Answer the next 4 questions on the basis of the following scenario.

Escherichia coli, a species of bacterium, lives in the intestinal tract of people and ordinarily causes no disease. Within the past 20 years, a strain or kind of E. coli has appeared that produces a toxin which destroys red blood cells. People infected with the new strain suffer a very bad watery and, later, bloody diarrhea. Small children may become very ill when they are infected usually by eating or drinking something contaminated with feces containing the new strain of E. coli. One recent hot summer a little girl (2 years old) moved with her family from suburban Atlanta, Georgia, to a very isolated small village by a very slowly moving stream in Tanzania. Some of the older children in the village had dammed off a shallow backwater so that the younger children could safely play in the water. Although the little girl who had just arrived seemed to have a stomach ache, her parents let her play with the other children in the backwater. The children cooled off in the water and swallowed some of it too as they jumped up and down. By that night the little girl was very ill with diarrhea and cramps. A week later she died. Many other children eventually became very ill with pains in the belly and diarrhea and most of these died. Some who died had taken their drinking water directly from the river and, being small children, left their excrement pretty close to the same part of the river. A cow that wandered down to the children's backwater also died with a bloody diarrhea. A visiting microbiologist sent some feces from the cow and several sick children off to be identified. It was the new strain of E. coli.

1. The new strain of E. coli probably

- a. was brought into the area in Tanzania by meteor
- b. appeared by spontaneous generation of living from nonliving material
- c. changed in order to survive in water treatment plants in the US
- d. became a pathogen because people ate their food raw
- e. mutated from the harmless strain that lives in the intestine

2. Suppose that many more people settled in the area around the village, not having heard about the illness. The percentage of people who become ill then increases. Which of the following was an important contributing factor to the increase?

- a. the range of air temperature in the area decreased
- b. immune response improved in the human population
- c. human population density in the area increased
- d. rotenone killed all the fish in the river
- e. the people who moved in were particularly stupid

3. Over the 300 years following the Atlanta girl's death, we would expect the percentage of people who become ill with this infection to ______

- a. steadily increase
- b. stay the same
- c. increase and then decrease
- d. decrease and then increase

4. Which hypothesis best explains the expected changes in the percentages of people who become ill during the 300 years following the Atlanta girl's death?

a. The bacterial population will steadily become more pathogenic for people.

b. Immune response to the bacterium probably will decrease in the human population.

c. The bacterial population and the human population will be maintained at the same levels.

d. Immune response to the bacterium will probably decline and then improve.

e. Immune response to the bacterium will probably improve very slowly.

5. The phagocytic cell that engulfs and serves as a host for the TB bacterium is a

a. Q cell (oocyte)b. macrophagec. cell that makes boned. an amoebae. skin cell



6. In the graph at right, the curve characteristic of populations with high mortality of the very young is

a.

b.

c.

7. A population of any organism is capable of exponential growth under ideal conditions (unlimited resources and space, no predators or parasites).

a. false b. true

8. Last year the tortoise population in my yard had 5 births/individual/year and 3 deaths/individual/year. The rate of increase (r) in this specific population last year was _____/individual/year.

a. 8.0 b. -2.0 c. 2.0 d. 4.0 e. 0.2

9. If I had a population of 20 tortoises in my yard at the beginning of the year, based on the data in the previous question what would the expected increase (G) be for one year?

a. 2
b. 22
c. 18
d. 40

e. 42

10. Plague is caused by the bacterium *Yersinia pestis*, which is a pathogen for rodents, fleas and people. Plague could be a density-dependent population control in _____.

a. people

- b. rodents
- c. fleas
- d. all of the above (a-c)

11. The evolution of *Mycobacterium tuberculosis* in response to humans and evolution of humans in response to *Mycobacterium tuberculosis* is called ______.

a. adaptive radiation

b. speciation

c. immunity

d. coevolution

e. antibiotic resistance

12. Epidemics can occur in _____.

a. people

b. trees

- c. algae
- d. amoebae
- e. all of the above (a d)

