

[I] Select the best one, 80%

1. What were the conditions necessary for life to begin?
 (A) conditions that favored chemical reactions that caused inorganic molecules to be transformed to organic molecules. (B) conditions that favored RNA synthesis. (C) conditions that facilitated the transformation of DNA → RNA → proteins. (D) conditions that facilitated the transformation of organic to inorganic molecules (organic → inorganic). (E) all of the above

2. Which of the following characteristic of phospholipids is responsible for their ability to form membranes?
 (A) The phospholipid tails can readily form hydrogen bonds. (B) They are amphipathic. (C) They contain saturated fatty acids. (D) They dissolve well in water. (E) All of the above are correct.

3. Found in plant cells, but not in animal cells, where it provides osmotic support for the cell, stores wastes, and contains digestive enzymes.
 (A) chloroplasts (B) central vacuole (C) cell membrane (D) cell wall (E) lysosome

4. Flagella and cilia are arranged in a
 (A) 9 + 2 array. (B) 9 + 4 array. (C) 9 + 0 array. (D) 9 + 3 array.
 (E) none of the above.

5. In general, most hormones
 (A) are produced in very large quantities. (B) are released from glands into ducts. (C) exert their main effects on specific target cells and tissues. (D) produce short-lived effects. (E) all of the above

6. As a tadpole matures to a frog, it moves from _____ to _____ as its primary form of nitrogenous waste.
 (A) urea; uric acid (B) ammonia; urea (C) uric acid; ammonia
 (D) uric acid; urea (E) urea; ammonia

7. In the thylakoid membranes, what is the main role of the antenna pigment molecules?
 (A) to split water and release oxygen to the reaction-center chlorophyll. (B) to harvest photons and transfer light energy to the reaction-center chlorophyll. (C) to synthesize ATP from ADP and Pi. (D) to pass electrons to ferredoxin and then NADPH. (E) to concentrate photons inside the stroma.

8. In what respect are the photosynthetic adaptations of C₄ plants and CAM plants similar?
 (A) In both cases, the stomata normally close during the day. (B) Both types of plants make their sugar without the Calvin cycle. (C) In both cases, an enzyme other than rubisco carries out the first step in carbon fixation. (D) Both types of

plants make most of their sugar in the dark. (E) Neither C₄ plants nor CAM plants have grana in their chloroplasts.

9. If there are 20 centromeres in a cell, how many chromosomes are there?
(A)10 (B)20 (C)30 (D)40 (E)80.
10. "Golden Rice" is a transgenic variety that
(A) is resistant to various herbicides and thus rice fields can be weeded with those herbicides. (B) is resistant to a virus that commonly attacks rice fields. (C) includes bacterial genes that produce a toxin that reduces damage from insect pests. (D) produces much larger, golden grains that increase crop yields. (E) contains daffodil genes that increase the vitamin A content of the rice.
11. Plant hormones produce their effects by
(A) altering the expression of genes (B) modifying the permeability of the plasma membrane (C) modifying the structure of the nuclear envelope membrane (D) both A and B (E) both B and C.
12. The probable role of salicylic acid in systemic acquired resistance of plants is to
(A) destroy pathogens directly (B) activate plant defenses throughout the plant before infection spreads (C) close stomata, thus preventing the entry of pathogens (D) activate heat-shock proteins (E) sacrifice infected tissues by hydrolyzing cells.
13. In a human population, the numbers for MM, MN, and NN are 321, 958, and 721, respectively. If the population is under Hardy-Weinberg equilibrium, the frequency of heterozygote three generations from now is
(A) 0.4790. (B) 0.1605. (C) 0.3605 (D) 0.8000. (E) 0.4000.
14. Selection acts directly on
(A) genotype. (B) the entire genome. (C) each allele. (D) gene pool. (E) phenotype.
15. In a village of the United States, one out of 10,000 babies is born with phenylketonuria (PKU), a metabolic disorder. The disease is caused by a recessive allele. (There are two alleles at this locus) If the population is under Hardy-Weinberg equilibrium, what is frequency of heterozygote three generations from now?
(A) 0.0198. (B) 0.010. (C) 0.990. (D) 0.0001. (E) 0.980.
16. Which theory did Darwin use to explain the similarities and dissimilarities between Galapagos finches?
(A) natural selection. (B) descent with modification. (C) gradualism. (D) survival of the fittest. (E) inheritance of acquired characteristics.
17. The largest unit in which gene flow is possible is a
(A) genus. (B) species. (C) population. (D) phylum. (E) order.

