



# Biology

## Standard and Higher level

### B1.1 Carbohydrates and lipids

### Paper 1A

12 May 2025

**Zone A** afternoon | **Zone B** morning | **Zone C** afternoon

2 hours 30 minutes [Paper 1A]

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#### Instructions to candidates

- Answer all questions.
- For each question, choose the answer you consider to be the best.
- A calculator is required for this paper.
- This paper generally presents questions in the same order the concepts are presented in the syllabus guide. The earlier questions are usually but not always easier than the later questions. Although most questions focus on this topic only, some are linked to other topics.
- This paper contains challenging IB-style problems. It is meant to enrich your learning and improve your mastery of the concepts presented in this topic after you have studied it.
- Many of the questions here are original and written by me. Several questions are taken from external sources, which are referenced at the end of the paper. None of the questions are from IB past papers.
- The duration of this paper was scaled according to the number of marks available and based on how much time, on average, each mark is worth in examination settings. Since this is a practice paper, expect to need more time to complete it.
- The maximum mark for this paper 1A is **[100 marks]**.

1. What makes carbon capable of producing a wide variety of biomolecules?
  - A. 4 valence electrons
  - B. 4 covalent bonds
  - C. 2 electrons per covalent bond
  - D. 6 total electrons
2. What is the nature of a covalent bond?
  - A. Each atom shares electrons equally
  - B. Each atom shares 1 electron
  - C. Each atom donates 1 electron
  - D. Each atom splits 2 electrons
3. What makes biomolecules functionally diverse?
  - A. The ability of carbon to bond with other non-metallic elements
  - B. The ability of carbon to form 4 covalent bonds
  - C. The ability to form single and double rings
  - D. The ability to form branched and unbranched chains
4. What are organisms composed of?
  - A. Inorganic compounds only
  - B. Organic compounds only
  - C. Inorganic and organic compounds
  - D. Organic and synthetic compounds

5. DNA is composed of repeating units held together by covalent bonds. Which of the following is the correct term to describe DNA?

- A. Polymer of bases
- B. Polymer of nucleotides
- C. Monomer of bases
- D. Monomer of nucleotides

6. How many water molecules are produced by disaccharide formation?

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

7. What happens when a dipeptide forms from two identical amino acids?

- I. Carbon forms a covalent bond with a non-metallic element
- II. The number of double bonds per one amino acid decreases
- III. The dipeptide contains more single bonds than both individual amino acids combined

- A. I only
- B. I and II only
- C. II and III only
- D. I, II, and III

8. How many water molecules are released in the formation of a polypeptide with 25 amino acids?

- A. 24
- B. 25
- C. 26
- D. 50

9. How many water molecules are released in the formation of 5 adenine nucleotides?

- A. 4
- B. 5
- C. 10
- D. 15

10. What bond(s) is/are formed during the production of a nucleotide?

- I. Bond between pentose sugar and phosphate group
- II. Bond between nitrogenous base and pentose sugar
- III. Bond between pentose sugar and water

- A. I only
- B. I and II only
- C. II and III only
- D. I, II, and III

11. The table shows reactants, products, and enzymes involved in several reactions. Which option correctly matches each letter to its identity?

Reactants	Products	Enzymes involved
Maltose, water	A	Maltase
B	Amino acids	Protease
Lipids, water	Fatty acids, C	Lipase

	A	B	C
A.	Polymaltose	Carboxyl	Glycerol
B.	Sucrose	Dipeptides	Esters
C.	Starch	Water	Esters
D.	Glucose	Dipeptides, water	Glycerol

12. A researcher adds a hydrolysis inhibitor to a culture of cells. Which of the following is/are likely to occur as a consequence?

- I. Cells have a higher than usual number of molecules that do not interfere with osmolarity
- II. The proportion of cells able to complete the S phase decreases
- III. The amount of water involved in the cell's metabolome increases

A. I only

B. I and II only

C. II and III only

D. I, II, and III

13. A mutation in a lysosomal enzyme inhibits glycoprotein hydrolysis in a cell. How might this lead to cell dysfunction?

- I. Less nutrients will be recycled in the cell
- II. Glycoprotein accumulation will affect cell osmolarity significantly
- III. The amount of water involved in the cell's metabolome increases

A. I only

B. I and II only

C. II and III only

D. I, II, and III

14. What is a unit of carbohydrates that cannot be further hydrolyzed?

A. Monosaccharides

B. Disaccharides

C. Oligosaccharides

D. Polysaccharides

15. The word hydrolysis is defined as the lysis of water. How does this apply to polymers?

- A. Polymers are synthesized by using the energy released by the breaking of water molecules into hydrogen and hydroxyl group
- B. Polymers break by separating water into hydrogen and hydroxyl group that are added to the monomers
- C. Polymers are separated into monomers producing energy and water molecules
- D. Polymers are hydrolyzed into monomers using water in the process and are called as dehydration synthesis

16. Which of the following bodily process would most likely be hindered by a lack of water in the human body?

- A. Protein synthesis
- B. Breathing
- C. DNA replication
- D. Digestion

17. During physical exercise, muscles hydrolyze glycogen into glucose. At rest, muscles condense glucose monomers back into glycogen. Which of the following statements must be correct?

- I. Glycogen formation by condensation reduces water influx in cells
- II. The number of oxidation reactions in cells during exercise increases
- III. Impaired glycogen hydrolysis reduces ATP availability during exercise

- A. I only
- B. I and II only
- C. II and III only
- D. I, II, and III

**18.** Glucose can undergo more oxidation than ribose, yet ATP, the main energy molecule for cells, is composed of ribose. What explains this?

