

國立中山大學 112 學年度 碩士班暨碩士在職專班招生考試試題

科目名稱：生物化學【生科系碩士班乙組】

— 作答注意事項 —

考試時間：100 分鐘

- 考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- 答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，請衡酌作答(不得另攜帶紙張，亦不得使用應考證空白處作為計算紙使用)。
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※本科目依簡章規定「不可以」使用計算機(選擇題)

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一、選擇題每題 2 分(100%) 單選

1. Which statement MOST COMPLETELY EXPLAINS the large ΔG° for the hydrolysis of phosphoenolpyruvate?
 - A. Hydrolysis of the phosphoanhydride bond along with the conversion of the enol to the keto form of pyruvate.
 - B. The hydrolysis of the phosphoanhydride bond.
 - C. Conversion from the enol to the keto form of pyruvate.
 - D. Strong bond energy along with a change in the stereochemistry of the molecule.
 - E. The large ΔG° of the phosphoester bond.
2. Which of the following statements regarding ATP is true?
 - A. the energy of hydrolysis is the same for all of the phosphate groups of the molecule
 - B. despite the very exergonic nature of the hydrolysis, ATP does not hydrolyze spontaneously due to a very high activation energy
 - C. the ΔG of hydrolysis within the cell is substantially greater than the ΔG° due to a higher concentration of ATP with respect to ADP
 - D. electrostatic attraction of the phosphate groups contributes to a more exergonic free energy
 - E. both b and c are correct
3. All are true statements about L-isoleucine EXCEPT:
 - A. Its enantiomer is named D-isoleucine.
 - B. L-alloleucine would be its diastereomer.
 - C. It contains a total of two asymmetric or chiral carbons.
 - D. It can also be named as (2S,3S)-isoleucine using the (R,S) system.
 - E. Its diastereomer would be named D-leucine.
4. Which statement is INCORRECT about these amino acids, and amino acid derivatives?
 - A. GABA (γ -aminobutyric acid) is a potent inhibitory neurotransmitter derived from glutamic acid.
 - B. Ornithine is an important metabolic intermediate.
 - C. Epinephrine is a hormone derived from tryptophan.
 - D. Serotonin is a neurotransmitter derived from tryptophan.
 - E. Histamine is a neurotransmitter derived from histidine.
5. Homologous proteins such as hemoglobin from different organisms do NOT:
 - A. have nearly identical lengths.
 - B. share little sequence homology with other proteins with similar function (e.g., myoglobin).
 - C. share a significant degree of sequence similarity.
 - D. perform the same function in different organisms.
 - E. have sequence identity in direct correlation to the relatedness of the species from which they were derived.
6. All of the statements about the peptide val-asp-trp-asn-ser are correct EXCEPT:
 - A. This peptide would show a strong absorption band at 280 nm.
 - B. Reaction with chymotrypsin would yield two peptides.
 - C. To synthesize this peptide using the solid phase method of Merrifield, the amino acid directly attached to the resin would be serine.

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- D. After the second round of Edman degradation using the reagent PITC, the PTH-amino acid residue released would be PTH-asp.
- E. The peptide is resistant to trypsin.
7. All of the information necessary for folding the peptide chain into its “native” structure is contained in the _____ of the peptide.
- A. amino acid sequence
 - B. amino acid composition
 - C. configuration
 - D. amino acid side chain charges
 - E. all are true
8. Secondary and higher orders of structure are determined by all EXCEPT:
- A. hydrophobic interactions.
 - B. ionic bonds.
 - C. van der Waals forces.
 - D. hydrogen bonds.
 - E. peptide bonds.
9. A β -barrel would most likely be composed of _____.
- A. parallel β -sheets connected by regions of α -helix
 - B. parallel β -sheets connected by β -turns.
 - C. parallel β -sheets connected by regions of random coil.
 - D. parallel β -sheets connected disulfide bonds.
 - E. both a and c are correct.
10. All of the statements about the tertiary structure of the enzyme triose phosphate isomerase are correct EXCEPT:
- A. Its β -strands are parallel.
 - B. Its α -helices are in the interior core of the molecular structure.
 - C. It contains a β -barrel in the center of its structure.
 - D. It is composed entirely of alternating α -helices and β -strands.
 - E. Hydrophobic residues are buried between concentric layers.
11. All of the following statements about the nature of glycogen are true EXCEPT:
- A. It is a polysaccharide used for storage.
 - B. It is a branched polymer of linked glucose residues.
 - C. It has all non-reducing ends.
 - D. The highly branched structure allows the rapid mobilization of glucose during metabolic need.
 - E. It is found primarily in the liver and skeletal muscles.
12. Cellulase is considered a _____.
- A. α -(1 \rightarrow 4) glucosidase
 - B. β -(1 \rightarrow 4) glucosidase
 - C. α -(1 \rightarrow 6) glucosidase
 - D. β -(1 \rightarrow 4) glucosidase
 - E. α -(1 \rightarrow 1) glucosidase

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13. Steroid hormones include all of the following EXCEPT:
- A. dolichol.
 - B. progesterone.
 - C. cortisol.
 - D. estradiol.
 - E. testosterone.
14. Which of the following enzymes is responsible for the release of arachidonic acid from membrane phospholipids?
- A. phospholipase A₁
 - B. phospholipase A₂
 - C. phospholipase B
 - D. phospholipase C
 - E. phospholipase D
15. Which of the following would be the most likely interaction between a peripheral membrane protein that contained a high lysine content and a membrane?
- A. ionic interaction
 - B. hydrophobic interaction
 - C. hydrogen bonding
 - D. covalent bonding
 - E. both a and c
16. The two major phospholipids on the outer leaflet of erythrocytes are:
- A. phosphatidylcholine and phosphatidylethanolamine.
 - B. phosphatidylcholine and sphingomyelin.
 - C. phosphatidylethanolamine and sphingomyelin.
 - D. phosphatidylserine and sphingomyelin.
 - E. phosphatidylcholine and phosphatidylserine.
17. Glycophorin is a membrane protein with:
- A. multiple transmembrane segments.
 - B. most of the mass oriented outside the surface of the cell.
 - C. about 10% carbohydrate and 90% protein.
 - D. transmembrane β -barrel segments.
 - E. All are true
18. Which of the following is true regarding membrane function?
- A. a caveola contains a very high concentration of cholesterol and unsaturated phospholipids.
 - B. scaffolding proteins, particularly those containing BAR domains, result in curvature of the cell membrane.
 - C. lateral membrane diffusion within a biological membrane is a completely unrestricted process
 - D. membrane fusion with vesicles is often accomplished with the aid of a SNARE protein.
 - E. both b and d are correct.
19. All are important functional groups participating in H-bond formation EXCEPT:
- A. amino group of the cytosine, adenine and guanine.
 - B. the ring nitrogens at position 3 of pyrimidines and 1 of purines.
 - C. the electronegative oxygen atoms.

