



20 AP-style MCQs across topics 1.1 to 1.7. Practice, review, revisit.

WHAT'S INSIDE

- ✓ 20 MCQs, four options each, in the style of the real AP exam
- ✓ Every question tagged to a Unit 1 topic so you know what to revise
- ✓ Full answer key with a short explanation for every question
- ✓ Mix of standalone and stimulus-style stems, matching real AP question formats

HOW TO USE IT

- 1. Untimed pass.** Work through slowly, aiming for around 90 seconds per question. Read every option before you commit.
- 2. Timed pass.** Redo the pack in 30 minutes. That matches AP exam pace (1.5 minutes per MCQ) and builds stamina.
- 3. Review.** Check the answer key and mark every miss. Revise those topics on Cognito, then retry after a week.

TOPICS COVERED

- **1.1** Structure of Water and Hydrogen Bonding
- **1.2** Elements of Life
- **1.3** Introduction to Macromolecules
- **1.4** Carbohydrates
- **1.5** Lipids
- **1.6** Nucleic Acids
- **1.7** Proteins

STRUGGLING WITH A TOPIC?



Any topic tricky? Scan the QR to jump straight to the Unit 1 notes on Cognito. For the full AP Biology course (all 8 units, lessons, quizzes, flashcards and past-paper FRQs), head to **cognitoedu.link/ap-bio-notes**. Rework the questions you got wrong a week later to lock the concepts in.

AP EXAM CONTEXT

8-11%

UNIT WEIGHT (MCQ SECTION)

60

MCQS ON THE REAL EXAM

1.5m

AVERAGE TIME PER MCQ

AP BIOLOGY

Unit 1: Chemistry of Life

SECTION I · MULTIPLE CHOICE

Time—30 minutes

20 Questions

Directions: Each of the questions or incomplete statements below is followed by four suggested answers or completions. Select the one that is best in each case and mark it clearly on your answer sheet or circle your choice below.

Questions 1, 2, 3 refer to the following information.

A student added 2,000 J of heat energy to 100 g samples of three liquids, each starting at 20°C, and recorded the temperature change. The student also looked up the energy needed to evaporate 1 g of each liquid at its boiling point. Hexane molecules are nonpolar.

Table 1. Thermal properties of three liquids

Liquid	Temperature change (°C)	Energy to evaporate 1 g (J)
Water	4.8	2,260
Ethanol	8.2	841
Hexane	8.8	335

- Which claim is best supported by the data in Table 1?
 - Hexane has the highest specific heat of the three liquids because its molecules are nonpolar.
 - Ethanol and water have similar specific heats because both molecules can form hydrogen bonds.
 - The temperature change of each liquid depends only on its molecular mass, not its intermolecular attractions.
 - Water has the highest specific heat, consistent with energy going into breaking its many hydrogen bonds.
- Many mammals cool their bodies by sweating. Based on Table 1, which statement best explains why the evaporation of water is an effective cooling mechanism?
 - Water evaporates at a lower temperature than ethanol or hexane, so it leaves the skin more quickly.
 - Each gram of evaporating water absorbs a large amount of body heat as its hydrogen bonds break.
 - Water's low specific heat allows the skin surface to lose heat rapidly to the surrounding air.
 - Evaporating water releases heat energy that is then carried away from the skin by moving air.

- Using Table 1, approximately how much heat energy is removed from a person's body when 50 g of sweat (assume pure water) evaporates from the skin?

- 11.3 kJ
- 42 kJ
- 113 kJ
- 226 kJ

Question 4 refers to the following information.

The lower ends of three narrow tubes were placed in a dish of water, and the height of the water column inside each tube was measured relative to the water level in the dish. Glass has a polar surface; the wax coating is nonpolar.

Table 2. Water column height in narrow tubes

Tube	Inner diameter (mm)	Height (mm)
Uncoated glass	0.5	+60
Uncoated glass	1.0	+30
Wax-coated glass	1.0	-8

- Which explanation best accounts for all of the data in Table 2?
 - Water rises in glass tubes because they are narrower than wax-coated tubes, so gravity acts on less water.
 - The wax coating absorbs water molecules, which removes water from the tube and lowers the water level.
 - Water adheres to polar glass and cohesion pulls more water up behind it; nonpolar wax gives little adhesion.
 - Water rises higher in wider tubes because a wider tube provides more glass surface for hydrogen bonding.

AP BIOLOGY · Unit 1: Chemistry of Life · Section I (continued)

Question 5 refers to the following information.

