

1) You have exam "A". Choose "A" on the scantron for this question.

2) Peptidoglycan forms sheets that stiffen the cell walls of bacteria. How is the formation of sheets possible?

- A) The polysaccharides in peptidoglycan are highly branched and form a network.
- B) The glycosidic linkages between monosaccharides in peptidoglycan are extraordinarily strong.
- C) Individual strands are joined by peptide bonds—a type of covalent bond.
- D) The polysaccharides in peptidoglycan form helical structures, as in cellulose.

3) At the pH found in cells (about 7.0), what happens to the amino group on an amino acid?

- A) It acts as a base and gains a proton, giving it a positive charge.
- B) It acts as an acid and loses a proton, giving it a negative charge.
- C) It is reduced, and tends to act as an electron donor in redox reactions.
- D) It remains neutral, like water, and does not have a charge.

4) Which of the following substances would most likely require a protein to facilitate its diffusion across a cell membrane?

- A) water
- B) glycerol
- C) fatty acid
- D) oxygen gas (O_2)

5) Which of the following includes *all* of the pyrimidines found in either RNA and DNA?

- A) cytosine and uracil
- B) cytosine and thymine
- C) cytosine, uracil, and thymine
- D) cytosine, uracil and guanine

6) Consider a fragment of DNA that has a total of eight bases. Five of these are adenines and three are cytosines. How many hydrogen bonds would there be in this fragment between purine/pyrimidine pairs?

- A) 15
- B) 16
- C) 19
- D) 21

7) In a polypeptide, what is most responsible for the secondary structure called an α -helix?

- A) the sequence of amino acids
- B) hydrogen bonds that form between carboxyl and amino groups on different residues
- C) hydrogen bonds and other interactions between side chains
- D) the number, identity, and arrangement of polypeptides that make up a protein

8) Which of the following increases the strength of the hydrophobic interactions in lipid bilayers, and thus makes them less permeable to polar molecules?

- A) the presence of double bonds
- B) increasing temperature
- C) removing cholesterol
- D) increasing length of the hydrocarbon chains

9) What is gel electrophoresis used for?

- A) to denature proteins for further analysis
- B) to separate macromolecules by size or charge
- C) to separate the two helices that make up the DNA double helix
- D) to identify the first self-replicating molecule that formed during chemical evolution

10) When doing gel electrophoresis, why do researchers add a "ladder" made up of molecules of known size?

- A) To help the molecules they are studying get through the gel more easily.
- B) To help the researchers identify the size of each molecule after the separation has occurred.
- C) To make sure the radioactivity doesn't interfere with the movement of the molecules that are being studied.
- D) The molecules being studied would not show up without the ladder.

11) You've just discovered an organism that lives in extremely cold environments. Which of the following would you predict to be true about the phospholipids in its membranes?

- A) They will have extremely long hydrocarbon tails.
- B) Their hydrocarbon tails will be short and saturated.
- C) Their hydrocarbon tails will be short and highly unsaturated.
- D) They will interact extensively with cholesterol.

12) What will happen to a red blood cell, which has an internal ion concentration of about 0.9 percent, if it is placed into a beaker of pure water?

- A) Nothing.
- B) The cell would shrink because the water in the beaker is hypotonic.
- C) The cell would shrink because the water in the beaker is hypertonic.
- D) The cell would swell because the water in the beaker is hypotonic.

13) What forms the "backbone" of a nucleic acid?

- A) a chain of sugar and phosphate groups, linked through phosphodiester bonds
- B) purine and pyrimidine pairs, hydrogen-bonded to each other
- C) a chain of amino and carboxyl groups, linked via peptide bonds
- D) a double helix of antiparallel strands

14) You've discovered an enzyme that can catalyze two different chemical reactions. Which of the following is most likely to be correct?

- A) The enzyme contains both α -helices and β -pleated sheets.
- B) The enzyme is subject to both competitive inhibition and allosteric regulation.
- C) Two types of allosteric regulation occur: The binding of one molecule activates the enzyme, while the binding of a different molecule inhibits it.
- D) Either the enzyme has two distinct active sites, or the reactants involved in the two reactions are very similar in size and shape.

15) What is the function of keratin, an important intermediate filament?

- A) imparts the ability to withstand mechanical stress and impermeability to the skin
- B) reinforces moveable joints
- C) enables the heart to contract as a unit
- D) provides nutrients to neural cells of the brain and spinal cord

16) In experiments that successfully simulate chemical evolution, why do researchers have to add a source of kinetic energy such as an electrical spark or ultraviolet radiation?

- A) to drive endergonic reactions
- B) to drive exergonic reactions
- C) to lower the activation energy required for the reactions
- D) to raise the entropy of the reactants

17) Asbestos is a material that was once used extensively in construction. One of the risks of working in a building that contains asbestos is the development of asbestosis. The asbestos fibers can be inhaled. Cells will phagocytose the foreign material, but are unable to degrade it. As a result, asbestos fibers build up in which of the following intracellular organelles?

- A) mitochondria
- B) nucleus
- C) peroxisomes
- D) lysosomes

18) How do the α and β forms of glucose differ?

- A) Their ring structures differ in the location of a hydroxyl group.
- B) Their linear structures differ in the location of a hydroxyl group.
- C) The β form can be involved in 1,4 and 1,6 glycosidic linkages; the α form can participate only in 1,4 linkages.
- D) The oxygen atom inside the ring is located in a different position.

