

**These review questions are for the Bio 1 biological macromolecules topics, which include carbohydrates, lipids, proteins, and nucleic acids. These questions were adapted from several sources, including the textbook's review questions.**

**Multiple choice review questions:**

- 1) Which of these molecules is not a macromolecule?
  - A) Water
  - B) Carbohydrates
  - C) Nucleic acids
  - D) Proteins
  - E) Lipids
  
- 2) Which of the following categories includes all others in the list?
  - A) monosaccharide
  - B) disaccharide
  - C) starch
  - D) carbohydrate
  - E) polysaccharide
  
- 3) Which of the following is a carbohydrate but not a polymer?
  - A) glucose
  - B) starch
  - C) cellulose
  - D) chitin
  - E) glycogen
  
- 4) Based on molecular formula, which of the following is a monosaccharide?
  - A)  $C_{18}H_{36}O_{18}$
  - B)  $C_{18}H_{32}O_{16}$
  - C)  $C_6H_{10}O_5$
  - D)  $C_{18}H_{10}O_{15}$
  
- 5) If two molecules of glucose were joined together, the disaccharide is called:
  - A) maltose.
  - B) fructose.
  - C) glucose.
  - D) galactose.
  - E) sucrose.

6) The molecular formula for glucose is

- A)  $C_6H_{12}O_6$
- B)  $C_5H_{10}O_6$
- C)  $C_5H_{10}O_5$
- D)  $5C_6H_{12}O_6$

7) Ribose is a monosaccharide containing five carbon atoms. The molecular formula for ribose is

- A)  $C_6H_{12}O_6$
- B)  $C_5H_{10}O_6$
- C)  $C_5H_{10}O_5$
- D)  $5C_6H_{12}O_6$

8) Lactose, a sugar in milk, is composed of one glucose monosaccharide joined to one galactose monosaccharide. How is lactose classified?

- A) as a 12 carbon monomer
- B) as 2 carbon monomer
- C) as a monosaccharide
- D) as a disaccharide
- E) as a polysaccharide

9) All of the following are polysaccharides *except*

- A) maltose
- B) glycogen.
- C) chitin.
- D) cellulose.
- E) starch

10) Which of the following is true of both starch and cellulose?

- A) They are both polymers of glucose.
- B) Their glucoses are all have the same orientation
- C) They can both be digested by humans.
- D) They are both used for energy storage in plants.
- E) They are both structural components of the plant cell wall.

11) Plant cells store glucose energy in the form of \_\_\_\_\_, and animal cells store energy in the form of \_\_\_\_\_.

- A) Fructose, glucose
- B) Disaccharides, monosaccharides
- C) Cellulose, Chitin

D) Starch, glycogen

12) On food packages, to what does the term *fiber* refer?

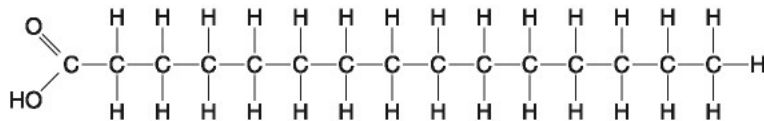
- A) cellulose
- B) polypeptides
- C) starch
- D) glycogen
- E) chitin

13) Which of the following statements is true for all the class of biological molecules known as lipids?

- A) They are hydrophobic.
- B) They are made from glycerol, fatty acids, and phosphate.
- C) They contain less energy than proteins and carbohydrates.
- D) They are made by dehydration reactions.
- E) They contain nitrogen.

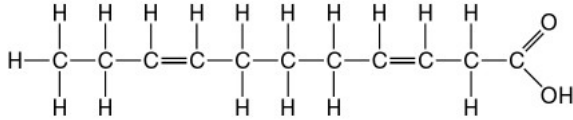
14) A triglyceride is composed of

- A) Fatty acids and glucose
- B) Fatty acids and glycerol
- C) Fatty acids only
- D) Cholesterol only
- E) Glycerol, fatty acids, and phosphate



15) Which of the following statements is the most complete description of the molecule above?

- A) It is a saturated fatty acid.
- B) A diet rich in this molecule may contribute to atherosclerosis.
- C) Molecules of this type are usually liquid at room temperature.
- D) It is a saturated fatty acid and a diet rich in this molecule may contribute to atherosclerosis.
- E) It is a saturated fatty acid, a diet rich in this molecule may contribute to atherosclerosis, and molecules of this type are usually liquid at room temperature.