Bacteria were grown in a medium containing either radioactive sulfur (^{35}S , as sulfate) or radioactive phosphorus (^{32}P , as phosphate). The cells were then separated into fractions, and the percentage of the total radioactivity in each fraction was measured.

Table 3. Distribution of radioactive label (%)

Cell fraction	^{35}S	^{32}P
Proteins	96	2
Nucleic acids (DNA and RNA)	1	78
Phospholipids	1	17
Other molecules	2	3

5. Which conclusion is best supported by the data in Table 3?

- (A) Sulfur and phosphorus are both used mainly to build nucleic acids and phospholipids in bacterial cells.
- (B) Sulfur is used mainly in proteins; phosphorus mainly in nucleic acids and phospholipids.
- (C) Phosphorus is used mainly in proteins; sulfur mainly in nucleic acids and phospholipids.
- (D) Neither element is needed to build macromolecules, because most of the label is in other molecules.

Question 9 refers to the following information.

An enzyme removes glucose monomers one at a time from the free ends of polysaccharide chains. Equal masses of two polysaccharides, amylose (unbranched) and glycogen (highly branched), were each incubated with the same amount of the enzyme.

Table 4. Glucose released (mg)

Time (min)	0	2	4	6
Amylose	0	3	6	9
Glycogen	0	14	27	39

9. Which explanation best accounts for the difference in glucose release shown in Table 4?

- (A) Glycogen monomers are held together by hydrogen bonds, which the enzyme breaks more easily than covalent bonds.
- (B) Hydrolysis of amylose releases water rather than glucose, so less glucose is detected.
- (C) The unbranched structure of amylose exposes more chain ends for the enzyme to act on.
- (D) Branching gives each glycogen molecule many free chain ends, so more sites are available to the enzyme at once.

- 6. A crop plant is grown with adequate water, carbon dioxide, and light, but in soil with very little available nitrogen. Synthesis of which pair of macromolecules would be most directly limited?
 - (A) Starch and cellulose
 - (B) Cellulose and triglycerides (fats)
 - (C) Triglycerides (fats) and starch
 - (D) Proteins and nucleic acids
- 7. An unbranched polysaccharide made of 250 glucose monomers is completely hydrolyzed. Which of the following correctly describes the water molecules involved and the products formed?
 - (A) 249 water molecules consumed; 250 glucose molecules produced
 - (B) 250 water molecules consumed; 250 glucose molecules produced
 - (C) 249 water molecules released; 250 glucose molecules produced
 - (D) 250 water molecules released; 249 glucose molecules produced
- 8. A dipeptide is hydrolyzed in water containing the heavy oxygen isotope ^{18}O . After the reaction, where would the ^{18}O most likely be found?
 - (A) In the amine group ($-\text{NH}_2$) of both amino acids
 - (B) In the R groups of both amino acids
 - (C) In the carboxyl group ($-\text{COOH}$) of one amino acid
 - (D) Only in free water molecules; neither amino acid is labeled

AP BIOLOGY · Unit 1: Chemistry of Life · Section I (continued)

10. A student claims that an unknown carbohydrate, X, is a polysaccharide rather than a monosaccharide. Which observation would best support this claim?
- (A) Hydrolysis of one molecule of X yields many monosaccharide molecules.
 - (B) X dissolves readily in water, tastes sweet, and is found in fruit juices.
 - (C) X contains only carbon, hydrogen, and oxygen, in roughly a 1:2:1 ratio.
 - (D) X cannot be broken down into smaller carbohydrate molecules by hydrolysis.

Questions 11, 12 refer to the following information.

Table 5 shows the melting points of four fatty acids. Each fatty acid has a chain of 18 carbon atoms.

Table 5. Melting points of 18-carbon fatty acids

Fatty acid	Number of C=C double bonds	Melting point (°C)
Stearic acid	0	69
Oleic acid	1	13
Linoleic acid	2	-5
α -Linolenic acid	3	-11

