"?  
(A) Mutation of a gene which cancels the effect of a previous mutation, enabling the wild-type phenotype to be restored.  
(B) Mutation of a stop codon, enabling the stop codon to turn into a normal codon.  
(C) Mutation occurs at the second codon of a gene.  
(D) Mutation occurs at the second nucleotide of any codon of a gene.
5. What enzyme can assist the proper folding of a protein?  
(A) Protease    (B) Spliceosome    (C) Chaperones    (D) Kinase
6. The bacterial ribosome contains  
(A) 50S+30S    (B) 40S+60S    (C) 50S+40S    (D) 30S+40S
7. The orientation and location of an **enhancer** will NOT affect its enhancement on a promoter  
(A) True      (B) False
8. The reason why a single gene can carry variant gene products (eg. DNA coding for IgM heavy chain can produce two types of IgM products) is due to  
(A) Homologous recombination;      (B) RNA silencing  
(C) Mutation of a stop codon;      (D) Alternative splicing
9. What protein can target another specific protein for **destruction**?  
(A) RNase H; (B) Ferritin protein; (C) ubiquitin; (D) DNase I

國立中興大學101學年度碩士班招生考試試題

科目：生物化學

系所：生物科技學研究所

本科目試題共9頁

10. Which one shown below is not one of the cytoskeleton elements?  
(A) microtubules; (B) intermediate filaments; (C) polar bodies; (D) microfilaments
11. What is the component to constitute the microtubules?  
(A) tubulin; (B) actin; (C) dynein; (D) myosin
12. When a migrating cell moves toward a greater or lesser concentration of a diffusible chemical, the response is known as:  
(A) migration; (B) diffusion; (C) chemotaxis ; (D) swimming
13. Which is **NOT** the function of DNA polymerase I?  
(A) 3'→5' exonuclease; (B) 5'→3' exonuclease; (C) Removes RNA primers used in DNA replication; (D) Makes RNA oligonucleotides that are used in DNA replication
14. A method for examining a cellular process occurring over time by successively exposing the cells to a labeled compound and then to the same compound in an unlabeled form is called  
(A) DNA microarray; (B) DNA fingerprinting; (C) Pulse-chase experiment; (D) Hershey-Chase experiment
15. \_\_\_\_\_ specifically degrades the RNA in **RNA:DNA hybrids** and will not degrade DNA or unhybridized RNA.  
(A) RNase H; (B) RNase I; (C) RNase L; (D) Primase
16. Taq DNA polymerase has been used in polymerase chain reaction. Why this enzyme is so efficient to produce large amount of amplified DNA but shows less fidelity?  
(A) lacks of 3'→5' exonuclease; (B) lacks of 5'→3' exonuclease; (C) lacks of polymerase activity; (D) none of above
17. Which one shown below is not one of the characteristics of histone protein?  
(A) Positive charge; (B) Lysine-rich; (C) Alanine-rich; (D) Arginine-rich
18. Which one shown below is not histone protein?  
(A) H1; (B) H2A; (C) RNA polymerase II; (D) H5

國立中興大學101學年度碩士班招生考試試題

科目：生物化學

系所：生物科技學研究所

本科目試題共9頁

19. Which one shown below is **correct** in Eukaryotes?  
(A) DNA replication in nucleus; (B) Transcription in cytoplasm; (C) Translation in nucleus; (D) RNA splicing in cytoplasm
20. Which one shown below is right for the naturally isolated plasmid?  
(A) Positive supercoiled DNA; (B) No supercoiled DNA; (C) Negative supercoiled DNA; (D) none of above

三、選擇題(單選，每題1分，答錯倒扣0.5分)