- A. Ribose is a pentose sugar that stores energy in its covalent bonds
- B. Ribose is a pentose sugar that binds to other energy-storing compounds
- C. Ribose is a hexose sugar that stores energy in its covalent bonds
- D. Ribose is a hexose sugar that binds to other energy-storing compounds

**19.** What is the role of hydrocarbon rings in sugars?

- A. Enhance solubility in water
- B. Store more energy for oxidation
- C. Chemical stability
- D. Improve transportability across membranes

**20.** What is correct about the two isomers of glucose?

- A. An OH group projects downwards at C<sub>1</sub> and C<sub>4</sub> in  $\alpha$  glucose and upwards at C<sub>2</sub> and C<sub>4</sub> in  $\beta$  glucose
- B. An OH group projects downward at C<sub>1</sub> in  $\alpha$  glucose and upward at C<sub>1</sub> in  $\beta$  glucose while C<sub>4</sub> remains the same in both
- C. An OH group points upward at C<sub>1</sub> in both isomers but downward at C<sub>2</sub> in  $\alpha$  glucose only
- D. The OH group at C<sub>1</sub> alternates between projections at C<sub>2</sub> and C<sub>4</sub> in  $\alpha$  and  $\beta$  glucose

**21.** How many hydrogen and oxygen atoms do you expect a sugar with 8 carbon atoms to have?

- A. 12 hydrogen atoms and 6 oxygen atoms
- B. 12 hydrogen atoms and 8 oxygen atoms
- C. 16 hydrogen atoms and 6 oxygen atoms
- D. 16 hydrogen atoms and 8 oxygen atoms

22. What is the role of hydroxyl groups in sugars?

- A. Enhance solubility in water
- B. Store more energy for oxidation
- C. Chemical stability
- D. Improve transportability across membranes

23. Which of the following contribute to the transportability of sugars in blood?

- I. Chemical stability
- II. Solubility
- III. Energy yield from oxidation

- A. I only
- B. I and II only
- C. II and III only
- D. I, II, and III

24. What is a chemical element found in all proteins and nucleic acids but not carbohydrates and lipids?

- A. C
- B. H
- C. O
- D. N

25. What is correct about the products of digested carbohydrates, lipids, and proteins?

- A. Some of them are water molecules
- B. They store energy within their bonds that is used by cells
- C. They all contain carbon, hydrogen, oxygen, and nitrogen atoms
- D. All of them contain sulfur atoms

26. What is true about glucose?

- A.  $\alpha$  and  $\beta$  glucose have different formulae
- B. Glucose is a monomer of polysaccharides like sucrose and cellulose
- C. It contains 5 hydroxyl groups
- D. Its ring contains 5 carbons

27. What is the difference between glycogen and amylopectin?

- A. Both are branched
- B. One of them is more branched
- C. Both are composed of glucose monomers
- D. One of them is helical

28. What do  $\alpha$ -1-6-glycosidic linkages lead to?

- A. Always branching
- B. Sometimes branching
- C. Always linear chains
- D. Sometimes linear chains

29. How are glycogen and starch similar?

- A. They are composed of  $\alpha$  and  $\beta$  monomers
- B. They affect water movement if placed in a cell culture
- C. They do not affect water movement if placed in a cell culture
- D. They are composed of branching  $\beta$  monomers

30. What is an advantage of polysaccharides being composed of identical monomers?

- A. Rapid condensation
- B. Rapid hydrolysis
- C. Rapid condensation and hydrolysis
- D. Smaller metabolome

31. What is the name of the linkage that occurs at the first carbon in a glucose molecule with the hydroxyl group oriented downwards?

- A.  $\beta$ -1-4' glycosidic linkage
- B.  $\beta$ -1-6' glycosidic linkage
- C.  $\alpha$ -1-4' glycosidic linkage
- D.  $\alpha$ -1-6' glycosidic linkage

32. Which of the following best explains why  $\beta$ -glucose may have been evolutionarily selected for structural roles in plants rather than  $\alpha$ -glucose?

- A. It forms strong fibers by glycosidic linkages
- B. It forms linear chains by hydrogen bonding
- C. It forms linear chains that hydrogen bond together
- D. It forms strong fibers by reducing interactions between chains

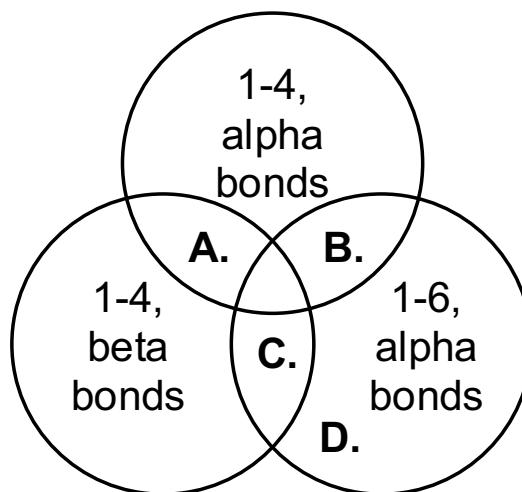
33. What affects the strength of interactions between amylose molecules and cis monounsaturated fatty acids?

- A. Boiling point
- B. Melting point
- C. Hydrogen bonding
- D. Molecule packing

34. What are the monomers of cellulose held together by?

- A. Alpha linkages
- B. Beta linkages
- C. Gamma linkages
- D. Covalent linkages

35. Which bonds are present in amylopectin?



36. Scientists add a chemical that causes the oxidation of carbohydrates into two solutions. Each solution contains a different type of sugar (X and Y) at equal concentrations. Once the chemical oxidizes all sugar molecules, the color of the solution turns purple. The table shows the volume of chemical required for each solution to turn purple.

Volume of chemical added to sugar X solution	Volume of chemical added to sugar Y solution
25.00 cm <sup>3</sup>	15.00 cm <sup>3</sup>

What is a valid conclusion?