16) Which of the following statements is the most complete description of the molecule above?

- A) It is an unsaturated fatty acid.
- B) A diet rich in this molecule may contribute to atherosclerosis.
- C) Molecules of this type are usually liquid at room temperature.
- D) It is an unsaturated fatty acid and a diet rich in this molecule may contribute to atherosclerosis.
- E) It is an unsaturated fatty acid and molecules of this type are usually liquid at room temperature.

17) Which of the following is a lipid that does **not** contain glycerol and fatty acid monomers?

- A) steroids
- B) saturated fats
- C) unsaturated fats
- D) triglycerides
- E) phospholipids

18) Human sex hormones (such as estrogen and testosterone) are this type of lipid:

- A) steroids
- B) saturated fats
- C) unsaturated fats
- D) triglycerides
- E) phospholipids

19) All of the following are proteins *except*

- A) enzymes.
- B) receptors.
- C) channel proteins.
- D) collagen.
- E) cellulose.

20) Amino acids are linked together to form a protein by

- A) Phosphodiester bonds
- B) Beta 1-4 linkages
- C) Peptide bonds
- D) Hydrogen bonds
- E) Ionic bonds

- 21) There are 20 different amino acids. What makes one amino acid different from another?
- A) different side chains (R groups) attached to a carboxylic acid carbon
  - B) different side chains (R groups) attached to the amino groups
  - C) different side chains (R groups) attached to the central carbon
  - D) different arrangement of the amine and the carboxylic acid functional groups
- 22) In order for a protein to be a membrane protein (such as a receptor protein or a channel protein) it would have to...
- A) be entirely hydrophilic.
  - B) be entirely hydrophobic.
  - C) contain at least one hydrophobic region.
  - D) be covalently bonded to phospholipids.
  - E) exposed on only one surface of the membrane.
- 23) Which of the following is a characteristic feature of a channel protein in a plasma membrane?
- A) It does not pass completely through the membrane.
  - B) It exhibits a specificity for transporting a particular type of molecule.
  - C) It must use cellular energy to transport molecules.
  - D) It has no binding site.
  - E) It has no hydrophobic amino acids.
- 24) Membrane proteins (such as receptors and channel proteins)...
- A) have at least one hydrophilic domain that protrudes outside the cell.
  - B) are confined entirely to the hydrophobic interior of the plasma membrane.
  - C) have at least one hydrophobic domain that protrudes into the cytoplasm.
  - D) are free to depart from the membrane and dissolve in the surrounding solution.
- 25) You are working on a team that is designing a new drug. In order for this drug to work, it must enter the cytoplasm of specific target cells (but **not** any other cells in the body). Which of the following would be a factor that determines whether the molecule selectively enters only the target cells?
- A) blood or tissue type of the patient
  - B) hydrophobicity of the drug molecule
  - C) lack of charge on the drug molecule
  - D) similarity of the drug molecule to other molecules transported only by the target cells
  - E) lipid composition of the target cells' plasma membrane.

- 26) The active site of an enzyme is the region that
- A) anchors the enzyme to the cell membrane.
  - B) binds the substrates of the enzyme.
  - C) binds all molecules (whether or not the molecules are substrates of the enzyme).
  - D) transports solute molecules through the cell membrane.
  - E) binds allosteric activators.
- 27) Which of the following is true of enzymes?
- A) Enzymes perform chemical reactions.
  - B) Enzyme function is always increased if the 3-D structure or conformation of an enzyme is altered.
  - C) Enzyme function is independent of physical and chemical environmental factors such as pH and temperature.
  - D) Enzymes are used as insulation to maintain body heat.
- 28) Zinc, an essential trace element for most organisms, is present in the active site of the enzyme carboxypeptidase. The zinc most likely functions as a(n)
- A) inhibitor of the enzyme.
  - B) substitute substrate for the enzyme if its main substrate is not available.
  - C) pollutant.
  - D) cofactor necessary for enzyme activity.
  - E) coenzyme derived from a vitamin.
- 29) Upon chemical analysis, a particular polypeptide was found to contain 100 amino acids. How many peptide bonds are present in this protein?
- A) 101
  - B) 100
  - C) 99
  - D) 98
  - E) 97
- 30) What aspects of protein structure are stabilized or assisted by hydrogen bonds?
- A) primary structure
  - B) secondary structure
  - C) tertiary structure
  - D) quaternary structure
  - E) secondary, tertiary, and quaternary structures, but not primary structure
- 31) Which bonds are created during the formation of the primary structure of a protein?
- A) peptide bonds
  - B) hydrogen bonds

- C) disulfide bonds
- D) phosphodiester bonds
- E) peptide bonds, hydrogen bonds, and disulfide bonds

32) What maintains the secondary structure of a protein?