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- D. the electron density in the double bonds of the bases.
E. the carbonyl group at position 4 of uracil and thymine, position 2 of cytosine, and position 6 of guanine.
20. All of the following are examples of nucleotide functions EXCEPT:
A. CTP in phospholipid synthesis.
B. UTP in complex carbohydrate synthesis.
C. ATP in energy for the cell.
D. GTP in protein synthesis.
E. TTP in phosphoryl group transfers.
21. In phosphoryl group transfer reactions, the _____ of the nucleotide serves as an information symbol, channeling the nucleotide to appropriate metabolic activities.
A. sugar
B. diphosphate anhydride
C. sugar-phosphate ester
D. base
E. none are true
22. All of the following are true for tRNA EXCEPT:
A. each amino acid in proteins has at least one unique tRNA species dedicated to chauffeuring its delivery to ribosomes for insertion into growing polypeptides.
B. are small molecules containing 73-94 residues.
C. fold into characteristic secondary structures.
D. possess a 3' terminal nucleotide sequence that reads -CCA.
E. all are true.
23. DNA double helix structure is stabilized by all of the following EXCEPT:
A. the sugar-phosphate backbones are oriented in opposite directions.
B. the glycosidic bonds holding paired bases are directly across the helix from one another.
C. cations such as Mg^{2+} bind to the anionic phosphates.
D. bases stack together through hydrophobic interactions and van der Waals forces.
E. appropriate base pairing builds a polymer whose external dimensions are uniform.
24. Urea and formamide are agents that denature dsDNA by
A. intercalating between base pairs and disrupting van der Waals interactions.
B. forming ionic bonds with the backbone phosphates.
C. competing effectively with the H-bonding between the base pairs.
D. changing the pH to cause hydrolysis.
E. none are true
25. In the Southern hybridization procedure, the gel after electrophoresis is treated with NaOH and then neutralized before blotting. What is the primary function of the alkaline treatment?
A. It neutralizes any acid soluble impurities in the gel.
B. It cleaves the DNA into smaller fragments to permit greater efficiency of transfer.
C. It inactivates any restriction endonucleases that may be in the gel.
D. It neutralizes any acidic phosphate groups that might prevent hybridization.
E. It denatures the duplex DNA to single-stranded DNA (ssDNA).
26. All are true for cDNA libraries EXCEPT:

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- A. reverse transcriptase synthesizes a DNA strand complement of the mRNA templates.
B. mRNA templates are isolated using oligo (dA)-cellulose chromatography.
C. linkers are added and the cDNA is cloned into suitable vectors.
D. the cDNA are copies from mRNA templates.
E. all are true
27. An enzyme's specificity can be due to:
A. the ratio of catalyzed rate to the uncatalyzed rate of reaction.
B. molecular recognition based on structural complementarity.
C. amount of enzyme produced by the cell.
D. amount of substrate available.
E. metabolic activators.
28. All of the following are properties of a coenzyme EXCEPT:
A. They are usually actively involved in the catalytic reaction of the enzyme.
B. They tend to be stable to heat.
C. They can serve as intermediate carriers of functional groups.
D. They are protein components.
E. They may contain vitamins as part of their structure.
29. All of the following statements about competitive inhibition are correct EXCEPT:
A. Competitive inhibitors are often chemical analogs of the substrate.
B. For a group-specific enzyme, one substrate would be a competitive inhibitor of reactions of the other possible substrate.
C. Sometimes a product of an enzyme-catalyzed reaction is a competitive inhibitor of its own production.
D. In the presence of a competitive inhibitor, the apparent K_m would be altered and V_{max} would be decreased.
E. Competitive inhibitors usually interact with the enzyme at the binding site for a substrate.
30. Malonate inhibition of succinate dehydrogenase is an example of:
A. noncompetitive inhibition.
B. competitive inhibition.
C. mixed noncompetitive inhibition.
D. irreversible inhibition.
E. uncompetitive inhibition.
31. All are true for the enzyme-transition state complex EXCEPT:
A. It is designated as EX^\ddagger .
B. The enzyme stabilizes the transition-state complex more than it stabilizes the substrate complex.
C. The enzyme is "designed" to bind the transition-state structure more tightly than the substrate or product.
D. The energy barrier between ES and EX^\ddagger is less than the energy barrier between S and X^\ddagger .
E. All are true.
32. All are true for low-barrier hydrogen bonds EXCEPT:
A. The hydrogen is centered between the two heteroatoms.
B. The interactions are more covalent.
C. The bond order approaches 0.5 for both O-H interactions.

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- D. The barrier that the hydrogen atom must surmount to exchange oxygens becomes lower.
E. All are true.
33. The mechanism of chymotrypsin involves which of the following elements?
A. deprotonation of an active site Asp residue by His to start the reaction
B. formation of an acyl-enzyme intermediate that must be hydrolyzed to complete the reaction
C. stabilization of the positively charged His by a Gln residue
D. direct deprotonation of water by His to generate a hydroxide ion for initiation of the reaction
E. both a and b occur
34. 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.
35. All are true for cAMP-dependent protein kinase EXCEPT:
A. also known as PKA.
B. phosphorylase kinase is a substrate.
C. consists of a pair of catalytic subunits.
D. two regulatory subunits block catalytic activity without cAMP binding.
E. phosphorylates glycogen phosphorylase.
36. The T form (tense or taut form) of deoxyhemoglobin differs from oxyhemoglobin (the R form or relaxed form) by all EXCEPT:
A. covalent linkages between subunits.
B. specific intrachain hydrogen bonds.
C. between β -subunit salt links (ion-pair bonds).
D. between α -subunits salt links (ion-pair bonds).
E. intrachain salt bridges.
37. What is the relationship between photoautotrophs and heterotrophic cells?
A. Photoautotrophs use light energy for synthesis of organic molecules while heterotrophs metabolize organic substances for fuel and building blocks.
B. photoautotrophs use organic compounds as a source of carbon while heterotrophs use CO_2 as a source of carbon.
C. Photoautotrophs synthesize CO_2 while heterotrophs synthesize O_2 .
D. Heterotrophs convert solar energy into chemical energy while photoautotrophs break down organic molecules.
E. There is no relationship between the two.
38. _____, a pathway that synthesizes glucose from non-carbohydrate precursors, uses seven of the same enzymes as glycolysis, but must replace three enzymes of glycolysis because they are _____:
A. Catabolism; to oxidative
B. Gluconeogenesis; irreversible
C. Oxidative phosphorylation; reductive

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- D. Gluconeogenesis; anabolic
E. Oxidative phosphorylation; irreversible
39. Fructose in the diet or fructose from sucrose in the diet can be a source of calories for fat synthesis in the liver because:
A. ketoses are fattening
B. fructose enters glycolysis after the primary regulation point, PFK-1
C. fructose provides a net of four ATP from glycolysis
D. fructose enters the branch of glycolysis that forms fat
E. glycerol (the "backbone" of triacylglycerols) comes specifically from fructose
40. Galactosemic individuals can be treated by _____ and the abnormality may disappear in adults due to metabolism of galactose-1-phosphate by:
A. medication; UDP-glucose pyrophosphorylase.
B. medication; UDP-glucose-4-epimerase.
C. restrictive diet; phosphoglucomutase.
D. restrictive diet; UDP-glucose pyrophosphorylase.
E. all of the above.
41. Isocitrate dehydrogenase has all of the characteristics EXCEPT:
A. ADP raises the K_m for isocitrate by a factor of 10.
B. virtually inactive in the absence of ADP.
C. sufficiently exergonic to pull the aconitase reaction forward.
D. allosterically inhibited by NADH and ATP.
E. an oxidative-decarboxylation reaction.
42. All are characteristics of succinyl-CoA synthetase EXCEPT:
A. succinyl-CoA can be used to drive phosphorylation of GDP or ADP.
B. the enzyme is named for the reverse reaction.
C. it provides an example of substrate-level phosphorylation.
D. succinyl-phosphate is an intermediate in the reaction catalyzed by succinyl-CoA synthetase.
E. all of the above are true.
43. Does electron transport stop if rotenone is added? Why?
A. Yes, there is not an electron source.
B. No, rotenone is not strong enough to inhibit all of the electron transport chain.
C. No, there is still a source of electrons from Complex II.
D. Yes, rotenone inhibits complex III, therefore, electrons can not be passed on.
E. Can not be determined from the information given.
44. All are properties of glycerol-3-phosphate dehydrogenases EXCEPT:
A. one is located in the cytosol.
B. works to carry electrons into mitochondria.
C. one is located in the inner mitochondrial membrane.
D. mitochondrial enzyme has bound coenzyme Q.
E. FAD-dependent mitochondrial enzyme.
45. Which of the following statements about the light reactions of photosynthesis is true?
A. There are two distinct photosystems, linked together by a mechanism similar to electron