- A. Sugar X is more soluble than Y
- B. Sugar X is less soluble than Y
- C. Sugar X yields less energy in cells than Y
- D. Sugar X yields more energy in cells than Y

37. What is the name of the molecule formed by combining a lipid and a carbohydrate?

- A. Lipohydrate
- B. Hydrolipid
- C. Carbolipid
- D. Glycolipid

38. What is not a lipid?

- A. Steroids
- B. Wax
- C. Oil
- D. Opioids

39. Cholesterol and glucose both contain rings, but only glucose is soluble in water. What explains this?

- I. 1 cholesterol molecule has more rings than 1 glucose molecule
- II. Glucose has less hydroxyl groups per ring
- III. Cholesterol has more hydroxyl groups per ring

- A. I only
- B. I and II only
- C. II and III only
- D. I, II, and III

40. Why are fatty acids non-polar even though they contain a polar carboxyl group?

- A. Polar region is larger
- B. Polar and non-polar regions are equal in size
- C. Non-polar region is larger
- D. Non-polar region is smaller

41. How many ester bonds are present in three phospholipid molecules?

- A. 3
- B. 6
- C. 9
- D. 12

42. What do fatty acids contain?

- A. A carboxyl group and methyl group
- B. A methyl group only
- C. A carboxyl group only
- D. A carboxyl group and hydrocarbon group

43. Why are fatty acids and steroids structurally different but still classified as lipids?

- A. Both are organic compounds
- B. Both are non-polar
- C. Both contain carboxyl groups
- D. Both contain hydroxyl groups

44. What is the difference between saturated and unsaturated fatty acids?

- A. Saturated fatty acids have more C=O bonds
- B. Saturated fatty acids have more methyl groups
- C. Saturated fatty acids have a higher carbon to hydrogen ratio
- D. Saturated fatty acids have a lower carbon to hydrogen ratio

45. Which of the following sugars should be administered to quickly resolve low blood sugar levels in a patient?

- A. Lactose
- B. Glucose
- C. Sucrose
- D. Maltose

46. An enzyme known to catalyze the cleavage of disaccharides is added to a pure sample of an unknown carbohydrate. The products of the reaction are then transferred into a plant tissue immersed in water. After some time, the volume of the plant tissue increases noticeably. What causes this change in volume?

- A. Monosaccharides
- B. Disaccharides
- C. Polysaccharides
- D. Water

47. An enzyme known to catalyze the hydrolysis of polysaccharides is added to a pure sample of an unknown carbohydrate. If the enzyme only digests branched sugars, which of the following organisms could it have been extracted from?

- I. Humans
- II. Plants
- III. Chimpanzees

- A. I only
- B. II only
- C. II and III only
- D. I, II, and III

48. A toxin disrupts the functioning of enzymes catalyzing carbohydrate condensation in plants. Which observation would confirm this?

- A. Osmotic stress
- B. Loss of monomers
- C. More starch
- D. Less water in cell

49. A researcher discovers an enzyme that only cleaves carbohydrates made of  $\alpha$ -1,4 glycosidic bonds. When exposed to two unknown carbohydrates, only one is fully hydrolyzed. What could the undigested carbohydrate be made out of?

- A.  $\alpha$ -glucose monomers
- B.  $\beta$ -glucose monomers
- C.  $\alpha$  or  $\beta$  glucose monomers
- D. Amylose

50. Plants exposed to a drought exhibit reduced rates of photosynthesis. What is going to likely increase in cells?

- A. Carbohydrate condensation
- B. Carbohydrate hydrolysis
- C. Monosaccharides
- D. Polysaccharides

51. A researcher identifies a new organic compound with a carbon backbone that includes a carboxyl group. It dissolves easily in water and is rapidly absorbed by intestinal cells. Which class of biomolecules does the organic compound most likely belong to?

- A. Carbohydrates
- B. Lipids
- C. Nucleic acids
- D. Proteins

52. Which compound(s) could be produced when triglycerides are hydrolyzed?

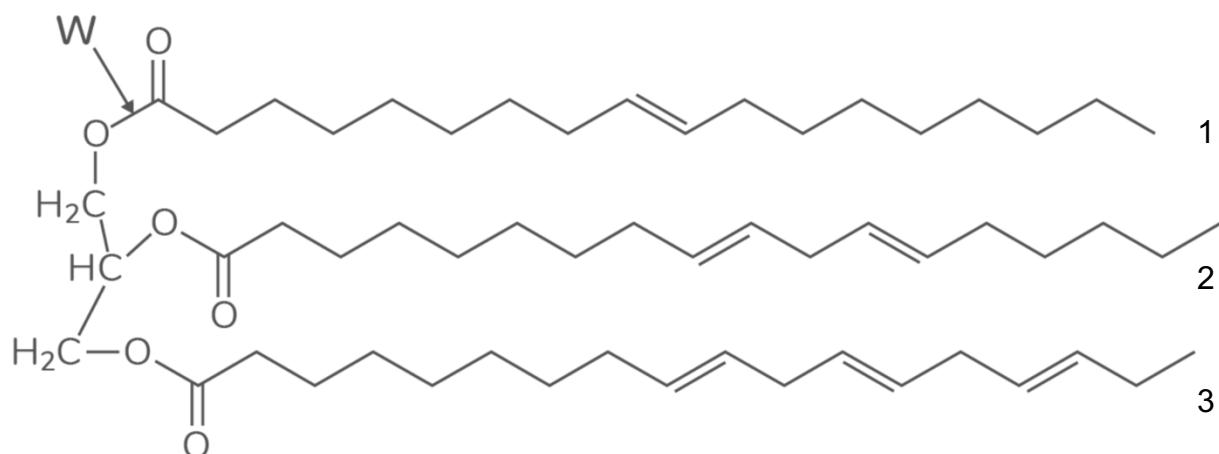
- I. Many  $C_3H_8O_3$  molecules
- II. Many compounds that do not dissolve in water
- III. Many compounds with carboxyl groups

- A. I only
- B. I and II only
- C. I and III only
- D. I, II, and III

53. Which of the following statements describe a typical lipid molecule?

- A. A molecule with an even number of carbon atoms in a linear chain
- B. An amphipathic molecule with many double bonds and carboxyl groups
- C. A linear hydrocarbon chain
- D. A polar hydrocarbon linear chain

Use the chemical structure of linseed oil to answer questions **54** and **55**.