- A) peptide bonds
- B) hydrogen bonds between the amino group of one peptide bond and the carboxyl group of another peptide bond
- C) disulfide bonds
- D) hydrophobic interactions
- E) hydrogen bonds between the R groups

33) Which type of interaction stabilizes the  $\alpha$  helix and the  $\beta$  pleated sheet structures of proteins?

- A) hydrophobic interactions
- B) disulfide bonds
- C) ionic bonds
- D) hydrogen bonds
- E) peptide bonds

34) Which level of protein structure do the  $\alpha$  helix and the  $\beta$  pleated sheet represent?

- A) primary
- B) secondary
- C) tertiary
- D) quaternary
- E) primary, secondary, tertiary, and quaternary

35) The amino acids of the protein keratin are arranged predominantly in an  $\alpha$  helix. This secondary structure is stabilized by

- A) covalent bonds.
- B) peptide bonds.
- C) ionic bonds.
- D) polar bonds.
- E) hydrogen bonds.

36) The tertiary structure of a protein is the

- A) bonding together of several polypeptide chains by weak bonds.
- B) order in which amino acids are joined in a polypeptide chain.
- C) the folding together of the secondary structures
- D) overall protein structure resulting from the aggregation of two or more polypeptide subunits.

37) What type of covalent bond between amino acid side chains (R groups) functions in maintaining a polypeptide's specific three-dimensional shape?

- A) ionic bond
- B) hydrophobic interaction
- C) van der Waals interaction
- D) disulfide bond
- E) hydrogen bond

38) At which level of protein structure are interactions between the side chains (R groups) most important?

- A) primary
- B) secondary
- C) tertiary

39) The R group or side chain of the amino acid serine is  $-\text{CH}_2-\text{OH}$ . The R group or side chain of the amino acid leucine is  $-\text{CH}_2-\text{CH}-(\text{CH}_2)_2$ . Where would you expect to find these amino acids in a globular protein in aqueous solution?

- A) Serine would be in the interior, and leucine would be on the exterior of the globular protein.
- B) Leucine would be in the interior, and serine would be on the exterior of the globular protein.
- C) Both serine and leucine would be in the interior of the globular protein.
- D) Both serine and leucine would be on the exterior of the globular protein.
- E) Both serine and leucine would be in the interior and on the exterior of the globular protein.

40) Changing a single amino acid in a protein consisting of 325 amino acids would

- A) alter the primary structure of the protein, but not its tertiary structure or function.
- B) cause the tertiary structure of the protein to unfold.
- C) always alter the biological activity or function of the protein.
- D) always alter the primary structure of the protein and disrupt its biological activity.
- E) always alter the primary structure of the protein, sometimes alter the tertiary structure of the protein, and sometimes affect its biological activity.

41) Normal hemoglobin is a tetramer protein, consisting of four polypeptides joined together. In sickle-cell disease, as a result of a single amino acid change, the mutant hemoglobin tetramer proteins bind to each other in abnormal ways and therefore assemble into large fibers. Based on this information alone, we can conclude that sickle-cell hemoglobin protein exhibits

- A) altered primary structure.



- B) altered secondary structure.
- C) altered tertiary structure.
- D) altered quaternary structure.
- E) altered primary structure and altered quaternary structure; the secondary and tertiary structures may or may not be altered.

42) Which statement below is **not** true about a mutation of a single amino acid in an enzyme...

- A) it may have no effect on the activity or properties of the enzyme.
- B) it may cause a change in the substrate specificity of the enzyme.
- C) it may denature the enzyme.
- D) it may convert the enzyme into a carbohydrate.

43) In a protein, where would you expect to find a hydrophobic amino acid like valine?

- A) in the interior of the folded protein, away from water
- B) on the exterior surface of the protein, interacting with water
- C) in the transmembrane portion interacting with lipid fatty acid chains
- D) in the interior of the folded protein, away from water, or in a transmembrane portion interacting with lipid fatty acid chains
- E) anywhere in the protein, with equal probability

44) How will heating to 95 degree C affect proteins?