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- transport.
- B. The source for electrons is located in the stroma of the thylakoid.
 - C. The Mn complex is the primary electron acceptor and is located on photosystem I.
 - D. The ultimate electron donor is molecular oxygen.
 - E. Plastoquinone is a fixed electron transporter in the system located in the inner membrane.
46. When light energy is absorbed by chlorophyll an electron is promoted to a higher orbital and then transferred to a suitable acceptor resulting in light energy conversion to chemical energy in a(n):
- A. isomerase reaction.
 - B. mutase reaction.
 - C. ligase reaction.
 - D. oxidation-reduction reaction.
 - E. none of the above.
47. In the gluconeogenic pathway, the three regulated reactions of glycolysis catalyzed by _____, _____ and _____ are replaced by alternative reactions.
- A. glucokinase; PFK-1; pyruvate kinase
 - B. phosphoglucoisomerase; PFK-1; pyruvate kinase
 - C. PFK-1; triose phosphate isomerase; pyruvate kinase
 - D. glucokinase; PFK-1; glyceraldehyde-3-phosphate dehydrogenase
 - E. glucokinase; PFK-1; pyruvate carboxylase
48. Which of the following is absolutely essential for the activation of pyruvate carboxylase?
- A. high concentrations of acetyl-CoA
 - B. low levels of ATP
 - C. high levels of oxaloacetate
 - D. high levels of TCA cycle intermediates
 - E. high levels of citrate
49. What are the three most common ketone bodies?
- A. acetone, butyrate and acetyl-CoA
 - B. acetoacetate, hydroxyacetone phosphate and butyrate
 - C. acetone, β -hydroxybutyrate and acetoacetate
 - D. acetoacetate, acetyl-CoA and acetone
 - E. butyrate, acetoacetate and acetone
50. Ketone bodies are transported to the tissues of utilization:
- A. complexed to serum albumin.
 - B. incorporated into VLDLs.
 - C. complexed to fatty acid binding protein.
 - D. freely dissolved in serum.
 - E. but require insulin to enter target tissues.

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科目名稱：生態學【生科系碩士班甲組】

題號：421002

※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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1. 近年來，高雄壽山地區的山羌族群數量快速下降，相較於 2018 年的估算結果，2022 年山羌的族群數量已經減少了大約 90%，只剩下約 50 隻左右。請問如果我們想要知道壽山地區的山羌族群是否已經進入滅絕漩渦(extinction vortex)，我們可以做些什麼調查或分析來估算該山羌族群的存續力(viability)？(20%)
2. 物種多樣性(species diversity)會隨著緯度、海拔、海洋深度，或是群落演替而發生變化，因此，生態學者們提出了許多不同的時間或空間因子來解釋物種多樣性的變化趨勢。請舉出至少 3 個空間因子與 3 個時間因子，並說明這些因子如何形塑物種多樣性隨著不同環境梯度的改變。(20%)
3. 群落的建構與組成是許多生態學家感興趣的議題，群落組成隨著時間會發生改變，早期的植物生態學家認為不同地區倘若具有相似的環境，最終應該會發育出類似的植物群落，稱之為極盛相(climax)，但後來另有許多學者認為一地區植被的極盛相並無法達成。請舉例說明群落中物種間的哪些特性會決定一群落的極盛相能否達成？而又有哪些生態過程(ecological processes)或假說可以用於解釋群落組成隨時間的改變？(20%)
4. 在全球尺度下，陸域和水域生態系初級生產力的地理分布並不相同，也分別受到不同的限制因子所影響，請分別說明決定陸域和水域生態系初級生產力的主要限制因子為何，以及這些因子如何影響其初級生產力的地理分布？(20%)
5. 台灣中南部的鳳凰木大約每隔 10 年，就會有一次因為其上的鳳凰木裳蛾族群大發生，造成鳳凰木的葉片被大量啃食至幾乎損失了所有的葉片。請問鳳凰木裳蛾這種週期性的大發生，可以用何項生態學理論所解釋？假設全球暖化會造成鳳凰木裳蛾族群增長的速度加快，請問這會如何影響鳳凰木的族群？而暖化又會如何影響鳳凰木裳蛾族群大發生的週期性？(20%)

國立中山大學 112 學年度

碩士班暨碩士在職專班招生考試試題

科目名稱：分子生物學【生科系碩士班乙組】

—作答注意事項—

考試時間：100 分鐘

- 考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- 答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，請衡酌作答(不得另攜帶紙張，亦不得使用應考證空白處作為計算紙使用)。
- 答案卡請以 2B 鉛筆劃記，不可使用修正液（帶）塗改，未使用 2B 鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，後果由考生自負。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶具有通訊、記憶或收發等功能或其他有礙試場安寧、考試公平之各類器材、物品（如鬧鈴、行動電話、電子字典等）入場。
- 試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。
- 試題採雙面列印，考生應注意試題頁數確實作答。
- 違規者依本校招生考試試場規則及違規處理辦法處理。

國立中山大學 112 學年度碩士班暨碩士在職專班招生考試試題

科目名稱：分子生物學【生科系碩士班乙組】

題號：421003

※本科目依簡章規定「不可以」使用計算機(選擇題)

