

國 立 清 華 大 學 命 題 紙

97 學年度 奈米工程與微系統研習班 (所) _____ 組碩士班入學考試

科目 生物化學 科目代碼 1807 共 2 頁 第 1 頁 *請在【答案卷卡】內作答

A. (75 %) Choose the correct answer.

Correct answer : +3; Wrong answer : -1; No answer: 0

1. Dietary essential fatty acids for humans include
 - a. γ -linolenic and oleic acids.
 - b. oleic and linoleic acids.
 - c. palmitic and oleic acids.
 - d. linoleic and γ -linolenic acids.
 - e. all are true.

2. Diets aimed at reducing coronary heart disease should be:
 - a. low in trans-fatty acids and high in saturated fatty acids.
 - b. low in trans-fatty acids and low in saturated fatty acids.
 - c. high in trans-fatty acids and low in saturated fatty acids.
 - d. high in trans-fatty acids and high in saturated fatty acids.
 - e. low in trans-fatty acids and low in unsaturated fatty acids.

3. A glycosidic bond would be present in:
 - a. β -D-galactosamine.
 - b. methyl- β -D-glucoside.
 - c. 2-deoxy- α -D-ribose.
 - d. β -D-glucose-6-phosphate.
 - e. α -D-fructose-1, 6-bisphosphate.

4. Because osmotic pressure depends only on _____, the osmotic pressure is greatly reduced by formation of polysaccharide molecules from monosaccharide molecules.
 - a. molecular weight
 - b. number of hydroxyl groups
 - c. numbers of molecules
 - d. numbers of hydrogen bonds

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97 學年度 奈米工程與微絲研究 系(所) _____ 組碩士班入學考試

科目 生物化學 科目代碼 1807 共 7 頁第 2 頁 *請在【答案卷卡】內作答

- e. none are true
5. Which of the following statements about cellulose fiber is true?
- It is a linear polymer of β (1 \rightarrow 4) glycosidic linked glucose and galactose residues.
 - It is extremely susceptible to hydrolysis.
 - It is water-soluble.
 - It is made up of very weak microfibrils.
 - Intermolecular hydrogen bonds play a major role in stabilization of the microfibrils.
6. Lipid bilayers differ from micelles in that micelles are:
- self limiting structures.
 - formed spontaneously.
 - stable in aqueous solution.
 - often transformed into vesicles.
 - all are true.
7. When we say that biological membranes are asymmetric structures we mean that:
- The lipids are not evenly distributed transversely in the membrane.
 - The proteins are not evenly distributed over the surface of the membrane.
 - Patches of cholesterol and other lipids occur on the surface of the membrane.
 - Certain membrane proteins seem to prefer association with specific lipids.
 - All are true
8. In the Na^+ , K^+ -ATPase mechanism, ATP is involved in all EXCEPT:
- binding E_2 to change conformation to E_1 and release of K^+ .
 - binding E_1 to facilitate binding of Na^+ .
 - transferring a phosphate group to make sodium phosphate.
 - hydrolysis to ADP and $\text{E}_1\text{-P}$.
 - none of the above.
9. _____ between tightly packed amino acid side chains in the interior of the protein are a major contribution to protein structure.
- Hydrogen bonds

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97 學年度 森林工程與微系統研究所 系(所) _____ 組碩士班入學考試

科目 生物化學 科目代碼 1807 共 7 頁第 3 頁 *請在【答案卷卡】內作答

- b. Electrostatic interactions
- c. Covalent ester bonds
- d. Van der Waals interactions
- e. All are true

10. A Ramachandran plot shows:

- a. the amino acid residues which have the greatest degree of rotational freedom.
- b. the sterically allowed rotational angles between R groups and α -carbons in a peptide.
- c. the sterically allowed rotational angles between C_{α} and the amide nitrogen (C_{α} -N) as well as between C_{α} and the amide carbonyl carbon (C_{α} -CO).
- d. the sterically allowed rotational angles about the amide nitrogen (NH) and CO.
- e. the amino acid residues that form α -helix, β -sheet, etc.

