

第一部份(佔 33 分):

單選題: 20%

1. The net charge of the predominant form of Asp is 0 at (A) pH 1.0 (B) pH 3.0 (C) pH 6.0 (D) pH 11.
2. Which of the following statement of a protein's structure is correct?
(A) Trp is more likely than Gln to be on a protein's surface.
(B) Phe is more likely than Glc to be on a protein's surface.
(C) Ser is more likely than Val to be in the protein's interior.
(D) Val is more likely than Ser to be in the protein's interior.
3. Which of the following one-letter abbreviation for each of the amino acid is correct? (A) Lysine: K; Arginine: R. (B) Phenylalanine: P; Glycine: G. (C) Glutamic acid: D; Glutamine: Q. (D) Tryptophan: W; Tyrosine: T.
4. Which of the following statement is correct?
(A) Ala, Arg and Asp are both glucogenic and ketogenic
(B) Leu and Lys are purely glucogenic
(C) Ile, Trp and Phe are both glucogenic and ketogenic
(D) Glu, Gly and Met are both glucogenic and ketogenic.
5. Which enzyme hydrolyzes 1-palmitoyl-2-oleoyl-3-phosphatidylserine to yield the products of palmitic acid and 2-oleoyl-3-phosphatidylserine? (A) phospholipase D (B) phospholipase C (C) phospholipase A₂ (D) phospholipase A₁.
6. Which of the following is not a true statement?
(A) Enzymes alter the speed of a chemical reaction
(B) Enzymes are always proteins.
(C) Enzymes are rarely consumed in chemical reaction.
(D) A particular enzyme cannot catalyze reactions involving many different substances.
7. Which of the following statement is correct?
(A) If a bilayer contains only gangliosides, it would be unstable
(B) Animals can synthesize linoleic acid and therefore must obtain this essential fatty acid from their diet.
(C) Steroid hormones cannot bind to cytosolic receptors.
(D) *Trans*-oleic acid has a lower melting point than *cis*-oleic acid.
8. Which of the following pairs of sugar are epimers of each other?
(A) D- arabinose and D-ribose. (B) D-fructose and L-fructose. (C) D-fructose and D-sorbose. (D) D-ribose and D-ribulose.
9. Which of the following compounds is likely to cross a membrane by nonmediated transport: (A) ethanol (B) glycine (C) messenger RNA (D) ATP
10. A tRNA molecule must be able to (A) recognize an anticodon. (B) recognize a codon. (C) distinguish one amino acid from another. (D) recognize DNA molecules.
11. Which of the following is wrong?
(A) Transfer RNA is needed because amino acids cannot stick to mRNA.
(B) Transfer RNA molecules are much smaller than mRNA molecules.
(C) Transfer RNA molecules are synthesized without the need for intermediary mRNA.
(D) Transfer RNA molecules bind amino acids without the need of any enzyme.
12. If one λ phage particle infects a cell lysogenic for λ phage, which of the following will probably happen?
(A) The cell will die.
(B) The λ DNA will circularize but will not replicate.

- (C) The λ prophage will be excised.
 (D) The λ DNA will not be injected.
13. Which of the following statement is true?
 (A) In the synthesis of DNA the covalent bond which forms is between a 3'-OH and a 5'-P group.
 (B) In general, the DNA replicating enzyme in *E. coli* is DNA polymerase I.
 (C) A single strand of DNA can be copied if the four nucleotide triphosphates and polymerase I, are provided.
 (D) If polymerase I is added to the four nucleotide triphosphates without a DNA template, DNA is synthesized but with a random base sequence.
14. If one of the following enzymes is absent, not even one nucleotide can be added at the replication fork. This enzyme is (A) Polymerase I (polymerizing activity). (B) Polymerase I (5'→3' exonuclease activity). (C) Polymerase III. (D) DNA ligase.
15. Which of the following is not synthesized directly from a DNA template? (A) Messenger RNA. (B) Transfer RNA. (C) Repressor. (D) Ribosomal RNA.
16. Which of the following amino acid changes cannot result from a single base change? (A) Met to Arg. (B) His to Glu. (C) Gly to Ala. (D) Proto Ala.
17. Which of the following purification methods cannot separate proteins of various sizes? (A) Polyacrylamide gel electrophoresis with SDS (B) Sephacryl HR chromatography. (C) Gel filtration chromatography. (D) Ionic chromatography.
18. Which of the following statement is correct?
 (A) Ammonium sulfate can precipitate IgG and keep the molecules biologically active.
 (B) Trichloroacetic acid (TCA) can precipitate IgG and keep the molecules biologically active.
 (C) Sodium dodecyl sulfate can precipitate IgG and keep the molecules biologically active.
 (D) Urea can precipitate IgG and keep the molecules biologically active.
19. Which of the following intermediates or compounds is not involved in the tricarboxylic acid cycle?
 (A) acetyl CoA. (B) succinate. (C) ATP. (D) NAD⁺.
20. Which of the following is a "high energy" compound? (A) transfer RNA. (B) malate. (C) phosphoenolpyruvate. (D) acetyl CoA.