共 7 頁 第 1 頁

一、單選題（每題 2 分，共 60 分。答錯不倒扣。）：

1. What is the maximum absorption wavelength of DNA?
(A) ~200 nm. (B) ~220 nm. (C) ~240 nm. (D) ~260 nm. (E) ~280 nm.
2. Thymine in DNA is replaced by uracil in RNA. What is the structural difference between thymine and uracil?
(A) Thymine has one methyl group in its structure whereas uracil does not.
(B) Thymine has one primary amine group in its structure whereas uracil does not.
(C) Uracil has one methyl group in its structure whereas thymine does not.
(D) Uracil has one primary amine group in its structure whereas thymine does not.
(E) Uracil has a two-ringed structure, whereas thymine has a single-ringed structure.
3. Which of the following statements is the correct regarding genome structure?
(A) All the chromosomes in prokaryotic cells are circular.
(B) Every prokaryotic cell contains only one chromosome.
(C) Genome size is the total number of base pairs in one copy of a haploid genome.
(D) An organism's complexity is directly proportional to its genome size.
(E) The protein-coding genes comprise ~1.5% of the *Escherichia coli* genome.
4. Which of the following statements is correct regarding repetitive elements?
(A) Repetitive elements comprise ~10% of the human genome sequences.
(B) Most interspersed repeats have repeat units of smaller than 100 base pairs.
(C) Microsatellites are interspersed repeats.
(D) Interspersed repeats are mostly transposable elements.
(E) Short-interspersed nuclear elements are DNA transposons.
5. Which of the following DNA polymerases removes primers in *Escherichia coli*?
(A) DNA polymerase I. (B) DNA polymerase II. (C) DNA polymerase III.
(D) DNA polymerase IV. (E) DNA polymerase V.
6. Which of the following statements is correct regarding the replication fork?
(A) Topoisomerase acts to separate two strands of duplex DNA.
(B) Synthesis of the two strands of DNA is not simultaneous.
(C) The lagging strand is the strand on which the polymerase moves in the same direction as the movement of the replication fork.
(D) The DNA fragment formed on the lagging strand is called the Okazaki fragment.
(E) Primase acts to join breaks in the phosphodiester backbone of DNA.
7. Telomerase:
(A) solves the end replication problem of leading-strand synthesis.
(B) uses endogenous DNA as template.
(C) acts to extend the 3' end of the telomere.
(D) synthesizes double-stranded DNA.
(E) is present in all the eukaryotes.
8. Direct uptake of exogenous naked DNA through the cell membrane is called:
(A) conjugation. (B) injection. (C) infection. (D) transformation. (E) transduction.

國立中山大學 112 學年度碩士班暨碩士在職專班招生考試試題

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共 7 頁第 2 頁

9. Which of the following is the correct pair between the type and the cause of DNA damage?
(A) Thymine dimer: ethidium bromide.
(B) Depurination: 5-bromouracil.
(C) Deamination: ultraviolet illumination.
(D) Double-strand breaks: γ -radiation.
(E) Deletion or addition of a base pair: nitrous acid.
10. Histones are subject to various modifications. Which of the following modifications does NOT appear in histones?
(A) Methylation.
(B) Phosphorylation.
(C) Acetylation.
(D) Ubiquitinylation.
(E) Carboxylation.
11. Which of the following is the correct pair between the recombinase and the recombination site?
(A) Bacteriophage λ integrase: *res* site.
(B) Phage P1 Cre: *lox* site.
(C) *Escherichia coli* XerC and XerD: *att* site.
(D) Yeast FLP: *ori* site.
(E) *Salmonella* Hin invertase: *int* site.
12. Which of the following complexes specifically recognizes Holliday junctions and promotes branch migration?
(A) RecBCD complex. (B) UvrABC complex. (C) ClpPR complex.
(D) RuvAB complex. (E) RhlAB complex.
13. Transcription initiation involves recognition of consensus sequences by specific regions/domains of the RNA polymerase in *Escherichia coli*. Which of the following regions or domains recognizes the -10 promoter element?
(A) σ factor region 2. (B) σ factor region 3. (C) σ factor region 4.
(D) C-terminal domain of subunit α . (E) N-terminal domain of subunit α .
14. The structural feature of mRNA at the intrinsic transcription terminator in prokaryotes is a hairpin structure followed by:
(A) an A-rich sequence. (B) a C-rich sequence. (C) a G-rich sequence.
(D) a U-rich sequence. (E) an AU-rich sequence.
15. Which of the following small nuclear ribonucleoproteins (snRNPs) recognizes the 5' splice site?
(A) U1. (B) U2. (C) U4. (D) U5. (E) U6.
16. A special form of RNA editing found in the mitochondria of trypanosomes and mediated by guide RNAs is deletion and insertion of:
(A) adenine. (B) uracil. (C) guanine. (D) cytosine. (E) inosine.

國立中山大學 112 學年度碩士班暨碩士在職專班招生考試試題

科目名稱：分子生物學【生科系碩士班乙組】

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17. The *Drosophila Dscam* gene contains 48 alternative forms of exon 6. What is the mechanism for having only one exon 6 variant in the mature mRNA?
- (A) Splicing factors cannot bind to more than one splicing site due to steric hindrance.
 - (B) Spliced mRNA with more than one exon 6 variant leads to nonsense-mediated RNA decay.
 - (C) The docking site binds to only one selector sequence located upstream of the exon 6 variant.
 - (D) Each exon 6 variant contains different sequences at the splicing sites.
 - (E) Only the exon 6 variant that recruits enough SR proteins is retained in the mature RNA.
18. What is the function of the Shine-Dalgarno sequence?
- (A) It recruits the RNA polymerase.
 - (B) It recruits the core transcription factors.
 - (C) It recruits the initiation factors
 - (D) It recruits the large ribosomal subunit.
 - (E) It recruits the small ribosomal subunit.
19. The first step of tRNA charging catalyzed by the aminoacyl-tRNA synthetase is:
- (A) Reaction of the amino acid with ATP.
 - (B) Reaction of the amino acid with GTP.
 - (C) Transfer of the amino acid to the 3' end of tRNA.
 - (D) Transfer of the amino acid to the 5' end of tRNA.
 - (E) Binding of the amino acid to the anticodon loop.
20. Which of the following statements is correct regarding upstream open reading frames (uORFs)?
- (A) uORFs can be found in both eukaryotes and prokaryotes.
 - (B) uORFs can be found in both 5' and 3' untranslated regions.
 - (C) The presence of uORFs typically causes an increase in protein expression.
 - (D) Translation of the open reading frame (ORF) encoding the yeast activator Gcn4 is inhibited when amino acids are deficient, because the ribosome moves slowly along the uORFs and then dissociates.
 - (E) The size of uORFs is typically more than 20 codons.
21. Which of the following bacterial elongation factors (EFs) catalyzes translocation of the tRNA and mRNA and causes conformational changes of the ribosome?
- (A) EF-Tu. (B) EF-Ts. (C) EF-G. (D) EF-P. (E) EF-4.
22. Which of the following statements is correct regarding the wobble base pair?
- (A) The wobble base pair follows Watson-Crick base pair rules.
 - (B) The wobble base pair takes place at 3' end of the tRNA anticodon.
 - (C) Hypoxanthine (I) can pair with uracil (U), adenine (A), or cytosine (C).
 - (D) Guanine (G) can pair with adenine (A) or cytosine (C).
 - (E) The Wobble hypothesis predicts that the minimum requirement to satisfy all possible codons is 21 tRNAs.

