

There are three parts in this exam (50% + 20% + 30%)

Part I. Single choice: 2 points for each question (單選題 每題 2 分) (50%)

- In spectrophotometric analysis, which wavelength is normally used to determine the nucleic acid concentration? (A) 2140nm (B) 445nm (C) 280nm (D) 260nm (E) 320nm.
- Among the following sequences, which is most likely present in a large number of eukaryotic promoters? (A) GAGAAA (B) TATAAAA (C) UAUAAAA (D) Shine-Dalgarno sequence (E) Pribnow box sequence.
- Which of the following RNAs has catalytic activity? (A) miRNA (B) mRNA (C) ribozyme (D) siRNA (E) snRNA
- Which of the following types of reactions use Pyridoxal phosphate (derived from vitamin B₆) as a coenzyme? (A) reductive amination; (B) transduction; (C) transamination; (D) nitrogen fixation; (E) ligation.
- Which statement concerning the structure of nucleic acid is correct? (A) The building blocks of nucleic acids are hexoses. (B) Nucleic acids are usually positively charged at normal, physiological pH. (C) Disulfide bonds are involved in the higher order structures. (D) The only difference between DNA and RNA is that RNA contains U instead of T. (E) None of the above.
- The RNA product obtained from the transcription of the DNA template below is



- (A) CUGUAAGUCCGU; (B) UCGGUGAAUGUC; (C) GACATTCAGGCA; (D) ACGGACUUACAG; (E) GACAUCAGGCA.
- The correct statement regarding DNA-dependent RNA polymerase is: (A) it requires a RNA template; (B) it requires a DNA primer; (C) it elongates the newly formed RNA chain in the 5' to 3' direction; (D) it requires deoxyribonucleotides for synthesize the products; (E) the templates must be linear double-stranded DNA.
 - Please choose the correct statement concerning the construction of recombinant DNA: (A) Viruses cannot be used to carry foreign DNA into cells. (B) Only circular DNAs could be used to transform bacteria. (C) The mRNAs may be used as templates in recombinant DNA technology by first converting the mRNAs to double stranded using reverse transcriptase. (D) It is necessary to use DNA ligase to ligate the target insert and the vector DNA ends before transformation. (E) Restriction enzymes are frequently used in recombinant DNA technology.
 - The transcription of DNA to RNA differs from replication of DNA in that (A) deoxyribonucleotides rather than ribonucleotides are the monomeric building blocks for RNA, (B) the base thymine in RNA is replaced by uracil in DNA, (C). RNA polymerase is involved in synthesizing RNA instead of DNA polymerase, (D) the direction of polymerization is different; (E).all of above.
 - Which of the following molecules is not known to server as genetic materials for biologically active organisms? (A) double-stranded linear ribonucleic acid; (B) double-stranded circular ribonucleic acids; (C) double-stranded riboses; (D) single-stranded DNA; (E) single-stranded RNA.
 - The Shine-Dalgarno sequence found in prokaryotic systems resides on the (A). tRNA, (B). charged tRNA, (C) rRNA, (D)mRNA.
 - Which of the following statements concerning "gluconeogenesis" is true?.(A) The pathway involves reactions in Golgi bodies. (B) It is the direct reversal of glycolysis. (C) It is a energy-consuming pathway overall. (D)