1. Since  $\Delta G^\circ = -RT \ln K$   
a) a 10-fold increase in K decreases  $\Delta G^\circ$  by about 10-fold  
b) a 10-fold decrease in K decreases  $\Delta G^\circ$  by about 10-fold  
c) a 10-fold decrease in K decreases  $\Delta G^\circ$  by about  $2.3 \times RT$   
d) a 10-fold increase in K decreases  $\Delta G^\circ$  by about  $2.3 \times RT$
2. How much does the radioactivity of a solution of  $[\gamma\text{-}^{32}\text{P}]\text{ATP}$  remain after a 42-day storage? ( $^{32}\text{P}$  has a half-life of 14.3 days)  
a) 1/3      b) 1/4      c) 1/6      d) 1/8
3. What is the approximate concentration of sodium chloride in a physiological saline solution (0.9% w/v)?  
a) 10 mM      b) 50 mM      c) 100 mM      d) 150 mM
4. One  $\mu\text{g}$  of compound X was dissolved in 1 liter water. The concentration of compound X is:  
a) 10 ppm      b) 100 ppm      c) 1 ppb      d) 10 ppb
5. How many folds of the relative centrifugal force (RCF) do increase when the speed of a centrifugation increases from 2000 to 6000 rpm?  
a) 2      b) 3      c) 6      d) 9
6. Assuming that the optical density of a solution is 2 under a 1-cm light path, then what is the percentage of the light transmitted through the solution?  
a) 20%      b) 10%      c) 2%      d) 1%

國立中興大學101學年度碩士班招生考試試題

科目：生物化學

系所：生物科技學研究所

本科目試題共9頁

7. A scientist is studying the metabolism of proteins in yeast cells to follow the formation of proteins from its earliest point. In her experiment, she will feed the yeast radioactive nutrients and follow the fate of the radioactivity in the cells. Which of the following radioactive atoms will allow her to exclusively follow proteins in the cell?
- a) nitrogen      b) carbon      c) sulfur      d) oxygen
8. What is ratio of the velocity of an enzyme at  $[S] = 9K_M$  to that at  $[S] = 0.1K_M$ ?
- a) 2      b) 9      c) 10      d) 90
9. Which statement about enzyme catalyzed reactions is NOT true?
- a) enzymes form complexes with their substrates  
b) enzymes lower the activation energy for chemical reactions  
c) enzymes change the  $K_{eq}$  for chemical reactions  
d) reactions occur at the "active site" of enzymes, where a precise 3D orientation of amino acids is an important feature of catalysis
10. How many amino acid residues are minimally needed to form a transmembrane  $\alpha$ -helix? (The thickness of lipid bilayer is about 45 angstrom.)
- a) 15      b) 30      c) 45      d) 60
11. Vitamin B1 coenzyme (PTT) is involved in :
- a) Carboxylation  
b) Oxidative decarboxylation  
c) Hydroxylation  
d) Transamination
12. Antioxidant vitamins include all of the following EXCEPT:
- a) Carotene      b) Vitamin C      c) Vitamin D      d) Vitamin E
13. Glucagon has all of the following effects in fat metabolism EXCEPT:
- a) It activates lipolysis in adipose tissue  
b) It activates fatty acids oxidation  
c) It stimulates ketogenesis  
d) It decrease plasma free fatty acid