國立中山大學 112 學年度碩士班暨碩士在職專班招生考試試題

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23. Which of the following statements is correct regarding translation termination in eukaryotes?
- (A) The structure and amino acid sequence of the Class I eukaryotic release factors (eRFs) are similar with those of the Class I release factors in prokaryotes.
 - (B) eRF1 induces release of the nascent polypeptide from the peptidyl-transferase center.
 - (C) Rli1 is an ATP-binding protein and brings eRF1 to the ribosome.
 - (D) eRF3 is a GTP-binding protein and catalyzes release of eRF1 from the A-site.
 - (E) Neither eRF1 nor eRF3 participates in separation of the large and small ribosomal subunits after release of the nascent polypeptide.
24. Both the catabolite activator protein (CAP) and the Lac repressor can bind DNA, but why does CAP facilitate transcription while the Lac repressor represses transcription?
- (A) CAP and the Lac repressor use different structural motifs to bind DNA.
 - (B) CAP binds to the region overlapping the promoter, while the Lac repressor binds to the region at a distance from the promoter.
 - (C) The Lac repressor can interact with the RNA polymerase to inhibit transcription.
 - (D) CAP has an activating surface that recruits the RNA polymerase.
 - (E) CAP binds as a homodimer, while the Lac repressor binds as a homotetramer.
25. Which of the following is the key bacteriophage λ regulatory protein that acts as an activator and establishes lysogeny upon infection of a new host?
- (A) CI. (B) CII. (C) CIII. (D) Cro. (E) Q.
26. Which of the following DNA binding domains or motifs is found in most bacterial regulatory proteins?
- (A) Zinc-finger domain. (B) Basic leucine zipper motif. (C) AT-hook motif.
 - (D) Helix-turn-helix motif. (E) Helix-loop-helix motif.
27. High throughput sequencing technologies become powerful tools to study molecular biology on a genome-wide scale. Which of the following sequencing techniques is used to assess the translational status?
- (A) RNA binding protein immunoprecipitation-sequencing (RIP-Seq).
 - (B) Chromatin immunoprecipitation-sequencing (ChIP-Seq).
 - (C) Global run-on sequencing (GRO-Seq).
 - (D) 4-thiouridine sequencing (4sU-Seq).
 - (E) Ribosome sequencing (Ribo-Seq).
28. Which of the following statements is correct regarding riboswitches?
- (A) Most riboswitches are *trans*-regulatory elements.
 - (B) Riboswitches can regulate gene expression at both transcriptional and translational levels.
 - (C) The riboswitch region that binds the small-molecule ligand is called the receptor.
 - (D) Riboswitches are typically found downstream of genes involved in the synthesis of the metabolite ligand recognized by the riboswitch.
 - (E) Riboswitches can mediate rho-dependent transcription termination.

國立中山大學 112 學年度碩士班暨碩士在職專班招生考試試題

科目名稱：分子生物學【生科系碩士班乙組】

題號：421003

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共 7 頁第 5 頁

29. Which of the following statements is correct regarding clustered regularly interspaced short palindromic repeats (CRISPR)?
- (A) CRISPR is found in the eukaryotic genome.
 - (B) A CRISPR locus consists of 2 major components: repeated and spacer sequences.
 - (C) The spacer sequences are acquired from infecting viruses.
 - (D) Cas1 and Cas2 are involved in processing of CRISPR RNA (crRNA).
 - (E) The CRISPR/Cas6 system is currently the most widely utilized tool for genome editing.
30. Which of the following statements is correct regarding small RNA-mediated silencing pathways in eukaryotes?
- (A) Piwi-interaction RNAs (piRNAs) are expressed predominantly in vegetative cells.
 - (B) Both small interfering RNAs (siRNAs) and microRNAs (miRNAs) are generated from longer RNA molecules by Dicer.
 - (C) The major component of the RNA-induced silencing complex is called Drosha.
 - (D) The size of small RNAs is typically in the range of 30-40 nucleotides.
 - (E) The miRNA is typically highly specific with only one mRNA target.

二、複選題（每題 4 分，共 40 分。每錯一選項扣 2 分，得分低於零分或所有選項均未作答者，該題以零分計）：

31. Which of the following statements are correct regarding the central dogma of molecular biology, as firstly stated by Francis Crick in 1957?
- (A) The sequential information can be transferred from DNA to RNA.
 - (B) The sequential information can be transferred from RNA to DNA.
 - (C) The sequential information can be transferred from RNA to protein.
 - (D) The sequential information can be transferred from protein to RNA.
 - (E) The sequential information can be transferred from protein to protein.
32. Which of the following histones form a tetramer in the first step of the assembly of a nucleosome?
- (A) H1. (B) H2A. (C) H2B. (D) H3. (E) H4.
33. Which of the following features are correct regarding the mechanism of DNA polymerase?
- (A) DNA polymerase uses a single active site to catalyze the addition of any of the four deoxynucleoside triphosphates.
 - (B) Steric constraints prevent DNA polymerase from using ribonucleoside triphosphates as substrate.
 - (C) The thumb domain of DNA polymerase is intimately involved in catalysis.
 - (D) Processivity is a crucial character for DNA polymerase and defines the average number of nucleotides added per template binding event.
 - (E) Removal of incorrectly base-paired nucleotides is mediated by intrinsic endonuclease activity of DNA polymerase.

國立中山大學 112 學年度碩士班暨碩士在職專班招生考試試題

科目名稱：分子生物學【生科系碩士班乙組】

題號：421003

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共 7 頁第 6 頁

34. Which of the following pairs between the type of DNA damage repair and the corresponding enzyme are correct?
- (A) Nucleotide excision repair: DNA glycosylase.
 - (B) Photoreactivation: DNA photolyase.
 - (C) Base excision repair: UvrABC endonuclease.
 - (D) Mismatch repair: MutS and MutL.
 - (E) Double-strand break repair: Rec A recombinase.
35. Which of the following mechanistic features of RNA polymerase are correct?
- (A) RNA polymerase acts to make RNA copies from the whole genome.
 - (B) RNA polymerase uses DNA as a template for RNA synthesis.
 - (C) RNA polymerase needs a primer for initiation of RNA synthesis.
 - (D) The error rate of RNA polymerase is lower than that of DNA polymerase.
 - (E) Prokaryotic mRNA and non-coding RNA are synthesized by the same RNA polymerase.
36. Which of the following eukaryotic RNA polymerases transcribe ribosomal RNA?
- (A) RNA polymerase I. (B) RNA polymerase II. (C) RNA polymerase III.
 - (D) RNA polymerase IV. (E) RNA polymerase V.
37. Which of the following processes are associated with phosphorylation of the C-terminal domain (CTD) tail of the eukaryotic RNA polymerase II?
- (A) Transcription preinitiation.
 - (B) Promoter escape.
 - (C) Transcription elongation.
 - (D) RNA 5' capping.
 - (E) RNA splicing.
38. Which of the following statements are correct regarding mRNA?
- (A) Each mRNA has at least one open reading frame (ORF).
 - (B) Many eukaryotic mRNAs are polycistronic.
 - (C) Polycistronic mRNAs usually encode proteins involved in related functions.
 - (D) The 5' cap is required to recruit ribosome to the eukaryotic mRNA.
 - (E) The Kozak sequence acts as a ribosome binding site of eukaryotic mRNA.
39. Three operators (O_{R1} , O_{R2} , O_{R3}) are located between the P_R and P_{RM} promoters in the genome of bacteriophage λ . Which of the following are correct regarding these three operators?
- (A) O_{R1} is located within P_R , while O_{R3} is located within P_{RM} .
 - (B) All three operators can bind to either λ repressor or Cro.
 - (C) The binding affinity of the three operators to Cro is $O_{R1} > O_{R2} > O_{R3}$.
 - (D) λ repressor at O_{R1} helps the repressor bind to O_{R2} by cooperative binding.
 - (E) Binding of λ repressor to O_{R3} leads to increase in the λ repressor gene expression.

