I. Select the best one: 80%

1. Which of these individuals is most likely to be successful in an evolutionary sense?
   (A) a reproductively sterile individual who never falls ill
   (B) an individual who dies after 5 days of life but leaves 10 offspring, all of whom survive to reproduce
   (C) a male who mates with 20 females and fathers 1 offspring
   (D) an individual who lives 100 years and leaves 2 offspring, both of whom survive to reproduce
   (E) a female who mates with 20 males and produces 1 offspring

2. Hormone X produces its effect in its target cells via the cAMP second messenger system. If you expose a target cell to only a single molecule, which of the following will produce the greatest effect?
   (A) a molecule of hormone X injected into the cytoplasm of the cell
   (B) a molecule of cAMP injected into the cytoplasm of the cell
   (C) a molecule of hormone X applied to the extracellular fluid surrounding the cell
   (D) a molecule of activated, cAMP-dependent protein kinase injected into the cytoplasm of the cell
   (E) a molecule of cAMP applied to the extracellular fluid surrounding the cell

3. When a potassium ion (K^+) passes from the soil into the vacuole of a root cell, it encounters some cellular barriers. Which of the following is the most direct path the K+ would take through these barriers?
   (A) secondary cell wall rightarrow plasma membrane rightarrow thylakoid
   (B) primary cell wall rightarrow secondary cell wall rightarrow tonoplast
   (C) primary cell wall rightarrow plasma membrane rightarrow tonoplast
   (D) cell wall rightarrow plasma membrane rightarrow tonoplast rightarrow grana
   (E) cell wall rightarrow plasma membrane rightarrow grana

4. All of the following statements about membrane structure and function are true except:
   (A) Diffusion of gases is faster in air than across membranes.
   (B) Diffusion, osmosis, and facilitated diffusion do not require any energy input from the cell.
   (C) Both sides of a membrane are identical in structure and function.
   (D) Voltage across the membrane depends on an unequal distribution of ions across the plasma membrane.
   (E) Special membrane proteins can cotransport two solutes by coupling diffusion with active transport.

(背面仍有題目,請繼續作答)

5. An organism is discovered that consumes a considerable amount of sugar, yet does not gain much weight when denied air. Curiously, the consumption of sugar increases as air is removed from the organism's environment, but the organism seems to thrive even in the absence of air. When returned to normal air, the organism does fine. Which of the following best describes the organism?

(A) It must use a molecule other than oxygen to accept electrons from the electron transport chain.

(B) It is a normal eukaryotic organism.

(C) The organism obviously lacks the Krebs cycle and electron transport chain.

(D) It is an anaerobic organism.

(E) It is a facultative anaerobe.

6. Why are C4 plants able to photosynthesize with no apparent photorespiration?

(A) They do not participate in the Calvin cycle.

(B) They use PEP carboxylase to initially fix CO_2.

(C) They are adapted to cold, wet climates.

(D) They conserve water more efficiently.

(E) They exclude oxygen from their tissues.

7. In general, a signal transmitted via phosphorylation of a series of proteins

(A) brings a conformational change to each protein.

(B) requires binding of a hormone to a cytosol receptor.

(C) cannot occur in yeasts because they lack protein phosphatases.

(D) always results in enzyme activation inside the target cell.

(E) allows target cells to change their shape and therefore their activity.

Use the data in Table 1 to answer the following questions.

The data below were obtained from a study of the length of time spent in each phase of the cell cycle by cells of three eukaryotic organisms, designated beta, delta, and gamma.

Table 1: Minutes Spent in Cell Cycle Phases

Cell Type	G_1	S	G_2	M
Beta	18	24	12	16
Delta	100	0	0	0
Gamma	18	48	14	20

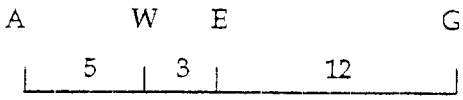
8. Of the following, the best conclusion concerning the difference between the S phases for beta and gamma is that
   (A) gamma contains more DNA than beta.
   (B) beta and gamma contain the same amount of DNA.
   (C) beta contains more RNA than gamma.
   (D) gamma contains 48 times more DNA and RNA than beta.
   (E) beta is a plant cell and gamma is an animal cell.