11. Which statement best describes and explains the relationship shown in Table 5?
- (A) Melting point increases as the number of double bonds increases, because double bonds are stronger than single bonds.
 - (B) Melting point decreases as the number of double bonds increases, because kinks prevent the tails from packing closely.
 - (C) Melting point decreases as the number of double bonds increases, because each double bond removes carbon atoms.
 - (D) Melting point is unrelated to the number of double bonds, because all four fatty acids have 18 carbons.
12. Fish of one species were kept at either 5°C or 25°C for several weeks. Based on Table 5, which prediction about the fatty acid tails of the phospholipids in their cell membranes is best supported?
- (A) Fish kept at 5°C will have more saturated tails, keeping their membranes rigid in cold water.
 - (B) Fish kept at 25°C will have more unsaturated tails, making their membranes more rigid in warm water.
 - (C) Fish kept at 5°C will have more unsaturated tails, helping their membranes stay fluid at low temperature.
 - (D) Fish at both temperatures will have identical tails, because the fatty acid composition of membranes cannot change.
13. Phospholipids are added to a beaker containing a layer of oil floating on water. Which arrangement of phospholipids is most likely to form at the boundary between the oil and the water?
- (A) A single layer, with hydrophilic heads in the water and hydrophobic tails extending into the oil
 - (B) A single layer, with hydrophobic tails in the water and hydrophilic heads extending into the oil
 - (C) A bilayer with tails facing each other, fully dissolved within the oil layer
 - (D) Individual phospholipid molecules spread evenly throughout the water layer

Question 14 refers to the following information.

Nucleic acid samples were isolated from four different sources, and the base composition of each sample was determined.

Table 6. Base composition (% of total bases)

Sample	A	T	G	C	U
1	30.9	29.4	19.9	19.8	0
2	25.1	0	32.5	17.9	24.5
3	20.0	19.8	30.1	30.1	0
4	24.6	32.7	24.1	18.6	0

14. Which sample in Table 6 is most likely single-stranded DNA?
- (A) Sample 1, because it contains more adenine than guanine
 - (B) Sample 2, because it contains uracil and lacks thymine
 - (C) Sample 3, because it contains more guanine and cytosine than adenine and thymine
 - (D) Sample 4, because it contains thymine but $A \neq T$ and $G \neq C$

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15. A double-stranded DNA molecule from a newly discovered bacterium contains 22% cytosine. Based on base-pairing rules, what percentage of its nucleotides contain adenine?
- (A) 22%
(B) 28%
(C) 44%
(D) 56%
16. A segment of one DNA strand has the sequence 5'-ATGCCA-3'. Which option correctly shows the complementary strand, written 5' to 3', and the end to which new nucleotides are added during synthesis?
- (A) 5'-TGGCAT-3'; nucleotides are added to the 3' end
(B) 5'-TACGGT-3'; nucleotides are added to the 3' end
(C) 5'-TGGCAT-3'; nucleotides are added to the 5' end
(D) 5'-TACGGT-3'; nucleotides are added to the 5' end
17. In sickle cell disease, one amino acid on the outer surface of the β -globin polypeptide of hemoglobin changes from glutamic acid, which has a charged R group, to valine, which has a nonpolar R group. At low oxygen levels, the altered hemoglobin molecules stick together into long fibers. Which explanation best accounts for this?
- (A) The substitution breaks peptide bonds, splitting β -globin into fragments that clump together.
(B) The substitution converts all of the protein's α -helices into β -pleated sheets.
(C) The nonpolar R group forms a hydrophobic surface patch that binds hydrophobic regions of other hemoglobin molecules.
(D) The charged R group of valine forms ionic bonds with the glutamic acid R groups on neighboring hemoglobin molecules.

18. Leucine, an amino acid with a nonpolar R group, is located in the interior of a water-soluble enzyme. A mutation replaces it with aspartic acid, which has a negatively charged R group. Which prediction is best supported?
- (A) The enzyme's shape will be unaffected, because only its primary structure has changed.
(B) The enzyme will become more stable, because charged R groups form stronger hydrophobic interactions.
(C) The enzyme will not be synthesized, because peptide bonds cannot form next to charged amino acids.
(D) Tertiary structure is likely disrupted, because a charged R group is unfavorable in the hydrophobic core.

Question 19 refers to the following information.

Samples of a purified enzyme were each treated with a reagent that disrupts one type of interaction, and enzyme activity was then measured. None of the treatments broke peptide bonds.

Table 7. Effect of treatments on enzyme activity

Treatment	Interaction disrupted	Activity (% of control)
None (control)	—	100
Urea	Hydrogen bonds and hydrophobic interactions	4
High salt	Ionic interactions	71
Reducing agent	Disulfide bridges	97

19. Which conclusion is best supported by the data in Table 7?
- (A) The enzyme's activity depends mainly on disulfide bridges, which link its amino acids together into a chain.
(B) Hydrogen bonds and hydrophobic interactions contribute most to maintaining the enzyme's functional shape.
(C) Ionic interactions play no role in the enzyme's structure, because activity remained above 50%.
(D) Urea reduced enzyme activity by changing the enzyme's primary structure.

