※答案一律依序寫在試卷上並標明題號，不可寫在試題紙上，否則不予計分。

I. Multiple Choice questions (75%, 1.5 points each)

1. Which of the following are properties of ALL life forms?
   1. heritable programs in the form of DNA 2. photosynthesis 3. growth and development
   a. 1 b. 2 c. 3 d. Only 1 and 3 are correct. e. 1, 2, and 3 are correct.

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

3. Which of the following statements best summarizes structural differences between DNA and RNA?
   a. RNA is a protein while DNA is a nucleic acid. b. DNA is not a polymer, but RNA is.
   c. DNA contains a different sugar than RNA. d. RNA is a double helix, but DNA is not.
   e. DNA has different purine bases than RNA.

4. 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.

5. Which of the following contains the 9+2 arrangement of microtubules?
   a. cilia b. centrioles c. basal bodies d. microfilaments e. nuclei

6. Which of the following does NOT contain functional ribosomes?
   a. a prokaryotic cell b. a plant mitochondrion c. a chloroplast
   d. an animal mitochondrion e. a nucleus

7. All of the following cellular activities require ATP energy EXCEPT
   a. movement of O 2 into the cell. b. protein synthesis.
   c. Na^+ ions moving out of the cell. d. cytoplasmic streaming.
   e. exocytosis.

8. All of the following are functions of membrane proteins EXCEPT
   a. enzyme synthesis. b. active transport. c. hormone reception.
   d. cell adhesion. e. cytoskeleton attachment.

9. The primary function of the mitochondrion is the production of ATP.
   To carry out this function, the mitochondrion must have all of the following EXCEPT
   a. the membrane-bound electron transport chain. b. proton pumps embedded in the inner membrane.
   c. enzymes for glycolysis. d. enzymes for the Krebs cycle. e. mitochondrial ATP synthase.

(背面仍有題目,請繼續作答)

10. In C_4 photosynthesis, carbon fixation takes place in the _____ cells, and then is transferred as malic or aspartic acid to _____ cells where carbon dioxide is released for entry into the Calvin cycle.
a. mesophyll; bundle sheath b. stomatal; mesophyll c. bundle sheath; epidermal
d. epidermal; mesophyll e. stomatal; epidermal

11. Measurements of the amount of DNA per nucleus were taken on a large number of cells from a growing fungus. The measured DNA levels ranged from 3 to 6 picograms per nucleus. One nucleus had 5 picograms of DNA. What stage of the cell cycle was this nucleus in?
a. G0 b. G1 c. S d. G2 e. M

12. 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.

13. A man is brought to court in a paternity case. He has blood type B, Rh positive. The mother has blood group B, Rh negative. The child's blood type is A, Rh negative. The woman's male secretary has a blood type of A, Rh positive. What can you say about the chances of the male secretary being the father?
a. He is the father. b. He might be the father. c. He is not the father.
d. He is almost certainly the father. e. There is not enough information to make a decision.

14. In birds, sex is determined by a ZW chromosome scheme. Males are ZZ and females are ZW. A lethal recessive allele that causes death of the embryo occurs on the Z chromosome in pigeons. What would be the sex ratio in the offspring of a cross between a male heterozygous for the lethal allele and a normal female?
a. 2:1 male to female b. 1:2 male to female c. 1:1 male to female
d. 4:3 male to female e. 3:1 male to female

15. The problem of replicating the lagging strand—that is, adding bases in the 3'→5' direction—is solved by DNA through the use of
a. base-pairing. b. replication forks. c. the unwinding enzyme, helicase.
d. Okazaki fragments. e. topoisomerases.

16. Which of the following is FALSE?
a. Transcriptionally produced gene products are molecules of RNA.
b. Proteins are translated in the cytoplasm.
c. Steroid hormones may bind directly to DNA and regulate expression.
d. Histones are found only in eukaryotic chromosomes.
e. RNA polymerase attaches to DNA at the promoter sequence.

17. The "central dogma" of molecular genetics is a statement describing the flow of information in a cell DNA makes RNA, which makes proteins. This path is not reversible. The exception to part of this statement seems to be
a. retroviruses. b. temperate phages. c. herpesviruses.
d. tumor viruses. e. all viruses.

18. A eukaryotic gene typically has all of the following features EXCEPT
a. introns. b. a promoter. c. an operator.
d. a start base triplet. e. a transcriptional stop message.

19. A DNA fingerprint was produced by
1. treating selected segments of DNA with restriction enzymes.
2. electrophoresis of restriction fragments. 3. oligonucleotides from PCRs.
4. electroporation of cDNAs.
a. 1 b. 2 c. 3 d. 4 e. Both 1 and 2 are correct.