問答題:

1. Draw the dipeptide Asp-His at pH 7.0. (5%)
 2. Cleavage of a polypeptide by CNBr and chymotrypsin yields fragments with the following amino acid sequences. What is the sequence of the intact polypeptide? (4%)

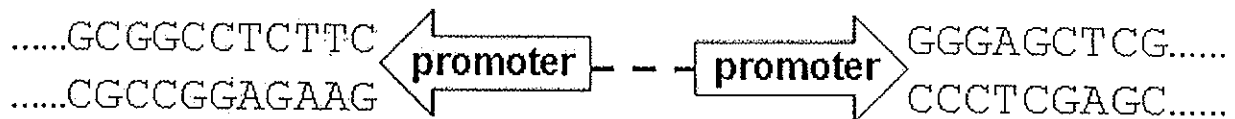
CNBr treatment	Chymotrypsin
Arg-Ala-Tyr-Gly-Asn	Met-Arg-Ala-Tyr
Leu-Phe-Met	Asp-Met-Leu-Phe
Asp-Met	Gly-Asn

3. The following growth factor receptor has a single transmembrane helix. Find and underline it in this partial sequence: (4%)

.... KSGPSIPKKIVGALLLVVALGIGILFRKKRRH

第二部份(佔 32 分):

- Which statement concerning the nature of nucleic acid is incorrect?
 - The building blocks of nucleic acids contain pentoses.
 - The heterocyclic bases are connected to the riboses through O-glycosidic linkage.
 - Hydrogen bonds are involved in the higher order structures.
 - RNA can also serve as the carrier of genetic information.
 - Nucleic acids are usually negatively charged at normal, physiological pH.
- The RNA products obtained from the transcription of the DNA template below driven by two promoters with different directions as indicated are:



- 5'-GCGGCCUCUUC... & 5'-GGGAGCUCG...;
 - 5'-CCCTCGAGC... & 5'-CTTCCTCCGGCG...;
 - 5'-GGGAGCUCG... & 5'-GAAGAGGCCGC...;
 - 5'-CCCUCGAGC... & 5'-GCGGCCUCUUC...;
 - 5'-CUUCUCCGGCG... & 5'-GACAUUCAGGCA.
- In *Escherichia coli*, RNA primers are not found in replicated DNA because:
 - the RNA primers can be removed by the 5' to 3' exonuclease activity of DNA polymerase I.
 - DNA polymerase II replaces the RNA primers using its RNA synthase activity.
 - the primase may carry the RNA primers to another origin of replication for re-initiation.
 - RNA polymerase I removes the primers using its RNA exonuclease activity.
 - RNA primers are in silent regions of the DNA.
 - The transcription of DNA differs from replication of DNA in that
 - the templates for transcription is usually ribonucleic acids.
 - the polymerization process of transcription proceeds from 3' to 5'.
 - Disulfide bonds are involved in formation of transcription products.
 - the major enzyme involved in transcription of DNA is DNA-dependent RNA polymerase.
 - the base thymine in RNA is replaced by uracil in DNA in replication.
 - Which class of bond directly participates in the recognition between of codons and anticodons in the translation of mRNAs?
 - Hydrogen bonds.
 - Ionic bonds.
 - Peptide bonds.
 - Covalent bonds.
 - Hydrogen bonds.
 - Nucleotides are NOT involved in which of the following biological activities?
 - Transcription and replication.
 - photosynthesis.
 - signal transduction.
 - glycolysis.
 - None of the above.

