113學年度 學士後醫學系招生考試

普通生物及生化概論試題封面

考試開始鈴響前，請勿翻閱本試題！

★考試開始鈴響前，請注意：

一、除准考證、應考文具及一般手錶外；行動電話、穿戴式裝置及其他物品均須放在臨時置物區。

二、請務必確認行動電話已取出電池或關機，行動電話及手錶的鬧鈴功能必須關閉。

三、就座後，不可擅自離開座位或與其他考生交談。

四、坐定後，雙手離開桌面，確認座位號碼、答案卡號碼與准考證號碼相同，以及抽屜中、桌椅下或座位旁均無非考試必需用品。如有任何問題，請立即舉手反應。

五、考試開始鈴響前，不得翻閱試題本或作答。

六、考試全程不得吃東西、喝水及嚼食口香糖。

七、違反上述規定，依「筆試規則及違規處理辦法」議處。

★作答說明：

一、考試時間：100 分鐘。

二、本試題（含封面）共 **16** 頁，如有缺頁或毀損，應立即舉手請監試人員補發。

三、本試題共 90 題，皆為單選題，共計 150 分；每題答錯倒扣，不作答不計分。

四、答題依題號順序劃記在答案卡上，寫在試題本上無效；答案卡限用 2B 鉛筆劃記，若未按規定劃記，致電腦無法讀取者，考生自行負責。

五、試題本必須與答案卡一併繳回，不得攜出試場。

Choose one best answer for the following questions

【單選題】每題 1 分，共計 30 分，答錯 1 題倒扣 0.25 分，倒扣至本大題零分為止，未作答，不給分亦不扣分。1~15 題為普通生物，16~30 題為生化概論。

1. In the process of photosynthesis, which component is responsible for absorbing light energy and initiating the light-dependent reactions?
   (A) ATP synthase (B) carbon dioxide (CO_2)
   (C) water (H_2O) (D) antenna pigments in photosystem II
   (E) rubisco enzyme

2. What is the sexual process in *Paramecium*?
   (A) conjugation (B) fission (C) budding
   (D) meiotic division (E) multiple division

3. The Malpighian tubules are important for excretory function in _____.
   (A) birds (B) flatworms (C) insects
   (D) jellyfish (E) frog

4. Which of the following molecules is produced by the citric acid cycle participating in the electron transport chain on the mitochondrial inner membrane to generate ATP?
   (A) GAPDH (B) FADH (C) ADP (D) NADH (E) NADPH

5. What principle does nonrandom mating, such as assortative mating, violate in the context of population genetics?
   (A) the principle of independent assortment
   (B) the Hardy-Weinberg principle
   (C) the principle of segregation
   (D) the law of thermodynamics
   (E) the principle of uniformitarianism

6. More than 80% of the world's staple food comes from _____.
   (A) bryophytes (B) monocots (C) lycophytes
   (D) eudicots (E) gymnosperms

7. In plants, lateral root formation is initiated from _____.
   (A) cortex (B) endodermis (C) epidermis
   (D) pericycle (E) pith

8. Red tides in water bodies are caused by _____.
   (A) bacteria (B) cyanobacteria (C) dinoflagellates
   (D) green algae (E) red algae

9. In the bacterial CRISPR-Cas system, Cas protein interacts with _____ to target invading phage DNA.
   (A) CRISPR RNA (B) CRISPR DNA (C) CRISPR nuclease
   (D) CRISPR peptide (E) restriction enzyme

10. Alfred Hershey and Martha Chase used radioactive phosphorus to trace the DNA of T2 phage in infected bacterial cells in their experiment. They finally demonstrated that _____.
   (A) DNA replication is semiconservative
   (B) genetic material is DNA
   (C) DNA is a double helix
   (D) there is a replication fork during cell division
   (E) DNA is in the linear form

11. Sleeping pills like benzodiazepines mainly induce calmness and sedation by enhancing which neurotransmitter?
   (A) serotonin (B) glutamate (C) acetylcholine (D) dopamine (E) GABA

12. Which of the following molecules and ions does **NOT** act as secondary messenger in signaling pathways?
   (A) cAMP (B) receptor tyrosine kinase (C) inositol triphosphate
   (D) diacylglycerol (E) calcium

13. Non-flowering vascular plants include _____.
   ① angiosperms ② ferns ③ gymnosperms ④ liverworts ⑤ mosses
   (A) ②③④⑤ (B) ②③④ (C) ②③ (D) ②③⑤ (E) ④⑤

14. The characteristics or structures only found in angiosperms but **NOT** in gymnosperms include _____.
   ① double fertilization ② flower ③ vessel element ④ sieve tube
   ⑤ annual growth habit
   (A) ①②③④⑤ (B) ①②④⑤ (C) ①②③⑤
   (D) ①②③④ (E) ②③④

15. In one of Mendel's experiments, he crossed pea plants that were true-breeding for violet flower color with plants true-breeding for white flower color. What was the phenotype ratio of flower color in the F2 generation?
   (A) 100% violet (B) 100% white
   (C) 75% violet and 25% white (D) 50% violet and 50% white
   (E) 25% violet and 75% white

16. The prosthetic group of mitochondrial NADH dehydrogenase is _____.
(A) FMN (B) FAD (C) NADH (D) NADPH (E) Heme

17. Which of the following statements is **FALSE**?
(A) Two-dimensional electrophoresis separates proteins of different molecular weights and pIs.
(B) Size exclusion chromatography separates proteins based on molecular weight.
(C) SDS polyacrylamide gel electrophoresis separates proteins based on their molecular weight.
(D) Ion exchanger chromatography separates proteins based on their pIs.
(E) The column matrix with bound anionic groups is called cation exchanger.

