

題號： 167
 科目： 生化學
 節次： 2

國立臺灣大學 112 學年度碩士班招生考試試題

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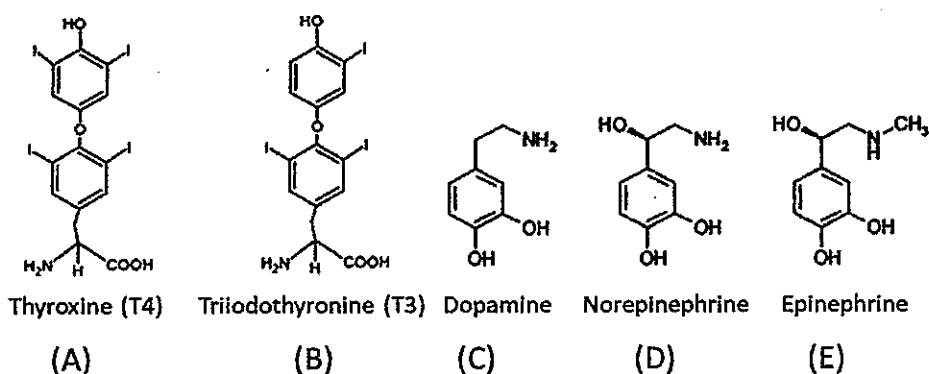
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- Please devise a plan for amplifying a single DNA fragment from a mixture. (3%)
- A graduate student is trying to separate protein S from other proteins in a solution. The proteins have the following properties:

	pI (isoelectric point)	Size (Da)	DNA-binding protein?
Protein S	7.8	25,000	yes
Protein X	3.8	24,000	yes
Protein Y	8.0	98,000	yes
Protein Z	7.6	22,000	no

Please devise effective methods for getting pure protein S. (6%)

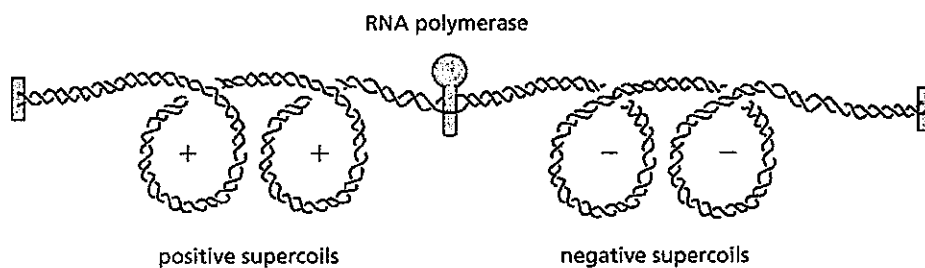
- A graduate student is attempting to extract plasmid DNA from *E. coli*. Please devise a suitable strategy for plasmid isolation, purification and validation. (7%)
- Illustrations of several hormones derived from the same molecule. (本大題之選擇題為方便閱卷核分，請勿作答在「選擇題作答區」，請務必作答於「試卷內頁作答區」標明題號依序作答。)



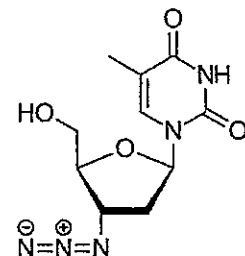
- What is the common molecule that these 5 hormones may be derived from? (2%)
- Please select the correct descriptions that can apply to the receptor of T4 and T3. (3%)
 - After binding to T4, the receptors of T4 dimerize
 - After binding to T4, the receptors of T4 degrade immediately
 - After binding to T4, the receptors of T4 bind to DNA
 - After binding to T4, the receptors of T4 autophosphorylate itself
 - After binding to T4, the receptors of T4 are localized to the nucleus
 - After binding to T4, the receptors of T4 remain on the plasma membrane
- What class of hormones are Dopamine, Norepinephrine, and Epinephrine? (2%)
 - Eicosanoid
 - Peptide hormones
 - Steroid
 - Catecholamine