20. Anatomical structures that show similar function but dissimilar embryonic and evolutionary background are said to be
a. homologous. b. primitive. c. analogous. d. monophyletic. e. polyphyletic.

21. In a population that is in Hardy-Weinberg equilibrium, the frequency of the allele "a" is 0.3. What is the percentage of the population that is heterozygous for this allele?
a. 3 b. 9 c. 21 d. 30 e. 42

22. Which of the following reproductive isolating mechanisms is postzygotic?
a. habitat isolation b. temporal isolation c. hybrid sterility
d. behavioral isolation e. gamete incompatibility

23. 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

24. The antibiotics known as penicillins inhibit the ability of bacteria to
a. form spores. b. perform respiration. c. replicate DNA.
d. synthesize proteins. e. synthesize cell walls.

25. Which of the following statements about prokaryotes is CORRECT?
a. Bacterial cells conjugate to mutually exchange genetic material.
b. Their genetic material is confined within a nuclear envelope.
c. They divide by binary fission rather than mitosis or meiosis.
d. The persistence of bacteria through time is due to metabolic similarity.
e. Genetic variation in bacteria arises from their geometric growth rates.

(背面仍有題目,請繼續作答)

26. Which of the following cause red tides?
a. red algae (Rhodophyta) b. dinoflagellates c. diatoms
d. Only red algae (Rhodophyta) and diatoms
e. red algae (Rhodophyta), dinoflagellates, and diatoms

27. A botanist discovers a new species of plant in a tropical rainforest. After observing its anatomy and life cycle, the following characteristics are noted: flagellated sperm, xylem with tracheids, separate gametophyte and sporophyte phases, and no seeds. This plant is probably most closely related to
a. mosses. b. conifers. c. ferns. d. liverworts. e. flowering plants.

28. 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. symbioses with algae

29. All of the following animal groups have evolved terrestrial life forms EXCEPT
a. Mollusca. b. Crustacea. c. Echinodermata. d. Arthropoda. e. Vertebrata.

30. Which one of the following has a two-chambered heart?
a. Osteichthyes b. Amphibia c. Reptilia d. Aves e. Mammalia

31. Which of the following are primary meristems?
a. procambium b. protoderm c. ground meristem
d. procambium and ground meristem e. procambium, protoderm, and ground meristem

32. The water within xylem vessels moves toward the top of a tree as a result of
a. active transport of ions into the stele. b. atmospheric pressure on roots.
c. evaporation of water through stoma. d. the force of root pressure.
e. osmosis in the root.

33. Why is nitrogen fixation such an important process?
a. Nitrogen fixation can only be done by certain prokaryotes.
b. Fixed nitrogen is most often the limiting factor in plant growth.
c. Nitrogen fixation is very expensive in terms of metabolic energy.
d. Nitrogen fixers are sometimes symbiotic with legumes.
e. Nitrogen fixing capacity can be genetically engineered.

34. Which developmental process transforms a fertilized egg into a plant?
a. growth b. morphogenesis c. cellular differentiation
d. growth and cellular differentiation e. growth, morphogenesis, and cellular differentiation

35. The application of which of the following hormones would be a logical first choice in an attempt to produce normal growth in mutant dwarf plants?
a. indoleacetic acid b. cytokinin c. gibberellin d. abscisic acid e. ethylene

36. Cartilage is described as which of the following types of tissues?
a. connective b. reproductive c. nervous d. epithelial e. adipose

37. A structure that produces no digestive secretions of any kind is the
a. duodenum. b. pancreas. c. salivary gland. d. gallbladder. e. liver.

38. Which of the following sequences does NOT incidate a direct pathway that blood might follow in mammalian circulation?
a. left ventricle aorta b. right ventricle pulmonary vein c. pulmonary vein left atrium
d. vena cava right atrium e. right ventricle pulmonary artery

39. A major difference between active and passive immunity is that active immunity requires
a. acquisition and activation of antibodies. b. proliferation of lymphocytes in bone marrow.
c. transfer of antibodies from the mother across the placenta.
d. direct exposure to a living or simulated disease organism.
e. secretion of interleukins from macrophages.