19) Which of the following cytoskeletal proteins are involved in changing cell shape or in cell movement?

- 2
- A) microfilaments only
 - B) microfilaments and myosin
 - C) microfilaments, microtubules, and intermediate filaments are all important in any processes involving cell movement
 - D) intermediate filaments and microtubules

20) Which of the following is *not* true of osmosis?

- 2
- A) It is a special case of diffusion.
 - B) It is an energy-demanding or "active" process.
 - C) Water moves from areas of high concentration to areas of low concentration.
 - D) It occurs whenever solutions are separated by a semipermeable membrane.

21) Which of the following observations is the strongest argument in favor of the hypothesis that protein structure and function are correlated?

- 4
- A) Proteins function best at certain temperatures.
 - B) Proteins have four distinct levels of structure and many functions.
 - C) Enzymes tend to be globular in shape.
 - D) Denatured (unfolded) proteins do not function normally.

22) By convention, biologists write the sequence of amino acids in a polypeptide in which direction?

- 2
- A) carboxy- to amino-terminus
 - B) amino- to carboxy-terminus
 - C) polar residues to nonpolar residues
 - D) charged residues to uncharged residues

23) What is the difference between an aldose sugar and a ketose sugar?

- 3
- A) the number of carbons
 - B) the position of the hydroxyl groups
 - C) the position of the carbonyl group
 - D) one is a ring form, the other is a linear chain

24) Which of the following best describes primary structure in proteins?

- 3
- A) It is the number of amino acids present in the complete protein.
 - B) It is the number of peptide bonds in the complete protein.
 - C) It is the sequence of amino acids in the complete protein.
 - D) It is the number of α -helices and β -pleated sheets in the complete protein.

25) Scientists found that polypeptides that are normally synthesized in the endoplasmic reticulum are about 20 amino acids longer when they are synthesized by ribosomes not attached to the endoplasmic reticulum. What is/are possible explanations for the greater length of these polypeptides?

- 2
- A) The ribosomes that function as free ribosomes function differently than ribosomes that are attached to the endoplasmic reticulum.
 - B) The 20 amino acids serve as a signal sequence that directs the forming polypeptide to the endoplasmic reticulum, where they are cleaved off during processing.
 - C) The 20-amino-acid sequence helps the endoplasmic reticulum package these proteins for shipping to the Golgi.
 - D) The protein has a different function in the cytosol than in the endoplasmic reticulum.

26) Phospholipid bilayer membranes are selectively permeable. What is meant by the phrase "selectively permeable"?

- 4
- A) allows everything but water to cross
 - B) allows only water to cross
 - C) allows everything nonpolar to cross
 - D) allows some things to cross while restricting others

27) Several of the molecules called vitamins act as enzyme cofactors. Vitamin deficiencies cause disease. What is the most direct explanation for this?

- 2
- A) Vitamins combine with nonprotein molecules to delay the onset of disease.
 - B) If cofactors are missing, enzymes cannot function properly, and important reaction products will be absent from cells.
 - C) Normal regulation cannot occur in the absence of cofactors. As a result, all enzymes will function all of the time.
 - D) Cofactors inhibit enzymes found in disease-causing bacteria and viruses. When cofactors are absent, these disease-causing agents multiply.

28) Nucleic acids have a definite polarity, or directionality. Stated another way, one end of the molecule is different from the other end. Why?

- 3
- A) One end has a hydroxyl group on the 2' carbon; the other end has a hydrogen atom on the 2' carbon.
 - B) One end contains a nitrogenous base; the other end lacks it.
 - C) One end has an unlinked 3' carbon; the other end has an unlinked 5' carbon.
 - D) One end has a phosphate group; the other end lacks it.

29) What do phospholipids and triglycerides have in common?

- 3
- A) They both contain serine or some other organic compound.
 - B) They both have three fatty acids.
 - C) They both have a glycerol backbone.
 - D) They both have a phosphate.

30) Which of the following is *not* a characteristic that chloroplasts and mitochondria share?

- 3
- A) They both have their own DNA.
 - B) They are both double-membrane structures.
 - C) They are both part of the endomembranal system.
 - D) They are capable of reproducing themselves.

31) What is the major structural difference between starch and glycogen?

- 4
- A) the types of monosaccharide subunits in the molecules
 - B) the type of glycosidic linkages in the molecule
 - C) whether glucose is in the α or β form
 - D) the amount of branching that occurs in the molecule

32) What is the difference between a ribonucleotide and a deoxyribonucleotide?

- 2
- A) ribonucleotides contain a phosphate group.
 - B) ribonucleotides have a hydroxyl group on the 2' carbon of their sugar subunit.
 - C) ribonucleotides contain a sugar with five carbon atoms.
 - D) ribonucleotides have a hydrogen atom on the 1' carbon of their sugar subunit.

33) Which of the following did Watson and Crick know when they were trying to determine the structure of DNA?

- 5
- A) The number of purines is always larger than the number of pyrimidines.
 - B) The number of pyrimidines is always larger than the number of purines.
 - C) The number of cytosines is always the same as the number of adenines.
 - D) The number of guanines is always the same as the number of thymines.
 - E) The number of purines is always the same as the number of pyrimidines.

34) How does the structure of an amino acid affect its most common function in cells?

