第一部份 (80分) 選擇(單選題，不倒扣，請將答案寫在選擇題答案紙上)

Choose the best answer to each question. Write the letter for that answer to the left of the question number.

1. What characterizes a prokaryotic cell?
a) the presence of mitochondria
b) the lack of a membrane-enclosed nucleus
c) the presence of a nucleus with no DNA
d) the lack of ribosomes
e) having a cell wall without a cell membrane

2. All of the following observations and ideas are incorporated into Darwin's concept of natural selection EXCEPT
a) Individuals of a population vary.
b) Reproductive potential exceeds what the environment can support.
c) A change in the environment will create an appropriate, heritable adaptation during the lifetime of individuals coping with that environment.
d) Through natural selection, a population may adapt to the environment over many generations.
e) Members of a population are unequal in their potential for leaving offspring.

3. Which of the following is a trace element that is essential to humans?
a) nitrogen
b) calcium
c) iodine
d) carbon
e) oxygen

4. Which type of lipid is most important in biological membranes?
a) fats
b) steroids
c) phospholipids
d) oils
e) triglycerides

5. How does an enzyme catalyze a reaction?
a) by supplying the energy to speed up a reaction
b) by lowering the energy of activation of a reaction
c) by lowering the ΔG of a reaction
d) by changing the equilibrium of a spontaneous reaction
e) by increasing the amount of free energy of a reaction

6. Why is ATP an important molecule in metabolism?
a) It has high energy phosphate bonds.
b) Its phosphate bonds are easily made and broken.
c) Its hydrolysis is endergonic.
d) It is readily obtained from an organism's environment.
e) It is extremely stable.

7. Which organelle is involved in the synthesis of lipids?
a) ribosomes
b) lysosomes
c) smooth endoplasmic reticulum
d) mitochondria
e) contractile vacuoles

8. Cycloheximide is a drug that inhibits protein synthesis on 80S ribosomes. Chloramphenicol is a drug that inhibits protein synthesis on 70S ribosomes. Which of the following cells (or parts of cells) would have protein synthesis inhibited if they were grown in the presence of chloramphenicol?
a) bacteria
b) chloroplasts
c) mitochondria
d) Only a and c are correct.
e) a, b and c are correct.

9. Glycoproteins and glycolipids of animal cell membranes are most important for
a) facilitated diffusion of molecules down their concentration gradients.
b) active transport of molecules against their concentration gradients.
c) maintaining the integrity of a fluid mosaic membrane.
d) maintaining membrane fluidity at low temperatures.
e) the ability of cells to recognize like and different cells.

10. The sodium-potassium pump is called an electrogenic pump because it
a) pumps equal quantities of Na^+ and K^+ across the membrane.
b) pumps hydrogen ions into the cell.
c) contributes to the membrane potential.
d) ionizes sodium and potassium.
e) pumps hydrogen ions into the cell and contributes to the membrane potential.

11. What does chemiosmosis involve?
a) The diffusion of water down an electrochemical gradient that drives ATP synthesis.
b) A proton gradient that drives the redox reactions of electron transport.
c) A proton-motive force that drives the synthesis of ATP.
d) An ATP synthase that pumps protons across the inner mitochondrial membrane.
e) The uptake of NADH produced in glycolysis into the mitochondrion.

12. The majority of cacti are
a) C3 plants
b) C4 plants
c) CAM plants
d) Only a and b are correct.
e) a, b and c are correct.

13. Why are C_4 plants able to photosynthesize with no apparent photorespiration?
a) They have a different leaf morphology.
b) They use a more efficient enzyme to initially fix CO_2.
c) They are adapted to warmer, dryer climates.
d) They conserve water more efficiently.
e) They do not use the Calvin cycle.

14. Which of the following organisms does not reproduce cells by mitosis?
a) cow
b) bacterium
c) mushroom
d) cockroach
e) banana

15. How does the sexual life cycle increase the genetic variation in a species?
a) by producing gametes with different combinations of parental chromosomes
b) by allowing the combination of chromosomes from two different individuals
c) by allowing recombination of alleles on a chromosome
d) a and b only
e) a, b, and c

16. What is a karyotype?
a) the phenotype of an individual
b) the genotype of an individual
c) a unique combination of chromosomes found in a gamete
d) the blood type of an individual
e) a method of organizing the homologous chromosomes of a cell in relation to their number, size, and type

17. What is a genetic cross between a homozygous recessive individual and one of an unknown genotype?
a) a self-cross
b) a test-cross
c) a hybrid cross
d) an F/ cross
e) a dihybrid cross

18. What was the most significant conclusion that Gregor Mendel drew from his research?
a) There is considerable genetic variation in garden peas.
b) Traits are inherited in discrete units, one from each parent.
c) Dominant genes occur more frequently than recessive ones.
d) Genes are composed of DNA.
e) An organism that is homozygous for many recessive traits is at a disadvantage.