見背面

- 4) Many drugs used in the treatment of psychotic disorders are dopamine antagonists. Dopamine antagonists (select the correct descriptions that apply): (3%)
- (a) are drugs that bind to Dopamine receptors
 - (b) do not activate Dopamine receptors
 - (c) do activate Dopamine receptors
 - (d) can block the actions of dopamine
 - (e) can trigger similar actions as dopamine
 - (f) has a greater K_d to the receptor than Dopamine
- 5) When Dopamine signals to Dopamine receptors D1/D2 complex, Phospholipase C is activated. What are the downstream second messengers of GPCR-Phospholipase C (PLC)? (2%)
- (a) NO and cGMP, and calcium
 - (b) IP₃, DAG, and calcium
 - (c) protein kinase C (PKC)
 - (d) cAMP and calcium
- 6) Ca^{2+} is an important second messenger in many signaling pathways. Please describe how the increase in intracellular Ca^{2+} concentration may promote the maturation and release of Insulin in beta cells. (4%)
5. In which direction along the template must the RNA polymerase in Figure below be moving to have generated the supercoiled structures that are shown? Would you expect supercoils to be generated if the RNA polymerase were free to rotate about the axis of the DNA as it progressed along the template? (4%)

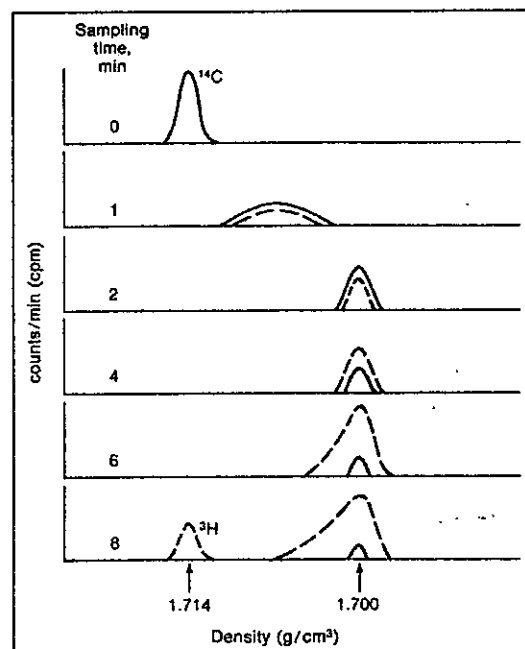


6. Why is the drug azidothymidine (AZT) block the growth of the AIDS virus HIV. (2%)



7. Consider a phage particle containing a small linear, single-stranded DNA molecule. Its replication mode is studied by centrifugation to equilibrium in CsCl. Its density in CsCl is 1.714 g/cm^3 . The density for double-stranded DNA is 1.700 g/cm^3 . Phage having ^{14}C -labeled DNA infects the bacterium in medium containing ^3H . Samples are taken at various times, DNA is isolated, and each sample is centrifuged. The results shown in Figure on right are obtained. (4%)

- 1) How does this phage replicate its DNA?
- 2) Do you think any progeny phage will be ^{14}C -labeled?



8. Decide whether the following statements are **True** or **False**, and then explain why. (6%)

- 1) A telomere allows a chromosome to be replicated precisely so that no nucleotides are lost from the end of the chromosome, thereby solving the end-replication problem.
- 2) Nuclease-hypersensitive sites in chromatin are located in the linker DNA between nucleosomes.
- 3) If a DNA-binding protein forms a symmetric dimer, it is likely that the recognition site in the DNA is symmetric as well.
- 4) In general, the DNA replicating enzyme in *E. coli* is DNA polymerase I.
- 5) Loss of the 3' to 5' exonuclease activity of DNA polymerase in *E. coli* should slow the rate of DNA synthesis but not affect its fidelity.
- 6) Pyrimidine dimers are usually formed between two thymines in different strands.

9. Abnormalities in the **catalytic activities** of key enzymes are commonly linked to diseases. Please describe (at least) three possible causes that may lead to abnormal enzyme activities (6%).