AP BIOLOGY · Unit 1: Chemistry of Life · Section I (continued)

20. A protein has a mass of 128 kDa in its functional form. After a treatment that disrupts all interactions between polypeptides but leaves peptide bonds intact, the sample contains two kinds of polypeptide, of 40 kDa and 24 kDa, in equal numbers. Which conclusion is best supported?
- (A) The protein is a single polypeptide that was hydrolyzed into two fragments.
 - (B) The protein lacks quaternary structure, because each polypeptide folds independently.
 - (C) The protein has quaternary structure made of four polypeptides, two of each kind.
 - (D) The protein has quaternary structure made of two polypeptides, one of each kind.

Q1. Answer: D

Topic 1.1 · Structure of Water

The smallest temperature change for the same energy input means the highest specific heat. Much of the energy added to water goes into breaking hydrogen bonds before molecular motion (temperature) rises. Water changed temperature far less than ethanol (4.8°C vs 8.2°C), so B is not supported. Hexane changed the most, so A is reversed. The data give no molecular masses, so C cannot be supported.

Q2. Answer: B

Topic 1.1 · Structure of Water

Water has a high heat of vaporization (2,260 J/g, far higher than the other two liquids). Molecules can only escape as vapor once their hydrogen bonds break, and the energy for this comes from the skin, which cools the body. Evaporation absorbs heat rather than releasing it (D). Water has a high specific heat, not a low one (C), and it is less volatile than ethanol or hexane (A).

Q3. Answer: C

Topic 1.1 · Structure of Water

$50 \text{ g} \times 2,260 \text{ J/g} = 113,000 \text{ J} = 113 \text{ kJ}$. B uses the ethanol value ($50 \times 841 \text{ J}$). A is out by a factor of 10. D doubles the mass. (Heat of vaporization at body temperature is slightly higher than at the boiling point, so this is a slight underestimate.)

Q4. Answer: C

Topic 1.1 · Structure of Water

Capillary rise needs adhesion (water hydrogen-bonding to the polar glass surface) plus cohesion (hydrogen bonds between water molecules pulling the column up). Nonpolar wax cannot hydrogen-bond with water, so cohesion between water molecules outweighs any attraction to the wax, the surface curves down, and the column is depressed. A fails because the 1.0 mm glass and wax tubes have the same diameter. D contradicts the data: the narrower tube gives the higher column.

Q5. Answer: B

Topic 1.2 · Elements of Life

96% of the ^{35}S ended up in proteins (some amino acids contain sulfur in their R groups). 95% of the ^{32}P ended up in nucleic acids (78%) and phospholipids (17%), both of which contain phosphate groups. This matches the CED: S is used in proteins, and P in nucleic acids and phospholipids. The 'other' fraction holds only 2-3% of each label, so D is wrong.

Q6. Answer: D

Topic 1.2 · Elements of Life

Nitrogen is found in the amine group of every amino acid and in the nitrogenous bases of nucleotides, so protein and nucleic acid synthesis depend on it. Starch, cellulose, and triglycerides contain only C, H, and O, so the plant can build them from CO_2 and water.

Q7. Answer: A

Topic 1.3 · Intro to Macromolecules

An unbranched chain of n monomers has $n - 1$ covalent bonds between monomers. Hydrolysis uses one water molecule to break each bond: 249 waters consumed, 250 glucose released. C and D describe dehydration synthesis, which releases water rather than consuming it.

Q8. Answer: C

Topic 1.3 · Intro to Macromolecules

In hydrolysis, water is split: the hydroxyl ($-\text{OH}$) is added to one monomer and the hydrogen to the other. The peptide bond formed between the carboxyl group of one amino acid and the amine group of the next. The labeled $-\text{OH}$ therefore rejoins the carbon that was in the peptide bond, re-forming a carboxyl group. The amine group only gains a hydrogen, so it carries no ^{18}O .

Q9. Answer: D

Topic 1.4 · Carbohydrates

Both polymers are made of glucose joined by covalent bonds (so A is wrong). Every branch point in glycogen creates another free chain end, so glycogen offers the enzyme many more sites to work on at once than an equal mass of unbranched amylose. That explains the roughly 4-5x faster release. C reverses this. B misdescribes hydrolysis, which consumes water and releases monomers.