7. One of the important implications of E. Chargaff's discovery that there is a 1:1 ratios for Adenine to Thymine and Guanine to Cytosine in several different species is that:
- (A) the different species studied are all genetically related.
 - (B) the numbers of Adenine and Guanine should be the same.
 - (C) all the different species studied share the same DNA sequences.
 - (D) all the different species studied share the same amount of DNA molecules.
 - (E) it indicated that adenine should be paired to thymine.
8. The expression of most prokaryotic genes is controlled at the transcriptional level because:
- (A) the replication and transcription in prokaryotes are coupled.
 - (B) the translational control requires too much energy for prokaryotes.
 - (C) there are no nuclear membranes in prokaryotes and thus transcription and translation are coupled.
 - (D) prokaryotes are unable to control gene expression at translational level.
 - (E) prokaryotes are usually mono-cistronic.
9. If you could charge the tRNAs that is normally specific for aspartic acid with glutamic acid instead, then:
- (A) the anticodons of these tRNAs would not base pair with the condon specific for aspartic acid.
 - (B) the anticodons of these tRNAs would base pair with the condon specific for glutamic acid.
 - (C) glutamic acid will probably be incorporated where aspartic acid should normally be in the protein.
 - (D) these glutamic acid-charged tRNAs would base pair with the condon specific for glutamic acid.
 - (E) neither glutamic acid nor aspartic acid will be incorporated into the protein product.
10. The concentrations and purity of DNA and proteins extracted from bacteria could be estimated by using a spectrophotometer with which of the following wavelength combinations, respectively?
- (A) 260 nm and 600 nm.
 - (B) 405 nm and 450 nm.
 - (C) 280 nm and 650 nm.
 - (D) 280 nm and 260 nm.
 - (E) 260 nm and 280 nm..
11. There presence of Okazaki fragment demonstrated that:
- (A) DNA synthesis occurs at only on fork of the replication bubble.
 - (B) DNA replication utilizes only one strand of the DNA as the template.
 - (C) DNA replication products is constantly cleaved into fragments.
 - (D) DNA templates in opposite directions could both serve as templates for DNA replication.
 - (E) at least one strand of DNA product is cleaved into fragments.
12. Which of the following RNA contains unuaual nucleotides, such as Pseudouridine, as their characteristic features?
- (A) The messenger RNAs.
 - (B) The ribosomal RNAs.
 - (C) The transfer RNAs.
 - (D) The small interfering RNAs.
 - (E) The micro RNAs.
13. The enzyme activity responsible for **proof-reading** during DNA replication is?
- (A) 3' to 5' exonuclease activity of RNA polymerase III.
 - (B) 5' to 3' exonuclease activity of DNA polymerase I.
 - (C) 3' to 5' exonuclease activity of DNA polymerase III.
 - (D) 5' to 3' exonuclease activity of primase.
 - (E) 3' to 5' exonuclease activity of telomerase.
14. The general implication of the Hershey and Chase Blender Experiment (1952) was:
- (A) Nucleic acid is the genetic material.