**54.** What is the bond labelled W called?

- A. Glyceridic
- B. Carboxylic
- C. Ester
- D. Hydrolytic

**55.** If one of the fatty acid chains of the linseed oil molecule were to be replaced by a phosphate group, which of these chains should be replaced to produce the most fluid phospholipid?

- A. 1
- B. 2
- C. 3
- D. Glycerol

**56.** Where are double bonds located in unsaturated lipid molecules?

- A. Within fatty acids only
- B. Within glycerol only
- C. Between fatty acids and glycerol
- D. Within fatty acids and within glycerol

57. Which of the following options correctly match the function to the sugar?

	<b>Amylose</b>	<b>Cellulose</b>	<b>Glycogen</b>	<b>Amylopectin</b>
A.	Storage	Storage	Structure	Storage
B.	Structure	Storage	Storage	Storage
C.	Storage	Storage	Storage	Structure
D.	Storage	Structure	Storage	Storage

58. Which statement(s) accurately describe(s) the properties of pentose and hexose sugars that arise from their structures?

- I. Hexose sugars yield more ATP per molecule than pentoses
- II. Pentose sugars are less soluble than hexoses
- III. Hexose sugars diffuse faster than pentoses due to stronger hydrogen bonding

A. I only

B. I and II only

C. I and III only

D. I, II, and III

59. Sugars are found in pathogen receptors that are recognized by the immune system. Which properties of sugars are most important for accurate cell-cell recognition?

- I. Orientation of hydroxyl groups on each carbon
- II. The presence of  $\alpha$  or  $\beta$  linkages
- III. Solubility of sugar in blood plasma

A. I only

B. I and II only

C. I and III only

D. I, II, and III

60. What do fatty acids and glycerol both contain?

- A. OH
- B. COOH
- C. COH
- D. CH<sub>3</sub>

61. What do fatty acids and amino acids both contain?

- A. COH
- B. CH<sub>3</sub>
- C. COOH
- D. CH<sub>4</sub>

62. In a patient with uncontrolled type II diabetes, excess fatty acids accumulate in the liver over time. How do the structural properties of lipids contribute to this?

- A. Lipids are formed through condensation reactions between hydroxyl groups
- B. Lipids are structurally similar to glucose and can replace it in ATP production
- C. Lipids contain long non-polar hydrocarbon chains ideal for energy storage
- D. Lipids dissolve easily in blood due to their polar phosphate heads

63. Over time, excess blood sugar levels in patients with diabetes mellitus could lead to reactions between proteins and sugar in the blood, producing unwanted glycoproteins. Which of the following consequences are most likely?

- I. Altered immunity
- II. Altered cell-cell recognition
- III. Altered proteome

- A. I only
- B. I and II only
- C. I and III only
- D. I, II, and III

64. Some foods contain hydrogenated vegetable oils, which are unsaturated fats that have been converted to saturated fats. Which property of the fats will have changed?

- A. They will become liquid at room temperature
- B. The number of double bonds in their structures will increase
- C. Their solubility in water will increase a bit
- D. Their hydrocarbons chains will pack together more closely

65. A student prepares two lipid droplets, one composed mainly of saturated lipids, and another of cis monounsaturated lipids. Over time, the droplet of unsaturated lipids remains liquid at room temperature, while the other solidifies. Which structural properties account for this observation?

- I. Cis double bonds introduce kinks that prevent tight hydrocarbon packing
- II. Saturated fatty acids have more hydroxyl groups, increasing hydrogen bonding
- III. Saturated chains adopt a linear conformation that enhances intermolecular interactions

- A. I and II only
- B. II and III only
- C. I and III only
- D. I, II, and III

66. Who can receive blood from a donor with blood type AB?

- I. Patient with blood type A
- II. Patient with blood type B
- III. Patient with blood type AB

- A. I only
- B. I and II only
- C. III only
- D. I, II, and III

67. [AHL] Even though glucose is a solute in blood, sodium ions are instead used to establish hypertonic conditions in the kidney's medulla. Which of the following statements explain this?

- A. Glucose channels for facilitated diffusion are larger and thus more metabolically expensive to translate compared to sodium ion channels
- B. Glucose is an organic molecule that is used in respiration, so it would be a waste to use it to establish a concentration gradient
- C. Due to their small size, sodium ions readily diffuse through the plasma membrane, unlike glucose which requires special transporters
- D. The sodium potassium pump ensures constant loss of sodium ions by cells