- Oxaloacetate is not involved in the pathway. (E) The reaction only occurs in bacteria.
13. ATP plays probably the most important role in living cells among all high-energy phosphorylated molecules because: (A) ATP has the lowest phosphoryl group transfer potential among all cellular phosphorylated molecules; (B) ATP is one of the building blocks of DNAs of living cells; (C) ATP occupies the top of the phosphoryl group transfer scale, which makes it a universal donor of the phosphoryl group; (D) ATP has a position roughly at the bottom of the phosphoryl group transfer scale, which allows it to serve as a pipeline to transfer energy from catabolism to anabolism; (E) None of the above.
14. Please choose the false statement regarding ΔG° of a reaction: (A) A reaction that has $\Delta G^{\circ} > 0$ is considered a spontaneous reaction. (B) For a reaction at equilibrium under standard conditions, $\Delta G = 0$. (C) A reaction that requires an input of energy to proceed as written has a positive ΔG° . (D) ΔG° of a reaction cannot be increased or decreased by enzymes as needed. (E) None of the above.
15. The expression of most genes in prokaryotic systems is regulated primarily at the level of: (A) Replication, (B) Translation, (C) Transduction, (D) Post translational modification, (E) Transcription.
16. "Okazaki fragments", as defined in DNA replication, can be isolated (A) after DNA synthesis is completed; (B) when DNA strands are treated with exonucleases; (C) when DNA strands are treated with ligases; (D) when DNA synthesis is disrupted; (E) before the replication complex is formed.
17. Which class of bond directly participates in the interaction of codons to anticodons between mRNAs and tRNAs? (A) Hydroxy bonds. (B) Ionic bonds. (C) Peptide bonds. (D) Covalent bonds. (E) Hydrogen bonds.
18. Isoelectric point is a point at which? (A) The net charge of protein is the highest; (B) The mass of protein is zero. (C) The speed of mobility in isoelectric focusing gels is increased. (D) The net charge of a protein is zero (E). All charged groups loss their charges.
19. Please choose the appropriate pair of terms to fill in the following blanks, respectively. Reverse transcriptase is capable of catalyzing the synthesis of ____ using ____ as the template. (A) RNA, DNA; (B) DNA, protein; (C) PNA, RNA; (D) DNA, RNA; (E) single-stranded RNA, double-stranded RNA.
20. The solution of a strong acid will have a: (A) high pKa; (B) low pH and high concentration of H^+ ; (C) high concentration of OH^- ; (D) high pH and low concentration of H^+ ; (E) low pH and low concentration of H^+ .
21. To prepare a 15 % sucrose solution, one should (A) add 15 g of sucrose into 100 ml of pure water; (B) add 15 ml of sucrose to 100 ml of pure water; (C) add 100 ml of pure water into 15 g of sucrose; (D) dissolve 7.5 g of sucrose in 35 ml of pure water, and bring the final volume to 50 ml with pure water; (E) add 10 g of glucose, 5 g of fructose into 100 ml of pure water.
22. . If you could charge the tRNAs that is normally specific for Arginine with Lysine instead, then: (A) the anticodons of these tRNAs would base pair with the mRNA condon specific for Lysine. (B) the anticodons of these tRNAs would not base pair with the mRNA condon specific for Arginine. (C) Arginine will probably be incorporated to the position where Lysine should normally be in the position. (D). neither lysine nor arginine will be incorporated into the resultant protein. (E) the Lysine-charged tRNA would base pair with the condon specific for arginine.
23. Which of the following statements regarding eukaryotic transcription is false? (A) It is the in vivo synthesis of DNA using a RNA template. (B) Ribosomes are not involved in the synthesis of new transcripts. (C) The primary transcripts are synthesized in the 5' to 3' direction. (D) Polypeptide chains are usually not used as the templates. (E) Promoter sequences can be recognized by transcription initiation factors.
24. The number of phosphodiester bonds in a short single-stranded polynucleotide of 10 nucleotides is: (A) 10; (B) 9; (C) 5; (D) 20; (E) 11.

25. Which of the following best describes the primary function of the "pentose phosphate pathway" (A) to create pentagons inside the cells; (B) to supply ATP to cells in anaerobic conditions; (C) to supply sucrose to increase the sweetness of the organism; (D) to provide precursors and reducing power for anabolic process; (E) none of the above.