國立中山大學 112 學年度碩士班暨碩士在職專班招生考試試題

科目名稱：分子生物學【生科系碩士班乙組】

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共 7 頁 第 7 頁

40. Which of the following processes belong to epigenetic regulation?
- (A) Maintenance of the lysogenic state of bacteriophage λ through cell division.
 - (B) Maintenance of the pattern of point mutations through cell division.
 - (C) Maintenance of the pattern of DNA methylation through cell division.
 - (D) Maintenance of the state of chromatin modification through generations.
 - (E) Expression of a gene controlled by an activator which is active only in the presence of a given inducer.

國立中山大學 112 學年度 碩士班暨碩士在職專班招生考試試題

科目名稱：普通生物學【生科系碩士班甲組】

—作答注意事項—

考試時間：100 分鐘

- 考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- 答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，請衡酌作答(不得另攜帶紙張，亦不得使用應考證空白處作為計算紙使用)。
- 答案卡請以 2B 鉛筆劃記，不可使用修正液（帶）塗改，未使用 2B 鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，後果由考生自負。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶具有通訊、記憶或收發等功能或其他有礙試場安寧、考試公平之各類器材、物品（如鬧鈴、行動電話、電子字典等）入場。
- 試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。
- 試題採雙面列印，考生應注意試題頁數確實作答。
- 違規者依本校招生考試試場規則及違規處理辦法處理。

國立中山大學 112 學年度碩士班暨碩士在職專班招生考試試題

科目名稱：普通生物學【生科系碩士班甲組】

題號：421004

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單選題，每題 4 分，共計 25 題

- 請問以下那一位學者的學說並未促成達爾文(Charles Darwin)發表物種源始(The Origin of Species)一書？
 - 林奈 (Carl Linnaeus)
 - 孟德爾 (Gregor Johann Mendel)
 - 拉馬克 (Chevalier de Lamarck)
 - 華萊士 (Alfred Russel Wallace)
 - 居維葉 (Georges Cuvier)
- 華萊士主張性徵(sexual trait)之所以變得較有吸引力是因為性徵本身就彰顯了某些性狀的品質，例如繁殖力。請問以下那種生物的特徵品質與其所暗示意義的關聯性可能支持華萊士的觀點？
 - 野生型孔雀魚的尾鰭長度
 - 孔雀的羽毛眼紋數量
 - 人類的膚色深淺
 - 蝴蝶的觸角長短
 - 海葵的觸手數量
- 以下何者屬於微觀演化(microevolution)的議題範疇？
 - 哺乳動物在更新世時普遍大型化 (gigantism)
 - 鳥類的羽毛源於獸足類恐龍的原始羽毛
 - 水污染會打破深水湖中不同水層近緣魚類之間的生殖隔離
 - 中生代海洋缺氧事件造就大量生態棲位出缺
 - 柏格曼定則(Bergmann's rule)預測近緣生物的體型大小會與其分布的緯度有關
- 黑面琵鷺在台灣的渡冬族群曾因細菌感染大量死亡，但經族群遺傳研究顯示存活族群的遺傳多樣性並未因此降低，這個現象暗示黑面琵鷺曾遭遇什麼效應但安然無事？
 - 邊際效應 (edge effect)
 - 創始者效應 (founder effect)
 - 瓶頸效應 (bottleneck effect)
 - 雜交優勢
 - 生態交匯帶效應
- 壽山的山羌一再被浪犬咬死，許多學者擔憂壽山的山羌可能滅絕，請問除了浪犬的攻擊外，那一種效應最有可能伴隨浪犬攻擊促成壽山山羌在未來的滅絕？
 - 繁殖力低落
 - 壽山國家自然公園內缺乏棲地
 - 與獼猴之間的棲位競爭
 - 棲地破碎化促進遺傳漂變
 - 種內競爭所造就的個體損失

試題請隨卷繳回，請留意背面是否有題

國立中山大學 112 學年度碩士班暨碩士在職專班招生考試試題

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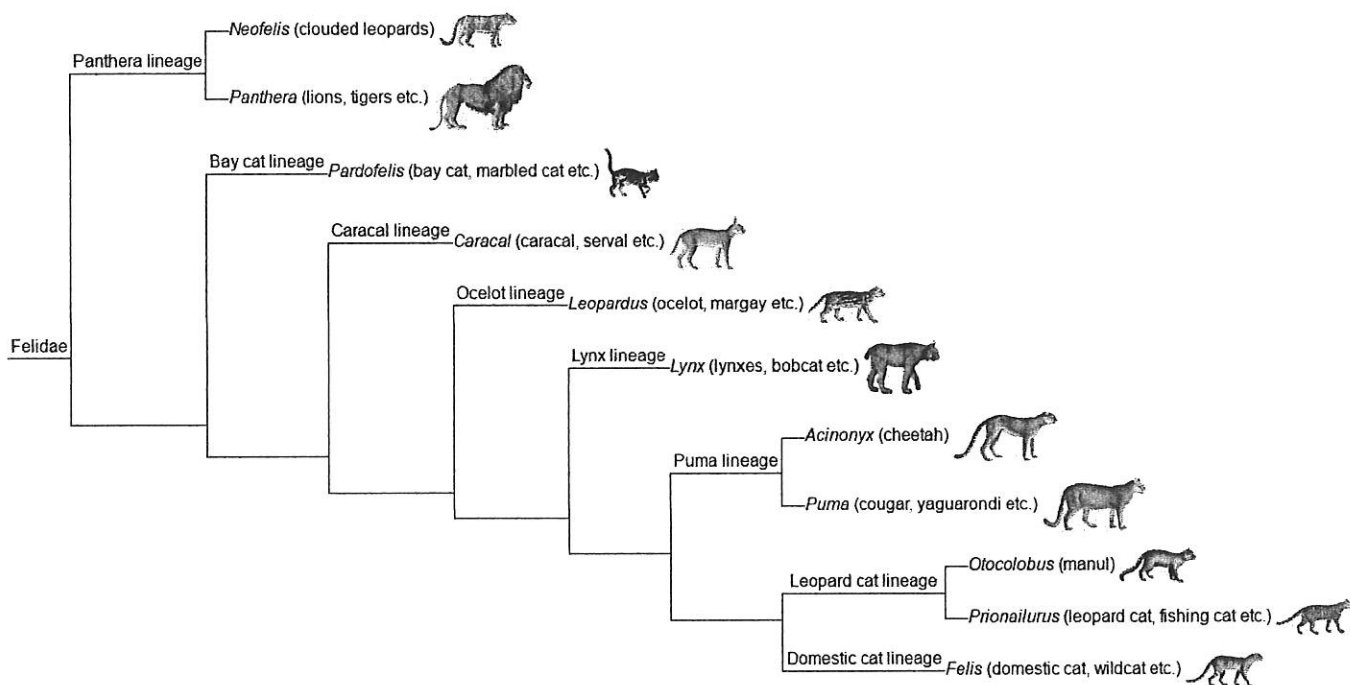
6. 有學者認為變溫動物在島嶼上容易因島嶼輻射等因素產生島嶼大型化現象(island gigantism)，所以就度量了臺灣與蘭嶼的斯氏攀蜥體長，但其結果發現臺灣本島與蘭嶼的攀蜥並沒有體型上的差異，請問你認為以下那一個假說無法解釋這個結果？