40. Injection of which of the following substances into the blood would NOT produce a change in the osmoregulatory activity of the human kidney?
a. aldosterone b. antidiuretic hormone c. angiotensin II d. angiotensinogen e. renin

41. A varying response to a common chemical messenger is possible because
a. various target cells have different genes.
b. each cell knows how it fits into the body's master plan.
c. various target cells differ in their receptors to the same hormone.
d. the circulatory system regulates responses to hormones by routing the hormones to specific targets.
e. the hormone is chemically altered in different ways as it travels through different branches of the circulatory system.

42. All of the following statements about hormones are correct EXCEPT:
a. They are produced by endocrine glands. b. They travel to different areas of the body.
c. They are carried by the circulatory system.
d. They are used to communicate between different individuals.
e. They elicit specific biological responses from target cells.

43. Which of the following is mismatched?
a. mesoderm—notochord b. endoderm—lungs c. ectoderm—liver
d. mesoderm—somites e. ectoderm—eye

44. In the sequence of permeability changes that depolarizes and then repolarizes the membrane of a neuron during an action potential, which of the following changes occurs first?
a. Sodium gates open. b. The Na^+-K^+ pump shuts down. c. The Na^+-K^+ pump is activated.
d. Potassium gates close. e. Potassium gates open.

(背面仍有題目,請繼續作答)

45. Which of the following are shared by skeletal, cardiac, and smooth muscle?
a. A bands and I bands b. transverse tubules c. gap junctions
d. motor units e. thick and thin filaments

46. 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

47. To measure the population density of monarch butterflies occupying a particular park, 100 butterflies are captured, marked with a small dot on a wing, and then released. The next day, another 100 butterflies are captured, including the recapture of 20 marked butterflies. One would correctly estimate the population to be a. 200. b. 500. c. 1,000. d. 10,000. e. 900,000.

48. According to the competitive exclusion principle, two species cannot continue to occupy the same
a. habitat. b. niche. c. territory. d. range. e. biome.

49. Which of these ecosystems has the highest primary productivity per square meter?
a. savanna b. open ocean c. boreal forest d. tropical rain forest e. temperate forest

50. A type of learning that can occur only during a brief period of early life and results in a behavior that is difficult to modify through later experiences is called
a. insight. b. imprinting. c. habituation. d. operant conditioning.
e. trial-and-error learning.

II. Matching questions (25%, 1 point each)

1. Match the key event of meiosis with the stages listed below to answer questions 1.1-1.4.

I. Prophase I VI. Prophase II
II. Metaphase I VII. Metaphase II
III. Anaphase I VIII. Anaphase II
IV. Telophase I IX. Telophase II
V. Interkinesis

1.1 Tetrads of chromosomes are align at the center of the cell; independent assortment soon follows.
a. I b. II c. III d. VI e. VIII

1.2 Synapsis of homologous pairs occurs; crossing over may occur.
a. I b. II c. IV d. VI e. VII

1.3 Nuclear envelopes may form; no replication of chromosomes takes place.
a. III b. V c. VI d. VII e. VIII

1.4 Centromeres of sister chromatids uncouple and chromatids separate.
a. II b. III c. VI d. VII e. VIII

2. Match the labeled components of the cell membrane (Figure 1) with its description in 1.1-1.5

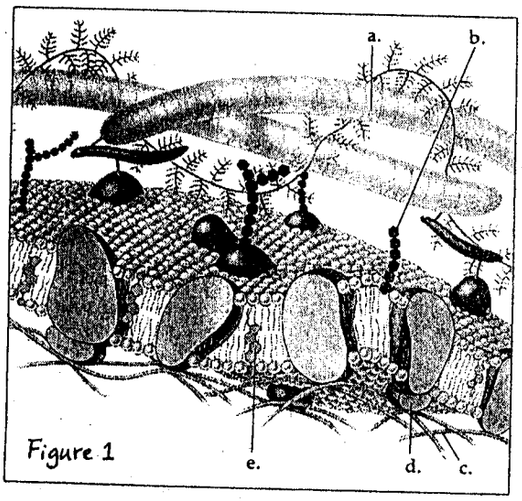

Figure 1

2.1 Peripheral protein.
2.2 Cholesterol.
2.3 Fiber of the extracellular matrix.
2.4 Filament of the cytoskeleton.
2.5 Glycolipid.

3. Refer to the simple metabolic pathway below to answer the questions 3.1-3.5.

enzyme a enzyme b
A - - - - - - - - - - - - - - > B - - - - - - - - - - - > C

3.1 According to Beadle and Tatum's one gene – one polypeptide theory, at least _____ gene(s) is (are) necessary for this pathway.
a. 0 b. 1 c. 2 d. 3 e. It cannot be determined from the pathway.