18. The DNA content of a diploid cell in the G1 phase of the cell cycle is measured. If the DNA content is x , then the DNA content at metaphase of meiosis II would be
(A) $0.25x$. (B) $2x$. (C) $0.5x$. (D) x . (E) $4x$.
19. The genotype of F1 individuals in a tetrahybrid cross is $AsBbCcDd$. Assuming independent assortment of these four genes, what are the probabilities that F2 offspring will have genotype $aabbccdd$
(A) $1/128$. (B) $1/16$. (C) $1/64$. (D) $1/256$. (E) $1/9$.
20. One of the primary reasons for the necessity of generating a large number in a eukaryotic genomic library is that
(A) each cosmid replicates nonautonomously (B) lysogenic phage continue to integrate their DNA into the host chromosome, thus reducing the number of desired recombinant clones (C) each vector can take up only a relatively small fraction of the eukaryotic DNA (D) each ligation product is sequence specific (E) the host range of the vector is limited.
21. There is about 1,000 times as much DNA in a human cell as in an *E. coli* cell, but only about 50 times as many genes. Why?
(A) a human cell has much more noncoding DNA (B) the DNA packing is much more complex in a prokaryotic cell (C) most of the genes in a human cell are turned off (D) *E. coli* are less able to respond to their environment than humans. Moreover, this response confuses cause and effect (E) human cells are much smaller than *E. coli* cells.
22. A geneticist raised a crop of T2 bacteriophages in a medium containing radioactive phosphorus, so that the DNA of the bacteriophages was labeled with radioactivity. The labeled phages were then allowed to infect nonradioactive bacteria. In a few hours, these bacteria burst open, releasing many bacteriophage. Some of these phages contained labeled
(A) DNA (B) RNA (C) protein (D) all of the above (E) DNA and protein only.
23. After the formation of replication bubbles, which of the following is the correct sequence of enzyme use for the synthesis of the lagging DNA strand?
(A) primase, helicases, DNA polymerase, ligase (B) helicases, primase, ligase, DNA polymerase (C) helicases, primase, DNA polymerase, ligase (D) helicases, DNA polymerase, primase, ligase (E) ligase, primase, DNA polymerase, helicases.
24. Regarding eukaryotic and prokaryotic genetic regulation, what process seems to be the most similar between the two
(A) transcriptional regulation (B) RNA splicing regulation (C) intron/exon shuffling (D) 5'-capping regulation (E) poly(A) tail addition.
25. Unlike prokaryotic DNA replication, eukaryotic DNA replication
(A) is completed by DNA polymerase (B) cannot be completed by DNA polymerase (C) is semiconservative (D) has a single origin (E) is error-free.

26. How does RNA polymerase know where to start transcribing a gene into mRNA?
(A) It starts at one end of the chromosome (B) Transfer RNA acts to translate the message to RNA polymerase (C) It starts at a certain nucleotide sequence called a promoter (D) The ribosome directs it to the correct portion of the DNA molecule (E) It looks for the AUG start codon.
27. If phages are labeled with radioactive sulfur and allowed to infect bacterial cells, the phage progeny resulting from lysis are expected
(A) to be non-radioactive (B) to have radioactive DNA (C) to have radioactive proteins (D) to have radioactive DNA and proteins (E) to have radioactive carbohydrates.
28. Without functioning parietal cells an individual would
(A) not be able to initiate protein digestion in the stomach (B) not be able to initiate mechanical digestion in the stomach (C) only be able to digest fat in the stomach (D) not be able to produce pepsinogen (E) not be able to initiate digestion in the small intestine.
29. A transfusion of type A blood given to a person who has type O blood would result in
(A) the recipient's B antigens reacting with the donated anti-B antibodies (B) the recipient's anti-A antibodies clumping the donated red blood cells (C) the recipient's anti-A and anti-O antibodies reacting with the donated red blood cells if the donor was a heterozygote (Ai) for blood type (D) no reaction because type O is a universal donor (E) no reaction because the O-type individual does not have antibodies.
30. Which of the following is (are) not involved in the activation and functioning of cytotoxic T cells?
(A) interleukins (B) antigen-presenting cells (C) class I MHC molecules (D) T cell surface protein CD4 (E) perforin.
31. In vertebrate animals, spermatogenesis and oogenesis differ, in that
(A) oogenesis begins at the onset of sexual maturity (B) oogenesis produces four haploid cells, whereas spermatogenesis produces only one functional spermatozoon (C) oogenesis produces one functional ovum, whereas spermatogenesis produces four functional spermatozoa (D) spermatogenesis begins before birth (E) spermatogenesis is not complete until fertilization occurs.
32. The drug RU-486 functions by
(A) inhibiting release of gonadotropins from the pituitary (B) blocking progesterone receptors in the uterus (C) preventing release of the secondary oocyte from the ovary (D) A and B (E) A, B, and C.
33. The cortical reaction functions directly in the
(A) formation of a fertilization membrane (B) production of a fast block to

polyspermy (C) release of hydrolytic enzymes from the sperm cell (D) generation of a nerve-like impulse by the egg cell (E) fusion of egg and sperm nuclei.

34. Assigns positional information along the anterior-posterior axis to developing avian limb buds
(A) homeodomains (B) morphogen (C) egg-polarity genes (D) zone of polarizing activity (E) cell adhesion molecules.
35. Which of the following statements about the transfer of fluid from the glomerulus to Bowman's capsule is CORRECT?
(A) It results from active transport. (B) It transfers large molecules (e. g., proteins) as easily as small ones. (C) It usually includes the transfer of red blood cells to the nephron tubule. (D) It is very selective as to which small molecules are transferred. (E) It is mainly a consequence of blood pressure force-filtering the fluid.
36. You are part of a desert plant research team trying to discover crops that will be productive in arid climates. You discover a plant that produces a guard cell hormone under water deficit conditions. Most likely the hormone is
(A) ABA (B) GA (C) IAA (D) 2,4-D (E) salicylic acid.
37. In order for a plant to initiate chemical responses to herbivory
(A) the plant must be directly attacked by an herbivore (B) volatile "signal" compounds must be perceived (C) gene-for-gene recognition must occur (D) phytoalexins must be released (E) all of the above must happen.
38. How many different combinations of maternal and paternal chromosomes can be packaged in gametes made by an organism with a diploid number of 8 ($2n = 8$)?
(A) 32. (B) 16. (C) 8. (D) 4. (E) 2.
39. Histone interact with DNA to form
(A) scaffold (B) nucleosome (C) nonhistone protein (D) polytene chromosomes (E) Balbiani ring.
40. DNA replication along the 3→5 template strand
(A) is continuous (B) is discontinuous (C) cannot occur (D) forms a lagging strand (E) occurs in both directions.

[III] Answer the following questions (20%)

What is genomics? What is proteomics? The success in studying genomics is encouraging biologists to move ahead to proteomics, why?