9. You are genetically unique. This is at least in part a result of
   (A) random fertilization.
   (B) genetic recombination.
   (C) independent assortment of chromosomes.
   (D) both A and C.
   (E) A, B, and C.

Use the following information to answer the questions below. A woman and her spouse both show the normal phenotype for pigmentation, but both had one parent who was an albino. Albinism is an autosomal recessive trait.

10. What is the probability that their first child will be an albino?
    (A) 0　(B) 1/4　(C) 1/2　(D) 3/4　(E) 1

11. The following is a map of four genes on a chromosome:



Between which two genes would you expect the highest frequency of recombination?
(A) A and W　(B) W and E　(C) E and G　(D) A and E　(E) A and G

Use Figure 1 to answer the following questions.

12. In the late 1950s Meselson and Stahl grew bacteria in a medium containing "heavy" nitrogen (15N) and then transferred them to a medium containing 14N. Which of the results in Figure 1would be expected after one DNA replication in the presence of 14N?

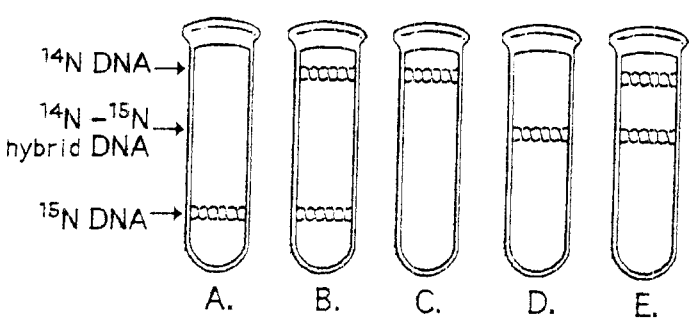


Figure 1

(背面仍有題目，請繼續作答)

For the following questions, each of the following is a modification of the sentence THECATATETHERAT.

13. Which of the above is analogous to a frameshift mutation?

(A) THERATATETHECAT

(B) THETACATETHERAT

(C) THECATARETHERAT

(D) THECATATTHERAT

(E) CATATETHERAT

14. If a cell were unable to produce histone proteins, which of the following would be expected?

(A) There would be an increase in the amount of "satellite" DNA produced during centrifugation.

(B) The cell's DNA couldn't be packed into its nucleus.

(C) Spindle fibers would not form during prophase.

(D) The amplification of other protein genes would compensate for the lack of histones.

(E) Pseudogenes would be transcribed to compensate for the decreased protein in the cell.

15. The DNA of a cell is like a library. The books of a library are analogous to genes, and the sections of a library are analogous to chromosomes. Which of the following would not be a library activity analogous to a function of biotechnology?

(A) finding a particular book in the library

(B) moving a book from one library to another

(C) reading and understanding the contents of a book

(D) identifying a library by the books that it has

(E) returning books that had been checked out

16. The cloning of a plant from somatic cells is consistent with the view that

(A) differentiated cells retain all the genes of the zygote.

(B) genes are lost during differentiation.

(C) the differentiated state is normally very unstable.

(D) differentiated cells contain masked mRNA.

(E) cells can be easily reprogrammed to differentiate and develop into another kind of cell.

17. Linnaeus' concept of taxonomy is that the more closely two organisms resemble each other, the more closely related they are in a classification scheme. In evolutionary terms, the more closely related two organisms are, the
(A) more similar their habitats are.
(B) less similar their DNA sequences are.
(C) more recently they shared a common ancestor.
(D) less likely they are to be related to fossil forms.
(E) more similar they are in size.

18. In a large, sexually reproducing population, the frequency of an allele changes from 60% to 20%. From this change, one can most logically assume that, in this environment,
(A) random processes have changed allelic frequencies.
(B) the allele reduces fitness.
(C) the allele is linked to a detrimental allele.
(D) the allele mutates readily.
(E) there is no sexual selection.