19. What do all males inherit from their mother?
a) mitochondrial DNA
b) X chromosome
c) male-pattern baldness trait
d) Only a and b are correct.
e) a, b and c are correct.

20. The frequency of crossing over between any two linked genes is
a) more likely if they are recessive.
b) difficult to predict.
c) determined by their relative dominance.
d) the same as if they were not linked.
e) proportional to the distance between them.

21. If cytosine makes up 22% of the nucleotides in a sample of DNA from an organism, then adenine would make up what percent of the bases?
a) 22
b) 44
c) 28
d) 56
e) It cannot be determined from the information provided.

22. Which of the following descriptions best fits the class of molecules known as nucleotides?
a) a nitrogen base and a phosphate group only
b) a nitrogen base and a five-carbon sugar only
c) a nitrogen base, a phosphate group, and a five-carbon sugar
d) a five-carbon sugar, a phosphate group, and a purine
e) a pyrimidine, a purine, and a six-carbon sugar

23. Which of the following is true for both prokaryotic and eukaryotic gene expression?
a) After transcription, a 3' poly A tail and a 5' cap are added to mRNA.
b) Translation of mRNA can begin before transcription is complete.
c) RNA polymerase may recognize a promoter region upstream from the gene.
d) mRNA is synthesized in the 3'→5' direction.
e) The mRNA transcript is the exact complement of the gene from which it was copied.

24. A frameshift mutation could result from
a) a base insertion only.
b) a base deletion only.
c) a base substitution only.
d) deletion of three consecutive bases.
e) either a base insertion or deletion.

25. Viruses have some of the properties of living organisms. Which of the following is a characteristic of all organisms, EXCEPT viruses?
a) genetic information stored as nucleic acid
b) ability to control metabolism
c) ability to reproduce
d) structure includes proteins
e) plasma membrane

26. In a hospital, a bacterium is isolated that is resistant to an antibiotic previously used against other kinds of bacteria. This is most likely the result of
a) transposition.
b) reverse transcription.
c) transduction.
d) transformation.
e) insertion.

27. The gene that stimulates tumorogenesis in Burkitt's lymphoma is expressed when it is moved to chromosome 14 from chromosome 8. This is an example of gene expression regulated by
a) diffusible factors.
b) gene amplification.
c) steroid hormones.
d) translocation.
e) point mutations.

28. It is theoretically possible to transfer a gene from any organism to any other organism. Why is this possible?
a) All organisms have the same genetic code.
b) All organisms are made up of cells.
c) All organisms have similar nuclei.
d) All organisms have ribosomes.
e) All organisms have transfer RNA.

29. The polymerase chain reaction is important because it allows us to
a) insert eukaryotic genes into prokaryotic plasmids.
b) incorporate genes into viruses.
c) make DNA from RNA transcripts.
d) make many copies of DNA.
e) insert regulatory sequences into eukaryotic genes.

30. What would be the best technique for determining the phylogenetic relationship among several closely related species?
a) examining the fossil record
b) comparison of homologous structures
c) comparative embryology
d) comparative anatomy
e) DNA analysis and protein comparison

31. The gene pool can best be described as the
a) group of genes not described by the Hardy-Weinberg theorem.
b) total number of gene loci that occur in each species.
c) total aggregate of genes in a population at any time.
d) group of genes responsible for polygenic traits.
e) genes only found in isolated populations.

32. Through time the movement of people on Earth has steadily increased. This has altered the course of human evolution by increasing
a) nonrandom reproduction.
b) geographical isolation.
c) genetic drift.
d) mutations.
e) gene flow.

33. Which of the following is the most likely pattern for the origin of species?
a) anagenesis
b) cladogenesis
c) phyletic evolution
d) spontaneous generation
e) inheritance of acquired characteristics

34. A rapid method of speciation that has been important in the history of flowering plants is
a) genetic drift.
b) parapatric speciation.
c) a mutation in the gene controlling the timing of flowering.
d) behavioral isolation.
e) polyploidy.