- A) It can serve a wide variety of functions in a cell, because it contains the atoms most commonly found in organisms (C, H, N, and O).
B) Because both carboxyl and amino groups are present, polymerization is exergonic. In addition, the presence of a side chain makes the molecule water soluble.
C) The presence of carboxyl and amino groups gives it the ability to form peptide bonds, and its side chain gives it unique chemical properties.
D) Because each amino acid contains a variety of functional groups, they can participate in a wide variety of chemical reactions.

35) Why do many researchers consider RNA to be the best candidate for the first life-form?

- A) It is simple in structure.
B) It is capable of self-replication and catalysis.
C) It carries more information than any other molecule.
D) All of its nucleotide components have been created under laboratory conditions that mimic early Earth.

36) Which of the following do starch and cellulose have in common?

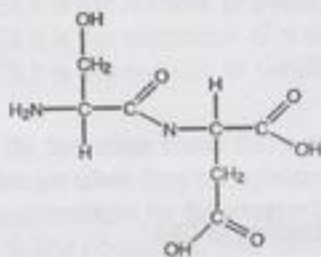
- A) the type of glycosidic linkage used
B) the size of their monosaccharide subunits
C) the amount of hydrogen bonding that occurs between parallel strands
D) their main function in plants

37) What is the most likely role of a cell that contains an extensive smooth ER?

- A) It plays a role in storage. B) It synthesizes large quantities of lipids.
C) It actively exports protein molecules. D) It plays a role in immune function.

38) During my gel electrophoresis demonstration, I said that detergent is not required to electrophorese DNA. Why?

- A) DNA is positively charged so the detergent won't stick to it
B) DNA is negatively charged so the detergent won't stick to it.
C) DNA is positively charged so it will enter the gel and migrate towards the positive electrode
D) DNA is negatively charged so it will enter the gel and migrate towards the positive electrode



39) How many chiral centers are there in the molecule above (it's called dopa)?

- A) 0 B) 1 C) 2 D) 3

40) Which of the following is most true for *cis* and *trans* fat?

- A) the hydrocarbon chains of *cis* fat are more kinky than *trans* fat
B) *trans* fat is natural whereas *cis* fat is synthetic
C) your body cannot metabolize *trans* fat
D) generally *trans* fat has far more carbonyl groups

You have exam "A". Choose "A" on the scantron.

1. Assume that a particular human cell is examined under a microscope, and it contains 22 autosomes and a Y chromosome. This cell is most likely to be

- 4
- A. a somatic cell of a male
 - B. a zygote
 - C. a somatic cell of a female
 - D. a sperm cell

2. The horse, *Equus caballus*, has 32 pairs of chromosomes; the donkey (*Equus asinus*) has 31 pairs of chromosomes. How many chromosomes would be expected in the somatic (non-gametic) tissue of the mule hybrid?

- 4
- A. 32
 - B. 44
 - C. 31
 - D. 63
 - E. 162

3. Crossing over usually contributes to genetic variation by exchanging chromosomal segments between

- 3
- A. sister chromatids of a chromosome
 - B. chromatids of nonhomologous chromosomes
 - C. non-sister chromatids of homologous chromosomes
 - D. nonhomologous loci of the genome
 - E. autosomes and sex chromosomes

4. How many different combinations of maternal and paternal chromosomes can be packaged in gametes made by an organism with a diploid chromosome number of 6 ($2n = 6$)?

- 3
- A. 2
 - B. 4
 - C. 8
 - D. 16
 - E. 32
- D 15 C
A 20 30 40
B 22 33 44
C 24 36 48

5. Autosomal trisomies are not randomly distributed in humans. Which autosomal trisomic condition occurs most frequently in humans? How is maternal age related to the incidence of this trisomic?

- 4
- A. Trisomy-3; there is no influence of maternal age on trisomy-3 incidence.
 - B. Trisomy-21; there is no influence of maternal age on trisomy-21 incidence.
 - C. Trisomy-21; as maternal age increases, the incidence of trisomy-21 decreases.
 - D. Trisomy-21; as maternal age increases, the incidence of trisomy-21 increases.

6. A couple who are first cousins are considering marriage and come in for genetic counseling. What type of inherited conditions are their children at increased risk for?

- 3
- A. autosomal dominant
 - B. X-linked dominant
 - C. autosomal recessive
 - D. reciprocal translocation
 - E. chromosome abnormality

7. An affected male transmits a rare disorder to all 5 of his daughters, who express the trait, and to none of his 4 sons. From this information the mode of inheritance of this disorder is most likely:

- 3
- A. autosomal dominant
 - B. X-linked recessive
 - C. X-linked dominant
 - D. multifactorial
 - E. none of the above

8. Red-green color blindness is X-linked in humans. If a male is red-green color blind, and both parents have normal color vision, which of the male's grandparents is most likely to be red-green color blind?

- 2
- A. maternal grandmother
 - B. maternal grandfather
 - C. paternal grandmother
 - D. paternal grandfather
 - E. either grandfather is equally likely

9. A color-blind (X-linked) male with hemophilia A mates with a normal female. They produce a daughter with Turner syndrome (X0) who is not color blind. What is the daughter's risk of developing hemophilia?

- 2
- A. 50%
 - B. 0%
 - C. 25%
 - D. 100%

10. Mendel crossed yellow-seeded and green-seeded pea plants and then allowed the offspring to self-pollinate to produce an F₂ generation. The results were as follows: 6022 yellow and 2001 green (8023 total). The allele for green seeds has what relationship to the allele for yellow seeds?