18. A sequence of amino acids in a certain protein is found to be –Ser–Gly–Pro–Gly–. The sequence is most probably part of a(n) _____.
(A) antiparallel β sheet (B) parallel β sheet (C) α helix
(D) α sheet (E) β turn

19. Concerning human prion protein amyloid, the protein aggregation is due to the formation of _____.
(A) huge circled α helix
(B) large parallel β sheet
(C) extensive region of α helix and little β sheet
(D) large scale of α helix embedding amylase
(E) α helix and little β sheet associated with polysaccharide

20. Which amino acids in proteins can undergo post-translational farnesylation?
(A) cysteine (B) glycine (C) lysine (D) asparagine (E) serine

21. Which of the following vitamins enter the cell nucleus to bind to nuclear receptor and to regulate gene expression?
(A) riboflavin and vitamin K (B) pantothenic acid and vitamin E
(C) retinol and thiamine (D) thiamine and pantothenic acid
(E) retinoic acid and vitamin D

22. In the presence of an enzyme inhibitor, the V_{max} decreases and the apparent K_m decreases as well, giving two parallel lines in the Lineweaver-Burk plot. What is this inhibitor called?
(A) competitive inhibitor (B) mixed inhibitor
(C) noncompetitive inhibitor (D) uncompetitive inhibitor
(E) suicide inhibitor

23. Which of the following proteins is **NOT** involved in DNA replication?
(A) nuclease (B) gyrase
(C) helicase (D) single-strand binding protein
(E) primase

24. Which non-histone chromosomal protein helps holding sister chromatids together immediately after replication?
(A) condensins (B) cohesins (C) helicase
(D) topoisomerase (E) telomerase

25. Which of the following activities of *E. coli* DNA polymerase I allows it to remove RNA primers during lagging strand synthesis?
(A) 3′ to 5′ exonuclease activity (B) 3′ to 5′ polymerase activity
(C) 5′ to 3′ exonuclease activity (D) 5′ to 3′ polymerase activity
(E) Endonuclease activity

26. Which glycosidic bond between two monosaccharide molecules is **FALSE**?
(A) α(1→1) (B) α(1→4) (C) α(1→6)
(D) β(1→1) (E) β(1→4)

27. Because skeletal muscle do not contain _____, glycogen in skeletal muscle cannot be a source of blood glucose.
(A) glucose-6-phosphatase (B) glycogen phosphorylase
(C) phosphoglucomutase (D) glucose 6-phosphate dehydrogenase
(E) phosphorylase

28. Which of the following conditions concerning de novo purine ribonucleotide synthesis is **FALSE**?
(A) Glutamate is a direct source of nitrogen atom for the purine ring.
(B) The utility of PRPP is committed step in the synthesis of phosphoribosylamine.
(C) Aspartate is a direct source of nitrogen atom for the purine ring.
(D) IMP is an intermediate in the synthesis of GMP and AMP.
(E) De novo synthesis of purine ribonucleotide would be inhibited by methotrexate.

29. Which compound is **NOT** an intermediate for the biosynthesis of cholesterol?
(A) mevalonate (B) isopentenyl pyrophosphate
(C) farnesyl pyrophosphate (D) squalene
(E) cholate

30. Which of the following statements about lipoproteins is **TRUE**?
(A) Chylomicrons carry the dietary fat from peripheral tissues to the intestine.
(B) VLDL carries TG from the liver to peripheral tissues.
(C) VLDL contains ApoB-100.
(D) Chylomicrons contain ApoE.
(E) LDL contains ApoB-48.

【單選題】每題 2 分，共計 120 分，答錯 1 題倒扣 0.5 分，倒扣至本大題零分為止，未作答，不給分亦不扣分。31~60 題為普通生物，61~90 題為生化概論。

31. In evolutionary biology, what is adaptive radiation, and where is it most likely to occur?
(A) It is the rapid evolution of a single species into multiple forms to fill different ecological niches, often seen in isolated environments like islands.
(B) It is the process by which species adapt to urban environments.
(C) It is the gradual change of a species over time in response to environmental changes.
(D) It refers to the radiation of electromagnetic waves by organisms.
(E) It is the diversification of species to occupy the same ecological niche.

32. In the life cycle of true plants, the _____ are diploid.
① gamete ② gametophyte ③ spore ④ sporophyte ⑤ zygote
(A) ②③④⑤ (B) ②④⑤ (C) ②③⑤ (D) ④⑤ (E) ②⑤

33. Which of the followings is **NOT** a role of carbohydrates in the extracellular matrix?
(A) providing structural support to plant cell walls
(B) facilitating cell adhesion in animal tissues
(C) acting as a lubricant in joint movements
(D) regulating cell growth and proliferation
(E) storing genetic information in cells

34. How does the sodium-potassium pump contribute to the negative charge inside a cell?
(A) by expelling more sodium ions than potassium ions it brings in
(B) by absorbing more sodium ions than potassium ions it expels
(C) by maintaining an equal balance of sodium and potassium ions
(D) by converting sodium ions into potassium ions inside the cell
(E) by moving anions in and out of the cell in addition to cations

35. Which of the followings is a characteristics that can be found in fungi?
(A) They perform photosynthesis.
(B) They have a cellulose cell wall.
(C) They store energy as glycogen.
(D) They are primarily autotrophic.
(E) They reproduce only asexually.

36. Enveloped viruses are sensitive to ethanol. Which of the following viruses cannot be prevented by ethanol-base hand disinfection?
(A) Corona virus
(B) Influenza virus
(C) Measles virus
(D) Respiratory syncytial virus
(E) Dengue virus

37. Which of the following plant hormones does **NOT** regulate seed germination positively or negatively?
(A) auxin
(B) gibberellins
(C) abscisic acid
(D) brassinosteroids
(E) strigolactones

38. Which unique feature is found in the phylum Cnidaria, such as jellyfish and sea anemones?
(A) exoskeleton made of chitin
(B) vascular tissue for nutrient transport
(C) notochord during some stage of their life cycle
(D) nematocysts for defense and capturing prey
(E) segmented body plan

39. Regarding prokaryotic gene regulation, what is the function of the lac operon in *E. coli*?
(A) It codes for enzymes involving in the synthesis of lactose.
(B) It is activated only when lactose is present and glucose is absent, allowing the cell to metabolize lactose.
(C) It prevents lactose metabolism when glucose is present.
(D) It enhances the binding of RNA polymerase to DNA, regardless of lactose presence.
(E) It is involved in the replication of the bacterial chromosome.

40. Kranz anatomy is a specialized structure in _____.
(A) C_4 plants
(B) C_3 plants
(C) CAM plants
(D) parasitic plants
(E) epiphytic plants

41. Which of the following characteristics is common to all prokaryotes?
(A) They possess a nucleus.
(B) They have membrane-bound organelles.
(C) Their DNA is not enclosed within a membrane.
(D) They all have a cell wall made of peptidoglycan.
(E) They reproduce exclusively by sexual reproduction.