Part II. Single choice: 2 points for each question (單選題 每題 2 分) (20%)

- Which one is NOT a protein (A) abzyme (B) ribozyme (C) lysozyme (D) isomerase (E) DNA restriction enzyme.
- Which one can be considered as a second message? (A) G protein (B) protein kinase C (C) cyclin (D) phospholipase C (E) diacylglycerol
- Which one is NOT a protein (A) pectin (B) integrin (C) miraculin (D) thaumatin (E) selectin.
- For degradation of polysaccharides with many branches, the degradation enzymes act only on (A) a non-reducing end (B) a reducing end (C) many non-reducing ends simultaneously (D) many reducing ends simultaneously (E) both non-reducing and reducing ends simultaneously.
- Which statement of lectin in the flowing is wrong? (A) is a protein (B) binds to an oligosaccharide specifically (C) hydrolyze its specific oligosaccharide to execute its biological function (D) its biological function is initiated by mediating cell-cell recognition and adhesion.
- Which one is not considered as an amphipathic molecule? (A) triacylglycerol (B) cholesterol (C) phosphatidic acid (D) glycolipid (E) phospholipid.
- O-linked glycosylation is attached to which amino acid residue(s) of a protein? (A) Tyr (B) Ser and Thr (C) Asn (D) Asn and Asp (E) any residue except for Pro.
- Which one is NOT a protein. (A) selectin (B) integrin (C) miraculin (D) thaumatin (E) saccharin.
- Which one is useful in predicting transmembrane from sequence (A) micelle (B) liposome (C) membrane potential (D) hydrophathy index (E) freeze-fracture.
- Which protein forces inward curvature in membranes? (A) aquaporin (B) porin (C) caveolin (D) bacteriorhodopsin (E) hemagglutinin.

Part III. Answer the following questions briefly 簡答題 (30%, 10% for each)

1. Which properties of proteins can be determined by Mass spectrometry?

(Please write down the whole table in your answer sheet)

Properties of proteins	Yes or No
identification	
1D structure: sequencing	
secondary structure: content of α -helices and β -strands	
3D structure:	
numbers of subunits	
numbers of domains	
phosphorylation sites	
glycosylation sites	
Cys residues for disulfide linkage	
N-terminal block	

2. An N-terminal block protein of 28 amino acids was executed with amino acid composition and sequencing. The result of amino acid composition is listed below:

Cys	Gly	Asn	Val	Lys	Leu	Ser	Phe	Asp	Ala
1	1	1	3	3	3	3	3	4	6

The results of amino acid sequencing after digestion with three different proteases are listed in the following:

- (a) V8 (cut peptide bonds of negatively charged residues at carbonyl side)
 Lys-Ser-Ala-Phe-Lys Leu-Ala-Phe-Leu-Ala
 Leu-Ala-Ala-Lys-Asp-Leu-Ala Cys-Ala-Phe-Ser-Asp-Leu-Ala
- (b) chymotrypsin (cut peptide bonds of aromatic residues at carbonyl side)
 Lys-Asn-Ser-Asp-Cys-Ala Leu-Ala-Val-Val-Val
 Ser-Asp-Leu-Ala-Ala-Lys-Asp-Leu
- (c) trypsin (cut peptide bonds of positively charged residues at carbonyl side)
 Asp-Leu-Ala-Phe-Leu-Ala-Val Ser-Ala-Phe-Lys-Asn-Ser
 Asn-Ser-Asp-Cys

Please write down the sequence of 28 residues in this polypeptide.

3. Dr. Wang obtained a protein of about 77 kDa estimated by SDS-PAGE. Dr. Wang purified this protein to homogeneity and sent it out for determination of amino acid composition. The result came out in the following table. (The average M_r of amino acids is 110)

residue	content (p mole)
Ala	380
Arg	160
Asp	350
Cys	25
Gly	370
Glu	370
His	120
Ile	180
Leu	300
Lys	100
Met	100
Phe	125
Pro	270
Ser	220
Thr	200
Tyr	60
Val	170

- (1) How many Met residues in this 77 kDa protein estimated from the table?
 (2) What are the maximal disulfide bonds that can be formed in this 77 kDa protein?