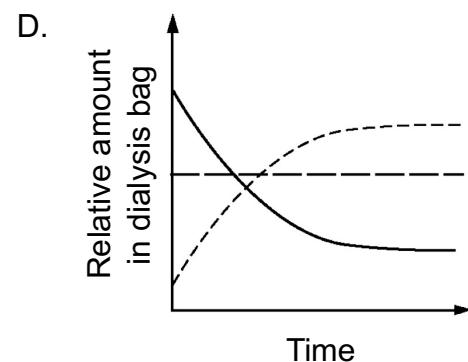
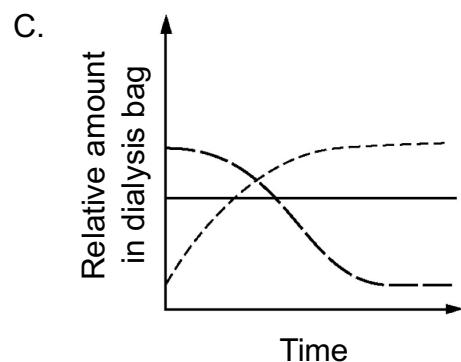
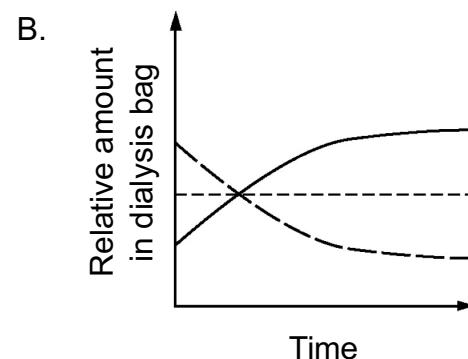
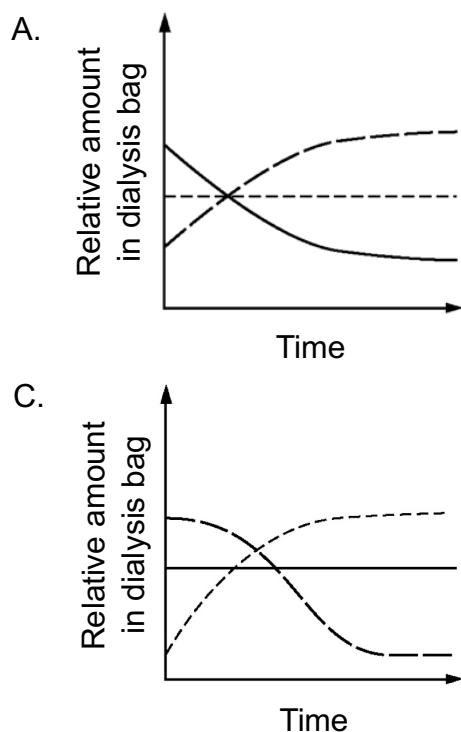
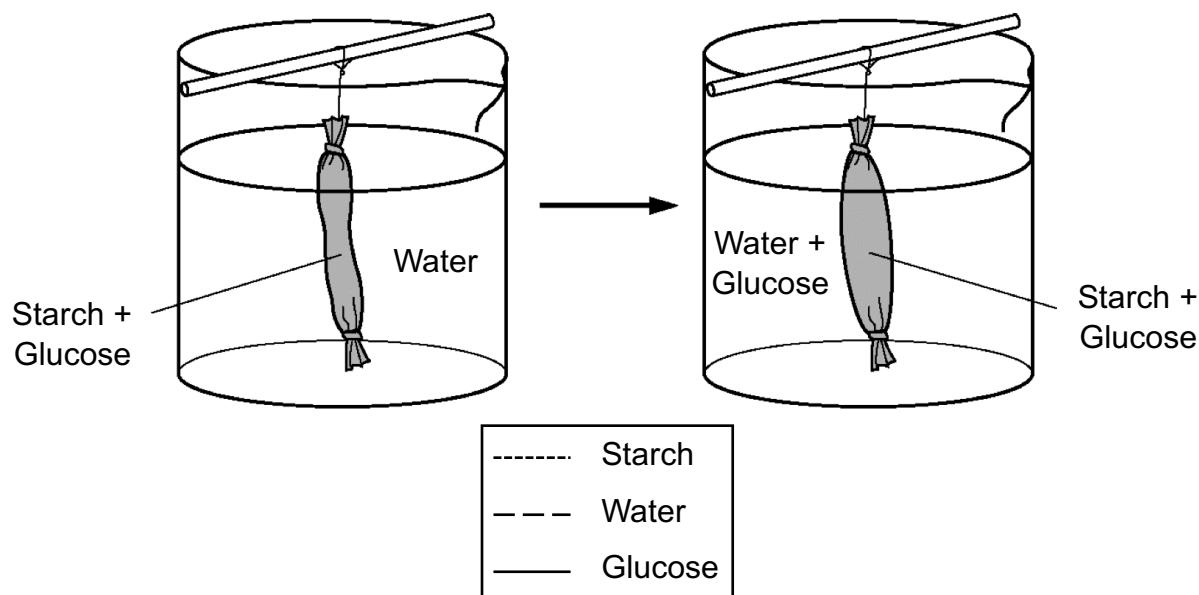
68. Which molecule is used as a primary energy source in humans?

- A. Lipids
- B. Phospholipids
- C. Glucose
- D. Proteins

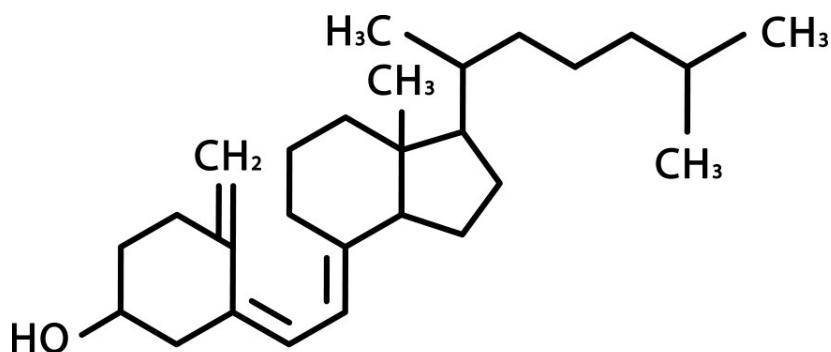
69. What do lipids mainly function as in living organisms?

- A. Sources of stored energy and transmitters of genetic information
- B. Sources of stored energy and components of cellular membranes
- C. Transmitters of genetic information and catalysts for chemical reactions
- D. Catalysts for chemical reactions and components of cellular membranes

70. A dialysis bag made of a semipermeable membrane was filled with a solution of glucose and starch and immersed in pure water. Which of the following graphs best represent the amount of starch, water, and glucose in the dialysis bag over time?