13. Suppose that growth of a population is described by the equation G=fN(K-N)/K

If K = 2000 and N = 2000, then

- a. growth of the population will be negative
- b. growth of the population will be zero
- c. growth of the population will be very slow
- d. exponential growth will occur
- e. none of the above will be true

14. *Yersinia pestis*, the infectious agent for plague, secretes a toxin that affects the inner mitochondrial membrane (cristae) in rats and people. You might reasonably hypothesize that in infected hosts who are very ill, _____.

a. feeding is no longer possible

b. NADPH is no longer produced in the thylakoid

c. glycolysis stops

- d. paralysis results from a failure of neurotransmitter to cross the synapse
- e. the electron transport system does not function normally

15. Mitochondria and chloroplasts both have/contain _____.

- a. ATP
- b. DNA
- c. H+ gradients

- d. double-membrane
- e. they both have all of the above (a d)

16. In how many of the following does cellular respiration occur?

--bacteria that cause TB --elm trees --people --red algae --dogs

a. 5 of theseb. 4 of thesec. 3 of thesed. 2 of thesee. 1 of these

17. AIDS has become a chronic disease rather than an acutely lethal disease in people who take protease inhibitors. These inhibitors interfere with replication of HIV (human immunodeficiency virus). In the US, the HIV in some AIDS patients is not affected by protease inhibitors. Which of the following is a reasonable hypothesis for why the HIV that is not affected by protease inhibitors is becoming more common?

a. HIV that is not affected by protease inhibitors reproduces more successfully than HIV that is affected by the inhibitors.

b. HIV is evolving.

- c. HIV has experienced a mutation that prevents interference by protease inhibitors.
- d. All of the above (a c) are reasonable hypotheses.

18. What do normal transmission of neural signals across the synapse and antibody production by B cells (lymphocytes) have in common?

a. exocytosis and light dependence

b. toxin activity

c. memory and action potential

- d. light dependence and density dependence
- e. exocytosis and membrane receptors

19. The bacterium that causes Lyme disease can be cultured in a Petri dish containing agar and nutrients. A reasonable prediction about the population growing in such a dish is that

d. these bacteria would be killed by rodent blood

e. the bacterial population would follow a logistic growth curve (S-shaped) as nutrients became less abundant

20. Following a period (years) of no epidemics in people and good weather for producing crops, the human population in Ireland became very dense. (There were then more people in Ireland -9

a. the bacterial population on a given dish would grow exponentially forever

b. these bacteria would no longer be able to infect ticks after 2 days in culture

c. these bacteria would have well-developed mitochondria

million in 1840 — than there are today.) Potatoes were planted in every bit of land that could be found for planting because so many people needed food.

Potato blight is a disease of potatoes caused by a fungus. The fungus lived with potatoes in Peru, where potatoes originated. In Peru the fungus infected some potatoes but epidemics of potato blight were very rare. By 1845 in Ireland, a series of wet years had favored the fungus and potato blight became epidemic. Potatoes died. There was a famine: people died of starvation and diseases that people could not fight off. Many people moved to the US. Which of the following probably contributed to the resulting potato famine in Ireland?

- a. ease of passing a pathogen from one plant to another
- b. high population density of people
- c. planting one kind of plant over large areas of land



of these (a-c) none of these

Which of the wing graphs predicts the ges through

time in numbers (N) of antibody-producing B cells in an individual human following exposure to and subsequent recovery from a new infectious disease?



Use the following NEXT 3 biologists have interdependent

information and graph to answer the QUESTIONS. On the planet Zinx, monitored populations of two species over time. The Aphlax is a

producer (autotroph) and the Scooter is a consumer (heterotroph).