42. What is a biodiversity hotspot?
(A) a region with a moderate level of species diversity
(B) an area where invasive species have caused the extinction of native species
(C) a region that experiences a high rate of habitat loss
(D) a location where biodiversity is low but species are well adapted to extreme environments
(E) an area with a high concentration of endemic species that is experiencing high rates of habitat loss

43. Which of the following traits is most commonly associated with protists?
(A) They are all multicellular organisms.
(B) They are all photosynthetic.
(C) They belong to a single, monophyletic kingdom.
(D) They exhibit a wide range of nutritional strategies.
(E) They all have a rigid cell wall.

44. Under transmission electron microscope (TEM), there is an organelle that often exhibits a granular or crystalline core, believed to be a dense collection of enzyme molecules. Which of the following enzymes is most likely to be found in that crystal?
(A) rubisco (B) PEP carboxylase (C) aldolase
(D) alcohol dehydrogenase (E) catalase

45. Which mechanism allows for the stable coexistence of multiple species within the same ecological community?
(A) competitive exclusion (B) resource partitioning
(C) unlimited resource availability (D) identical niche requirements for all species
(E) absence of predators within the community

46. Which of the following statements about circadian rhythm is **FALSE**?
(A) Circadian rhythm is an intrinsic biological clock that can be synchronized by external day/night cycles.
(B) Cyclic alterations of human body temperature also reflect circadian rhythm.
(C) If an organism is kept in a constant environment, such as continuous light, its circadian rhythm will remain precisely 24 hours.
(D) Melatonin secretion also follows circadian rhythm, with its concentration peak occurring around 4:00 AM.
(E) Both phytochromes and blue light photoreceptors can entrain circadian rhythm in plants.

47. Which of the following vertebrates is first characterized by the presence of an amniotic egg?
(A) amphibians (B) fishes (C) reptiles (D) mammals (E) chordates

48. What is the primary role of the vestibular system in humans?
(A) to detect and process visual information
(B) to maintain balance and spatial orientation
(C) to facilitate communication through speech and language
(D) to process and interpret sounds
(E) to detect and respond to changes in temperature

49. Which of the following reactions increases the proton gradient across the thylakoid membrane in the light for chemiosmosis?
① photolysis of water
② electron transport through plastoquinone
③ electron transport through plastocyanin
④ electron transport from ferredoxin to $NADP^+$
⑤ fixation of CO_2 through Rubisco
(A) ①② (B) ①③ (C) ①②③
(D) ①②③④ (E) ⑤

50. Please select the **TRUE** order of human fertilization.
A. cortical reaction B. acrosomal reaction C. formation of perivitelline space
D. calcium release
(A) A→B→C→D (B) B→D→A→C (C) B→C→A→D
(D) D→B→C→A (E) D→C→B→A

51. Which of the following statements about genetically modification is **FALSE**?
(A) *Bt* (*Bacillus thuringiensis*) maize is a genetically modified organism (GMO) with a transgene encoding *Bt* toxin, which can prevent maize from insect feeding.
(B) Golden rice is a GMO created to address vitamin A deficiency.
(C) Soil bacteria *Agrobacterium* is commonly used as a tool for transferring exogenous genes into plants for GMO generation.
(D) Purple sweet potatoes are GMOs in which anthocyanin biosynthetic genes are overexpressed.
(E) Papaya in Hawaii is genetically engineered for resistance to a ringspot virus.

52. Which of the following statements is **TRUE** for Gram-negative bacteria?
(A) Gram-negative bacteria cell wall is lack of lipopolysaccharide.
(B) Gram-negative bacteria generally contain a capsule outside the cell wall.
(C) Gram-negative bacteria contain endotoxin, whereas Gram-positive bacteria do not.
(D) Gram-negative bacteria show a darker color than Gram-positive bacteria.
(E) Gram-negative bacteria have thicker peptidoglycan than Gram-positive bacteria.

53. Which of the following organs is specialized root in plants?
(A) rhizome (B) stolon (C) tuber
(D) pneumatophore (E) petiole

54. Which of the following cells abundantly express both the MHC I and MHC II molecules?
(A) macrophage and dendritic cell (B) macrophage and neutrophil
(C) B lymphocyte and macrophage (D) B lymphocyte and neutrophil
(E) neutrophil and dendritic cell

55. Which of the following characteristics are common in archaea and bacteria?
① composition of the cell wall
② absence of histones
③ lack of a nuclear envelope
④ presence of introns in genes
⑤ presence of RNA polymerase

(A) ①③④ (B) ②③④⑤ (C) ②④⑤
(D) ②③④ (E) ③④⑤

56. Which of the following hormones triggers the adrenal gland to promote the synthesis of glucose from noncarbohydrates in response to stress?
(A) aldosterone (B) epinephrine (C) cortisol
(D) glucocorticoid (E) adrenocorticotropic hormone

57. Which of the following hormones are synthesized in the hypothalamus and released from the posterior pituitary?
(A) prolactin, oxytocin (B) oxytocin, antidiuretic hormone
(C) luteinizing hormone, prolactin (D) follicle-stimulating hormone, oxytocin
(E) antidiuretic hormone, prolactin

58. Which part of the digestive tract secretes appetite suppressant to counter appetite stimulant?
(A) stomach (B) pancreas (C) liver
(D) small intestine (E) duodenum

59. Which kind of fungus commonly causes athlete's foot?
(A) Ascomycetes (B) Basidiomycetes (C) Mucoromycetes
(D) Oomycetes (E) Zoopagomycetes

60. Which of the following concepts is illustrated by a phylogenetic tree that depicts the evolutionary relationships among various species?
(A) the morphological similarities among species
(B) the biochemical pathways shared by different species
(C) the reproductive mechanisms of different species
(D) the geographical distribution of species
(E) the evolutionary history and lineage of organisms

61. Which of the followings are used to determine the primary structure of proteins?
① size exclusion chromatography ② SDS polyacrylamide gel electrophoresis
③ Edman degradation ④ circular dichroism ⑤ analysis of amino acid composition
(A) ①② (B) ②③ (C) ③④ (D) ④⑤ (E) ③⑤

62. Which structural motifs or domains are likely to interact with DNA?
① helix-turn-helix ② EF-hand ③ immunoglobulin fold ④ homeodomain ⑤ zinc finger
(A) ①②③ (B) ①③④ (C) ②③⑤ (D) ①④⑤ (E) ③④⑤

63. Which of the following statements regarding oxygen-binding to hemoglobin is **TRUE**?
(A) H^+ increases the affinity of hemoglobin for oxygen.
(B) BPG competes with O_2 for binding to the heme groups of hemoglobin.
(C) Fetal hemoglobin binds O_2 with higher affinity due to no bound BPG.
(D) CO binds with lower affinity to fetal hemoglobin than to adult hemoglobin.
(E) CO binding lowers the affinity of hemoglobin to O_2.