- 3
- A. dominant
 - B. incompletely dominant
 - C. recessive
 - D. semidominant

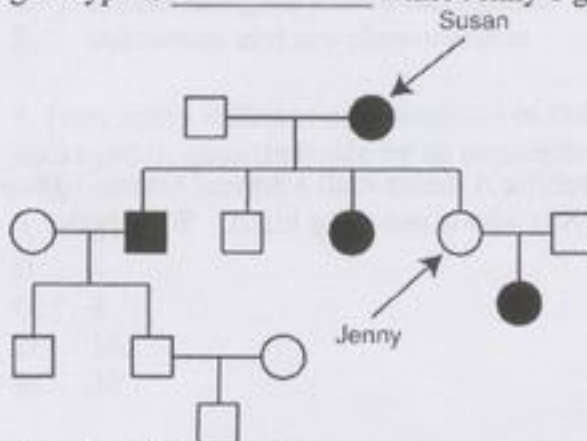
11. A man has six fingers on each hand and six toes on each foot. His wife and their daughter have a normal number of digits. Having extra digits is a dominant trait. The couple's second child has extra digits. What is the probability that their next (third) child will have extra digits?

- A. $1/2$
 B. $1/16$
 C. $1/8$
 D. $3/4$
 E. $9/16$

12. Suppose two $AaBbCc$ individuals are mated. Assuming that the genes are not linked, what fraction of the offspring are expected to be homozygous recessive for the three traits?

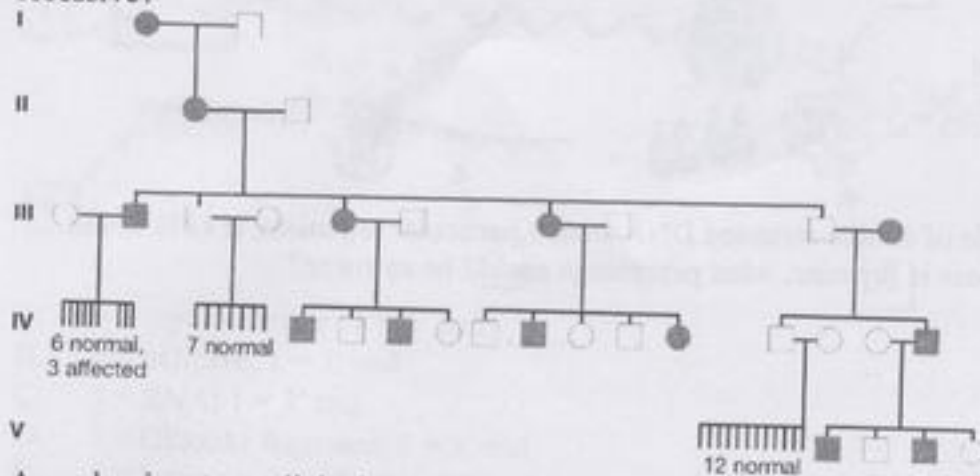
- A. $1/4$
 B. $1/8$
 C. $1/16$
 D. $1/64$
 E. $1/256$

13. The pedigree below traces the inheritance of alkaptonuria, a biochemical disorder in humans. Affected individuals are indicated by filled-in circles (females) and squares (males). This disease state appears to be caused by a _____ gene, and Susan's genotype is _____ while Jenny's genotype is _____.



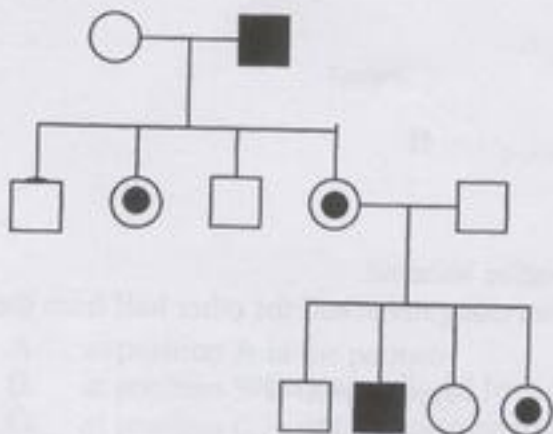
- A. dominant; aa ; Aa
 B. recessive; AA ; aa
 C. dominant; AA ; aa
 D. recessive; aa ; Aa
 E. semidominant; AA ; AA

14. The pedigree that follows is for the human trait called osteopetrosis, which is characterized by bone fragility and dental abscesses. Is the gene that affects bone and tooth structure autosomal or sex-linked? Is the allele for osteopetrosis dominant or recessive?



- A. dominant, sex-linked
 B. recessive, autosomal
 C. recessive, sex-linked
 D. dominant, autosomal

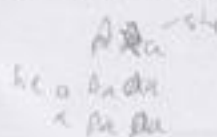
15. The pedigree is an example of:



- A. autosomal dominant inheritance.
 B. sex-linked recessive inheritance.
 C. sex-linked dominant inheritance
 D. maternal inheritance.
 E. autosomal recessive inheritance.

16. A recessive allele on the X chromosome is responsible for red-green color blindness in humans. A woman with normal vision whose father is color-blind marries a color-blind male. What is the probability that this couple's first son will be color-blind?

- 2
- A. 25%
 - B. 50%
 - C. 100%
 - D. 75%
 - E. 0%



17. In a sample of double-stranded DNA from a particular organism, if 15% of the nitrogenous base is thymine, what percentage should be cytosine?

