國立中山大學111學年度
碩士班暨碩士在職專班招生考試試題

科目名稱：生態學【生科系碩士班甲組】

－作答注意事項－

考試時間：100分鐘

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國立中山大學111學年度碩士班暨碩士在職專班招生考試試題

科目名稱：生態學【生科系碩士班甲組】　　題號：421002

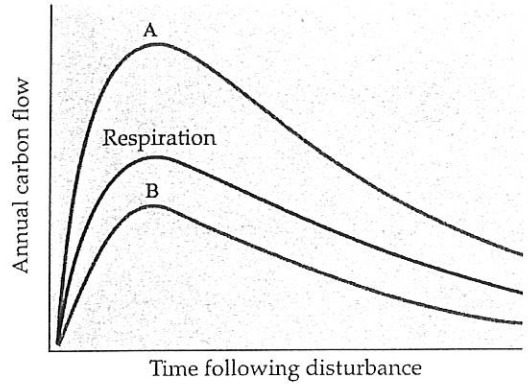
※本科目依簡章規定「不可以」使用計算機(混合題)　　

一、選擇題(單選，共45分，每題3分)

1. A group of individuals of a single species living in a particular area and interacting with one another is called a(n)
   A. biosphere.
   B. community.
   C. ecosystem.
   D. population.
   E. biome
2. Fish such as salmon, which are born in freshwater streams but spend most of their adult lives in the ocean, are termed
   A. ahedonistic.
   B. anadromous.
   C. androgynous.
   D. oscillatory.
   E. olderous.
3. Trees that routinely drop their leaves during cold or dry periods are referred to as
   A. deciduous.
   B. succulent.
   C. sclerophyllous.
   D. ruderal.
   E. savannic.
4. Which of the following types of organisms would most likely be able to tolerate the 90℃ environments that occur in hot springs?
   A. Mollusks
   B. Insects
   C. Protists
   D. Fish
   E. Bacteria
5. When exposed to intense light, plants often use the xanthophyll cycle to dissipate light energy. Thus, when a plant is exposed to intense light one would expect to see a decline in the concentration of
   A. phycocyanin.
   B. zeaxanthin.
   C. antheraxanthin.
   D. phycoerythrin.
   E. violaxanthin.
6. The recovery of egg hatching rates in the Illinois population of prairie chickens was most likely due to
   A. genetic drift.
   B. disruptive selection.
   C. gene flow.
   D. stabilizing selection.
   E. mutation.

7. Which of the following is a specialized form of phenotypic plasticity?
   A. Anisogamy
   B. Polyphenism
   C. Isogamy
   D. Direct development
   E. Senescence
8. Many insects remain essentially dormant at the pupal stage during winter conditions. This is an example of
   A. diapause.
   B. endosperm.
   C. anisogamy.
   D. geotaxis.
   E. isogamy.
9. Which of the following terms refers to the physiologically independent plants?
   A. Biotic
   B. Gamete
   C. Genet
   D. Ramet
   E. Quadrat
10. The addition of excess nutrients into aquatic systems often disrupts the ecosystem. This phenomenon is known as
   A. environmental stochasticity.
   B. resource dysgenesis.
   C. dampened oscillations.
   D. Allee effects.
   E. eutrophification
11. The study of the chemical, physical, and biological factors that influence the movements and transformations of elements is called
   A. biomorphic geochemistry.
   B. biogeochemisty.
   C. geomorphic biochemistry.
   D. biogeography.
   E. biogeophysics.
12. Milkweed beetles are so named because they feed on the milkweed plant. They are an example of a _____ and are part of the _____ trophic level.
   A. herbivore; first
   B. herbivore; second
   C. detritivore; first
   D. carnivore; first
   E. carnivore; second

13. - 14. Refer to the graph below, which shows NPP changes during forest succession.



13. Curve A of the graph represents _____, and curve B represents _____.
   A. NPP; GPP
   B. NPP; NDVI
   C. NDVI; NPP
   D. GPP; NPP
   E. GPP; NDVI

14. During succession, leaf area index decreases after maximum forest development. In the graph, this is represented by the _____ side of _____.
   A. right; curve A
   B. left; curve A
   C. left; the Respiration curve
   D. right; the Respiration curve
   E. left; curve B

15. In addition to positive interactions, the collective term for mutualisms and commensalisms is
   A. amelioration.
   B. conciliation.
   C. facilitation.
   D. benefactory.
   E. symbiosis.