64. Which statement for the allosteric regulation of an enzyme activity is **FALSE**?
(A) The two principal models for allosteric enzyme behaviors are called the concerted and sequential models.
(B) The bound allosteric effector could be homotropic or heterotropic.
(C) There are two forms, taut T form and relaxed R form.
(D) In a sequential model, binding substrate to one subunit induces the other subunit to adopt R form.
(E) Negative cooperativity could be observed in concerted model.

65. Which statement about the pentose phosphate pathway (PPP) is **FALSE**?
(A) It provides NADH for biosynthesis reaction.
(B) It operates exclusively in the cytosol.
(C) It metabolizes the dietary pentose sugar.
(D) It provides ribose-5-phosphate for nucleotide biosynthesis.
(E) It provides ribose-5-phosphate for histidine biosynthesis.

66. Photophosphorylation and oxidative phosphorylation appear to be generally similar processes, both consisting of ATP synthesis coupled to the transfer of electrons along an electron carrier chain. Which statement is **FALSE** for both processes?
(A) Both contain cytochromes and flavins in their electron carrier chains.
(B) Both processes are associated with membranous elements of the cell.
(C) Both use oxygen as a terminal electron acceptor.
(D) Each represents the major route of ATP synthesis in those cells in which it is found.
(E) Protons are pumped from the inside to the outside of both mitochondria and chloroplast membranes.

67. Which statement is **FALSE** for the structural features of nucleotides?
(A) There are two types of bases, purines and pyrimidines.
(B) The most common form of DNA in nature is B-form.
(C) DNA is more stable than RNA.
(D) An A-T base pair has two H-bonds, and a G-C base pair has three H-bonds.
(E) Cytosine, uracil, and thymine belong to purines; adenine and guanine belong to pyrimidines.

68. Which of the following enzymes are inhibited by ATP?
① glucose-6-phosphatase ② phosphofructokinase ③ pyruvate kinase ④ hexokinase ⑤ fructose-1,6-bisphosphatase

(A) ①② (B) ②③ (C) ③④ (D) ④⑤ (E) ①⑤

69. To identify the groups of N-linked glycans in a mixed sample, _____ can be used to achieve it.
(A) mass spectrometry (B) lectin arrays (C) glycan arrays
(D) antibody arrays (E) glycoconjugate analysis

70. Three of the ten reactions in glycolysis are not reversible. They are the reactions catalyzed by _____.
① hexokinase ② phosphofructokinase ③ glyceraldehyde-3-phosphate dehydrogenase ④ phosphoglycerate kinase ⑤ pyruvate kinase

(A) ①②④ (B) ②③⑤ (C) ①③④
(D) ①②⑤ (E) ②④⑤

71. Put the following steps concerning fatty acid synthesis in the appropriate order.
① condensation ② release of a C_{16} fatty acid ③ dehydration
④ reduction of a carbonyl group ⑤ formation of a carbonyl group

(A) ⑤①④③② (B) ④⑤③①② (C) ①⑤③④②
(D) ⑤④③①② (E) ⑤③④①②

72. Which is the citric acid cycle enzyme that can transfer electrons from its bound $FADH_2$ through a series of iron-sulfur centers to coenzyme Q?
(A) isocitrate dehydrogenase
(B) malate dehydrogenase
(C) succinate dehydrogenase
(D) α-ketoglutarate dehydrogenase complex
(E) succinyl-CoA synthetase

73. Which of the following statements is **TRUE**?
① Thromboxanes and leukotrienes are eicosanoids.
② Prostaglandins are not eicosanoids.
③ Aspirin inhibits the biosynthesis of leukotrienes.
④ Prostaglandin endoperoxide H synthase shows cyclooxygenase activity.
⑤ Leukotrienes are derived from Thromboxanes via lipoxygenase-mediated reactions.

(A) ①② (B) ①③ (C) ①④ (D) ②③⑤ (E) ③④⑤

74. Which of the following statements concerning fatty acid metabolisms is **FALSE**?
(A) De novo fatty acid biosynthesis occurs in the cytosol.
(B) The synthesis of oleic acid from palmitic acid is in the cytosol.
(C) Ketone body formation occurs predominantly in mitochondria.
(D) Acetyl-CoA for de novo fatty acid biosynthesis is formed by citrate cleavage.
(E) For storing triglyceride, the predominant fatty acyl group is oleic acid.

75. Which of the following conditions favors the increase of ketone body synthesis?
(A) increasing of glycolysis in skeletal muscle
(B) increasing glycogenolysis in liver
(C) increasing gluconeogenesis in liver
(D) increasing fatty acid synthesis in brain
(E) increasing of lipolysis in adipose tissue

76. Which of the followings are **TRUE** regarding the complete oxidation of one mole of palmitate (16:0) via the β-oxidation pathway?
① 8 moles of NADH are formed.
② The initial substrate for β-oxidation is palmitoyl-CoA.
③ NADH transfers electrons to the respiratory chain through Complex I.
④ Acetyl-CoA enters the citric acid cycle for further energy production.
⑤ Oxidation of acetyl-CoA produced from one mole of palmitate yields 106 moles of ATP.

(A) ①②③ (B) ①③④ (C) ①④⑤ (D) ②③④ (E) ③④⑤

77. Which statement for gluconeogenesis from pyruvate to glucose is **FALSE**?

(A) Oxaloacetate is one of the intermediates.
(B) TPP is a cofactor to catalyze carboxylation of pyruvate.
(C) The carboxylation of pyruvate requires energy provided by ATP.
(D) GTP is required to convert the intermediate to phosphoenolpyruvate.
(E) The intermediate formed in mitochondria can either be converted to phosphoenolpyruvate or malate to leave mitochondria.