- 4
- A. 15%
 - B. 30%
 - C. 70%
 - D. 35%
 - E. 40%

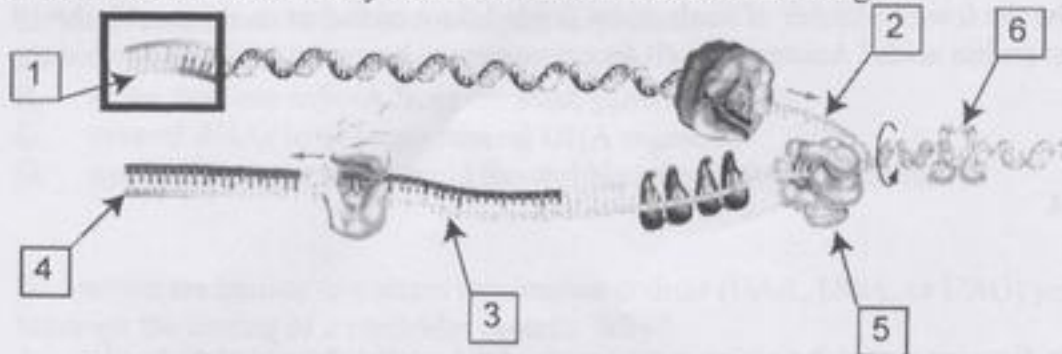
18. A bacterial culture is grown on medium containing radioactive thymine (represented by $T^{\#}$) until all of the thymine in the DNA is radioactive. The culture is then transferred to a medium containing nonradioactive thymine (T). Samples are removed after one round of DNA replication. Which of the following double-stranded sequences represents a sequence of DNA after one round of replication? (Note that A, T, C, and G represent the nucleotides with the four standard bases. The slash [/] separates the two strands of the double helix.)

- 1
- A. $AT^{\#}CG / TAGC$
 - B. $CTAG / CT^{\#}AG$
 - C. $AT^{\#}TT / CAA^{\#}A$
 - D. $GAT^{\#}A / CUAU$
 - E. $AT^{\#}TT / AT^{\#}TT$

19. DNA replication is said to be semiconservative because:

- 4
- A. Half of the DNA in a new cell comes from one gamete and the other half from the other gamete.
 - B. The same process of DNA replication is used by all organisms.
 - C. The number of nucleotides within genes remains constant.
 - D. Each new DNA molecule is composed of one old strand and one new strand.
 - E. The total amount of DNA within an individual remains the same.

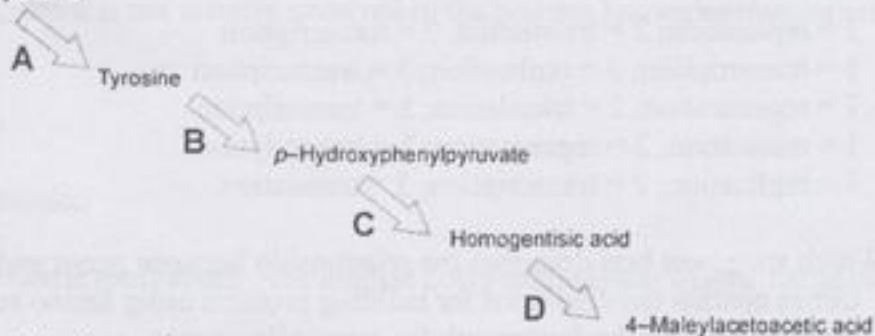
20. Here is a diagram (not to scale) of DNA in the process of replication. Choose the answer below that correctly identifies structures shown in the figure.



- A. 5 = topoisomerase; 1 = 5' end
 B. 6 = helicase; 1 = 3' end
 C. 5 = RNA; 1 = 3' end
 D. 5 = Okazaki fragment; 1 = 3' end
 E. 5 = helicase; 3 = Okazaki fragment

21. In 1902, a physician named Archibald Garrod observed that people suffering from alkaptonuria excreted large quantities of homogentisic acid in their urine. Given the metabolic pathway shown here, where would you suppose that the genetic block occurs in individuals with alkaptonuria?

DIET → Phenylalanine

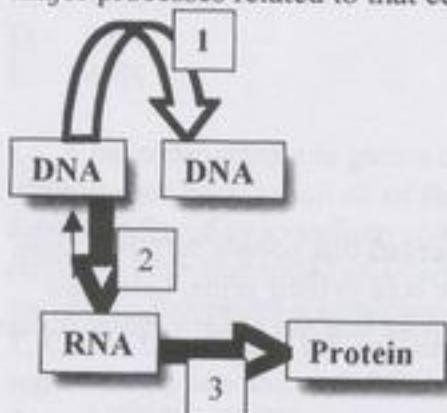


- A. at position A in the pathway
 B. at position B in the pathway
 C. at position C in the pathway
 D. at position D in the pathway
 E. anywhere after tyrosine

22. Early in the evolution of life-forms, there likely were fewer than 20 amino acids. If "primitive proteins" were composed of only 14 different kinds of amino acids, what would be the fewest number of nucleotides needed for a code that could specify the 14 different amino acids? Assume that all four nitrogenous bases are available for coding.

- A. 1
B. 2
C. 3
D. 14
E. 4

23. This diagram shows the major components of the central dogma of molecular biology as described in your text. The three numbered arrows represent which three major processes related to that central dogma?