- A) Protein molecules that are normally separated will link together.
- B) Proteins will unfold (denature) but will return to their original shape when cooled to body temperature.
- C) Proteins will permanently denature.
- D) Proteins will hydrolyze into separate amino acids.
- E) The amino terminus and the carboxyl terminus will reverse polarity.

45) The structural level of a protein *least* affected by a disruption in hydrogen bonding is the

- A) primary level.
- B) secondary level.
- C) tertiary level.
- D) quaternary level.
- E) All structural levels are equally affected.

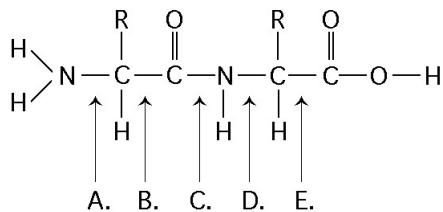
46) How might an amino acid change at a site distant from the active site of the enzyme alter the enzyme's substrate specificity?

- A) by changing the enzyme's stability
- B) by changing the enzyme's location in the cell

- C) by changing the shape and folding of the protein
- D) by changing the enzyme's pH optimum
- E) an amino acid change away from the active site cannot alter the enzyme's substrate specificity

47) When you have a severe fever, what grave consequence may occur if the fever is not controlled?

- A) destruction of your enzymes' primary structure
- B) removal of amine groups from your proteins
- C) denaturing your enzymes
- D) removal of the amino acids in active sites of your enzymes
- E) binding of your enzymes to inappropriate substrates



48) At which bond would water need to be added to achieve hydrolysis of the peptide shown above, back to its component amino acids?

- A) A
- B) B
- C) C
- D) D
- E) E

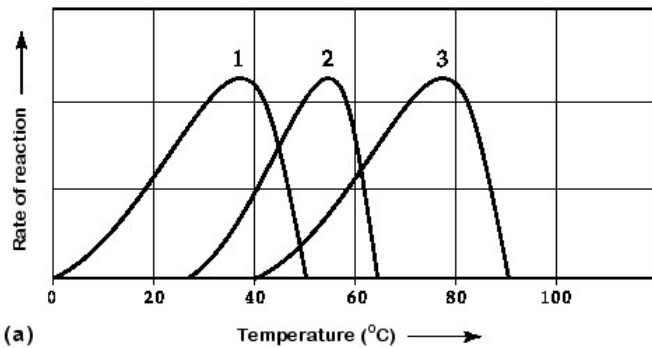
49) Which bond of the peptide shown in question 48 is a peptide bond?

- A) A
- B) B
- C) C
- D) D
- E) E

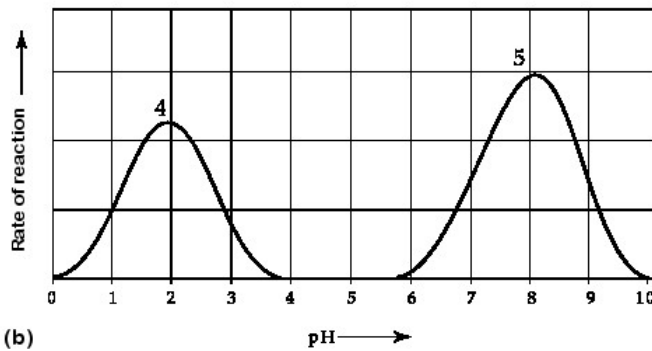
50) Which bond of the peptide shown in question 48 is closest to the amino terminus of the molecule?

- A) A
- B) B
- C) C
- D) D
- E) E

- 51) Some bacteria are metabolically active in hot springs because
- A) they are able to maintain a lower internal temperature.
  - B) high temperatures make catalysis unnecessary.
  - C) their enzymes have high optimal temperatures.
  - D) their enzymes are completely insensitive to temperature.
  - E) they use molecules other than proteins or RNAs as their main catalysts.



(a)



(b)

**Activity of various enzymes at various temperatures (a) and at various pH (b).**

52) Which curve(s) on the graphs may represent the temperature and pH profiles of an enzyme taken from a bacterium that lives in a mildly alkaline hot springs at temperatures of 70°C or higher?

- A) curves 1 and 5
- B) curves 2 and 4
- C) curves 2 and 5
- D) curves 3 and 4
- E) curves 3 and 5

53) Which temperature and pH profile curves on the graphs for question 52 were most likely generated from analysis of an enzyme from a human stomach where conditions are strongly acid?