19. Plant species A has a diploid number of 8. A new species, B, arises as an autopolyploid from A. The diploid number of B would probably be
(A) 32. (B) 4. (C) 64. (D) 8. (E) 16.

20. Nucleic acid sequences that undergo few changes over the course of evolutionary time are said to be conserved. Conserved nucleic acids should
(A) be proportionately more common in eukaryotic introns than in eukaryotic exons.
(B) comprise a larger proportion of pre-mRNA (immature mRNA) than of mature mRNA.
(C) include all mitochondrial DNA.
(D) be found in the most crucial portions of proteins.
(E) be abundant in ribosomes.

21. What is the correct sequence of these events, from earliest to most recent, in the evolution of life on Earth?
1. origin of mitochondria
2. origin of multicellular eukaryotes
3. origin of chloroplasts
4. origin of cyanobacteria
5. origin of fungal/plant symbioses
(A) 4, 3, 2, 1, 5 (B) 3, 4, 1, 2, 5 (C) 4, 3, 1, 5, 2 (D) 4, 1, 2, 3, 5 (E) 4, 3, 1, 2, 5

(背面仍有題目，請繼續作答)

22. "By studying modern prokaryotic organisms, we can be absolutely certain of how metabolic pathways evolved." This statement is
(A) false, because we have no evidence of ancient metabolic pathways.
(B) true, because both ancient and modern prokaryotes have few enzymes.
(C) false, because our understanding of early metabolic pathways must always be hypothetical.
(D) impossible to evaluate, because ancient prokaryotes are all dead.
(E) true, because all the fossil evidence indicates that ancient prokaryotes were much like modern prokaryotes.

23. You are given an unknown organism to identify. It is unicellular and heterotrophic. It is motile, using many short extensions of the cytoplasm, each featuring the 9+2 pattern. It has well-developed organelles and three nuclei, one large and two small. This organism is most likely to be a member of which taxon?
(A) kinetoplastids (B) rhizopods (C) water molds (D) actinopods (E) ciliates

24. A botanist discovers a new species of plant with a dominant sporophyte, chlorophyll a and b, and a cell wall made of cellulose. In assigning this plant to a division, all of the following would provide useful information except whether or not the plant has
(A) seeds. (B) flowers. (C) endosperm. (D) starch. (E) flagellated sperm.

25. You are given an organism to identify. It has a fruiting body that contains many "sacs" with eight haploid spores lined up in a row. What kind of a fungus is it most likely to be?
(A) zygomycete (B) basidiomycete (C) deuteromycete (D) chytridiomycete
(E) ascomycete

26. What kind of data should probably have the greatest impact on animal taxonomy in the coming decades?
(A) comparative morphology of living species
(B) nucleotide sequences of homologous genes
(C) similarities in metabolic pathways
(D) fossil evidence
(E) the number and size of chromosomes within nuclei

27. A species of terrestrial animal is discovered with the following characteristics: exoskeleton; tracheal system for gas exchange; modified segmentation. A knowledgeable zoologist would predict that its adults probably also would have
(A) a water vascular system. (B) eight legs. (C) a sessile lifestyle. (D) parapodia. (E) wings.

The following questions refer to the phylogenetic tree shown in Figure 2

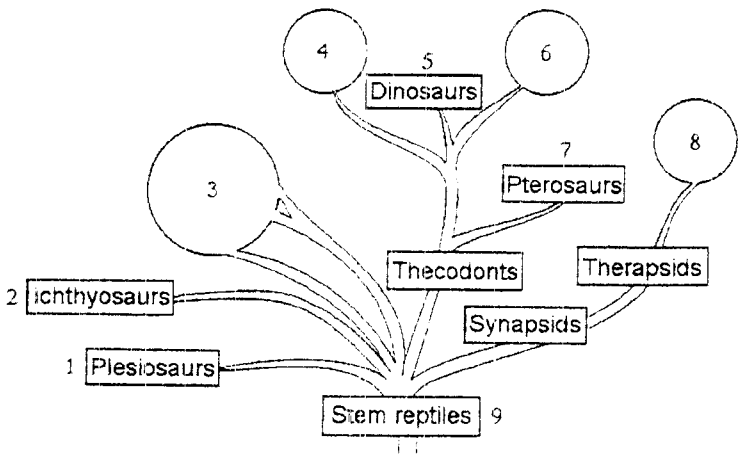


Figure 2

28. The organisms represented by 8 most likely are (Figure 2)

(A) flying reptiles. (B) all mammals except humans. (C) all mammals. (D) birds. (E) modern reptiles.