Q10. Answer: A

Topic 1.4 · Carbohydrates

Monosaccharides are the monomers of polysaccharides, so only a polymer yields many monomers when hydrolyzed. D describes a monosaccharide. B fits simple sugars better than polysaccharides. C is roughly true of all carbohydrates, so it cannot tell them apart.

Q11. Answer: B

Topic 1.5 · Lipids

Melting point falls from 69°C to -11°C as double bonds go from 0 to 3. Each (cis) double bond puts a kink in the chain, so the tails cannot pack as tightly and fewer intermolecular attractions have to be overcome for melting. Chain length is fixed at 18 carbons (so C is wrong), and the trend is clear (so D is wrong).

Q12. Answer: C

Topic 1.5 · Lipids

Table 5 shows that more unsaturation lowers the melting point. At 5°C, saturated tails would pack tightly and make the membrane too rigid, while unsaturated tails keep it fluid. B is wrong because unsaturated tails make membranes more fluid, not more rigid. Many ectotherms (fish included) do change their membrane lipid composition with temperature, so D is wrong.

Q13. Answer: A

Topic 1.5 · Lipids

Phospholipids have a polar (hydrophilic) phosphate head and nonpolar (hydrophobic) fatty acid tails. At an oil-water boundary, the heads interact with water and the tails with nonpolar oil, so one layer is enough. A bilayer forms only when water is on both sides (as in cell membranes). Spreading through the water (D) would expose the tails to water.

Q14. Answer: D

Topic 1.6 · Nucleic Acids

Thymine (and no uracil) marks Samples 1, 3, and 4 as DNA. In double-stranded DNA, A pairs with T and G with C, so $A = T$ and $G \approx C$, as in Samples 1 and 3. Sample 4 breaks this rule (A 24.6% vs T 32.7%), so its bases are not paired: it is single-stranded. Sample 2 contains uracil, so it is RNA.

Q15. Answer: B

Topic 1.6 · Nucleic Acids

C pairs with G, so $G = 22\%$ and $G + C = 44\%$. The remaining 56% is split equally between A and T, so $A = 28\%$. 22% (A) is the cytosine value rather than adenine's, 44% (C) is the $G + C$ total, and 56% (D) is the $A + T$ total.

Q16. Answer: A

Topic 1.6 · Nucleic Acids

The strands are antiparallel, so the complement of 5'-ATGCCA-3' reads 3'-TACGGT-5', which is 5'-TGGCAT-3' when written 5' to 3'. B and D write the complement without reversing it, which ignores antiparallel orientation. New nucleotides are always added to the 3' end of the growing strand, where the 3' hydroxyl forms a covalent bond with the next nucleotide's phosphate (1.6.A.2).

Q17. Answer: C

Topic 1.7 · Proteins

A change in primary structure changes R-group chemistry. Putting a hydrophobic R group on the protein's water-facing surface creates a sticky patch that binds hydrophobic regions of neighboring deoxygenated hemoglobin molecules, forming fibers. The overall fold of each subunit changes very little. A substitution does not break peptide bonds (A). Valine's R group is nonpolar, not charged (D).

Q18. Answer: D

Topic 1.7 · Proteins

Nonpolar R groups cluster in the interior through hydrophobic interactions, which help stabilize tertiary structure. A charged R group buried among them cannot join in those interactions and is energetically unfavorable, so the fold, and possibly the active site, is likely to be disrupted. A change in primary structure can change the overall shape (1.7.A.3), so A is wrong. Charged R groups are not hydrophobic (B).

Q19. Answer: B

Topic 1.7 · Proteins

Disrupting hydrogen bonds and hydrophobic interactions almost abolished activity (4%), so these interactions matter most for the tertiary structure that forms the active site. Ionic interactions contribute (activity fell by 29%, so C is wrong). Disulfide bridges contribute little (97%), and peptide bonds, not disulfide bridges, form the chain (A). No peptide bonds were broken, so primary structure was unchanged (D).

Q20. Answer: C

Topic 1.7 · Proteins

Two kinds of polypeptide means more than one polypeptide chain, so the protein has quaternary structure. One of each kind gives $40 + 24 = 64$ kDa, but two of each gives $2(40) + 2(24) = 128$ kDa, matching the functional protein (hemoglobin has the same $\alpha_2\beta_2$ pattern). Peptide bonds were left intact, so A is wrong. D would give only 64 kDa.