78. Transport of fatty acids from the cytoplasm to the mitochondrial matrix requires _____.

(A) ATP, carnitine, and acetyl-CoA carboxylase
(B) carnitine, coenzyme A, and acetyl-CoA
(C) ATP, carnitine, and coenzyme A
(D) carnitine, coenzyme A, and manolyl-CoA
(E) ATP, carnitine, and acetyl-CoA

79. The human genetic disease phenylketonuria can result from _____.

① a defect in phenylalanine hydroxylase
② a defect in homogentisate dioxygenase
③ inability to convert phenylalanine to tyrosine
④ urine containing excessive phenylpyruvate
⑤ deficiency of phenylalanine in the diet

(A) ①②③ (B) ①③④ (C) ①②⑤ (D) ②③④ (E) ①③⑤

80. Which statement for DNA supercoiling is **FALSE**?

(A) In prokaryotes, class I topoisomerases cut the phosphodiester backbone of one strand of DNA, pass the other end through, and then reseal the backbone.
(B) Class II topoisomerases cut both strands of DNA, pass some of the remaining DNA helix between the cut ends, and then reseal.
(C) DNA helicase is a bacterial topoisomerase that introduces negative supercoils into DNA.
(D) In eukaryotes, DNA forms a complex called chromatin that mainly contains histones.
(E) A relaxed DNA can be converted either to positive supercoil or negative supercoil.

81. Which of the followings can be used to detect DNA-protein interactions?

① Southern blotting ② Footprinting ③ Agarose electrophoresis
④ Electrophoresis mobility shift assay ⑤ Co-immunoprecipitation

(A) ①② (B) ②③ (C) ③④ (D) ②④ (E) ②⑤

82. Uracil-DNA N-glycosylase is involved in which of the following DNA repair mechanisms?
(A) base-excision repair (B) nucleotide excision repair
(C) direct repair (D) mismatch repair
(E) double-strand break repair

83. Chromatin immunoprecipitation can be used to isolate DNA fragments containing a DNA-binding protein of interest. If you wish to know the feature of the DNA fragment in the mixture, what is the next experiment you can detect? (suppose the DNA fragment being unknown)
(A) polymerase chain reaction (B) DNA sequencing
(C) Edman degradation (D) tandem mass spectrometry
(E) Southern blot

84. Which of the following statements concerning Shine-Dalgarno sequence is **TRUE**?
(A) It plays as restriction enzyme site on the plasmid.
(B) It is a polyadenylation signal.
(C) It is a sequence in upstream of the start codon in prokaryotic systems.
(D) It regulates DNA replication in eukaryotic systems.
(E) It interacts with ion transporter.

85. Which metabolic effect is associated with AMP-activated protein kinase (AMPK)?
(A) When activated, AMPK stimulates insulin release from the pancreas.
(B) When activated, AMPK activates fructose 2,6-bisphosphatase.
(C) When activated, AMPK phosphorylates glycogen synthase, inhibiting glycogen synthesis during periods of metabolic stress.
(D) When activated, AMPK activates fatty acid synthase 1, stimulating fatty acid synthesis.
(E) None of the answers is correct.

86. Which statement about the transcription in eukaryotes is **TRUE**?
(A) Protein synthesis can begin while DNA replication is still proceeding.
(B) Transcription occurs in the nucleus.
(C) Capping and splicing reactions proceed in the cytoplasm.
(D) The mature mRNA contains both introns and exons.
(E) A poly-A tail is attached to the RNA transcript after it is transported to the cytoplasm.

87. Which of the followings participate in translation?
① dNTP ② ribosome ③ primer ④ tRNA ⑤ mRNA ⑥ promoter ⑦ rRNA ⑧ enhancer ⑨ reverse transcriptase ⑩ rho factor

(A) ①②④⑥ (B) ②④⑤⑦ (C) ③⑦⑧⑩
(D) ⑤⑥⑦⑨ (E) ③④⑦⑧

88. Which statement for prokaryotic protein synthesis is **FALSE**?

(A) Protein synthesis begins at an AUG codon on the mRNA.

(B) The initial complex contains two main ribosomal subunits, the mRNA, GTP, and three initiation factors.

(C) The fMet-tRNA^{fMet} binds to the P-site of the ribosome.

(D) After a chain elongation, the ribosome moves one codon, leaving a peptidyl-tRNA in the P-site and a new aminoacyl-tRNA entering the A site.

(E) When the ribosome encounters a stop codon, the chain is terminated in a process requiring GTP and three protein release factors.

89. Which of the following statements is **FALSE**?

(A) Estrogen-estrogen receptor complex activates estrogen-responsive gene.

(B) Estrogen receptor has the “Zinc finger” structural motif.

(C) Tamoxifen binds to estrogen receptors but does not activate estrogen-responsive genes.

(D) Estrogen binds to “Zinc finger” motif of estrogen receptors.

(E) Estrogen binds to estrogen receptor in the cytoplasm, and the estrogen-estrogen receptor complex translocates into the nucleus.

90. Which of the following statements are **TRUE** about the effect of insulin?

① Increased uptake of glucose in adipose and muscle tissue

② Activation of glycolysis in the liver

③ Inhibition of synthesis of fatty acids and TG in liver and adipose tissue

④ Increased gluconeogenesis in the liver

⑤ Increased glycogen synthesis in the liver and muscle

(A) ①③④ (B) ①④⑤ (C) ①②⑤ (D) ②③④ (E) ②④⑤

後醫-普通生物及生化概論

題號	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
答案	D	A	C	D	B	B	D	C	A	B	E	B	C	B	C	A	D	E	B	A
題號	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
答案	E	D	A	B	C	D	A	A	E	B	A	D	E	A	C	E	A	D	B	A
題號	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
答案	C	E	D	E	B	C	C	B	A	B	D	C	D	A	E	C	B	D	A	E
題號	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
答案	E	D	C	E	A	C	E	B	A	D	A	C	C	B	E	D	B	C	B	C
題號	81	82	83	84	85	86	87	88	89	90										
答案	D	A	B	C	C	B	B	B	D	C										