- (B) Protein is the genetic material.
(C) Bacterial proteins and phage proteins are similar.
(D) Phage DNA could float to the top of the tube after centrifugation.
(E) Phage DNA could be labeled using the radio-active isotope S^{35} .
15. If you analyze a plasmid DNA of 3.0 kbp by electrophoresis through a 1 % agarose gel in common TBE (Tris-borate-EDTA) buffer, pH 8.3. How would the plasmid DNA migrate?
(A) From positive pole to negative pole.
(B) From negative pole to positive pole.
(C) From hydrophilic pole to hydrophobic pole.
(D) The plasmid DNA would not move in the gel.
(E) The plasmid DNA would move randomly in the gel.
16. Fluoroquinones are inhibitors of DNA gyrase. Bacteria could not grow in media containing Fluoroquinones because:
(A) the bacterial cell wall formation is inhibited.
(B) bacterial DNA replication is blocked.
(C) bacterial DNA transcription is blocked.
(D) bacterial mutation is inhibited.
(E) bacterial DNA is broken.
17. The notions 5' and 3' refer to which of the following moieties of nucleic acids:
(A) the carbon number in the sugar.
(B) the carbon or nitrogen number in the base.
(C) the carbon number in the phosphate backbone.
(D) the hydrogen number in the pentose sugar.
(E) the carbon number in the hexose.
18. Recent molecular evidence supported which of the following hypotheses for DNA replication?
(A) Conservative hypothesis.
(B) Semi-conventional hypothesis.
(C) Semi-conservative hypothesis.
(D) Semi-conversation hypothesis.
(E) Dispersive hypothesis.
19. Nucleoside is made of either a pyrimidine or purine base that is:
(A) linked to a pentose sugar through hydrogen bonds.
(B) linked to a hexose sugar through hydrogen bonds.
(C) linked to a pentose sugar through ionic bond.
(D) linked to a phosphate through ionic bond.
(E) linked to a pentose sugar through covalent bond.
20. Which of the following does **NOT** lead to mutations?
(A) misincorporation of nucleotides during DNA replication.
(B) carcinogenic chemicals.
(C) high energy radiations.
(D) the formation of canonical hydrogen bonds between guanine and cytosine.
(E) tautomerism.

簡答題：

Please briefly explain the following terms: (每題 4 分)

1. Dideoxynucleotides
2. microRNA
3. TATA box (in the context of gene expression)

第三部份(佔 35 分):

單選題(每題1分):

1. An example of an eicosanoid hormone is:
A) epinephrine. B) retinoic acid. C) testosterone. D) thromboxane. E) thyroxine.
2. Glucokinase:
A) acts in the conversion of liver glycogen to glucose 1-phosphate.
B) converts fructose-6-phosphate to glucose-6-phosphate
C) converts glucose 6-phosphate to fructose 6-phosphate.
D) is a hexokinase isozyme found in liver hepatocytes.
E) is found in all mammalian tissues.
3. When blood glucose is abnormally high, the pancreas releases:
A) epinephrine. B) glucagon. C) glucose. D) insulin. E) trypsin.
4. Epinephrine triggers an increased rate of glycolysis in muscle by:
A) activation of hexokinase.
B) activation of phosphofructokinase-1.
C) conversion of glycogen phosphorylase a to glycogen phosphorylase b.
D) inhibition of the Cori Cycle
E) the Pasteur effect.
5. The radioimmunoassay (RIA) is based on competition of unlabeled and radiolabeled:
A) antibodies for binding to a hormone.
B) antibodies for binding to a receptor.
C) hormone for binding to a receptor.
D) hormone for binding to an antibody.
E) receptor for binding to a hormone.
6. For the oligoribonucleotide pACGUAC:
A) the nucleotide at the 3' end has a phosphate at its 3' hydroxyl.
B) the nucleotide at the 3' end is a purine.
C) the nucleotide at the 5' end has a 5' hydroxyl.
D) the nucleotide at the 5' end has a phosphate on its 5' hydroxyl.
E) the nucleotide at the 5' end is a pyrimidine.
7. Which of the following statements about the polymerase chain reaction (PCR) is *false*?
A) DNA amplified by PCR can be cloned.
B) DNA is amplified at many points within a cellular genome.
C) Newly synthesized DNA must be heat-denatured before the next round of DNA synthesis begins.
D) The boundaries of the amplified DNA segment are determined by the synthetic oligonucleotides used to prime DNA synthesis.
E) The technique is sufficiently sensitive that DNA sequences can be amplified from a single animal or human hair.
8. Which of the following is *not* true of sterols?
A) Cholesterol is a sterol that is commonly found in mammals.
B) They are commonly found in bacterial membranes.
C) They are more common in plasma membranes than in intracellular membranes (mitochondria, lysosomes, etc.).
D) They are precursors of steroid hormones.
E) They have a structure that includes four fused rings.