11. Tertiary structure of proteins depends on all EXCEPT:

- a. protein structure depends on primary structure.
- b. α -helices and β -sheets often associate and pack close together.
- c. secondary structures form whenever possible.
- d. peptide segments between secondary structures are short.
- e. proteins are stable as a single-layer structure.

12. Which statement is correct about the β - α - β motif?

- a. The two β -strands are antiparallel.
- b. The peptide segment connecting the β -strands usually contains no more than five amino acids.
- c. The peptide segment connecting the two β -strands commonly contains proline.
- d. The cross-over connection itself contains an α -helical segment.
- e. none are correct.

13. Protein isolation and purification include all of the techniques EXCEPT:

- a. gas-liquid chromatography.
- b. ion exchange chromatography.

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科目 生物化學 科目代碼 1807 共 7 頁第 4 頁 *請在【答案卷卡】內作答

- c. electrophoresis.
- d. solubility ("salting in" and "salting out").
- e. affinity chromatography.

14. Edman degradation will:

- a. determine the C-terminal amino acid by using a carboxypeptidase.
- b. cleave the protein into a multitude of smaller peptides.
- c. compare overlapping sets of peptide fragments.
- d. determine the N-terminal amino acid.
- e. generate two different, but overlapping sets of peptide fragments.

15. The *lac repressor* is an example of a(n):

- a. enzyme.
- b. regulatory protein.
- c. transport protein.
- d. storage protein.
- e. structural protein.

16. Nucleosides are relatively stable to _____ hydrolysis, and pyrimidine nucleotides are stable to _____ hydrolysis, but purine nucleotides are unstable to _____ hydrolysis.

- a. base; acid; acid
- b. base; base; acid
- c. acid; base; base
- d. acid; acid; base
- e. none are true

17. What is the nucleotide sequence of the DNA strand that is complementary to 5'-ATCGCAACTGTCAC TA-3' ?

- a. 5'-TAGCGTTGACAGTGAT-3'
- b. 5'-UAGUGACAGUUGCGAU-3'
- c. 5'-TAGCGTTGACAGTGAT-3'
- d. 5'-TAGTGACAGTTGCGAT-3'
- e. 5'-ATCACTGTCAACGCTA-3'

18. Individual amino acids are attached to their corresponding tRNAs:

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- a. through an ester linkage to the 3'-OH in the acceptor stem.
 - b. through an amide linkage to the anticodon loop.
 - c. through an amide linkage to the adenine ring at the 3' end of the tRNA.
 - d. through a phosphoester linkage to the 5' end of the tRNA.
 - e. None of the above.
19. A method used to insert or transform cells with a plasmid is to:
- a. add the DNA to bacterial cells that have been lightly treated with lysozyme to produce "holes" in the cell wall.
 - b. add the DNA to a heated suspension of cells at 42° C.
 - c. treat the bacteria with Ca^{2+} , add the DNA, and briefly heat to 42° C.
 - d. incubate the DNA with the cells overnight at 4° C.
 - e. mixing plasmids with an extract of broken cells.
20. A genomic DNA library is:
- a. a collection of short fragments from nuclear DNA digestion.
 - b. arrays of synthetic oligonucleotides used to select for a specific DNA.
 - c. a set of cloned fragments that collectively represent the genes of a particular organism.
 - d. a short segment of DNA whose sequence is complementary to a portion of the DNA of interest.
 - e. a circular DNA molecule of 1 kb to 200 kb found in bacteria and yeast cells.
21. Entropy change, ΔS , is
- a. the sum of heat absorbed and work.
 - b. not a thermodynamic state function.
 - c. a measure of disorder in a system.
 - d. determined by pressure change at a constant temperature.
 - e. equal to the heat transferred at constant pressure and volume.
22. If the rate constant for the enzyme catalyzed reaction is $2 \times 10^5/\text{sec}$ and the rate constant for the uncatalyzed reaction is $2 \times 10^{-6}/\text{sec}$, the catalytic power of the enzyme is:
- a. 10^{11}
 - b. 2×10^{-11}
 - c. 10^{-11}