高雄醫學大學113學年度學士後醫學系招生考試試題參考答案疑義釋疑公告

科目	題號	釋疑答覆	釋疑結果
普通生物學	4	題目已明確指出最佳答案，TCA cycle 產出 NADH 為最多因此為最適合答案。且 FAD 還原態為 $FADH_2$。	維持原答案
	14	裸子植物 Sieve cell 與被子植物 sieve tube 差異甚多。	維持原答案
	35	真菌不只有 asexually 一種選項方式。	維持原答案
	36	登革熱需要病媒蚊叮咬行為才能傳播，非直接接觸傳播。	維持原答案
	37	教科書該章節已有表格明確顯示各種植物賀爾蒙與種子發芽相關。研究期刊並非定論。	維持原答案
	39	在有 glucose 存在的情況下會優先利用 glucose，並避免 lactose 代謝	答案為(B)或(C)均可
	49	Chemiosmosis（化學滲透）已可由 cyclic phosphorylation 形成，與 $NADP^+$不必然相等 。	維持原答案
	54	B lymphocyte 為抗原呈現細胞，也同時具 MHC I 與 MHC II	答案為(A)或(C)均可
	55	本題目選項誤植	無正確答案送分
	56	題目主要問哪個 hormone 刺激 adrenal gland 使其促進 glucose synthesis，因為刺激 adrenal gland 的激素為 ACTH (adrenocorticotropic hormone)，所以答案更正為 E (adrenocorticotropic hormone)。	答案更正為(E)
	58	因 Cholecystokinin (CCK)有抑制食慾的功能，並由十二指腸(duodenum)中釋放	答案為(D)或(E)均可

高雄醫學大學113學年度學士後醫學系招生考試試題參考答案疑義釋疑公告

科目	題號	釋疑答覆	釋疑結果
生化概論	28	(E) Methotrexate 可以同時抑制de novo synthesis of both purine and pyrimidine。但是 Methotrexate作為dihydrofolate reductase 的抑制劑，乃透過抑制salvage pathway。因此答案仍維持(A)	維持原答案(A)
	30	(C) VLDL亦含ApoB-100。因此原答案(B)與(C)均正確。	(B)和(C)皆為正確答案
	66	(E) Protons are pumped from the inside to the outside of both mitochondria and chloroplast membranes. 此敘述亦不盡正確。	(C)和(E)皆為正確答案
	69	雖然lectin與glycan有binding關係，但若想解析unknown glycan之組成，仍然依賴Mass spectrometry。因此維持原答案。	維持原答案(A)
	71	Before the condensation reactions that build up the fatty acid chain can begin, the acetyl group of acetyl-CoA is transferred to ACP in a reaction, so called formation of a carbonyl group. 所以維持原答案。	維持原答案(A)
	75	(C) Increased gluconeogenesis consumes most of available oxaloacetate, but does not indicate the increase of ketone bodies in liver. (E) breakdown of fat produce large amount of acetyl CoA, which is used to produce ketone body. 所以維持原答案。	維持原答案(E)
	76	選項⑤，在問 Palmitate 經過 beta-oxidation 後，1 Acetyl CoA(非 Palmitate)產生多少 ATP? 因此維持原答案。	維持原答案(D)
	79	PKU 乃因為 defect in phenylalanine hydroxylase 所造成 phenylalanine 無法轉換為 tyrosine，才使得 phenylpyruvate 出現在尿中。以上現象稱為 PKU 並無誤，因此維持原答案。	維持原答案(B)
	81	Co-immunoprecipitation 主要是研究 protein-protein interaction Chromatin immunoprecipitation 才是可以決定 DNA-protein interaction 的技術。因此維持原答案(D)。	維持原答案(D)
	88	(E) 進行 Protein chain termination 需要利用 3 種 protein release factors，此處並未強調 3 種同時參與。因此維持原答案(B)。	維持原答案(B)
	89	(E) Estrogen binds to Estrogen Receptor in cytoplasm and translocate to the nucleus, where it binds to its hormone response element (HRE). 因此維持原答案。See Lehninger Principle of Biochemistry 8th ed. Fig. 28-34a, pp. 3731	維持原答案(D)

普通生物

張劍鴻(張芸潔)老師提供

高雄醫學大學 113 學年度 學士後醫學系
生物試題命題範疇分析

- 本年度高醫後醫的普通生物試題配分如下：
  (1) 第 1 -15題，每題 1 分，共15分。
  (2) 第31-60題，每題 2 分，共60分。

- 45 題的試題中，高達 38 題為生物學課本 Campbell 的所闡述的基礎生物概念，其中更有 6 題為題庫考題或曾出現過的考古題；
  - 另外，有 5 題亦為生物學課本 Campbell 的生物領域概念；
  - 僅第40題考 Kranz anatomy of C4 plants、和第51題 non-GMOs food: purple sweet potatoes為超出範圍題型。

- 若能循正規的方式準備，確實熟悉Campbell生物學之概念，該75分要有60以上的表現並不困難。

生物各試題命題範疇分析

		第1-15題，一分題
1	Unit 7 植物學	Photosystem，完全命中：The light-harvesting complexes act as an antenna 正課講義：Chap 29 植物訊號和行為， page 120 複習課程：Unit 7 Plant Biology, page 26
2	Unit 6 微生物免疫學	Protists，完全命中：sexual shuffling of genes occurs during conjugation, when two individuals exchange haploid micronuclei 正課講義：Chap 27 微生物， page 199 複習課程：Unit 6 Microbiology and Immunology, page 29

		第1-15題，一分題
3	Unit 2 動物生理學	Excretory systems，完全命中：溫古知新#156； Malpighian tubules that remove nitrogenous wastes and also function in osmoregulation 正課講義：Chap 12 排泄系統， page 49 複習課程：Unit 2 Animal Physiology, page 44
4	Unit 3 生物化學	Cellular respiration，完全命中：溫古知新#155； The electron transport chain accepts electrons from the breakdown products of the first two stages (most often via NADH). 正課講義：Chap 16 細胞呼吸， page 7 複習課程：Unit 3 Biochemistry, page 11
5	Unit 8 演化學	Hardy-Weinberg equation，完全命中：five conditions for nonevolving populations 正課講義：Chap33 演化機制， page 53 複習課程：Unit 8 Evolution, page 17-18
6	Unit 7 植物學	Human welfare depends on seed plants，完全命中： Six crops (wheat, rice, maize, potatoes, cassava, and sweet potatoes) yield 80% of the calories consumed by humans. 正課講義：Chap30 植物多樣性， page 54
7	Unit 7 植物學	Plant Structure，完全命中：溫古知新＃140； Lateral roots may sprout from the outermost layer of the vascular cylinder, the pericycle. 正課講義：Chap 28 植物構造和生長， page 38 複習課程：Unit 7 Plant Biology, page 9
8	Unit 6 微生物免疫學	Protists，完全命中：Dinoflagellate *blooms*- cause “red tides” in coastal 正課講義：Chap27 微生物， page 198 複習課程：Unit 6 Microbiology and Immunology, page 28