22. At time A, the Aphlax population growth rate (r) is _____.

- a. increasing with time
- b. positive
- c. negative
- d. zero

23. At time B, the Aphlax population incremental growth (G) is _____.

- a. negative
- b. zero
- c. positive
- d. none of the above

24. The best explanation for what is occurring at time B is _____.

- a. the Scooter population is decreasing, freeing more space for Aphlaxes
- b. the Scooter population is increasing, providing more food for Aphlaxes
- c. the Aphlax population is decreasing, freeing more space for Scooters
- d. the Aphlax population is increasing, providing more food for Scooters
- e. the Aphlax population is decreasing, causing food shortages for Scooters

25. In which of the following organisms is cell growth most likely dependent only on nutrient availability?

- a. fish
- b. insects
- c. trees
- d. humans
- e. bacteria

26. In general, it is most important to equally divide which of the following cell components during cell division?

- a. membrane b. DNA
- c. mRNA
- d. protein

27. Ultraviolet light can damage all of the following cell components. Which damaged component would have the greatest impact on descendants of the UV- treated cell?

- a. RNA
- b. DNA
- c. protein
- d. all of the above (a c) would have equal impact on the descendants

28. Which of the following characteristics would you expect to find in cancer cells?

- a. absence of cell division
- b. fewer genes than usual
- c. halted cell cycle
- d. mutated genes

e. none of the above

29. Dr. Strangemind isolated some double-stranded DNA from a maple tree seedling and then analyzed the nucleotide content of the DNA. He later announced that he had obtained the following percentages - A (20%), G (20%), C (30%), and T (30%). Dr. Strangemind's results

a. are not consistent with current understanding of DNA structure

b. suggest he is analyzing RNA, not DNA

c. prove that trees have many genes

d. are consistent with current understanding of DNA structure

e. apply only to seedlings but not to larger trees

30. Which of the following patterns represents proper codon size and spacing of the sequence ATGCAAGTCGGA? Each underlined segment represents a codon.

a. AT GC AA GT CG GAb. ATGC AAGT CGGAc. ATG CAA GTC GGAd. A T G C A A G T C G G Ae. ATGCAA GTCGGA

31. Nerve cells rarely regenerate (divide and form new nerve cells) because they

a. have no nucleusb. have very high mutation rates

c. have no DNA

d. are very specialized and do not proceed to S phase in the cell cycle

32. Cells of male bees are haploid. At what phase(s) in the cell cycle do their cells have two copies of each gene?

a. G2

b. G1

- c. neither G1 nor G2
- d. both G1 and G2

33. Which of the following is complementary to the sequence GAGCTATCCT ? Assume all are properly aligned left to right for pairing.

a. TCTAGCGAAGb. GAGCUAUCCUc. CTCGATAGGAd. CGGCTATCCTe. none of the above

34. Which of the following amino acid sequences corresponds to the DNA coding sequence CCGAGGCAC? Use the partial genetic code below.

a. pro-try-leu

b. gly-ala-leu-ser-pro-arg-valc. gly-ser-vald. pro-arg-leu

mRNA

codons AGG CAC CGU CUC CCG GUG GCU GGC UGG UCC amino acids arg his arg leu pro val ala gly try ser

35. If cells are exposed to streptomycin, a drug that inhibits translation, which of the following would most likely happen as a direct response to this drug?

- a. reduced RNA synthesis
- b. increased DNA synthesis
- c. increased protein synthesis
- d. reduced DNA synthesis
- e. reduced protein synthesis

36. Dr. Strangemind attempted to purify DNA molecules from pig liver cells using a new technique. He analyzed his final preparation of DNA for bases and found the following: adenine (A), cytosine (C), guanine (G), uracil (U), and thymine (T). Which of the following best describes his final preparation?

a. pure RNAb. RNA contaminated with proteinsc. DNA contaminated with RNA

d. pure DNA

e. DNA contaminated with proteins

37. Many large eukaryotic cells increase their exchange of nutrients and wastes with the environment by

a. having a nucleus

b. doubling their DNA content

c. being spherical

d. being stretched out or flattened

e. none of the above (a - d)

38. Completing an entire cell cycle requires _____

a. the completion of DNA synthesis

b. mitosis

- c. the replication of DNA
- d. all of the above (a c)

39. Dr. Strangemind isolated an important gene from corn plants but in his haste to publish his finding he accidentally threw out his tube containing this gene. Which of the following would be most useful in trying to determine the DNA sequence of this gene?