71. The chemical structure of vitamin D<sub>3</sub> is shown. Which class of molecules does it most likely belong to?



- A. Glycolipids
- B. Glycoproteins
- C. Lipids
- D. Steroids

72. Why do phospholipids form a bilayer in aqueous solution?

- A. Their fatty acid tails are hydrophobic and bond noncovalently with water
- B. Their fatty acid tails are hydrophobic and attracted to the cytoplasm
- C. Their phospholipid heads are hydrophilic and embedded in the membrane
- D. Their phospholipid heads are hydrophilic and are attracted to water

73. How would increasing the number of cis double bonds in a phospholipid affect membrane structure?

- A. Decrease fluidity
- B. Increase fluidity
- C. Decrease solubility
- D. Increase solubility

74. How are fats different from proteins?

- A. Fats have more double bonds than proteins
- B. Fats are more oxidized than proteins
- C. Fats have less polar bonds than proteins
- D. Fats only have non-polar bonds

75. Where are double bonds found in triglycerides?

- A. Within fatty acids only
- B. Within glycerol only
- C. Within fatty acids and glycerol
- D. Between fatty acids and glycerol

76. Which of the following statements about triglycerides is not correct?

- A. They store energy in adipose tissue
- B. They are hydrophobic molecules
- C. Only unsaturated triglycerides have double bonds
- D. They contain one glycerol molecule

77. The table shows the results of Gorter and Grendel's published study in 1925. Which of the following conclusions is supported by the data?

Animal	Total surface area of cells (a)	Total surface area of cell membrane lipids (b)	Factor (a:b)
Dog	31.3	62	2
Sheep	2.65	5.8	2.2
Rabbit	5.46	9.9	1.8
Guinea pig	0.52	1.02	2
Goat	0.33	0.66	2
Human	0.47	0.89	1.9

A. Most but not all plasma membranes are two molecules thick

B. All plasma membranes are two molecules thick

C. Plasma membrane thickness varies amongst species

D. Plasma membrane thickness is between 1.8 to 2.2 molecules on average

78. What is the role of adipose tissue in animals?

A. Store carbohydrates

B. Store carbohydrates and fat

C. Store fat

D. Store fat and nucleic acids

79. How can cis and trans unsaturated fatty acids be distinguished from their physical properties?

A. Cis fats have a higher boiling point than trans fats

B. Only trans fats are liquid at room temperature

C. Cis fats have a lower melting point than trans fats

D. Only trans fats do not have a bend in their structure

80. What is the difference between trans and cis unsaturated fatty acids?

- A. Only trans fats have glycerol on the same side of the fatty acids
- B. Only cis fats have glycerol on the same side of the fatty acids
- C. Only trans fats have hydrogen atoms on the same side of a double bond
- D. Only cis fats have hydrogen atoms on the same side of a double bond

81. What does the melting point of polyunsaturated fatty acids depend on?

- A. The length of the fatty acid chains
- B. The number of cis double bonds
- C. The number of trans double bonds
- D. The number of cis and trans double bonds

82. How are testosterone and estradiol similar?

- A. Both are polar steroid hormones
- B. Both are non-polar steroid hormones
- C. Both are amphipathic steroid hormones
- D. Both are hydrophilic steroid hormones

83. Which ratio of single to cis double bonds in a fatty acid would provide the highest melting point?

- A. 18:2
- B. 40:4
- C. 8:1
- D. 14:6

84. Where are the double bonds in polyunsaturated fatty acids?

- A. Anywhere on the fatty acid chain
- B. In specific locations on the fatty acid chain
- C. Near the carboxyl group of the fatty acid chain
- D. One in glycerol and the others are anywhere in the fatty acid chain

85. A 70 kg adult has 18% of their body mass as adipose tissue. If adipose tissue is 90% triglyceride by weight, what is the total mass of triglyceride stored in this person's adipose tissue?

- A. 10800g
- B. 11340g
- C. 12600g
- D. 14122g

86. An adipose tissue cell's lipid droplet initially contains 0.0048 ng of triglyceride. If the cell synthesizes triglycerides at a rate of 0.0002 ng/hour and deposits all of it into the droplet over 12 hours, what is the percentage increase in the droplet's mass?

- A. 100%
- B. 75%
- C. 50%
- D. 25%

87. An adipose tissue cell's lipid droplet initially contains 0.02ng of triglyceride. The cell imports triglyceride at a rate of 0.00015ng per hour for every 1mM of blood triglyceride. After lunch, blood triglyceride concentration rises to 1.5mM. If the elevated concentration persists for 4 hours, what is the percentage increase in the droplet's mass?

- A. 3.0%
- B. 4.5%
- C. 6.0%
- D. 7.5%

88. An adipose tissue cell initially contains 0.03ng of triglyceride in its lipid droplet. The cell exports triglyceride at 0.0015 ng/hour and simultaneously imports at 0.0010 ng/hour. Over a 24-hour period, what is the net percentage change in the droplet's mass?

A. + 60%  
B. + 40%  
C. - 40%  
D. - 60%

89. A molecule is found to have a 3-carbon backbone with two long hydrocarbon chains attached to two of the carbons in the backbone and another side chain on the third carbon. Which of the following could be the identity of this molecule?

A. Triglyceride  
B. Lipid  
C. Phospholipid  
D. Polysaccharide

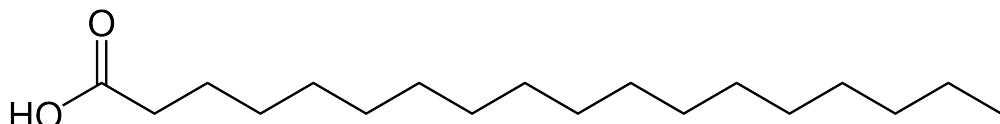
90. Which of the following is true regarding saturated and unsaturated fatty acids?

A. A 15-carbon saturated fatty acid has the same number of hydrogen atoms as a 15-carbon unsaturated fatty acid  
B. A 15-carbon saturated fatty acid has more oxygen atoms than a 15-carbon unsaturated fatty acid  
C. A 15-carbon saturated fatty acid has more carbon atoms than a 15-carbon unsaturated fatty acid  
D. A 15-carbon saturated fatty acid weighs more than a 15-carbon unsaturated fatty acid

91. The plasma membrane of a particular cell is composed of saturated phospholipids. What can you change to increase the fluidity of the membrane without changing temperature?