		第1-15題，一分題
9	Unit 6 微生物免疫學	Adaptive immunity- bacteria and archaea, CRISPR-Cas9，完全命中：CRISPR locus- a family of DNA sequences found within prokaryotic genomes 正課講義：Chap27 微生物， page 97 複習課程：Unit 6 Microbiology and Immunology, page 11
10	Unit 4 分子生物學	DNA was the genetic material，完全命中：Alfred Hershey and Martha Chase showed that DNA was the genetic material of the phage T2 正課講義：Chap 21 核苷酸與遺傳， page 6； 112義守後中#40，104高醫後醫， 101中國內轉，溫古知新#114 複習課程：Unit 4 Molecular Biology, page 19
11	Unit 2 動物生理學	Amino acid neurotransmitters，完全命中：GABA-the most major inhibitory neurotransmitter in the brain 正課講義：Chap 5 神經元和突觸， page 65 複習課程：Unit 2 Animal Physiology, page 8
12	Unit 1 細胞生物學	Signal transduction，完全命中：second messenger-cAMP, calcium, DAG and IP_3 正課講義：Chap 3 細胞訊號傳遞， page 38-39 複習課程：Unit 1 Cell Biology, page 11
13	Unit 7 植物學	The Diversity of Plants，完全命中：seedless vascular plants and “naked” seeds piants 正課講義：Chap 30 植物多樣性， page 22 and 62 複習課程：Unit 7 Plant Biology, page 30
14	Unit 7 植物學	The Diversity of Plants，完全命中：The reproductive adaptations of angiosperms 正課講義：Chap 30 植物多樣性， page 70 複習課程：Unit 7 Plant Biology, page 35-37
15	Unit 4 分子生物學	Mendelian genetics，完全命中：Law of segregation 正課講義：Chap 19 孟德爾， page 7-8 複習課程：Unit 4 Molecular Biology, page 9

		第31-60題，二分題
31	Unit 8 演化學	Adaptive Radiations，命中：occur when organisms colonize new environments with little competition 正課講義：Chap34 物種起源， page 112-113
32	Unit 7 植物學	The life cycle of plants，完全命中：Four key traits distinguish land plants 正課講義：Chap 30 植物多樣性， page 15 複習課程：Unit 7 Plant Biology, page 30
33	Unit 3 生物化學	Macromolecules，命中：Carbohydrates 正課講義：Chap 15 生物巨分子， page 13-20 複習課程：Unit 3 Biochemistry, page 3
34	Unit 1 細胞生物學	Primary active transport，完全命中：Sodium-potassium pump- the major electrogenic pump in animals, pumps two K^+ inside for every three Na^+ that it moves out 正課講義：Chap 2 細胞膜， page 35-36 複習課程：Unit 4 Molecular Biology, page 9
35	Unit 8 演化學	Fungi，命中：Fungi are heterotrophs that feed by absorption 正課講義：Chap 31 真菌， page 4-10 複習課程：Unit 8 Evolution, page 3
36	Unit 6 微生物免疫學	Viral diseases，完全命中：insect borne- Dengue virus；112清華後醫#13已出現過 正課講義：Chap27 微生物， page 129 講義圖片及上課版書補充 複習課程：Unit 6 Microbiology and Immunology, page 23
37	Unit 7 植物學	Plant hormones，完全命中：plant hormones control plant growth and development by affecting the division, elongation, and differentiation of cells 正課講義：Chap 29 植物訊號和行為， page 7-15 複習課程：Unit 7 Plant Biology, page 16-19

		第31-60題，二分題
38	Unit 8 演化學	Phylum Cnidaria，完全命中：**Nematocysts** are specialized organelles within cnidocytes that eject a stinging thread. 正課講義：Chap32 動物多樣性， page 31 複習課程：Unit 8 Evolution, page 8
39	Unit 4 分子生物學	Operon model，完全命中：The *lac* operon is under dual control: negative control by the *lac* repressor and positive control by CAP. 正課講義：Chap 23 基因表現控制， page 8-12 複習課程：Unit 4 Molecular Biology, page 34
40	Unit 7 植物學	Kranz anatomy is a specialized structure in C4 Plants where the mesophyll cells are clustered around the bundle-sheath cells in a ring-like fashion 正課講義：Chap 29 植物訊號和行為， page 128 複習課程：Unit 7 Plant Biology, page 29
41	Unit 1 細胞生物學	Prokaryotic- Bacteria and Archaea，完全命中：the DNA is concentrated in the **nucleoid**, without a membrane separating it from the rest of the cell. 正課講義：Chap 1 細胞構造和功能， page 10 複習課程：Unit 1 Cell Biology, page 3
42	Unit 9 生態學	Biodiversity，命中：Preserving biodiversity hot spots 正課講義：Chap38 生態系， page 71 複習課程：Unit 9 Ecosystems, page 12
43	Unit 6 微生物免疫學	Protists，完全命中：Protists are the most nutritionally diverse of all eukaryotes 正課講義：Chap27 微生物， page 190 複習課程：Unit 6 Microbiology and Immunology, page 26
44	Unit 1 細胞生物學	Peroxisome，命中：Microbodies contain enzymes for the breakdown of fats, alcohols and amino acids. 正課講義：Chap 1 細胞構造和功能， page 33

		第31-60題，二分題
45	Unit 9 生態學	Community interactions，完全命中：**Resource partitioning** is differentiation of ecological niches, enabling similar species to coexist in a community. 正課講義：Chap37 多樣性和群落， page 5 複習課程：Unit 9 Ecosystems, page 7
46	Unit 2 動物生理學	Circadian rhythm，完全命中：**Circadian rhythms** are daily cycles of biological activity that occur in organisms 正課講義：Chap 6 神經系統， page 35-36 複習課程：Unit 2 Animal Physiology, page 11
47	Unit 8 演化學	Chordates，完全命中：Reptiles- Amniotes are tetrapods that have a terrestrially adapted egg 正課講義：Chap32 動物多樣性， page 84 複習課程：Unit 8 Evolution, page 13
48	Unit 2 動物生理學	The inner ear contains the organs of equilibrium，完全命中：a vestibule with two chambers: the **utricle** and the **saccule**…the utricle is oriented horizontally and the saccule is positioned vertically 正課講義：Chap 7 感覺， page 48-49 複習課程：Unit 2 Animal Physiology, page 14
49	Unit 7 植物學	Photosystems in the thylakoid membrane，完全命中：Linear electron flow 正課講義：Chap 29 植物訊號和行為， page 120-122 複習課程：Unit 7 Plant Biology, page 26
50	Unit 2 動物生理學	Embryonic development，完全命中：human fertilization 正課講義：Chap 14 動物發育， page 4-9 複習課程：Unit 2 Animal Physiology, page 44

