

國立中山大學 104 學年度碩士暨碩士專班招生考試試題

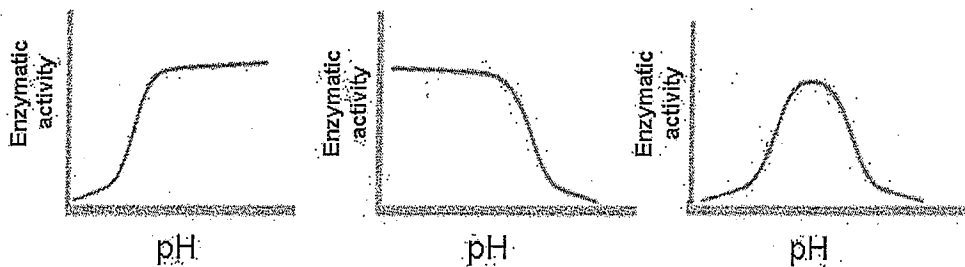
科目名稱：生物化學【生醫所碩士班】

題號：427001

※本科目依簡章規定「不可以」使用計算機(問答申論題)

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- (20 分、每題 4 分) 解釋名詞
 - DNA methylation
 - Affinity chromatography
 - Allosteric regulation
 - siRNA
 - Apoptosis
- (10 分) 請說明蛋白質一、二、三、四級結構之定義？並舉例說明分析蛋白質形成四級結構的實驗方法及由其實驗結果如何得知蛋白質形成四級結構？
- (10 分) 請說明蛋白質後轉譯修飾(Post-translational modification)的種類及其對蛋白質功能活性之重要性？
- (10 分) 酵素活性作用可受溶液中酸鹼值的影響，酵素活性隨 pH 產生下列三種 pH-dependent 圖形，請說明酵素活性作用機制中，此三種 pH-dependent 活性作用產生的分子機制為何？-



- (10 分) DNA 由何種糖基及 Nucleotide 組成？細胞內 DNA 可能形成之構型為何？DNA 可能形成之構型對基因 Transcription 之影響性為何？
- (10 分) RNA 可區分為 Coding RNA 及 Non-coding RNA，請說明 Non-Coding RNA 所具有生理功能為何？
- (10 分) 請說明 Transcriptional factors 和 DNA 結合的結構可分為幾種 Motif 及其結構特質？並請舉三例說明如何分析 Transcriptional factors 和 DNA 作用的實驗方法及實驗結果代表之意義？
- (10 分) 請說明影響 mRNA 在細胞內穩定性的影響因素？並舉出三種實驗方法如何分析偵測細胞內 mRNA 的 expression？
- (10 分) 請說明細胞膜的組成成分為何？細胞膜 Asymmetrical distribution 之意義及調控機制為何？

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說明：本試卷為單選題，計 50 題（每題二分）。

1. Which of the following interactions is NOT seen during base pairing of DNA nucleotides? (A) Adenine – Thymine; (B) Pyrimidine – Purine; (C) Purine – Purine; (D) Guanine – Cytosine.
2. Which of the following is NOT the structure component of a nucleotide? (A) Phosphate group; (B) Purine or Pyrimidine base; (C) Acetyl group; (D) Deoxyribose sugar.
3. The major stabilizing force for nucleic acids is through? (A) electrostatic bond; (B) hydrogen bonds; (C) Van der Waals forces; (D) conformational entropy.
4. Which of the following linkages or forces are used to connect adjacent nucleotides on one polynucleotide chain? (A) Covalent bonds; (B) Hydrogen bonds; (C) Phosphodiester bonds; (D) Van der Waals forces.
5. The enzyme responsible for initiating DNA replication in prokaryotes is? (A) DNA polymerase I; (B) DNA polymerase III; (C) Primase; (D) DNA ligase.
6. In the Primidine synthesis step, eukaryotic cells can use uracil to feedback and inhibit which of the following enzymes? (A) Carbamoyl phosphate synthase; (B) Asparate Transcarbamoylase; (C) Adenylosuccinate synthtase; (D) Thymidylate synthase.
7. The structure that allows one copy of each duplicated and condensed chromosome to be pulled into each daughter cell is called a? (A) Centromere; (B) Telomere; (C) Mitotic spindle; (D) Histones.
8. The structures that cap at the ends of all linear eukaryotic chromosomes are called? (A) Centromeres; (B) Telomeres; (C) Mitotic spindles; (D) Histones.
9. Which of the following amino acid residue is in abundance in histones? (A) Arginine; (B) Aspartic acid; (C) Tryptophan; (D) Phenyl alanine.
10. What statement about nucleosomes is FALSE? (A) A nucleosome is a “bead” on a string of unfolded chromatin. (B) A nucleosome produces a 3-fold packing ratio of DNA. (C) Nucleosomes are found only in mitotic chromosomes. (D) A nucleosome consists of DNA wrapped around 8 histone proteins, plus a short segment of linker DNA.
11. When does DNA recombination take place during chromosomal replication? (A). Mitosis; (B) Meiosis I; (C) Meiosis II; (D) Both mitosis and meiosis.
12. Which of the following best describes how histones interact with DNA? (A) Histone core proteins interact with the major groove of DNA via the helix-turn-helix-turn-helix motif. (B) Interactions between histone core proteins and DNA occur through positive and negative charge interactions at the minor groove. (C) The N-terminal tails of histone core proteins interacts with the major groove of the DNA double helix. (D) Histone core proteins are covalently bound to the DNA double helix.
13. DNA replication takes place during what phase of the cell cycle? (A) Interphase; (B) Prophase; (C) Metaphase; (D) Telophase.
14. Which of the following is a TRUE statement regarding restriction enzymes? (A) Restriction enzymes likely evolved in bacteria as a defensive mechanism for recognizing and destroying the genomes of bacteriophages and transposable elements. (B) Restriction enzymes disrupt the