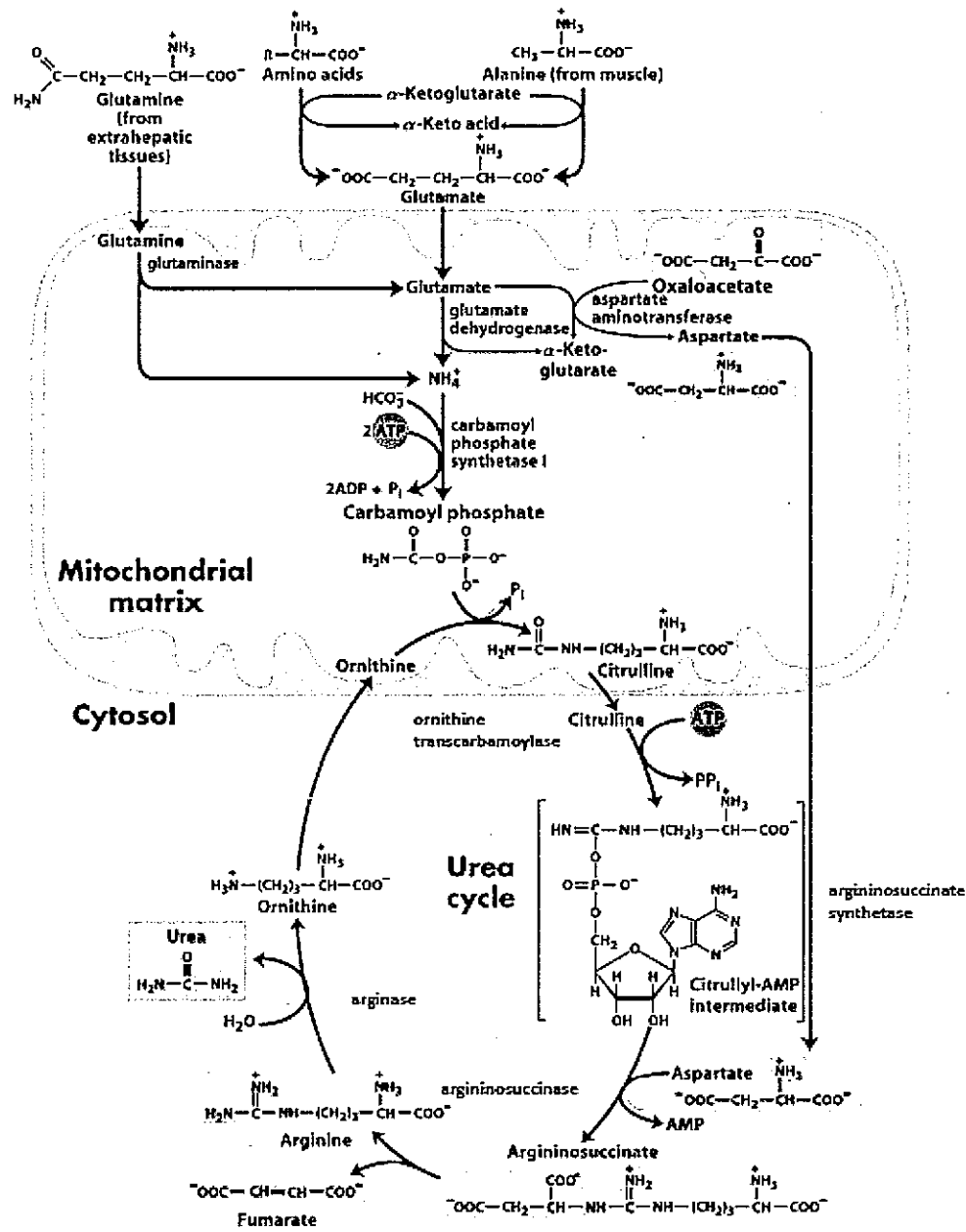
10. Explanation of Terms (名詞解釋，簡答即可)

- 1) serine protease (2%)
- 2) allosteric regulation (3%)
- 3) prosthetic group (2%)
- 4) competitive inhibitor (3%)

11. How do you experimentally determine the V_{\max} (maximum velocity) and K_M (Michaelis constant) of an enzyme? (4%)

12. Write all you know about a membrane bilayer. What is it for? What is it made of? What are its chemical constituents? What properties does it have? What are the methods to study its properties? What are its functions? How do its constituents work for its functions? (8%)

13. Describe the figure below. Note: it starts from amino acids. What are the diseases associated with it? How does one deal with the diseases? Can the urea cycle work alone? What are the roles of oxaloacetate? What does the cell do when oxaloacetate is used up by the urea cycle? (8%)



14. Please explain the difference between eukaryotic and prokaryotic mRNAs in following aspects and explain how they affect translation. (8%)

- 1) 5' modification.
- 2) Shine-Dalgarno sequence.
- 3) polycistronic/monocistronic.
- 4) 3' modification.

15. Please explain the function of following post-translational modifications, and explain which amino-acid residues have these modifications. (8%)

- 1) Ubiquitination.
- 2) Isoprenylation.
- 3) Methylation.
- 4) Phosphorylation.