		第31-60題，二分題
51	Unit 5 生物科技	Genetically modified organisms， non-GMOs food-purple sweet potatoes 正課講義：Chap 24 DNA 科技， page 59-61 複習課程：Unit 5 Biotechnology, page 3
52	Unit 6 微生物免疫學	Bacteria virulence，完全命中：Endotoxins are lipopolysaccharide components of the outer membrane of some gram-negative bacteria 正課講義：Chap27 微生物， page 22； 111高醫後醫 複習課程：Unit 6 Microbiology and Immunology, page 15
53	Unit 7 植物學	Modified roots，完全命中：pneumatophore- air roots, mangroves 正課講義：Chap 28 植物構造和生長， page 20 複習課程：Unit 7 Plant Biology, page 3
54	Unit 6 微生物免疫學	Antigen-presenting cells (APC) ，完全命中：APC (B cells, dendritic cells or macrophages) have both class I and class II MHC molecules 正課講義：Chap27 微生物， page 105-106 複習課程：Unit 6 Microbiology and Immunology, page 10
55	Unit 6 微生物免疫學	Prokaryotes，完全命中：The comparison of archaea and bacteria 正課講義：Chap27 微生物， page 42 複習課程：Unit 6 Microbiology and Immunology, page 18
56	Unit 2 動物生理學	Tropic hormones regulation，完全命中：ACTH stimulates the production and secretion of steroid hormones by the adrenal cortex. 正課講義：Chap 12 排泄系統， page 49； 溫古知新#214 複習課程：Unit 2 Animal Physiology, page 33

		第31-60題，二分題
57	Unit 2 動物生理學	**Posterior pituitary** is an extension of the hypothalamus，完全命中：Neurosecretory cells of the hypothalamus synthesize two hormones: oxytocin and ADH. These hormones travel along the long axons of neurosecretory cells to the posterior pituitary, where they are stored and released in response to nerve impulses transmitted by the hypothalamus. 正課講義：Chap 10 內分泌， page 42-43 複習課程：Unit 2 Animal Physiology, page 33；溫古知新#47
58	Unit 2 動物生理學	Appetite control，完全命中：CCK- secreted by enteroendocrine cells in the duodenum, acts as a hunger suppressant. Peptide YY (PYY) -released by cells in the ileum and colon, response to feeding ; acts to reduce appetite 正課講義：Chap11 消化系統， page 98-100 複習課程：Unit 2 Animal Physiology, page 40
59	Unit 8 演化學	Fungi as Parasites，完全命中：The general term for a fungal infection in animals is mycosis. **Athlete's foot** are examples of human mycoses. 正課講義：Chap 31 真菌， page 35 複習課程：Unit 8 Evolution, page 6
60	Unit 8 演化學	Tree of Life，完全命中：Phylogenetic tree- evolutionary relationships 正課講義：Chap34 物種起源， page 6 複習課程：Unit 8 Evolution, page 19

生化概論

莊老師(施政安)老師提供

A.113 年度高醫後西醫試題命中分析

題號	講　　義	總復習	實戰解析
16	4-59 (Complex I)	p.8	T3-15
17	2-7 (ion exchanger)	-	-
18	1-319 (95年試題)	-	-
19	1-159 (PrP^{sc})	-	-
20	1-150 (farnesylation at Cys)	-	T1-24
21	1-233, 6-211 (nuclear receptor)	-	-
22	2-152 (uncompetitive inhibition)	p.20	-
23	6-5 (replication)	-	-
24	3-25 (cohesin)	-	-
25	6-38 (DNA Pol I)	p.39	-
26	3-76 (carbohydrate)	-	-
27	3-232 (G6Pase)	-	-
28	4-164 (HAT medium)	p.35	-
29	4-249~253 (cholesterol合成)	-	T1-23
30	4-258 (lipoprotein and Apo protein)	-	-
61	2-51 (protein sequencing)	-	-
62	6-211 (DNA-binding motif)	-	-
63	2-119 (Hb and Mb)	-	-
64	2-165 (allosterism)	-	-
65	3-242 (PPP)	-	-
66	none	-	-
67	3-6 (base)	-	-
68	3-216 (glycolysis)	-	-
69	3-84 (carbohydrate)	-	-
70	3-166 (glycolysis)	-	T2-18

題號	講　　義	總復習	實戰解析
71	4-218 (fatty acid 合成)	-	-
72	4-23 (TCA cycle)	-	T3-11
73	3-135 (eicosanoid)	-	-
74	4-187 (desaturation site)	-	-
75	5-47 (ketone bodies)	-	-
76	4-68 (β-oxidation)	p.30	-
77	5-25 (biotin)	p.22	-
78	4-192 (carnitine shuttle)	-	-
79	4-125 (PKU)	-	-
80	3-4 (topoisomerase)(**爭議**)	-	-
81	6-240 (DNA-protein interaction)	p.43	-
82	6-78 (BER)	p.55	-
83	none(**爭議**)	-	-
84	6-179 (SD sequence)	-	-
85	上課筆記(AMPK)	-	-
86	6-146 (transcription)	-	-
87	6-168 (translation)	-	-
88	6-171 (translation)	-	-
89	1-233 (zinc finger)	-	-
90	5-63 (insulin)	-	-

(註: ***符號含義***: 4-39 = 第四回講義第39頁; p.25 = 總復習講義第25頁;
T1-7 = 實戰解析試題Test one/第7題; T2-33 = 實戰解析試題
Test two/第33題; T3-2 = 實戰解析試題Test three/第2題)

B. 113 年度高醫後西醫試題爭議題分析

80. (E)也是錯的: relaxed DNA 不能和 supercoilic DNA 自由互變,
必須外力介入,例如 topoisomerase 之作用或 DNA helicase 的
向前推進才能產生 supercoilic DNA structure
故(C)(E)皆可選

83. 開始所得之 DNA 量通常會很少, 所以常先做 PCR, 把 DNA 量放大
後, 才夠去做 DNA sequencing. 故應選(A) polymerase chain reaction