- A. 1 = replication; 2 = translation; 3 = transcription
B. 1 = transcription; 2 = replication; 3 = transcription
C. 1 = regeneration; 2 = translation; 3 = transcription
D. 1 = translation; 2 = regeneration; 3 = transcription
E. 1 = replication; 2 = transcription; 3 = translation

24. Which statement best describes the relationship between genes and proteins?

- A. Genes contain the directions for building proteins using amino acid components.
B. Proteins provide the framework for assembling genes.
C. Proteins are the basic building blocks of genes.
D. Genes provide the raw materials for building large protein molecules.

25. The TATA box (-10 or Pribnow box) has all the following characteristics *except*:

- A. It is both transcribed and translated.
B. It is upstream from most genes.
C. It is part of the binding site for the RNA polymerase.
D. It is part of a consensus (common) sequence of the promoter.

26. It has been hypothesized for some time that by having eukaryotic mRNAs spliced (removal of introns), an opportunity exists for alternative splicing (i.e., removal of different combinations of introns/exons) to produce

- A. more than one polymerase at a replication fork
- B. more than one mRNA from the same genetic locus
- C. several RNAs to generate several DNA segments
- D. many tRNA species to avoid the wobble seen during translation

27. Introns are known to contain termination codons (UAA, UGA, or UAG) yet not interrupt the coding of a particular protein. Why?

- A. UAA, UGA, and UAG are initiator codons, not termination codons.
- B. Exons are spliced out of mRNA before translation.
- C. These triplets cause frameshift mutations, not termination.
- D. More than one termination codon is needed to stop translation.
- E. Termination codons within an intron are not involved in translation, because the introns are removed before translation.

28. What kind of bond joins amino acids in a polypeptide chain?

- A. ionic bonds
- B. double bonds
- C. hydrogen bonds
- D. peptide bonds

29. Which component is not directly involved in the process known as translation?

- A. mRNA
- B. tRNA
- C. ribosomes
- D. DNA
- E. codon/anticodon

30. In a polyribosome (polysome), the longest polypeptide chain will be found on the ribosome

- A. nearest to the translation initiation site.
- B. closest to the middle of the mRNA.
- C. closest to but just before the termination site.
- D. after it has passed the termination site.

31. A nonsense mutation is one in which:

- A. Multiple amino acid substitutions occur in the mutant protein.
- B. A single amino acid substitution occurs in the mutant protein.
- C. The mutant protein is shorter than normal.
- D. Each frameshift has called in an AUG triplet.
- E. None of the above apply.

32. A class of mutations that results in multiple contiguous (side-by-side) amino acid changes in proteins is probably caused by the following type of mutation:

- A. reading frame shift
- B. transversion
- C. transition
- D. base analogue
- E. recombinant

33. Which of the following mutations would have the greatest negative impact on the protein product of a gene?

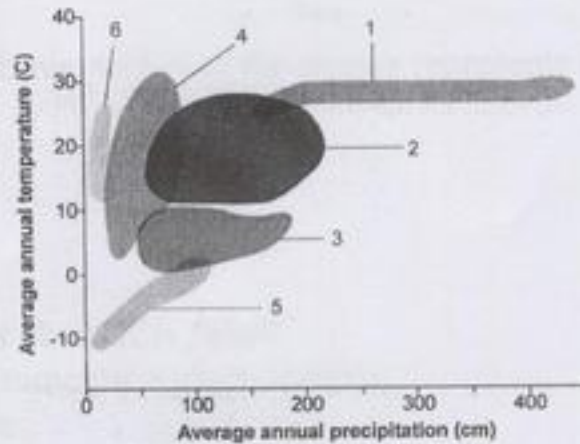
- A. a base-pair substitution
- B. a deletion of three bases near the middle of the gene
- C. a single base insertion near the start of the coding region of the gene
- D. a single base deletion close to the end of the coding region of a gene

1) Indicate which midterm version you are writing:

- A. Version 1 (** you are writing this version **)
 B. Version 2

2) Which of the following is an abiotic component of a burrow community?

- A. the different species living in the burrow
 B. the population of each species in the burrow
 C. the air quality of the burrow
 D. the food sources in the burrow



3) Looking at the above figure, which numbers would designate the desert biome and the arctic tundra biome?

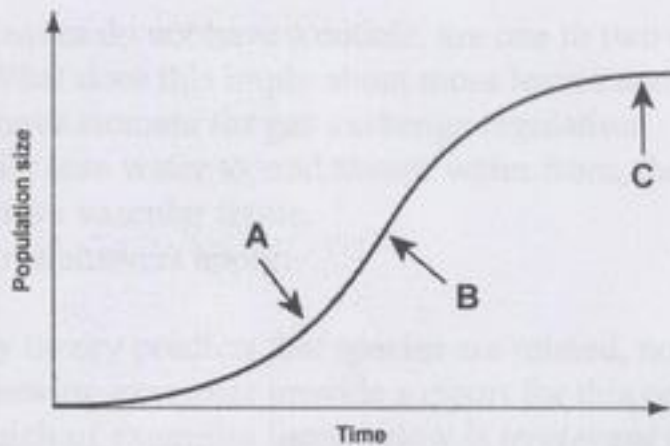
- A. 1 and 5
 B. 3 and 6
 C. 5 and 6
 D. 1 and 6

4) In testing his hypothesis that "territorial defense in European robins is a fixed action pattern that is released by the sight of orange feathers," Lack found that robins defended their territory by attacking anything that was of similar size and had an orange patch. How would you show that it was indeed color that initiated the defense responses?

- A. Repeat the experiment using live specimens.
 B. Repeat the experiment using other shapes.
 C. Repeat the experiment removing the orange patch.
 D. Repeat the experiment with giant specimens.