二、問答題(共55分)

1. Defining "alternative stable states" (5 points).
2. Defining "beta diversity" (5 points).
3. Defining "biome" (5 points).
4. Defining "climax stage" (5 points).
5. Defining "continental drift" (5 points).
6. Defining "ecological niche" (5 points).
7. Defining "evolutionarily signification unit" (5 points).
8. Defining "gene flow" (5 points).
9. Defining "lottery model" (5 points).
10. Defining "population size" (5 points).
11. Defining "trophic cascade" (5 points).

國立中山大學111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

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國立中山大學111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**

※本科目依簡章規定「不可以」使用計算機(問答申論題)

1. 近年來台灣山區水鹿族群數量持續上升，水鹿會啃咬許多樹木的樹皮，造成樹木枯死，不過關於這個現象過去有不同的假說被提出，有學者認為水鹿是因為缺乏足夠的食物資源所以開始啃食樹皮，但也有學者認為是因為水鹿啃食樹皮的行為與體內的寄生蟲有關，請問這兩種的假說是屬於 top-down control 或是 bottom-up control 的機制？又我們可以如何設計實驗來驗證這兩種假說？(20%)

2. 台灣兩棲類保育志工在 2021 年 11 月初，在南投草屯發現了列為世界百大入侵種的海蟾蜍，相關單位接獲通報後立即展開移除作業。有些外來種在歸化後，其族群數量會快速增長，成為這些地區的優勢物種，並威脅到當地的原生物種。請舉出兩種用於解釋外來入侵種其族群能快速增長的假說，並說明其可能的機制。(20%)

3. 氣候變遷對於生物會有直接與間接的影響，有些研究甚至指出氣候變遷所帶來的間接影響可能會大於直接影響的效應。請舉例說明氣候變遷，像是暖化或是降雨的改變，對於生物的直接影響與間接影響為何？(20%)

4. 一個地區的植被受到干擾後，其物種組成會隨著演替進行而逐漸發生改變，有些學者認為這些物種組成的改變是有順序性且可預測的，但有些學者則認為演替過程中物種組成的改變是難以預測的。演替過程中早期出現的物種與晚期出現的物種其關係大致可以分成三類，請分別說明，並用此解釋為何不同學者對於植群演替會有不同的看法？(20%)

5. 熱帶地區有著非常高的生物多樣性，而隨著緯度或海拔增加，生物多樣性則逐漸下降，從過去到現在有非常多的假說被提出，試圖解釋生物多樣性隨著緯度增加而減少的這個現象，請舉出四個解釋這個現象的假說，並說明其支持的證據與相關反駁的論點。(20%)

試題請隨卷繳回，請留意背面是否有題

國立中山大學111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

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國立中山大學111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】　　題號：421001

※本科目依簡章規定「不可以」使用計算機(問答申論題)　　

1. Please describe the metabolic oxidation of organic substrates as a three-stage process (30%)

2. A question is how the enormous diversity of immunoglobulin molecules is generated so that antibodies to an almost unlimited range of antigens are provided (20%)

3. Give two examples of the mechanism of immune checkpoints (20%)

4. What is the process of autophagy? (10%)

5. Please describe the relationships between inorganic and organic nitrogen metabolism (10%)

6. Please describe how to prove that DNA is genetic material (10%)

國立中山大學111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—

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國立中山大學111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(混合題)

I. Multiple Choice Questions (單選題，每題 2.5 分，共計 80 分)

1. A eukaryotic gene is most likely to be transcribed if it is located where?
   A) in the telomeric region of a chromosome
   B) in a heterochromatic region of the genome
   C) in a euchromatic region of the genome
   D) in a region of the genome in which the histones are deacetylated

2. Sister chromatid is:
   A) The same thing as homologous chromosomes.
   B) A pair of chromosomes of the same kind.
   C) Identical copies of the same chromosome attached at the centromere.
   D) Always haploid.
   E) Always diploid.