35. A randomly selected group of organisms from a family would show more genetic variation than a randomly selected group from a
a) class.
b) genus.
c) kingdom.
d) order.
e) phylum.

36. Which of the following can be a mechanism of macroevolution?
a) a change in a regulatory gene, which has a major impact on morphology
b) a change of the classification protocol from phenetic to cladistic
c) DNA-DNA hybridization
d) introgression
e) genetic drift

37. What is the evidence that protobionts may have formed spontaneously?
a) the discovery of ribozymes, showing that prebiotic RNA molecules may have been autocatalytic
b) the laboratory synthesis of microspheres, liposomes, and coacervates
c) the fossil record found in the Fig Tree Chart
d) the abiotic synthesis of polymers
e) the production of organic compounds within a laboratory apparatus simulating conditions on Earth

38. In what way is the complex process of photosynthesis similar to the simple reactions that are thought to have led to the origin of life on Earth?
a) Both involve an electron transport chain.
b) In both, simple molecules are reduced to form more complex organic molecules.
c) Both require light energy in order to proceed.
d) Oxygen is a byproduct of both types of reactions.
e) Both must occur within membrane-bound structures.

39. Prokaryotes have ribosomes different from those of eukaryotes. Because of this, which of the following is true?
a) Some selective antibiotics can block protein synthesis of bacteria without harming the eukaryotic host.
b) It is believed that eukaryotes did not evolve from prokaryotes.
c) Protein synthesis can occur at the same time as transcription in prokaryotes.
d) Some antibiotics can block the formation of cross links in the peptidoglycan walls of bacteria.
e) Prokaryotes are able to use a much greater variety of molecules as food sources.

40. Which of the following cause Red tides?
a) red algae (rhodophyta)
b) dinoflagellates
c) diatoms
d) Only a and c are correct.
e) a, b and c are correct

41. The strongest evidence for the endosymbiotic origin of eukaryotic organelles is the homology between extant prokaryotes and
a) nuclei and cloroplasts.
b) mitochondria and chloroplasts.
c) cilia and mitochondria.
d) ribosomes and nuclei.
e) ribosomes and cilia.

42. Fruits have contributed to the success of angiosperms by
a) nourishing the plants that make them.
b) facilitating dispersal of seeds by wind, animals, etc.
c) attracting insects to the pollen inside.
d) producing sperm and eggs inside a protective coat.
e) producing triploid cells via double fertilization.

43. Bryophytes have all of the following characteristics EXCEPT
a) multicellularity.
b) specialized cells and tissues.
c) well-developed vascular tissue.
d) a protected, stationary egg cell.
e) a reduced, dependent sporophyte.

44. In fungi, karyogamy does not immediately follow plasmogamy, which
a) means that sexual reproduction can occur in specialized structures.
b) results in more genetic variation during sexual reproduction.
c) allows fungi to reproduce asexually most of the time.
d) creates dikaryotic cells that may benefit from the presence of duplicate copies of alleles.
e) is necessary to create coenocytic hyphae.

45. Which of the following do all fungi have in common?
a) meiosis in basidia
b) coenocytic hyphae
c) sexual life cycle
d) absorption of nutrients
e) symbiosis with algae

46. Which of the following is a characteristic of echinoderms?
a) radial symmetry
b) spiral cleavage
c) incomplete digestive system
d) external skeleton
e) a lophophore

47. Which Molluscan class includes clams?
a) polyplacophora
b) bivalvia
c) cephalopoda
d) gastropoda
e) None of the above; clams are not mollusks.

48. What is one characteristic which separates chordates from all other animals?
a) true coelom
b) hollow dorsal nerve cord
c) blastopore, which becomes the anus
d) bilateral symmetry
e) segmentation

49. Which of the following is a feature that sets primates apart from all other mammals?
a) placental embryonic development
b) hairy bodies
c) naked faces
d) ability to produce milk
e) opposable thumbs

50. Which of the following is a difference between primary and secondary growth in plants?
a) Only primary growth is localized at meristems.
b) All plants do not have secondary growth.
c) Only stems have secondary growth.
d) Only secondary growth produces reproductive structures.
e) Monocots have only primary growth and dicots have only secondary growth.