- a. the nucleotide sequence of the mRNA produced by this gene
- b. the amino acid sequence of the protein encoded by this gene
- c. the 3-dimensional structure of the protein encoded by this gene
- d. the universal genetic code
- e. the number of codons in this gene

40. Which of following is the best hypothesis regarding the purpose of chromosome condensation?

- a. chromosomes condense during the S phase of the cell cycle
- b. chromosomes condense as a mechanism to prevent entanglement
- c. chromosomes condense during the cell cycle
- d. genes are found on chromosomes
- e. chromosomes condense so that scientists can see them
- 41. Which of the following is true regarding phenotypes and genotypes?
 - a. phenotypes describe the DNA of the cell
 - b. genotypes describe the physical or function characteristics of the cell
 - c. genotype and environment together determine an individual's phenotype
 - d. phenotype and environment together determine an individual's genotype
 - e. all of the above (a d)

42. Which of the following best explains why liver cells contain certain types of proteins that are absent in muscle cells?

- a. liver and muscle cells express different sets of genes
- b. muscle cells only contain chromosomes inherited from the mother
- c. liver cells undergo meiosis
- d. liver cells are usually cancerous
- e. none of the above
- 43. If bacteria were diploid rather than haploid which of the following would most likely be true? a. bacteria would be able to do twice as many things because they would have twice as many different genes
 - b. bacteria would be more likely to die when exposed to ultraviolet light
 - c. bacteria would heat up quicker in the sun
 - d. bacteria would be less likely to express the effect of mutation after exposure to ultraviolet light
 - e. bacteria would be smaller in size

44. A mutation has occurred in a gene that codes for a neurotransmitter receptor located in a neuromuscular junction. This particular mutation resulted in a massive shape change in the protein which forms the receptor. Which of the following would be a direct result of this mutation?

a. lack of a postsynaptic action potential

b. lack of a presynaptic action potentialc. convulsionsd. all of the above (a - c)e. none of the above

45. Farmer Bob planted two fields of rice using different sources of seed. The plants in field #1 grew uniformly but the plants in field #2 were quite variable with respect to plant size. Assume that the environments are identical in the two fields. Which of the following best describes the plants in these fields?

a. the plants of field #2 will likely be better able to respond to environmental change through several generations compared to field #1

b. the plants of field #1 are likely to have a greater genetic variability than the plants of field #2

c. the genotype of plants in field #2 is likely to be more consistent from plant to plant d. the phenotype of plants in field #2 is likely to be more consistent from plant to plant e. the plants of field #1 will always produce more rice regardless of any environmental changes

46. In humans, the phenotype for excreting iron is dominant and the phenotype for storing iron is recessive. Two people who excrete iron MUST have the same ______.

- a. parents
- b. environments
- c. genotype
- d. phenotype

47. A man and woman who are both carriers (heterozygous) for the cystic fibrosis (CFTR) gene plan to have several children. ______ of their children should show symptoms of cystic fibrosis.

- a. None
- b. All
- c. Some

48. If your mother's genotype is AA for blood type and your father's genotype is AB, what is the probability that you have blood phenotype A?

- a. 100%
- b. 75%
- c. 50%
- d. 25%
- e. none of the above

49. Three alleles (A, B and o), are involved in the inheritance of ABO blood groups. The A and B alleles are codominant and each results in the production of a protein (antigen) on the surface of red blood cells. The o allele results in absence of protein (antigen) on the surface of red blood cells. A child with type O blood (homozygous for the o allele) has a mother with type A blood (has at least one A allele). What blood types could the child's father possibly have?

a. only O

b. only B c. only AB d. only A e e. A, B or O

50. The allele for red coat in cattle is codominant with the allele for white coat. A heterozygous animal has both white hairs and red hairs. An animal with only the alleles for white hair has a white coat and an animal with only the alleles for red hairs has a red coat. A cross between a cow and bull who are both heterozygous for this pair of alleles is expected to yield how many different phenotypes (coat colors) among their offspring?

a. 1

b. 4

c. 2

d. 6

e. 3