3. Which of following RNA participates in ribosome biogenesis?
   A) small nucleolar RNA
   B) transfer RNA
   C) small nuclear RNA
   D) microRNA
   E) small interfering RNA

4. Which of the following enzymes is the major processive enzyme in leading strand synthesis during eukaryotic DNA replication?
   A) DNA polymerase α(alpha)
   B) DNA polymerase β (beta)
   C) RNA polymerase γ (gamma)
   D) DNA polymerase ε (epsilon)
   E) Telomerase

5. Which form of DNA damage is least likely to be encountered on a day to day basis?
   A) Double strand breaks.
   B) Hydroxylation.
   C) Deamination.
   D) Pyrimidine dimers.
   E) Tautomerization.

6. If a replicating cell encounters significant DNA damage during S phase, what is the most likely result?
   A) It will arrest in the S phase checkpoint and undergo repair
   B) It will immediately trigger apoptosis and die
   C) It will utilize telomerase to extend past the damage
   D) It will utilize bypass polymerases to complete S phase
   E) It will undergo a reductive division

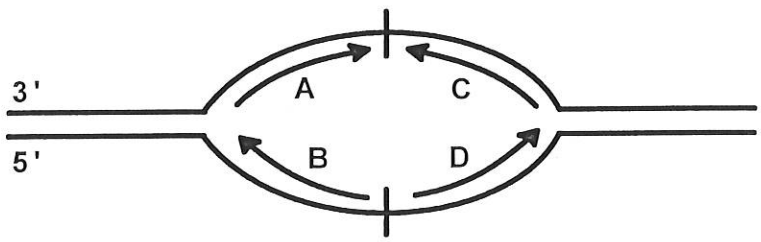
7. Which of the following is not part of a zinc-finger motif?
   A) zinc ion
   B) proline residue
   C) cysteine residue
   D) histidine residue

8. Which of the following protein domains would be most likely to recognize and bind to acetylated lysine residues on nucleosomes?
   A) homeodomains
   B) zinc fingers
   C) bromodomains
   D) chromodomains

9. Cells, when infected by a DNA virus, can transcribe both stands of the viral DNA and process it into ~21 nt single stranded fragments that can be loaded into protein complexes which target viral protein encoding transcripts for degradation. Which statement below correctly characterizes this process?
   A) This siRNA silencing results in a gene knock out.
   B) This siRNA silencing results in a gene knock down.
   C) This miRNA silencing results in a gene knock out.
   D) This miRNA silencing results in a gene knock down.
   E) This miRNA silencing results in reversible gene regulation

10. The Central Dogma of molecular biology states that one gene leads to one transcript and results in one protein product. Which of the following processes would refute this dogma?
   A) Ordered splicing.
   B) RNA editing.
   C) Telomerase activity.
   D) Translation start site recognition.
   E) Polyadenylation of new transcripts.

11. Which of the arrows in the diagram below best represents the position and direction of **leading strand** DNA synthesis? The vertical bars at the center of the diagram depict the replication origin.
   A) A
   B) B
   C) C
   D) D



12. Not all mutations inside the open reading frame of a gene encoding a protein change the amino acid sequence of the protein because:
   A) tRNAs carrying different amino acids can recognize the same codon
   B) some codons specify more than one amino acid
   C) two different codons can specify the same amino acid
   D) some codons are skipped during translation
   E) some codons consist of more than three nucleotides

13. Eukaryotic protein synthesis:
   A) proceeds in a 5'→ 3' direction
   B) is coupled to transcription
   C) always begins with a formyl-methionine
   D) utilizes energy stored in the aminoacyl-tRNA
   E) terminates at the sequence 5'-AAUAAA-3'

14. RNA molecules that exhibit catalytic activity are called
    A) mRNAs
    B) ribonucleases
    C) ribosomes
    D) ribozymes

15. Which of the following scientists provided definitive evidence for the chromosomal theory?
    A) Mendel
    B) Morgan
    C) McClintock
    D) Miescher
    E) Avery

16. Which of the following would not be considered a mutation?
    A) permanent replacement of guanine with thymine in a DAN strand
    B) deletion of gene segment
    C) insertion of an intron in the middle of an exon
    D) permanent replacement of cytosin with adenine
    E) crossing over of two gene regions during meiosis

17. A patient presents with α-thalessemia. Below is the mRNA transcribed from the patient's α-globin gene. What is the most likely result in this individual?
    Note: The ellipse (…) represents a continuation of the RNA beyond the sequence you are given.