5) Evolution by natural selection changes the population but not the individual.

- A. true B. false



6) In the diagram above, which of the arrows represents the carrying capacity K ?

- A. arrow A
- B. arrow B
- C. arrow C

7) Which statement about K is *false*?

- A. K is always the same for a given species.
- B. K varies in space.
- C. K varies in time.
- D. K varies among different populations of the same species.

8) Which of the following is *not* an example of a mutualism?

- A. fungi residing in plant roots, such as endomycorrhizae
- B. bacteria fixing nitrogen in plants
- C. rancher ants that protect aphids in exchange for sugar-rich honeydew
- D. birds eating insects jumping out of the path of army ants

9) Gill pouches in chick, human, and house-cat embryos are an example of:

- A. structural homology
- B. developmental homology
- C. analogy/convergent evolution
- D. the inheritance of acquired characters

10) Which of the following does *not* tend to promote speciation?

- A. the founder effect
- B. gene flow
- C. natural selection
- D. polyploidy

11) Most moss leaves do not have a cuticle, are one to two cells thick, and have no veins. What does this imply about moss leaves and their structure?

- A. They do not have stomata for gas exchange regulation.
- B. They can easily lose water to, and absorb water from, the atmosphere.
- C. They do not have vascular tissue.
- D. All of the above answers apply.

12) Evolutionary theory predicts that species are related, not independent. Three of the following examples provide support for this prediction, but one is irrelevant. Which of examples listed below is *irrelevant* to the claim that species are related?

- A. Many dinosaurs and other organisms went extinct following a huge asteroid impact at the end of the Cretaceous.
- B. All prokaryotes and eukaryotes use DNA to carry their genetic information.
- C. Ground squirrel species found on the North and South sides of the Grand Canyon are very similar to each other.
- D. Before synthetic insulin was available, diabetics used injections of purified pig insulin to manage their disease.

13) Which of these conditions are always true of populations evolving due to natural selection?

- Condition 1:** The population must vary in traits that are heritable.
 - Condition 2:** Some heritable traits must increase reproductive success.
 - Condition 3:** Individuals pass on all traits they acquire during their lifetime.
- A. condition 1 only
 - B. condition 2 only
 - C. conditions 1 and 2
 - D. conditions 2 and 3
 - E. conditions 1, 2, and 3

14) Which statement restates the fact that resistance to the drug rifampin in *Mycobacterium tuberculosis* is an adaptation?

- A. Rifampin resistance is a heritable trait that increases fitness of individuals compared to susceptible individuals.
- B. Rifampin resistance is caused by a point mutation in the *rpoB* gene.
- C. A mutation occurred in the *rpoB* gene of one cell, and this mutant cell continued to grow and divide.
- D. Drug-resistant strains now account for about 10 percent of the *Mycobacterium tuberculosis*-caused infections throughout the world.

15) Suppose 75% of a remote mountain village can taste Phenylthiocarbamide (PTC) and must therefore have at least one copy of the dominant PTC taster allele. If this population conforms to Hardy-Weinberg expectations for this gene, what percentage of the population must be heterozygous for this trait?

- A. 15%
- B. 25%
- C. 75%
- D. 50%

16) House finches were found only in western North America until 1939, when a few individuals were released in New York City. These eastern individuals established a breeding population and gradually expanded their range westward. The western population also expanded its range somewhat eastward, and currently the two populations are nearly in contact. If the two forms are unable to interbreed when their expanding ranges meet, what would this situation illustrate?

- A. vicariance
- B. allopolyploidy
- C. allopatric speciation
- D. sympatric speciation

17) Which of the following describes the most likely order of events in speciation?

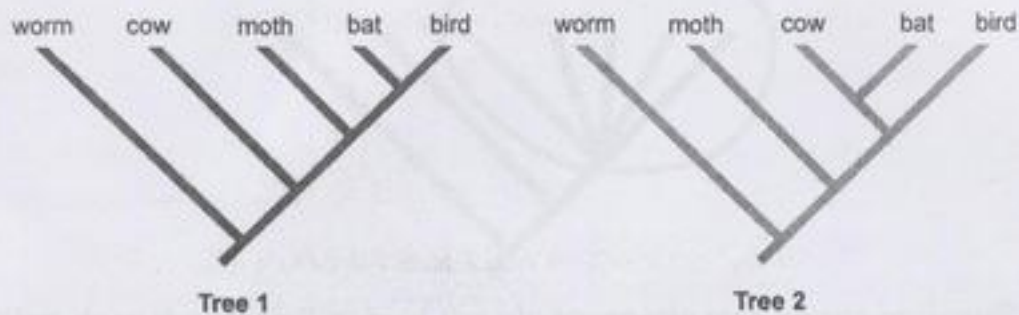
- A. genetic drift, genetic isolation, divergence
- B. genetic isolation, divergence, genetic drift
- C. divergence, genetic drift, genetic isolation
- D. divergence, genetic isolation, genetic drift
- E. genetic isolation, genetic drift, divergence

18) A storm brings two formerly separated populations of beetles together. They look very similar. Under the biological species concept, which of the following would show that the two populations are different species?

- A. One population breeds in spring, the other in fall.
- B. Males of the two populations have different flight patterns in courtship.
- C. When individuals from the two populations mate with each other in the laboratory, the eggs fail to hatch.
- D. All of the above are correct.
- E. None of the above are correct.