- A. 蘭嶼的族群是近期才從臺灣播遷過去的
- B. 攀蜥的體型不存在個體差異
- C. 臺灣與蘭嶼對攀蜥來說其食物資源不一樣
- D. 蘭嶼面積太小不足以呈現島嶼輻射對變溫動物的效應
- E. 攀蜥在臺灣本島的分布範圍廣所以會稀釋蘭嶼個體的差異

7. 秋行軍蟲為近年入侵台灣的外來物種，據美國方面報導，秋行軍蟲可危害超過 200 種被子植物。但是秋行軍蟲入侵台灣後卻只危害玉米。請問以下何種假說可解釋此現象？

- A. 創始者效應
- B. 蝴蝶效應
- C. 農藥防治效果顯著
- D. 基改作物可殺死多數毛蟲
- E. 瓶頸效應

8. 這是貓科動物的親緣關係樹，家貓(*Felis* 屬)與石虎所屬的 *Prionailurus* 之間可產生可孕的後代，在市面上被稱為「豹貓」。然而兩個屬並非姐妹群(sister group)，請問以下那一個假說可解釋這個象？



- A. 分類分錯了，石虎和家貓是同屬生物
- B. 石虎和家貓雜交打破了合子形成後(post-zygotic)的生殖隔離
- C. 石虎與家貓的生態棲位相同
- D. 石虎與家貓的分化過程是異域種化(allopatric speciation)所以生殖隔離薄弱
- E. 石虎與家貓的分化過程為共域種化(sympatric speciation)所以再雜交並不意外

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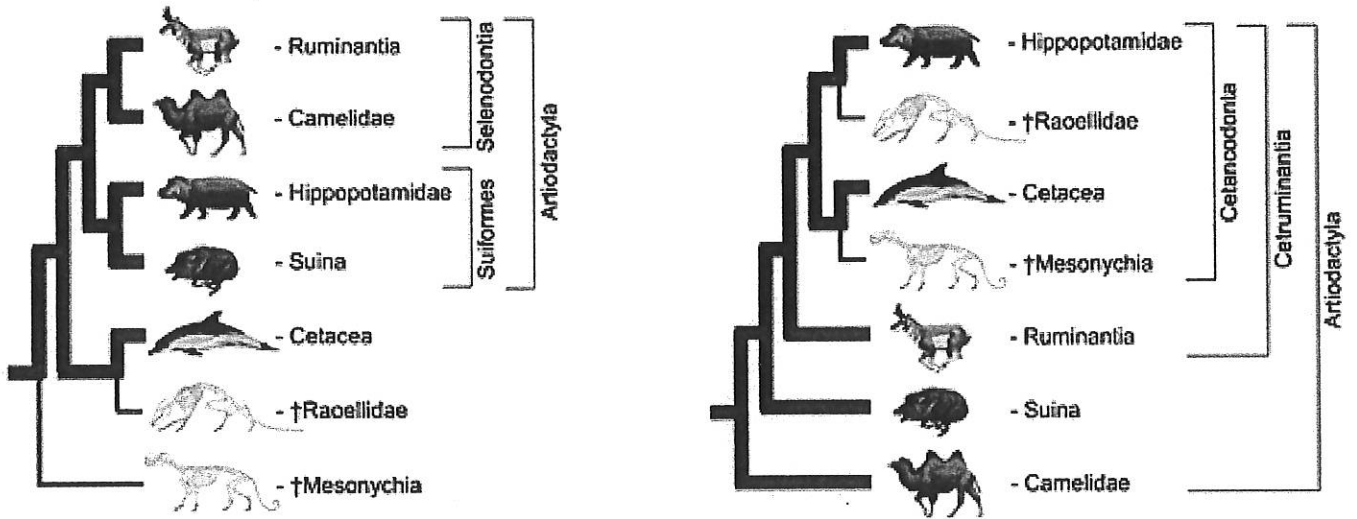
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9. 這是兩個有關偶蹄類與鯨豚關係以及鯨豚起源的假說，請問以下解讀何者錯誤？

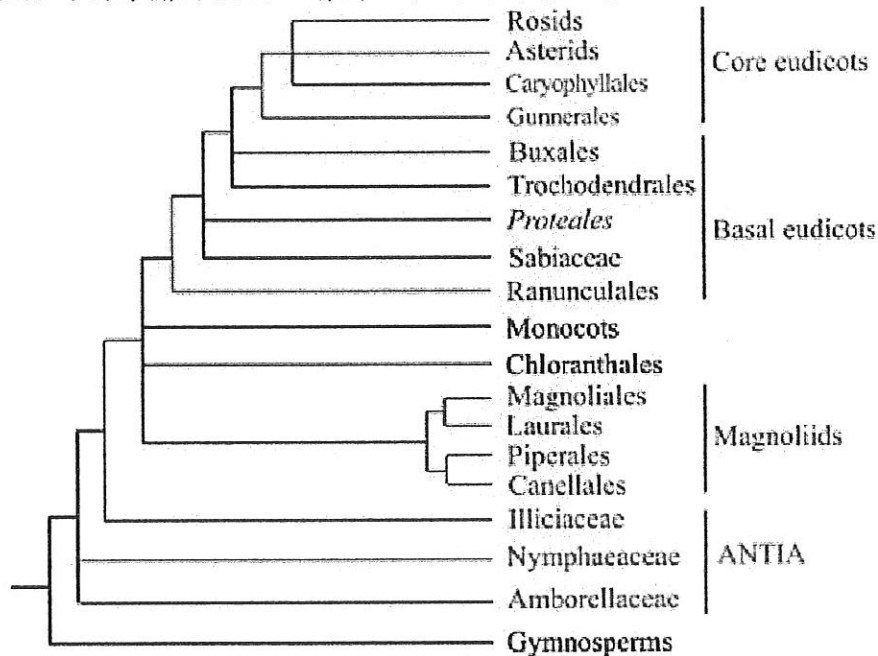


A) Thewissen et al., 2007

B) O'Leary and Gatesy, 2008

- A. Thewinsse et al. (2007)的假說指出偶蹄類+勞氏獸(Raocellidae)的祖先為中爪獸(Mesonychia)
- B. O'Leary & Gatesy (2008)的假說指出鯨豚的姐妹群為中爪獸
- C. O'Leary & Gatesy (2008)的假說指出 Cetanodonta 為水生動物
- D. Thewinsse et al. (2007)的假說指出從中爪獸到羚羊，水生這個性狀的演化是獨立出現的
- E. O'Leary & Gatesy (2008)的假說指出若去除化石類群，河馬與鯨豚是現生最接近的兩群動物

10. 這是一個被子植物的親緣關係假說，請問以下說明何者正確？



- A. ANTIA 為單系群
- B. Basal eudicots 為併系群
- C. Monocots 是(Basal eudicot + core eudicots)的姐妹群
- D. Chloranthales 是 Basal eudicots 的祖先
- E. Magnoliids 是單系群

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11. 在你的餐桌上有以下六種生物：甲、海帶；乙、香菇；丙、兩來菇；丁、虎皮蛙；戊、雞；己、豬。請問以下那個親緣關係假說最吻合近代科學家的觀點？

- A. (乙(甲(丙(丁(戊+己))))))
- B. (甲(丙(乙(丁(戊+己))))))
- C. (丙(甲(乙(丁(戊+己))))))
- D. (丙(甲(乙(己(戊+丁))))))
- E. (甲(丁(戊(己(乙+丙))))))