- A) curves 1 and 4
- B) curves 1 and 5

- C) curves 2 and 4
- D) curves 2 and 5
- E) curves 3 and 4

54) DNA and RNA are both polymers of

- A) Monosaccharides
- B) Nucleotides
- C) Amino acids
- D) Fatty acids

55) Which carbohydrate would you find as a part of a molecule of RNA?

- A) Galactose
- B) Deoxyribose
- C) Ribose
- D) Glucose

56) Which of the following descriptions best fits the class of molecules known as nucleotides?

- A) a nitrogenous base and a phosphate group
- B) a nitrogenous base and a ribose sugar
- C) a nitrogenous base, a phosphate group, and a ribose sugar
- D) a phosphate group and an adenine or uracil
- E) a ribose sugar and a purine or pyrimidine

57) Which of the following are nitrogenous bases of the pyrimidine type?

- A) guanine and adenine
- B) cytosine and uracil
- C) thymine and guanine
- D) ribose and deoxyribose
- E) adenine and thymine

58) Which of the following are nitrogenous bases of the purine type?

- A) cytosine and guanine
- B) guanine and adenine
- C) adenine and thymine
- D) thymine and uracil
- E) uracil and cytosine

59) Which of the following statements about the 5' end of one strand of DNA is correct?

- A) The 5' end has a hydroxyl group attached to the number 5 carbon of ribose.
- B) The 5' end has a phosphate group attached to the number 5 carbon of ribose.
- C) The 5' end has phosphate attached to the number 5 carbon of the nitrogenous base.
- D) The 5' end has a carboxyl group attached to the number 5 carbon of ribose.
- E) The 5' end is the fifth position on one of the nitrogenous bases.

60) What is meant by the description "antiparallel" regarding the strands that make up DNA?

- A) The twisting nature of DNA creates nonparallel strands.
- B) The 5' to 3' direction of one strand runs in the opposite to the 5' to 3' direction of the other strand.
- C) Base pairings create unequal spacing between the two DNA strands.
- D) One strand is positively charged and the other is negatively charged.
- E) One strand contains only purines and the other contains only pyrimidines.

61) In an analysis of the nucleotide composition of DNA, which of the following will be found?

- A)  $A = C$
- B)  $A = G$  and  $C = T$
- C)  $A + C = G + T$
- D)  $G + C = T + A$

62) In analyzing the number of different bases in a DNA sample, which result would be consistent with the base-pairing rules?

- A)  $A = G$
- B)  $A + G = C + T$
- C)  $A + T = G + T$
- D)  $A = C$
- E)  $G = T$

63) If a DNA sample were composed of 10% thymine, what would be the percentage of guanine?

- A) 10
- B) 20
- C) 40
- D) 80
- E) impossible to tell from the information given

64) Cytosine makes up 42% of the nucleotides in a sample of DNA from an organism. Approximately what percentage of the nucleotides in this sample will be thymine?

- A) 8%

- B) 18%
- C) 31%
- D) 42%
- E) It cannot be determined from the information provided.

65) A double-stranded DNA molecule contains a total of 120 purines and 120 pyrimidines. This DNA molecule could be composed of

- A) 120 adenine and 120 uracil molecules.
- B) 120 thymine and 120 adenine molecules.
- C) 120 cytosine and 120 thymine molecules.
- D) 120 adenine and 120 cytosine molecules.
- E) 120 guanine and 120 thymine molecules.

66) If one strand of DNA is 5' ATCGTTAAGCGAGTCA 3', then the complementary strand must be

- A) 5' TAGCAATTCGCTCAGT 3'
- B) 5' ACTGAGCGAATTGCTA 3'
- C) 5' TGA CTCGCTTAACGAT 3'
- D) 5' ATCGTTAAGCGAGTCA 3'

67) Which of the following pairs of base sequences could form a short stretch of a normal double helix of DNA?

- A) 5'-AAAA-3' with 3'-UUUU-5'
- B) 5'-AGCT-3' with 5'-TCGA-3'
- C) 5'-GCGC-3' with 5'-TATA-3'
- D) 5'-ATGC-3' with 5'-GCAT-3'
- E) All of these pairs are correct.

68) Which of the following is most similar in structure to ATP?

- A) a ribose sugar
- B) a DNA nucleotide
- C) an RNA nucleotide
- D) an amino acid with three phosphate groups attached
- E) a phospholipid

69) Why is ATP an important molecule in metabolism?