51. Most of the water and minerals taken up from the soil by a plant are absorbed by
a) taproots.
b) root hairs.
c) the thick parts of the roots near the base of the stem.
d) storage roots.
e) sections of the root that have secondary xylem.

52. Hydrophytes, plants that are adapted to live in aquatic habitats, are most likely to show which of the following morphologies?
a) no vascular tissue
b) no roots
c) leaves reduced to spines
d) stomata located on the top of leaves
e) stomata located in pits

53. Capillarity is insufficient as the only hypothesis of xylem function because
a) the cohesion between water molecules is disrupted by xylem structure.
b) at one atmosphere water can be raised a distance of only 10.4 meters.
c) there is a limited adhesion to xylem vessel walls because of waxy layers.
d) the xylem vessels are too big in diameter for capillarity to be a potential explanation for the upward movement of water.
e) capillarity is purely a physical process and plants are biological.

54. The area of Asia where agriculture and cities first originated is now a desert. What is the most likely cause of this change?
a) tribal warfare
b) poor soil management
c) the "greenhouse effect"
d) widespread disease
e) change in world climate

55. A unique feature of fertilization in angiosperms is that
a) a chemical attractant guides the sperm nucleus toward the egg.
b) cross fertilization is common.
c) sperm do not swim.
d) it is a double fertilization.
e) All of the above are unique to angiosperms.

56. Morphogenesis in plants is largely a result of
a) genetic differences among the cell lineages involved.
b) the plane of cell divisions and the direction of cell expansion.
c) morphogens that create gradients in developing leaves.
d) Only b and c are correct.
e) a, b and c are correct.

57. All of the following may function in signal transduction in plants EXCEPT
a) calcium ions.
b) nonrandom mutations.
c) receptor proteins.
d) phytochrome.
e) second messengers.

58. In order to flower, what does a short-day plant need?
a) a burst of red light in the middle of the night
b) a burst of far red light in the middle of the night
c) a day that is longer than a certain length
d) a night that is longer than a certain length
e) a higher ratio of Pr:Pfr.

59. In a typical multicellular animal, the circulatory system interacts with specialized surfaces in order to exchange materials with the exterior environment. Which of the following is NOT an example of such an exchange surface?
a) lung
b) muscle
c) skin
d) intestine
e) kidney

60. Muscles are joined to bones by
a) ligaments.
b) tendons.
c) loose connective tissue.
d) Haversian systems.
e) positive feedback.

61. Which of the following is an advantage of a complete digestive system over a gastrovascular cavity?
a) Food items are retained longer.
b) Specialized regions are possible.
c) Digestive enzymes can be more specific.
d) Extensive branching is possible.
e) Intracellular digestion is easier.

62. Where do air breathing insects carry out gas exchange?
a) in specialized external gills
b) in specialized internal gills
c) in the alveoli of their lungs
d) across the membranes of cells
e) across the thin cuticular exoskeleton

63. In which animal does blood flow through vessels from the respiratory organ back to the heart before circulating through the rest of the body?
a) annelid
b) mollusc
c) fish
d) frog
e) insect

64. Jenner successfully used cowpox virus as a vaccine against a different virus that causes smallpox. Why was he successful even though he used viruses of different kinds?
a) The immune system responds nonspecifically to antigens.
b) The cowpox virus made antibodies in response to the presence of smallpox.
c) Cowpox and smallpox are antibodies with similar immunizing properties.
d) There are some antigenic determinants common to both pox viruses.
e) All of the above are true.

65. The clonal selection theory is an explanation for
a) how a single type of stem cell can produce both red blood cells and white blood cells.
b) how antibody proteins can be molded to fit antigens after the antigen interacts with an antibody-producing type of cell.
c) how an antigen can provoke development of very few cells to result in production of high levels of specific antibodies.
d) how the AIDS virus can disrupt the immune system.
e) how macrophages can recognize specific T cells and B cells.

66. Which of the following mechanisms would account for increased urine production as a result of drinking alcoholic beverages?
a) Increased aldosterone production
b) Increased blood pressure
c) Decreased amount of antidiuretic hormone
d) The proximal tubule reabsorbs more water
e) The osmoregulator cells of the brain increase their activity

67. Hormones are able to control homeostasis because
a) they are not produced by exocrine glands.
b) they are subject to negative feedback.
c) they may be found in the lymphatic system.
d) they are present at low concentrations.
e) they are steroids.