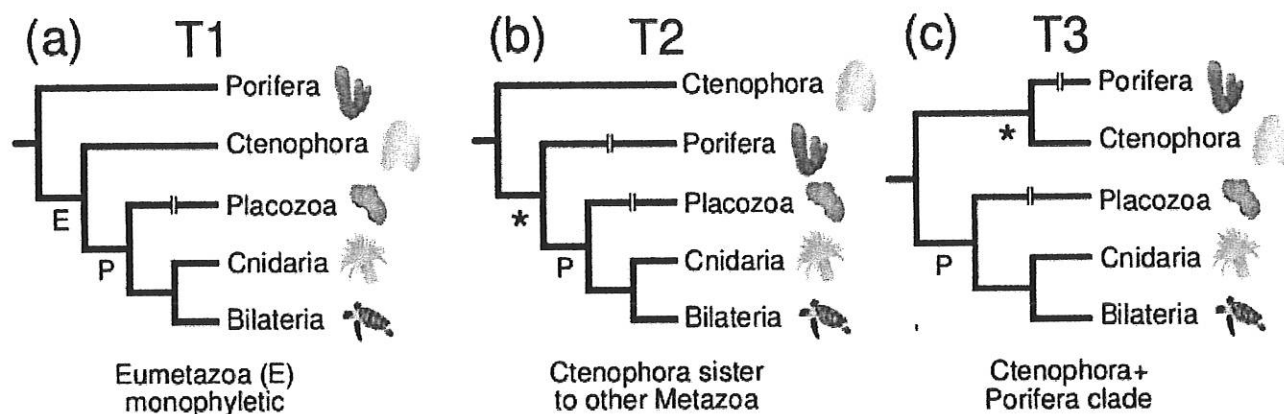
12. 在葉片的起源假說中，小型葉(microphyls)被認為來自支持孢子囊的單一條狀不分叉維管束組織。請問以下何種結構比較可能是小型葉？

- A. 櫻花的托葉
- B. 菱角的水中葉
- C. 石松的葉片
- D. 金魚藻的葉片
- E. 銀杏的子葉

13. 以下何者是風媒花的特徵？

- A. 種子容易隨風播散
- B. 維管束組織具有發達的氣洞(lacuna)
- C. 花冠發達
- D. 兩性花
- E. 花粉具有氣囊

14. 近年許多學者使用基因體資訊重建動物主要類群間的演化關係，結果發現海綿動物未必是所有現生動物的最基群，也就是現生最接近祖先的類群。請根據以下(a)(b)(c)三個假說回答何者解讀正確？



- A. (a)假說指出神經系統的出現獨立演化了兩次
- B. (b)假說指出肌肉組織的出現演化了一次
- C. (c)假說指出神經系統的出現獨立演化了一次
- D. (a)與(b)假說的差異在於胚胎發育時口(mouth)的出現時期與位置
- E. (b)與(d)假說的差異在於具有刺絲胞的 Ctenophora 與 Cnidaria 是否趨同演化

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15. 被囊動物(海鞘)為漂浮或固著生物，為何牠被視為兩側對稱動物的成員？
- A. 具備中樞神經系統
 - B. 成體具備頭部
 - C. 可行濾食生活
 - D. 具有完整的食道與肛門
 - E. 幼體具有中空神經索
16. 人類之所以屬於硬骨魚(osteichthyes)的原因何者正確？
- A. 具有發達的頭顱
 - B. 具有兩對肢體(limbs)
 - C. 具有磷酸鈣硬骨基質
 - D. 具有上下頷的分化
 - E. 具有鰓裂或其同源結構
17. 以下何種證據足以判斷一群生物的地理分布與岡瓦納古陸(Gondwana)有關？
- A. 現在只分布於紐西蘭的鱷蜥在華南也有化石出土
 - B. 斐濟鬣蜥的祖先來自南美洲
 - C. 東亞的寬尾鳳蝶的祖先來自北美洲
 - D. 澳洲與馬達加斯加的淡水魚演化關係緊密
 - E. 印度北部與青康藏高原的生物相接近
18. 如果有一種原產於南美亞馬遜盆地的淡水龜是熱門寵物，主管單位擔心數量增多可能成為入侵種，請問以下那些生物因子與牠是否可在臺灣建立野外族群無關？
- A. 食性廣度
 - B. 幼龜顏色鮮豔討喜
 - C. 成體需上岸曬太陽
 - D. 性別決定因子
 - E. 婚配模式
19. 親代照護(parental care)對親代來說是相當大的投資，請問以下何者是具有親代照護行為物種的特質？
- A. 成體在護幼期間不取食以降低天敵攻擊幼體機率
 - B. 兩性間會合作護幼
 - C. 兩性間沒有敵對行為(agonistic behavior)
 - D. 雌性壽命較雄性長
 - E. 有親代照護行為的成體壽命較沒有親代照護物種之成體長
20. 以下何種現象不足以說明親屬選擇(kin selection)的存在？
- A. 如果獨木橋只能過兩個人，你決定先救媽媽而不是配偶
 - B. 親緣關係越近的樹木在森林中的競爭關係比較激烈

試題請隨卷繳回，請留意背面是否有題

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- C. 生娘那有養娘親，養育之恩大過天
D. 生長距離越遠的酢醬草的授粉成功率越低
E. 蝌蚪的同類相食行為在親屬間比例較低
21. 有關共同花園(common garden)這類實驗設計的目的，以下何者正確？
- A. 這類試驗比較適用植物，而非動物與真菌
B. 藉由把不同生物都移植到同樣環境，以評估何者的適應力較佳
C. 促進一個棲地的物種多樣性
D. 藉由互相移植生物到共同環境，以評估環境對生物性狀的效應
E. 共同花園的實驗設計只能檢測短期效應，無法看到長期效應
22. 長江三峽大壩是一個影響東亞生態系統的重大工程，請問長江三峽大壩後對東亞生態系統的影響何者為非？
- A. 改變東海藻類相
B. 降低淡水注入東海的量
C. 東海與黃海鹽度提高
D. 黑潮變得容易進入東海而改變生物分布
E. 影響長江魚類洄游
23. 若學者要制定計畫移除一個外來入侵動物，以下何種資訊是不必要的？
- A. 兩性生命表
B. 生殖週期
C. 婚配模式
D. 最小可存活族群
E. 親代照護模式
24. 在光電板搶奪農漁用地的爭議中，有人主張光電板可降低優養化，但也有人認為光電板會阻隔陽光降低生產力，請問容易受陽光影響的產業為何？
- A. 鰻魚
B. 台灣鯛
C. 文蛤
D. 白蝦
E. 午仔魚
25. covid-19 是一個典型的跨物種傳播人畜共通病毒。請問以下何者可解釋 alpha 病毒株初期造成高死亡率後來卻能一直產生新的病毒株？
- A. covid-19 的可能祖先來自蝙蝠，與人類關係甚遠，所以易造成高致死率
B. 新病原感染新宿主時較容易與宿主共存導致感染鏈擴大
C. 新病原感染新宿主時必然造成高致死率
D. covid-19 的中間宿主至今不明影響溯源

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E. 因病毒快速感染大量個體，但各地個體免疫力與防疫措施不同造就天擇壓力對病毒的差異性