29. A short branch was cut into three segments as shown in Figure 3 to root some cuttings. Roots will form at which position(s)?

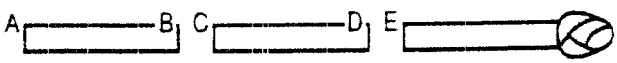


Figure 3

(A) A only (B) A and B (C) A, B, and C (D) A, C, and E (E) A, B, C, D, and E

30. Which of the following would have an effect on water potential (Psi) in plants?

(A) air pressure

(B) dissolved solutes

(C) water-attracting matrices

(D) A and C only would have an effect.

(E) A, B, and C would have an effect.

31. Hyphae form a covering over roots. Altogether, these hyphae create a large surface area that helps to do which of the following?

(A) increase cellular respiration

(B) anchor a plant

(C) protect the roots from ultraviolet light

(D) maintain cell shape

(E) aid in absorbing minerals and ions

(背面仍有題目,請繼續作答)

32. If you were shipping green bananas to a supermarket in Boston, which of the following chemicals would you want to eliminate from the plants' environment?
(A) CO_2 (B) gibberellic acids (C) auxin (D) cytokinins (E) ethylene

33. All of the following are adaptations to an herbivorous diet except
(A) a rumen. (B) ingestion of feces. (C) bile salts. (D) amylase. (E) broad, flat teeth.

34. Which one of these statements about lungs is false?
(A) Gas exchange takes place across moist membranes.
(B) The concentration of CO2 is higher in the air than in the alveolar capillaries.
(C) The lining of the alveoli is only one cell thick.
(D) The gases move across the exchange membranes by diffusion.
(E) The total exchange surface area is relatively large.

35. Which of the following would be most beneficial in treating an individual who has been bitten by a poisonous snake that has a fast-acting toxin?
(A) injection of interferon
(B) injection of antibodies to the toxin
(C) injection of interleukin-2
(D) vaccination with a weakened form of the toxin
(E) injection of interleukin-1

36. Compared to the seawater around them, most marine bony fishes are correctly described by which of the following?
I. hypertonic
II. hypotonic
III. isotonic
(A) I only (B) II only (C) III only (D) I and III only (E) II and III only

37. If the release of LH were inhibited in a human female, which of the following events would not occur?
(A) ovulation of a secondary oocyte
(B) release of FSH from the pituitary
(C) production of estrogen by follicle cells
(D) maturation of a primary follicle and oocyte
(E) release of GnRH from the hypothalamus

38. The development of the experimental technique leading to fate maps was a serious blow to which idea?

(A) morphogenesis

(B) preformationism

(C) involution

(D) epigenesis

(E) induction

39. A drug might act as a stimulant of the somatic nervous system if it

(A) increases the sensitivity of the postsynaptic membrane to acetylcholine.

(B) stimulates the activity of acetylcholinesterase in the synaptic cleft.

(C) increases the sensitivity of the presynaptic membrane to acetylcholine.

(D) makes the membrane permanently impermeable to sodium.

(E) increases the release of substances that cause the hyperpolarization of the neurons.

40. As you travel toward the poles, _____ becomes the major factor in delimiting biomes. Near the equator, _____ is the major factor.

(A) temperature ... precipitation

(B) sunlight intensity ... topography

(C) precipitation ... wind

(D) wind ... photoperiod

(E) photoperiod ... temperature

II. Answer the question (20%)

1. What is SNPs? What is the information that SNPs can provide regarding to the biological questions? (or its application)