19) Natural selection for traits that keep distinct populations from reproducing with each other is called reinforcement. When is reinforcement beneficial?

- A. when populations would otherwise fuse over time
- B. when hybrids have lower fitness than either parent population
- C. when prezygotic isolating mechanisms are in place
- D. when one population could be overwhelmed by the other



20) Applying the principle of parsimony to the trait "ability to fly," which of the two phylogenetic trees above is better?

- A. Tree 1
- B. Tree 2

21) What is still lacking in the hypothesis of an asteroid impact as the cause of the end-Cretaceous mass extinction?

- A. evidence of the location where an asteroid hit Earth
- B. evidence that an asteroid hit Earth at the time of the extinctions (65 million years ago)
- C. a convincing explanation of why mammals radiated after the event
- D. a convincing explanation of why some lineages survived while others vanished

22) The dinoflagellate *Pfiesteria piscicida* can feed off algae and bacteria. They can also "steal" intact chloroplasts from algae and become photosynthetic. In the presence of large amounts of fish, *Pfiesteria* can secrete a toxin that kills fish, allowing it to feed on decaying fish matter. How would you classify this species?

- A. predator
- B. primary producer
- C. detritivore
- D. all of the above
- E. A and C only

23) You might be interested to know how many different types of bacteria live on the shower curtain in your bathroom. What is the most efficient method for answering this question?

- A. laboratory culture
- B. direct sequencing
- C. laboratory culture and direct sequencing are equally efficient methods



24) What does the circled part of the phylogenetic tree above indicate?

- A. an adaptive radiation
- B. a mass extinction event
- C. rapid speciation
- D. A and C
- E. A, B and C

25) Which of the following adaptations did *not* aid in the evolution of a mobile lifestyle?

- A. a body cavity to act as a hydrostatic skeleton
- B. a bony jaw to capture and grasp prey
- C. a muscular post-anal tail
- D. pharyngeal gill slits
- E. segmentation of body structures such as muscle, nerves & blood vessels

26) Which of the following is a correct element of alternation of generations?

- A. The sporophyte is haploid and produces gametes.
- B. The sporophyte is diploid and produces spores.
- C. The gametophyte is haploid and produces spores.
- D. The gametophyte is diploid and produces gametes.
- E. Two spores unite to form a zygote.

27) Very few organisms besides fungi have a heterokaryotic stage in their life cycle. Which of the following is another typical aspect of the fungal life cycle?

- A. Alternation of generations
- B. They produce eggs and sperm in approximately equal numbers, instead of many sperm and a few eggs.
- C. Spores have to fuse with each other before they develop into a new mycelium.
- D. Most varieties undergo sexual reproduction without producing eggs or sperm.

28) Which of the following represents a conflict between phylogenetic trees estimated from morphological data versus DNA sequence data?

- A. Choanoflagellates are the closest living relative of animals.
- B. Protostomes and deuterostomes are a fundamental split within the Bilateria.
- C. Sponges are the most ancient, or basal, lineage of animals.
- D. Body cavities evolved in the following order: acoelomate, pseudocoelomate, coelomate.

29) Among protostomes, which morphological trait is the most varied (shows the most diversity)?

- A. type of symmetry (bilateral vs. radial vs. none)
- B. type of body cavity (coelom vs. pseudocoelom vs. acoelom)
- C. number of embryonic tissue types (diploblasty vs. triploblasty)
- D. direction of gastrulation (pore becomes mouth vs. pore becomes anus)

30) What behaviour makes humans unique amongst animals?

- A. manufacture and use of tools
- B. use of symbolic language
- C. organized warfare against same species
- D. high levels of parental care
- E. all of the above
- F. none of the above

31) HIV contains an RNA genome in the viral particle. When the virus infects, the RNA is copied into DNA by the reverse transcriptase enzyme. Reverse transcriptase is a very sloppy enzyme and makes frequent mistakes. Which of the following statements is **true** due to this property of reverse transcriptase?

- A. It is very difficult to make a vaccine for HIV.
- B. HIV accumulates mutations in its genome.
- C. HIV evolves very quickly.
- D. All of the above answers apply.
- E. B and C

32) How did the development of the jaw contribute to evolutionary diversification of vertebrate lineages?

- A. It allowed vertebrates to devote neural crest cell development to expansion of the brain.
- B. It allowed vertebrates to grow a bony skull.
- C. It allowed vertebrates to develop lungs, which enabled them to move onto land.
- D. It allowed vertebrates to feed on a wider variety of food sources.
- E. It allowed vertebrates to develop gills and thus respire more efficiently.

33) Which statement does not support, or is in conflict with, the hypothesis that modern humans (*Homo sapiens*) radiated out from Africa:

- A. mtDNA sequences from African populations show the greatest diversity, compared to mtDNA in populations from other continents.
- B. All early hominin (eg. *Australopithecus*, *Paranthropus*) fossils found to date have been located in Africa.
- C. Fossils of a previously undescribed human sp. (*H. floresiensis*), thought to have evolved from *H. erectus*, were recently found in Indonesia.
- D. mtDNA sequence divergences follow a geographic pattern that mostly agrees with human migration paths estimated from archaeology.
- E. None of the above statements conflict with the Out-of-Africa hypothesis.

34) In gene therapy, researchers attempt to use attenuated viruses to carry the normal gene into cells and replace the defective gene. Which type of virus is suited to this application?

- A. lytic viruses
- B. lysogenic viruses
- C. either lytic or lysogenic viruses