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phosphodiester bonds between adjacent nucleotides. (C) The products of restriction enzymes will have either blunt, 5' overhang or 3' overhang ends. (D) All of the above.

15. Which of the ends (digested by restriction enzymes) can be simply re-joined together by DNA ligase? (A) 5' overhang – Blunt end; (B) Blunt end – Blunt end; (C) Blunt end – 3' overhang; (D) 5' overhang – 3' overhang.

16. Which of the following pairings displays a transition mutation? (A) T:G; (B) G:A; (C) T:C; (D) T:T.

17. The Mismatch Repair System works during which phase of the cell cycle? (A) G1 phase; (B) S phase; (C) G2 phase; (D) M phase.

18. Which of the following best describes the mechanisms of the Nucleotide Excision System repairs? (A) Incorrect base pairings by DNA Polymerase; (B) Oxidation, alkylation, deamination and hydrolysis of nucleotides; (C) Single and double strand breaks (SSB and DSB); (D) Addition of large organic molecules to nucleotides.

19. What enzymes directly reverses the damage induced by ultraviolet (UV) light? (A) DNA Photolyase; (B) Nucleotide Excision Repair; (C) Error-prone DNA Polymerase; (D) All of the above; (E) None of the above.

20. Non-homologous end joining (NHEJ) is the preferred method of repairing double-stranded breaks (DSBs) under which of the following circumstances? (A) When the DSB is accompanied by a deletion of a section of the genome. (B) When the DSB is “precise” – meaning that it does not delete any genomic material. (C) None of the above.

21. During the process of transcription, sequence specific transcription factors interact with which of the following types of enzymes? (A) General transcription factors (ie TFIID) and RNA Polymerase. (B) Histone modifying enzymes and chromatin remodeling proteins. (C) The mediator complex. (D) All of the above.

22. At which base(s) does RNA polymerase II pause during transcription? (A) -10; (B) +30 to +50; (C) +1 to +9; (D) +1.

23. Which of the following does NOT have introns? (A) eukaryotic genomic DNA; (B) Non-processed pseudo genes; (C) Processed mRNA; (D) Primary RNA transcript.

24. Which statement about RNA synthesis is NOT true? (A) The major enzyme is RNA polymerase; (B) The energy is supplied by ring cleavage; (C) The RNA sequence is complementary to the template strand of DNA; (D) The RNA sequence is of opposite polarity to the template strand of DNA.

25. A small hairpin RNA or short hairpin RNA (shRNA) is which of the following sequence that makes a tight hairpin turn that can be used to silence gene expression through RNA interference? (A) DNA; (B) RNA; (D) Piwi-interacting RNA; (D) Pseudo DNA.

26. All of the following are able to translate to protein products EXCEPT? (A) rRNA; (B) SiRNA; (C) tRNA; (D) snRNA.

27. Where are CpG islands normally located within eukaryotic gene locus? (A) Within or near the core promoter; (B) Within enhancer elements; (C) At the exon-intron junctions; (D) Throughout intronic

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sequences.