9. Erythropoietin (EPO) is a:
- A) genetic disease.
 - B) bacteriophage vector for cloning DNA.
 - C) plasmid vector for cloning DNA.
 - D) protein.
 - E) variation in DNA base sequence.
10. Restriction enzymes:
- A) act at the membrane to restrict the passage of certain molecules into the cell.
 - B) are highly specialized ribonucleases that degrade mRNA soon after its synthesis.
 - C) are sequence-specific DNA endonucleases.
 - D) are very specific proteases that cleave peptides at only certain sequences.
 - E) catalyze the addition of a certain amino acid to a specific tRNA.
11. The enzyme fumarase catalyzes the reversible hydration of fumaric acid to l-malate, but it will not catalyze the hydration of maleic acid, the cis isomer of fumaric acid. This is an example of:
- A) biological activity.
 - B) chiral activity.
 - C) racemization.
 - D) stereoisomerization.
 - E) stereospecificity.
12. Enzymes are biological catalysts that enhance the rate of a reaction by:
- A) decreasing the activation energy.
 - B) decreasing the amount of free energy released.
 - C) increasing the activation energy.
 - D) increasing the amount of free energy released.
 - E) increasing the energy of the transition state.
13. Hydrophobic interactions make important energetic contributions to:
- A) binding of a hormone to its receptor protein.
 - B) enzyme-substrate interactions.
 - C) membrane structure.
 - D) three-dimensional folding of a polypeptide chain.
 - E) all of the above are true.
14. Osmosis is movement of a:
- A) charged solute molecule (ion) across a membrane.
 - B) gas molecule across a membrane.
 - C) nonpolar solute molecule across a membrane.
 - D) polar solute molecule across a membrane.
 - E) water molecule across a membrane.
15. In glycoproteins, the carbohydrate moiety is always attached through the amino acid residues:
- A) asparagine, serine, or threonine.
 - B) aspartate or glutamate.
 - C) glutamine or arginine.
 - D) glycine, alanine, or aspartate.
 - E) tryptophan, aspartate, or cysteine.
16. Scatchard analysis can provide information on:
- A) enzyme cascades.

- B) enzyme mechanisms.
C) gated ion channels.
D) protein phosphorylation.
E) receptor-ligand interactions.
17. In an anaerobic muscle preparation, lactate formed from glucose labeled in C-3 and C-4 would be labeled in:
A) all three carbon atoms.
B) only the carbon atom carrying the OH.
C) only the carboxyl carbon atom.
D) only the methyl carbon atom.
E) the methyl and carboxyl carbon atoms.
18. In mammals, each of the following occurs during the citric acid cycle except:
A) formation of α -ketoglutarate.
B) generation of NADH and FADH₂.
C) metabolism of acetate to carbon dioxide and water.
D) net synthesis of oxaloacetate from acetyl-CoA.
E) oxidation of acetyl-CoA.
19. Which of these is able to cross the inner mitochondrial membrane?
A) Acetyl - CoA
B) Fatty acyl - carnitine
C) Fatty acyl - CoA
D) Malonyl - CoA
E) None of the above can cross.
20. Which one of the following analytical techniques does *not* help illuminate a gene' s cellular function?
A) DNA microarray analysis
B) Protein chip analysis
C) Southern blotting
D) Two-dimensional gel electrophoresis
E) Two-hybrid analysis

問答題(每題 5 分)

21. 解釋以下兩名詞並說明其相關性
(a) Oncogenes, (b) Apoptosis
22. 解釋以下兩技術並說明其應用之領域
(a) DNA microarray analysis, (b) Yeast two-hybrid analysis
23. A scientist wishes to produce a mammalian protein in *E. coli*. The protein is a glycoprotein with a molecular weight of 40,000. Approximately 20% of its mass is polysaccharide. The isolated protein is usually phosphorylated and contains three disulfide bonds. The cloned gene contains no introns. (a) What sequences or sites will be required in the vector to get this gene regulated, transcribed, and translated in *E. coli*? (b) List two problems that might arise in producing a protein identical to that isolated from mammalian cells and describe each problem in no more than ten sentences.