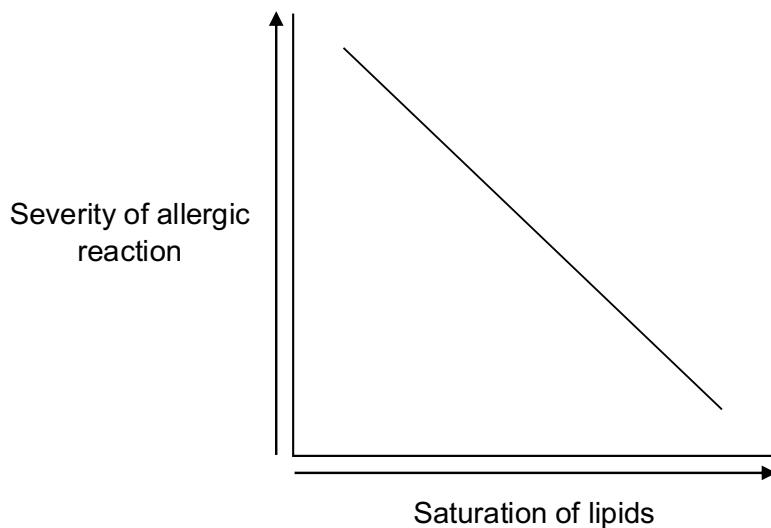
- A. Make the fatty acids unsaturated by adding trans double bonds
- B. Make the fatty acids unsaturated by adding cis double bonds
- C. Add polysaccharides to increase the amount of glycolipids
- D. Add transmembrane proteins

92. Poison ivy (*Toxicodendron radicans*) produces urushiol, which contains a mixture of lipid compounds. The chemical structure of stearic acid, a compound found in soap, is shown. If a person is exposed to poison ivy, which treatment would be most effective?



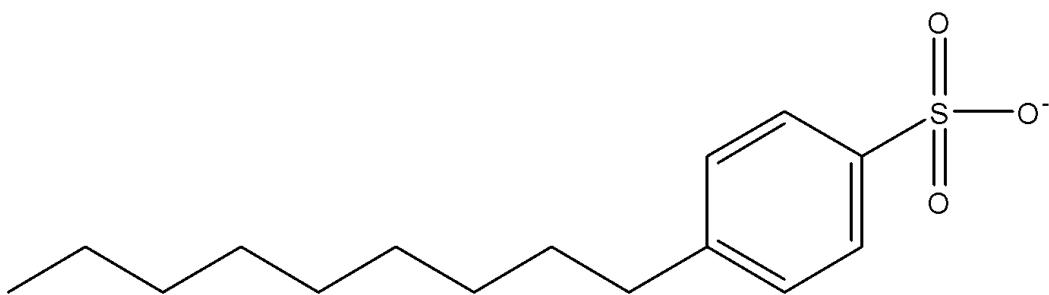
- A. Wash skin with water
- B. Wash skin with antibiotics and soap
- C. Wash skin with soap and water
- D. Wash the area with isotonic solution

93. Poison ivy (*Toxicodendron radicans*) produces urushiol, which contains a mixture of lipid compounds. Scientists researched the relationship between the severity of the allergic reaction and the saturation of the lipids in urushiol. Which statement best explains the results shown in the graph?



- A. Saturated lipids contain more hydrogen atoms than unsaturated lipids so they are better at hydrogen bonding
- B. Saturated lipids contain more energy than unsaturated lipids so they are more reactive with immune cells
- C. Unsaturated lipids are less water soluble than saturated lipids, which enhances immune recognition
- D. Unsaturated lipids are more fluid at room temperature than saturated lipids, which enhances skin penetration

94. The chemical structure of a molecule common in detergents is shown.



Which of the following statements might explain why this detergent helps to remove blood stains from clothes?

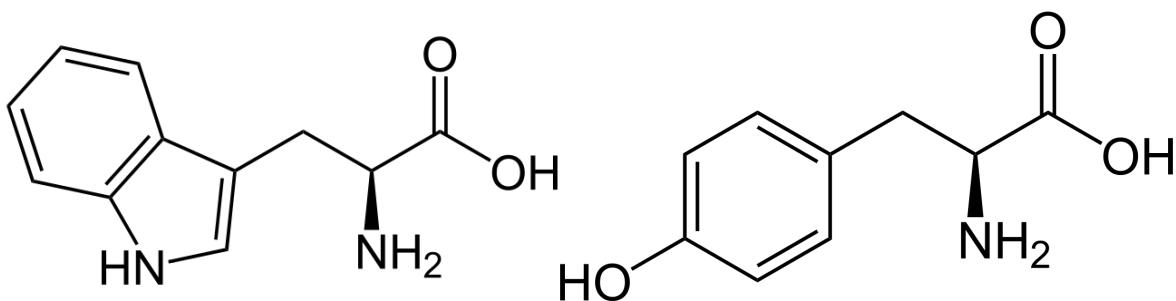
A. It disrupts blood cell membranes because it is amphipathic