68. Which of the following is an endocrine gland?
a) parathyroid gland
b) salivary gland
c) sweat gland
d) hypothalamus
e) gall bladder

69. Embryonic hormone which maintains progesterone and estrogen secretion by the corpus luteum through the first trimester of pregnancy.
a) luteinizing hormone (LH)
b) follicle stimulating hormone (FSH)
c) progesterone
d) human chorionic gonadotropin (HCG)
e) gonadotropin releasing hormone (GnRH)

70. In a frog embryo, gastrulation
a) produces a blastocoel displaced into the animal hemisphere.
b) occurs along the primitive streak in the animal hemisphere.
c) is impossible because of the large amount of yolk in the ovum.
d) proceeds by involution as cells roll over the dorsal lip of the blastopore.
e) occurs within the inner cell mass that is embedded in the large amount of yolk.

71. In the "chain of inductions" to form the lens, cornea, and retina of the eye, which tissue is the primary inducer (i.e., the tissues that starts the whole sequence of events)?
a) notochord
b) mesoderm
c) ectoderm
d) lens vesicle
e) optic cup

72. After an action potential, how is the resting potential restored?
a) the opening of sodium activation gates
b) the opening of voltage-sensitive potassium channels and the closing of sodium activation gates
c) an increase in the membrane's permeability to potassium and chloride ions
d) the delay in the action of the sodiumpotassium pump
e) the refractory period in which the membrane is hyperpolarized

73. Animals perceive their world in a variety of ways, many of them very different from human perception. What is the primary reason for these differences?
a) Animals differ in morphological complexity.
b) Animals differ in size.
c) Animals that are adapted perceive what they need for survival.
d) Animals that are adapted perceive the strongest signals from around them.
e) Animals have different reproductive methods.

74. All of the following are correct statements about the vertebrate eye EXCEPT
a) The vitreous humor regulates the amount of light entering the pupil.
b) The transparent cornea is an extension of the sclera.
c) The fovea is the center of the visual field and contains only cones.
d) The ciliary muscle functions in accommodation.
e) The retina lies just inside the choroid and contains the photoreceptor cells.

75. Organisms respond to environmental changes (such as global warming) in several ways. Which response is the slowest, and thus least likely in the event of rapid environmental change?
a) physiological adaptation
b) morphological adaptation
c) migration
d) evolutionary adaptation
e) behavioral adaptation

76. Which of the following is characteristic of an opportunistic species?
a) usually one reproductive episode per lifetime with many offspring
b) extensive homeostatic capability to deal with environmental fluctuations
c) long maturation time and long generation time
d) large body size and large offspring or eggs
e) several reproductive episodes with parental care provided to offspring

77. The following factors were found to limit the distribution of fish populations: temperature, oxygen content of the water, free protein in the water. This is a
a) dimensional profile.
b) mutualistic niche.
c) realized niche.
d) resource profile.
e) fundamental niche.

78. If the flow of energy in an Arctic ecosystem goes through a simple food chain from seaweeds to fish to seals to polar bears, then which of the following is true?
a) Polar bears could provide more food for Eskimos than seals could.
b) The total energy content of the seaweeds would be lower than that of the seals.
c) Polar bear meat would probably contain the highest concentrations of fat-soluble toxins.
d) Seals would be more numerous than fish.
e) The carnivores could provide more food for the Eskimos than the herbivores could.

79. In which cycle are bacteria important for processes other than decomposition?
a) nitrogen cycle
b) hydrologic cycle
c) carbon cycle
d) phosphorous cycle
e) energy cycle

80. It is difficult for humans to study the behavior of other animals for all of the following reasons EXCEPT
a) human information processing is different from other animals.
b) other animals' behavior seems to resemble human behavior.
c) we perceive our world with sensory organs more or less unlike those of other animals.
d) humans can manipulate tools and other animals cannot.
e) humans have more learned behavior than other animals.

第二部份 (20分) 問答

在原野生長開黃花的植物之中，有一區都開了白花。如何知道白色的花是由於遺傳的變異，抑或受了某種環境或病毒的感染？又某人從小就患有一種不常見的皮膚病，如何推測這是先天性或者後天性的病因？請分別提出你認為應作的研究，說明理由、基本方法和可靠性。