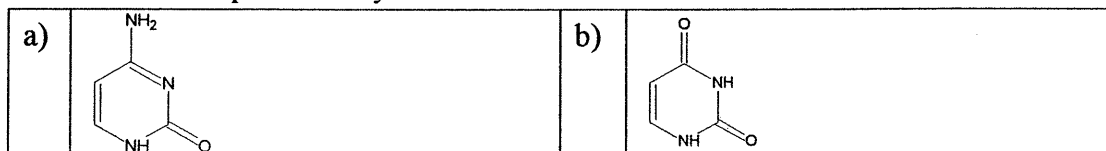
國立中興大學101學年度碩士班招生考試試題

科目：生物化學

系所：生物科技學研究所

本科目試題共 9 頁

14. Secondary messengers are needed by cells ligands only bind to surface receptors but its action would affect some internal structures within the cells. The following ligands require secondary messengers EXCEPT:
- a) Steroid hormones      b) Adrenalin      c) Insulin      d) Glucagon
15. Which is a true statement comparing phospholipids and triglycerides?
- a) Both molecules contain a phosphate group.  
b) Triglycerides may be saturated or unsaturated, but all phospholipids are saturated.  
c) Phospholipids are the primary storage form for fats in our bodies.  
d) Phospholipid molecules have a distinctly polar 'head' and a distinctly non-polar 'tail,' whilst triglycerides are predominantly non-polar.
16. Placing phospholipids into an aqueous solution immediately results in their forming a lipid bilayer. What is the driving force causing this ordered arrangement?
- a) The phospholipids are very ordered in water, and gain freedom of movement by forming a bilayer.  
b) Water, when associated with lipids, is forced into an ordered arrangement with fewer hydrogen bonds. Forcing lipids into a bilayer gains freedom of movement for the water.  
c) Phospholipids have a strong affinity for other phospholipids, leading to self assembly.  
d) van der Waals forces between the fatty acid side chains drive the formation of lipid bilayer.
17. What is the function of the Shine-Dalgarno sequence?
- a) recognized by ribosome  
b) recognized by RNA polymerase  
c) recognized by *lac* repressor  
d) terminator signal for transcription
18. Which base is present only in RNA?

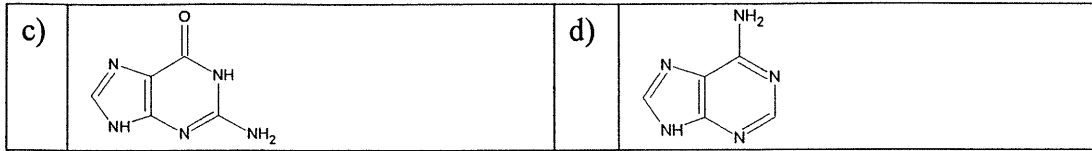


國立中興大學101學年度碩士班招生考試試題

科目：生物化學

系所：生物科技學研究所

本科目試題共9頁



19. In the absence of oxygen, the primary purpose of fermentation is to:

- a) produce amino acids for protein synthesis
- b) generate a proton gradient for ATP synthesis
- c) generate alcohol for beverages
- d) regenerate  $\text{NAD}^+$  from  $\text{NADH}$  allowing glycolysis to continue

20. ATP synthase can produce ATP using \_\_\_\_\_ as a direct energy source:

- a) energy from the conversion of glucose to pyruvate
- b) energy from the oxidation of pyruvate producing  $\text{CO}_2$  and  $\text{H}_2\text{O}$
- c) energy from a proton gradient established in mitochondria
- d) energy derived from the breakdown of  $\text{NADH}$  and  $\text{FADH}_2$

# 國立中興大學101學年度碩士班招生考試試題

科目：生物化學

系所：生物科技學研究所

本科目試題共 9 頁

## 四、Answer the following two questions briefly: 10% (簡答題 每題 5 分)

- (1) 請說明 2008 年大陸毒奶粉事件發生的科學背景原因（不肖業者為何會在奶粉中添加三聚氰胺(melamine)？）。其添加是爲了偽裝提高那一類成份？醣類、蛋白質(胺基酸)、脂肪(酸)、核苷酸、或無機鹽類。
- (2) 請說明 2011 年台灣黑心起雲劑（食品添加塑化劑）事件發生的科學背景原因（不肖業者為何會在飲品中添加塑化劑？）。下列那一類成份常做爲安全合法的食品添加起雲劑？醣類、蛋白質(胺基酸)、脂肪(酸)、核苷酸、或無機鹽類。

## 五、單選題，每題 2 分，答錯倒扣 1 分

- (1) 茄紅素(lycopene) is a (A) protein (B) polysaccharide (C) nucleotide (D) glycolipid (E) small organic compound.
- (2) 甲殼素(chitin) is a (A) protein (B) polysaccharide (C) nucleotide (D) glycolipid (E) small organic compound.
- (3) 神秘果素(miraculin) is a (A) protein (B) polysaccharide (C) nucleotide (D) glycolipid (E) small organic compound.
- (4) 索馬甜(thaumatin) is a (A) protein (B) polysaccharide (C) nucleotide (D) glycolipid (E) small organic compound.
- (5) 納豆激酶(nattokinase) is a (A) restriction enzyme (B) phosphorylation enzyme (C) dephosphorylation enzyme (D) proteolytic enzyme (E) structural protein.