5'	-	AGAGAGAACCCACCAUGGTGCTGTCT…-3'	Normal
5'	-	AGAGAGAACCCACCAUAGTGCTGTCT…-3'	Patient

    A) defective transcription initiation
    B) normal protein, this is a silent mutation
    C) defective translation initiation
    D) shorter protein, this is a nonsense mutation
    E) Glycine → Serine mutation in the protein

18. All the following statements about molecular chaperones are true except
    A) They play a role in the proper folding of proteins.
    B) They are located in every cellular compartment.
    C) They are found only in mammals.
    D) They bind a wide range of proteins.

19. As topoiosomerases play an important role during replication, a large number of anticancer drugs have been developed that inhibit the activity of these enzymes. Which of the following statements is NOT true about topoisomerases as a potential anticancer drug target?
    A) As cancer cells are rapidly growing cells, they usually contain higher level of topoisomerases.
    B) The transient DNA breaks created by topoisomerases are usually converted to permanent breaks in the genome in the presence of topoisomerase targeted drugs.
    C) As cancer cells often have impaired DNA repair pathways, they are more susceptible towards topoisomerase targeted drugs.
    D) The drugs that specifically target topoisomerase, usually do not affect normal fast growing cells.

20. Which one of the following statements about the chromatins is NOT true?
A) DNA winds approximately 1.65 times around the nucleosomes
B) H2A-H2B bind to both the entry and exit ends of DNA in nucleosomes
C) Covalent modification of histones influence chromatin compaction
D) Non-histone proteins are part of mitotic chromosomes

21. Gametes are _____ and somatic cell are _____.
A) diploid; haploid
B) haploid, diploid
C) haploid; haploid
D) diploid, diploid

22. Which two Uvr component molecules scan the DNA during nucleotide excision repair?
A) UvrB, UvrC
B) UvrC, UvrA
C) UvrD, UvrA
D) UvrA, UvrB

23. How does tyrosine recombinase acts?
A) Cleaves and rejoin two DNA pairs one after another
B) First join then cleave
C) First cleave then join
D) Both process occur simultaneously

24. The genome of a bacterium is composed of a single DNA molecule which is 10^9 bp long. How many moles of genomic DNA is present in the bacterium? [Consider Avogadro No. $6*10^{23}$].
A) $1/6*10^{23}$
B) $1/6*10^{14}$
C) $1/6*10^{9}$
D) $6*10^{14}$
E) $6*10^{23}$

25. Which of the following is wrongly paired?
A) Nucleic acid – hydrogen bond
B) Polysaccharide – glycosidic bond
C) Proteins – peptide bond
D) Phospholipids – phosphate linkage

26. Which of the following does not contribute to the stability of tRNA?
A) Hydrogen bonding
B) Hydrophobic interactions
C) Base and sugar-phosphate backbone interaction
D) Base pairing

27. Which of the following will form a palindromic sequence?
A) AGTCCTGA
B) GTTCCAAG
C) ATTGCAAT
D) GTTGGAAC

28. Which special enzyme introduces negative supercoils in DNA?
    A) Type I topoisomerase
    B) Type II topoisomerase
    C) Gyrase
    D) Helicase

29. Which type of DNA is connected by a holiday junction?
    A) Homologous DNA duplex
    B) Heteroduplex DNA
    C) Mutated DNA
    D) Asymmetric DNA

30. During eukaryotic protein synthesis, stress conditions result in activation of specific kinases leading to phosphorylation of a key translation initiation factor that inhibits protein synthesis from a large number of cellular mRNA. Which one of the following factors is the target of the kinase?
    A) eIF4E
    B) eIF4G
    C) eIF2α
    D) Gcn4

31. Which of the following is wrong?
    A) Site specific recombination between two linear chromosomes result in exchange of segment.
    B) Site specific recombination between two circular chromosomes will result in insertion.
    C) Site specific mutation in one linear molecule will lead to excision.
    D) For recombination to take place recombinase is a must.