- 28. Which of the following best description regarding the effect of DNA methylation?** (A) Transcriptional activation; (B) Transcriptional repression; (C) RNA Pol II pausing; (D) Promoter clearance (or escape).
- 29. Which of the following elements are removed from the mRNA transcript during RNA splicing?** (A) 5' and 3' untranslated regions; (B) Intron sequences ; (C) Exon sequences; (D) CpG islands.
- 30. What would a predicted silent mutation have to be located to actually result in a loss-of-function mutation (and potentially lead to the onset of disease)?** (A) Intron-exon junction/splice site; (B) Translational start site; (C) Stop codon; (D) Anywhere within the exonic sequences.
- 31. Which of the following is a true statement for tRNA molecule?** (A) A single tRNA molecule can interact with more than one codon. (B) The inosine nucleotide (within the tRNA) can interact with adenine, cytosine and uracil nucleotides within the mRNA transcript. (C) tRNAs do not recognize the three stop codons. (D) All of the above.
- 32. What are involved in removal of introns from the pre-mRNA?** (A) Lysosomes; (B) Ribosomes; (C) Spliceosomes; (D) Phagosome.
- 33. What is the start codon in the mRNA for protein synthesis?** (A) UGA; (B) UAG; (C) AUG; (D) UAA.
- 34. When a sodium channel opens and sodium rushes into a myocyte (heart cell), the cell membrane becomes...** (A) polarized; (B) depolarized; (C) paralyzed; (D) apoptosis.
- 35. Where are ribosomes produced in a eukaryotic cell?** (A) Endoplasmic reticulum; (B) Vacuole; (C) Centrosome; (D) Nucleolus.
- 36. The rough endoplasmic reticulum is...**(A) an intracellular double-membrane system to which ribosomes are attached. (B) an intracellular membrane that is studded with microtubular structures. (C) a membranous structure found within mitochondria. (D) only found in prokaryotic cells.
- 37. Lysosomes are formed by budding from which cellular organelle?** (A) Smooth endoplasmic reticulum; (B) Golgi apparatus; (C) Rough endoplasmic reticulum; (D) Nucleus.
- 38. The main function of ribosomes in the cell is...**(A) Produce ATP; (B) Ferment carbohydrates; (C) Synthesize proteins; (D) all of these.
- 39. The animal cell centriole is a ring of how many groups of microtubules?** (A) 4; (B) 9; (C) 12; (D) 3.
- 40. Which of the following organelles is directly connected to the outer membrane of the nucleus in a eukaryotic cell?** (A) Mitochondrion; (B) Lysosome; (C) Golgi apparatus; (D) Endoplasmic reticulum.
- 41. Microtubules, motor proteins, and actin filaments are all parts of..** (A) the mechanism of photosynthesis that occurs in chloroplasts; (B) the rough ER (endoplasmic reticulum) in prokaryotic cells; (C) the cytoskeleton of eukaryotic cells; (D) the process that moves small molecules across cell membranes.

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42. The Nobel Assembly at Karolinska Institute decided to award the 2014 Nobel Prize in Physiology or Medicine, to Drs. John O'Keefe, May-Britt Moser and Edvard I. Moser, for their discoveries of mechanisms for cells that? (A) Program cell death; (B) Induced pluripotent stem (iPS) cells; (C) The brain's inner GPS system, the grid cells; (D) Cloning animals.
43. The final step in the process of cellular respiration is the electron transport chain (ETC). What best describes the first step in the electron transport chain? (A) Hydrogen ions diffuse through the membrane. (B) Electrons in the inner membrane are energized by the light. (C) Electrons from NADH and FADH₂ bond with hydrogen ions to form water molecules. (D) Energized electrons from NADH and FADH₂ activate transport proteins.
44. Once enough H⁺ ions have been pumped outside the membrane, they tend to move back inside the membrane. What is this random movement of particles from areas of high concentration to low concentration called? (A) Diffusion; (B) Endocytosis; (C) Active transport; (D) Exocytosis.
45. As the ions move back through the membrane, they flow through the enzyme that is the center of all cellular respiration. What is this important enzyme? (A) ATP synthase; (B) Glucose hexokinase; (C) Acetyl CoA; (D) Phosphoglucosomerase.
46. At the end of their life, proteins are destroyed by a cellular component known as the proteasome. What happens to the majority of the amino acids which result from this degradation? (A) been excreted into the urine; (B) been converted into fat and are stored in adipose tissue; (C) been excreted in sweat; (D) been recycled to make new proteins or are converted into different biomolecules.
47. The amino acid sequence of a protein is thought to contain signals which determine the protein's lifespan. For example, the amino acid sequences of several proteins with intracellular half-lives less than 2 hours contain one or more regions are enriched in proline, glutamate, serine, and threonine. What name, derived using the one letter codes of these amino acids, is used to describe these sequences? (A) PGST sequences; (B) PEST sequences; (C) LEAD sequences; (D) DEAD sequences.
48. Many signaling pathways involve small, water-soluble molecules, nonprotein or ions called messengers. For example, one such messenger, which can transmit signals from the plasma membrane to the metabolic machinery of the cytoplasm, is identified by Dr. Earl Sutherland and his colleagues. What are these messengers? (A) Calcium ions; (B) cAMP; (C) Adenylyl; (D) Potassium ions.
49. Most water-soluble signal molecules bind to specific sites on receptor proteins on the cellular membrane. Such a receptor transduces information from the extracellular space into the cell by changing shape or aggregating when a specific ligand, or the molecule that specifically binds to another molecule, binds to it. There are three major types of such membrane receptors. Which of the following membrane receptors is NOT one of them? (A) G-Protein-linked receptors; (B) Ion channel receptors; (C) Active receptor relay proteins; (D) Receptor tyrosine kinases.
50. The receiving end of a cellular communication can be dissected into three stages. These stages were elucidated by Dr. Earl Sutherland, who received a Nobel Prize in 1971. He and his colleagues investigated how an animal hormone that stimulates the breakdown of the storage polysaccharide glycogen in the liver cells and skeletal muscles, which in turn releases the sugar glucose-1-phosphate, which the cell converts to glucose-6-phosphate. (A) Adrenalin; (B) Insulin; (C) Oxytocin; (D) Thyroid-stimulating hormone.