## 六、Describe briefly the following terms: 10% (2 points for each)

- (1) prosthetic group
- (2) monoclonal antibody
- (3) abzyme (catalytic antibody)
- (4) N-terminal block of a protein
- (5) chaperone



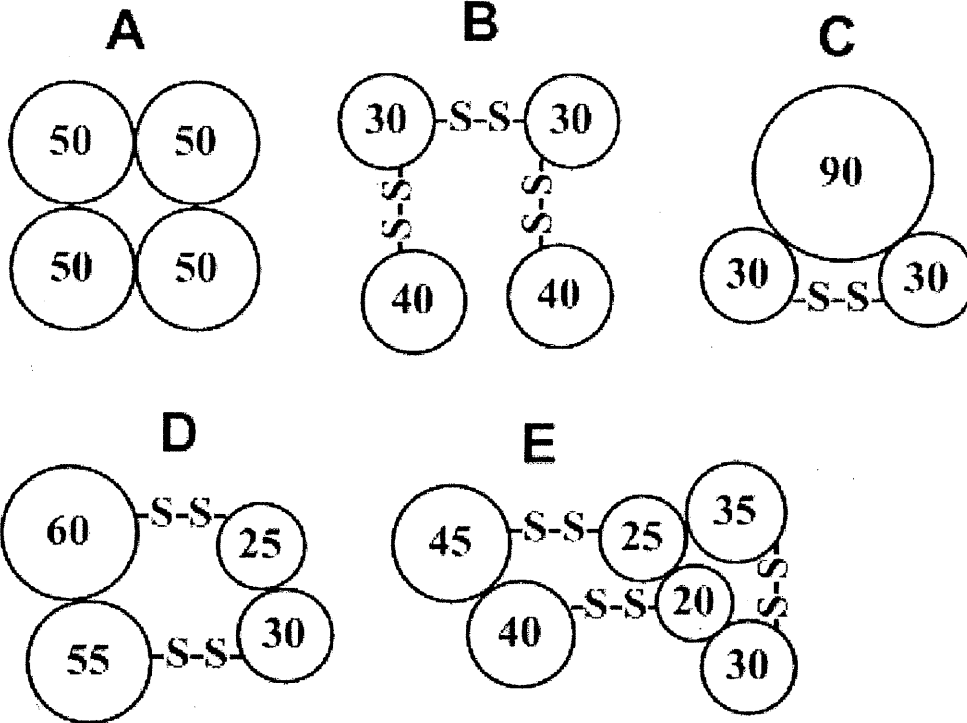
國立中興大學101學年度碩士班招生考試試題

科目：生物化學

系所：生物科技學研究所

本科目試題共 9 頁

七、Please answer the following ten questions. 10% (1 point for each) Subunit structural organizations of five proteins, A, B, C, D, and E are shown below:



- (1) In gel filtration (molecular sieving), which protein (in its native form) is expected to run fastest?
- (2) In gel filtration (molecular sieving), which protein (in its native form) is expected to run slowest?
- (3) In SDS-PAGE (in the presence of  $\beta$ -mercaptoethanol), which protein is expected to possess the highest band?
- (4) In SDS-PAGE (in the presence of  $\beta$ -mercaptoethanol), which protein is expected to possess the lowest band?
- (5) In SDS-PAGE (in the presence of  $\beta$ -mercaptoethanol), which protein is expected to possess the most bands?
- (6) In SDS-PAGE (in the presence of  $\beta$ -mercaptoethanol), which protein is expected to possess the least bands?
- (7) In SDS-PAGE (in the absence of  $\beta$ -mercaptoethanol), which protein is expected to possess the highest band?
- (8) In SDS-PAGE (in the absence of  $\beta$ -mercaptoethanol), which protein is expected to possess the lowest band?
- (9) In SDS-PAGE (in the absence of  $\beta$ -mercaptoethanol), which protein is expected to possess the most bands?
- (10) In SDS-PAGE (in the absence of  $\beta$ -mercaptoethanol), how many proteins are found as a single band in the gel?

**Hint:** Assuming subunits of the same molecular mass migrate to the same position in SDS-PAGE gels and are considered as one band. SDS can break the subunit interaction, but cannot break disulfide bonds;  $\beta$ -mercaptoethanol can break disulfide bonds.