32. The most likely consequence of a mutation present at the location indicated by the arrow in the above hnRNA schematic would be:
    A) none, this region of the RNA has no function
    B) aberrant splicing of the RNA
    C) the mRNA would be improperly capped
    D) the mRNA would be unstable and prone to degradation
    E) an altered response to regulatory factors

II. Fill-in-the blank Questions: (20 points)

1. Match the description to the molecule(s). Each choice will be used only once. **(每空格 2 分，共計 10 分)**

   A) DNA　B) mRNA　C) tRNA　D) More than one of the above　E) None of the above

a) Will always have an equal percentage of A and G, and an equal percentage of C and T: _____

b) Has an anticodon and carries an amino acid: _____

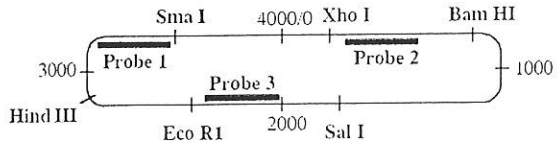
c) Serves as a messenger for taking genetic information from the nucleus to the cytoplasm: _____

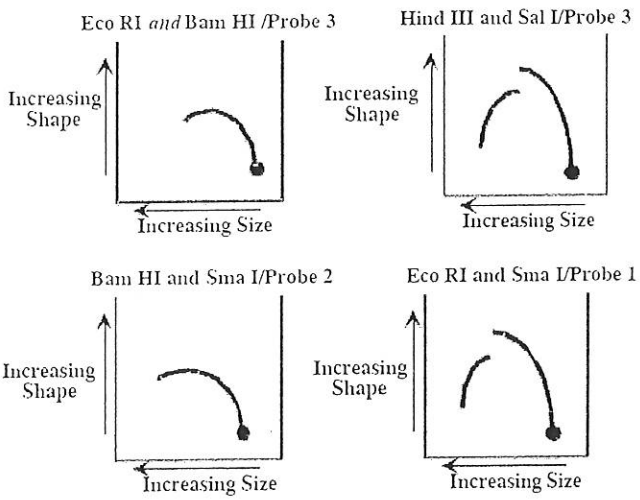
d) Involved in the process of translation: _____

e) Partially unzips/unwinds during the process of transcription: _____

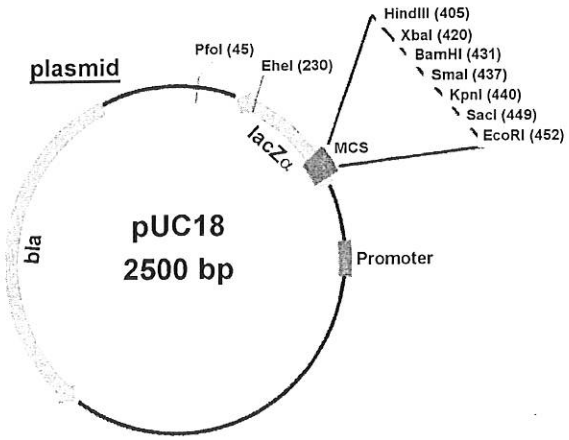
2. You are studying a novel thermophilic eukaryote called *S. mokin*. You found that some *S. mokin* cells contain a 4 kb plasmid with B form double strands DNA. You use 2D gel analysis to locate the origin of replication in the plasmid and obtain the following results.
   The replication origin is located between which 2 restriction enzymes (the shortest regions): **(每空格2分，共計4分)**

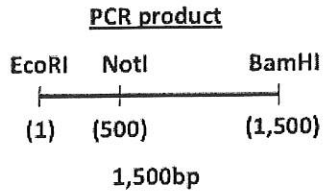
   _____ and _____.





3. Below are shown schematics of a 1,500bp PCR product and the pUC18 plasmid, with important restriction sites and their position in parentheses. You clone the PCR product between BamHI and EcoRI sites of pUC18.





For each lane of the agarose gel below, show the bands that will result from digesting your plasmid (pUC18 with your PCR product inserted between BamHI and EcoRI sites) with the indicated restriction enzymes. On the left and right sides of the gel are DNA ladders to serve as comparison. As shown above, the insert PCR product is 1,500bp, and pUC18 plasmid is 2,500bp. **(6 分)**