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科目 生物化學 科目代碼 1807 共 7 頁第 6 頁 *請在【答案卷卡】內作答

d. 10^{-1}

e. 2×10^{-1}

23. How do catalysts work to accelerate a chemical reaction?

- a. They raise the average energy of the reactants.
- b. They provide a means of acceleration by being completely consumed in the reaction.
- c. They lower the energy of activation.
- d. They lower the overall free energy change of the reaction.
- e. They raise the overall free energy change of the reaction.

24. HIV-1 protease is different from most mammalian aspartic acid proteases in that it has:

- a. two subunits each with a two-aspartate active site.
- b. two subunits each contributing an aspartate to the active site.
- c. two active sites on one protein.
- d. two subunits, one with an active site, and the other with a regulatory activity.
- e. none of the above.

25. The function of glycogen phosphorylase is:

- a. the conversion of glucose-1-phosphate to glucose-6-phosphate.
- b. to break down ATP.
- c. to catalyze the phosphorolysis of glucose-1-phosphate from glycogen molecules.
- d. to inhibit the production of glucose-1-phosphate.
- e. to stimulate the build up of glycogen.

B. (25 %) Answer the following questions.

1. List one basic property that distinguishes RNA polymerases from DNA polymerase, and list one property they share.
2. Describe and contrast positive regulation and negative regulation of gene expression.
3. What is the essential difference between a genomic library and a cDNA library?
4. The template strand of a segment of double-stranded DNA contains the sequence:

(5') CTT TGA TAA GGA TAG CCC TTC

(a) What is the base sequence of the mRNA that can be transcribed from this strand? (b) What amino acid sequence could be coded by the mRNA base sequence in (a), using only the first reading frame starting at the 5' end? (Refer to the genetic code table.) (c) Suppose the other (complementary) strand is used as a template for transcription. What is the amino acid sequence of the resulting peptide, again starting from the 5' end and using only the first reading frame?

THE GENETIC CODE

		SECOND LETTER						
		U	C	A	G			
FIRST (5') LETTER	U	UUU } Phe	UCU } Ser	UAU } Tyr	UGU } Cys	U	THIRD (3') LETTER	
		UUC } Phe	UCC } Ser	UAC } Tyr	UGC } Cys			C
		UUA } Leu	UCA } Ser	UAA } Ochre (terminator)	UGA } Opal terminator			A
		UUG } Leu	UCG } Ser	UAG } Amber (terminator)	UGG } Trp			G
	C	CUU } Leu	CCU } Pro	CAU } His	CGU } Arg	U		
		CUC } Leu	CCC } Pro	CAC } His	CGC } Arg	C		
		CUA } Leu	CCA } Pro	CAA } Gln	CGA } Arg	A		
		CUG } Leu	CCG } Pro	CAG } Gln	CGG } Arg	G		
	A	AUU } Ileu	ACU } Thr	AAU } Asn	AGU } Ser	U		
		AUC } Ileu	ACC } Thr	AAC } Asn	AGC } Ser	C		
		AUA } Ileu	ACA } Thr	AAA } Lys	AGA } Arg	A		
		AUG } Met (initiator)	ACG } Thr	AAG } Lys	AGG } Arg	G		
	G	GUU } Val	GCU } Ala	GAU } Asp	GGU } Gly	U		
		GUC } Val	GCC } Ala	GAC } Asp	GGC } Gly	C		
		GUA } Val	GCA } Ala	GAA } Glu	GGA } Gly	A		
		GUG } (initiator)	GCG } Ala	GAG } Glu	GGG } Gly	G		

5. Polymerase chain reaction or PCR is a *in vitro* technique used to amplify specific sequences of DNA. It consists of repeated cycles of a three-step process:
 What are the three steps that constitute a cycle and what happens during each step?