B. It develops a bilayer around blood cells to help dissolve them

C. It binds to hemoglobin and dissolves it to remove the red color

D. It reacts with iron at its polar head and turns stains colorless

95. If the two molecules shown were to react, what is the most likely product?



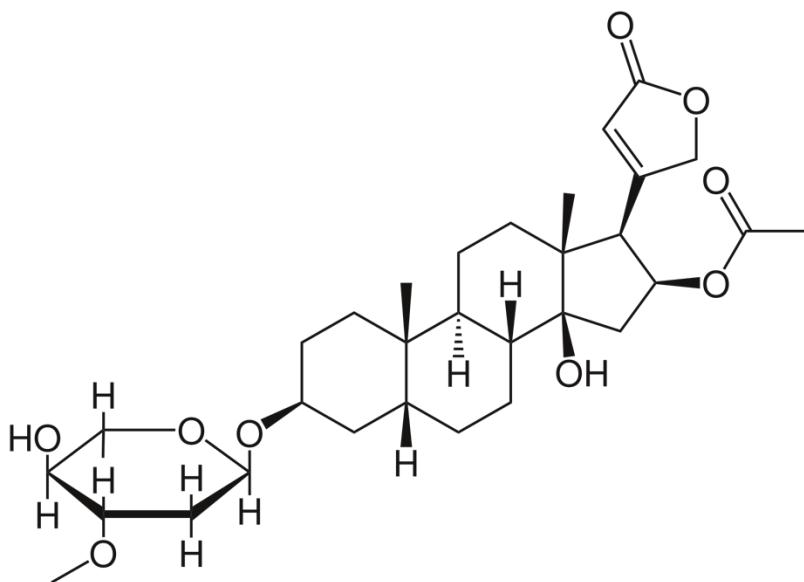
A. A steroid with 4 rings

B. A polysaccharide made up of three monomers

C. A dipeptide with 3 rings

D. A nucleotide without the phosphate group

96. Oleandrin is a toxic compound produced by the plant *Nerium oleander* L. Based on its chemical structure, what biomolecule(s) constitute(s) oleandrin?

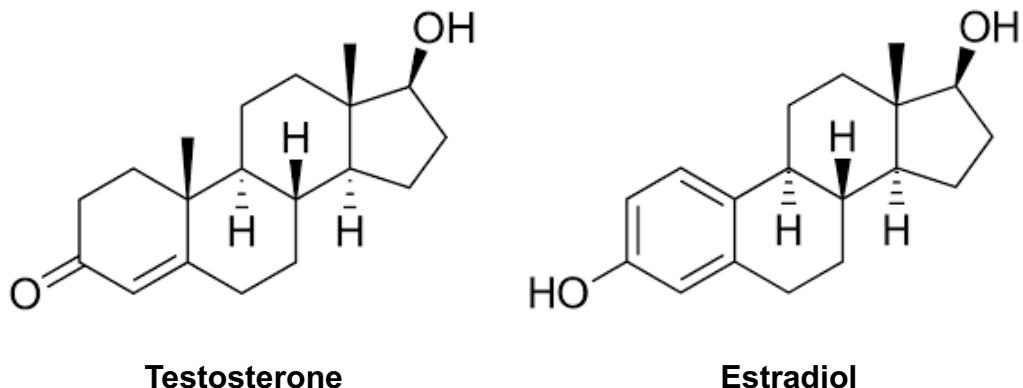


- A. 1 steroid only
- B. 1 steroid, and 1 hexose sugar only
- C. 1 steroid, 1 hexose sugar, 1 pentose sugar only
- D. 1 steroid, 1 hexose sugar, 1 pentose sugar, and 2 methyl groups

97. Why do testosterone and estradiol not need to bind to protein receptors on cells?

- A. They are steroids that can replace cholesterol if they bind to a protein receptor
- B. They are amphipathic since they are steroids
- C. They are steroids that bind to glycolipids for cell-cell recognition
- D. They can bypass the lipid membrane and elicit a cellular response

98. The chemical structures of testosterone and estradiol are shown. What explains why the differences in their structures do not change their overall properties?

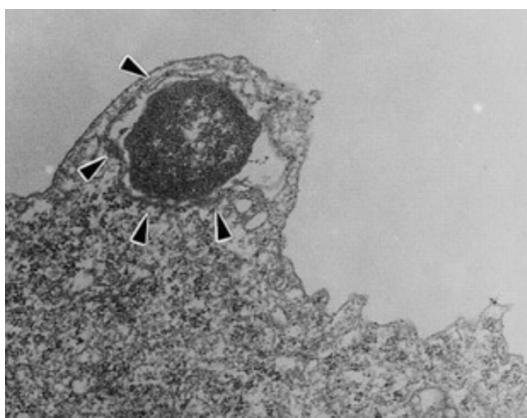


- A. Both are relatively similar in terms of overall polarity
- B. Both of them have four rings characteristic of steroids
- C. Their different functional groups do not alter hydrophobicity
- D. Both of them have hydroxyl and methyl groups

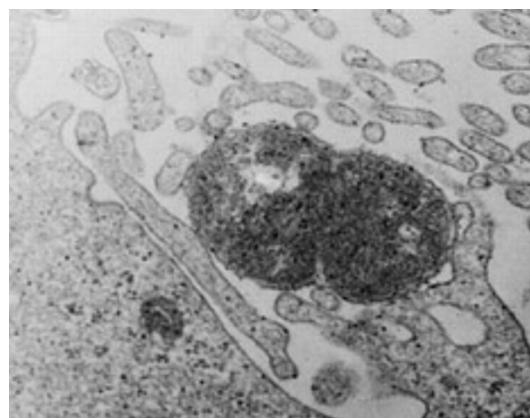
99. What is the role of glycolipids in safe blood transfusions?

- A. They help trigger immunity to donor blood
- B. They present ABO antigens on erythrocytes (red blood cells)
- C. They help the immune system to recognize foreign glycolipids
- D. They present antibodies of the donor to the recipient

100. The bacterium *Neisseria gonorrhoeae* causes gonorrhea. Researchers studied the mechanisms by which it adheres to human cells by genetically editing strains of *N. gonorrhoeae* that do not express a specific glycolipid on its outer membrane. Based on the results shown in the micrograph, what can be concluded?



Glycolipid present



Glycolipid absent

**Key:**

▲ indicates strong attachment between *N. gonorrhoeae* (dark stain) and human cells (light stain)

- A. The absence of the glycolipid causes human cells to become more fragmented
- B. The absence of the glycolipid increases the amount of *N. gonorrhoeae* bacteria that can simultaneously attach to the same human cell
- C. The presence of the glycolipid changes the environment around the bacterium
- D. The presence of the glycolipid enables strong adhesion of *N. gonorrhoeae* to human cells

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