- A) It removes toxins by binding to them.
- B) It provides energy for reactions inside the cell.
- C) It is very stable and can thereby stabilize other cellular molecules.
- D) It is one of the four building blocks for RNA synthesis.
- E) It is one of the four building blocks for DNA synthesis.

70) What is the difference (if any) between the structure of ATP and the structure an A nucleotide in RNA?

- A) The sugar molecule is different.
- B) The nitrogen-containing base is different.
- C) The number of phosphates is three instead of one.
- D) The number of phosphates is three instead of two.
- E) There is no difference.

71) If cells are grown in a medium containing radioactive phosphate, which of these molecules will become radioactive?

- A) All phospholipids
- B) All nucleic acids
- C) All proteins
- D) All starch
- E) All phospholipids and all nucleic acids
- F) All phospholipids, all nucleic acids, and all proteins

72) If cells are grown in a medium containing radioactive nitrogen, which of these molecules will **not** become radioactive?

- A) fatty acids
- B) nucleic acids
- C) enzymes
- D) receptors

73) Which of the following is an example of hydrolysis?

- A) the reaction of two monosaccharides, forming a disaccharide with the release of water
- B) the linking together of two amino acids, forming a peptide with the release of water
- C) the breakdown of a fat molecule, forming glycerol and fatty acids with the release of water
- D) the breakdown of a fat molecule,, forming glycerol and fatty acids with the consumption of water
- E) the synthesis of a nucleotide from a phosphate, a pentose sugar, and a nitrogenous base with the production of a molecule of water

74) Which of the following is not a monomer/polymer pairing?

- A) monosaccharide/polysaccharide
- B) amino acid/protein
- C) triglyceride/phospholipid bilayer
- D) deoxyribonucleotide/DNA
- E) ribonucleotide/RNA

75) Which class of biological polymer has the greatest number of functions?

- A) polysaccharides
- B) proteins
- C) DNA
- D) lipids

76) The nitrogenous base adenine is found in all members of which group?

- A) proteins, triglycerides, and steroids
- B) proteins, ATP, and DNA
- C) ATP, RNA, and DNA
- D) glucose, ATP, and DNA
- E) proteins, carbohydrates, and ATP

77) When two monomers become linked to form a polymer, which answer below best describes how the monomers become linked together?

- A) A new covalent bond forms between a carbon atom on one monomer and a carbon atom on the other monomer (a new C-C bond)
- B) By the removal of an -OH from one monomer and a hydrogen atom from the other monomer (dehydration synthesis)
- C) By the addition of an -OH to one monomer and a hydrogen atom to the other monomer (hydrolysis)
- D) Through hydrogen bonding between the monomers
- E) By hydrophobic interaction between the two monomers

78) Which chemical property of lipids accounts for their insolubility in water?

- A) The polar COOH group of fatty acids
- B) The large number of non-polar C-H and C-C bonds
- C) The branching of saturated fatty acids
- D) The C=C bonds in unsaturated fatty acids

79) Which is **never** a component of DNA?

- A) The pyrimidine uracil
- B) Five-carbon sugar
- C) The purine adenine
- D) Phosphate groups

80) The bonds that hold complementary strands of DNA together (in other words, the bonds between complementary bases) are

- A) Hydrogen bonds



- B) Peptide bonds
- C) Ionic bonds
- D) Phosphate bonds

**Answers to multiple choice questions:**

- 1) A
- 2) D
- 3) A
- 4) A
- 5) A
- 6) A
- 7) C
- 8) D
- 9) A
- 10) A
- 11) D
- 12) A
- 13) A
- 14) B
- 15) D
- 16) E
- 17) A
- 18) A
- 19) E
- 20) C
- 21) C
- 22) C
- 23) B
- 24) A
- 25) D
- 26) B
- 27) A
- 28) D
- 29) C
- 30) E
- 31) A
- 32) B
- 33) D
- 34) B
- 35) E
- 36) C

- 37) D
- 38) C
- 39) B
- 40) E
- 41) E
- 42) D
- 43) D
- 44) C
- 45) A
- 46) C
- 47) C
- 48) C
- 49) C
- 50) A
- 51) C
- 52) E
- 53) A
- 54) B
- 55) C
- 56) C
- 57) B
- 58) B
- 59) B
- 60) B
- 61) C
- 62) B
- 63) C
- 64) A
- 65) B
- 66) C
- 67) D
- 68) C
- 69) B
- 70) C
- 71) E
- 72) A
- 73) D
- 74) C
- 75) B
- 76) C
- 77) B
- 78) B
- 79) A
- 80) A