3.2 A mutation results in a defective enzyme a. Which of the following would be a consequence?
a. an accumulation of A and no production of B and C
b. an accumulation of A and B and no production of C
c. an accumulation of B and no production of A and C
d. an accumulation of B and C and no production of A
e. an accumulation of C and no production of A and B

3.3 One strain of a diploid organism is homozygous for a recessive allele coding for a defective enzyme a. Another strain is homozygous for a recessive allele coding for a defective enzyme b. Crossing those two strains will result in a strain that would grow on which of the following?
a. All of these are correct. b. a minimal medium (supplying A)
c. a minimal medium (supplying A), supplemented with B
d. a minimal medium (supplying A), supplemented with C
e. a minimal medium (supplying A), supplemented with B and C

(背面仍有題目,請繼續作答)

4. Answer questions 4.1-4.4 by referring to Figure 2, which is based on the drawing of root or stem cross sections.

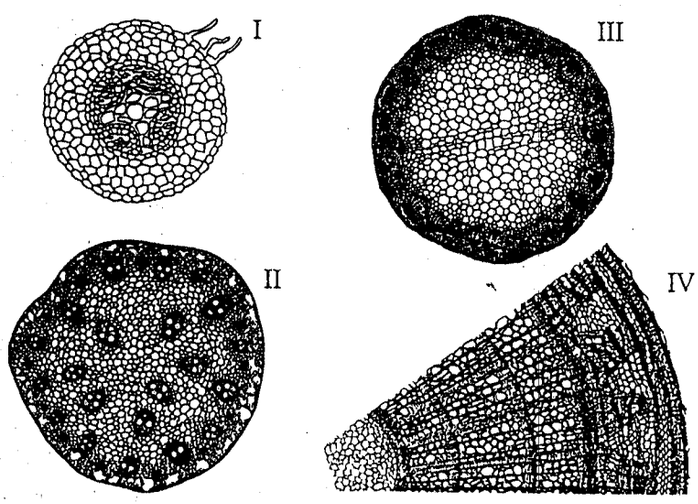

Figure 2

4.1 Endodermis is present in
a. I only b. II only c. III only d. IV only e. both I and III

4.2 A woody dicot is represented by
a. I only b. II only c. III only d. IV only e. both I and III

4.3 A monocot stem is represented by
a. I only b. II only c. III only d. IV only e. both I and III

4.4 A plant that is at least three years old is represented by
a. I only b. II only c. III only d. IV only e. both I and III

5. Choose the term from the list below that best fits each of the descriptions in 5.1-5.4. Each term may be used once, more than once, or not at all.

a. luteinizing hormone (LH) b. follicle-stimulating hormone (FSH) c. progesterone
d. human chorionic gonadotropin (HCG) e. gonadotropin-releasing hormone (GnRH)

5.1 Embryonic hormone which maintains progesterone and estrogen secretion by the corpus luteum through the first trimester of pregnancy.

5.2 Triggers ovulation of the secondary oocyte.

5.3 Hormone produced by the corpus luteum when stimulated by LH.

5.4 Hypothalamic hormone which triggers the secretion of FSH.

6. Use Figure 3 to answer questions 6.1-6.5. Examine this food web for a particular terrestrial ecosystem. Each number is a species. The arrows represent energy flow.

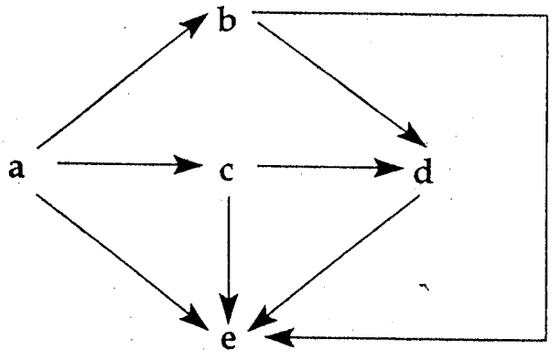

Figure 3

6.1 Which species is autotrophic? a. 1 b. 2 c. 3 d. 4 e. 5

6.2 Which species is most likely the decomposer? a. 1 b. 2 c. 3 d. 4 e. 5

6.3. A toxic pollutant would probably reach its highest concentration in which species?
a. 1 b. 2 c. 3 d. 4 e. 5

6.4 Species 3 makes its predators sick. Which species is most likely to benefit from being a mimic of 3? a. 1 b. 2 c. 3 d. 4 e. 5

6.5 Excluding the decomposer, biomass would probably be smallest for which species?
a. 1 b. 2 c. 3 d. 4 e. 5