

PRACTICE MULTIPLE CHOICE QUESTIONS:

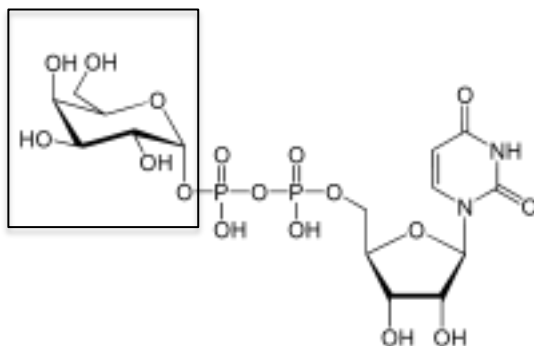
The actual exam will be ~22-24 MC questions. These will give you some idea of what the flow of the exam will be like. Key posted next week – try to work on it without the key first.

1) Which of the following is NOT associated with a definition of living things.

- A. Exchange of energy with the environment
- B. Exchange of matter with the environment
- C. An ability to create disorder
- D. An ability to reproduce
- E. A common ancestry

2) The highlighted part of the molecule below by the rectangular box was derived from:

- A. lipid
- B. carbohydrate
- C. nucleotide
- D. amino acid

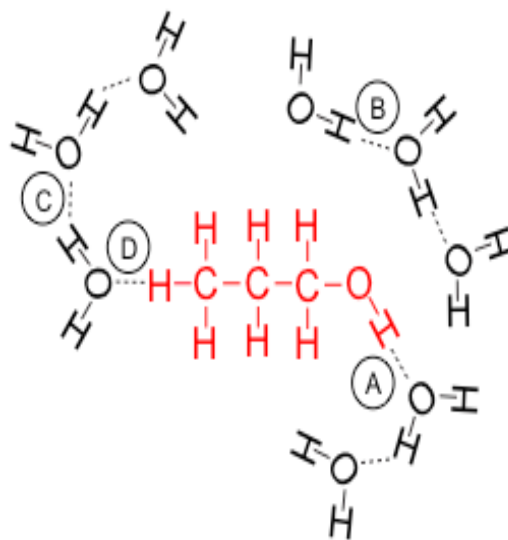


3) What determines if a bond between two atoms is polar, nonpolar, or ionic?

- A. The number of protons
- B. The bond distances
- C. The differences in the electronegativities of the atoms
- D. The ionic charges
- E. All of the above

4. A model of the molecule of propanol (center) and some of its potential interactions with water is shown in the figure below. Identify which, if any, of the putative interactions (indicated by the dashed lines. Labeled A through D) are NOT consistent with our understanding of hydration.

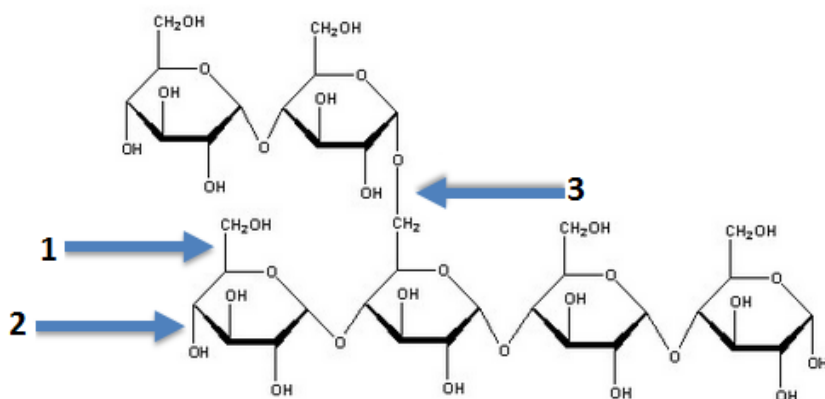
- A. The interaction labeled A is not correct.



- B. The interaction labeled B is not correct.
- C. The interaction labeled C is not correct
- D. The interaction labeled D is not correct
- E. All interactions are correct.

5. Condensation reactions can be used to combine multiple monomers into a polymer. What is a condensation reaction and which arrow points to the bond formed by a condensation reaction?

- A. a reaction that connects two subunits together with the removal of water, arrow 1
- B. a reaction that connects two subunits together with the addition of water, arrow 3
- C. a reaction that disconnects two subunits together with the addition of water, arrow 2
- D. a reaction that connects two subunits together with the removal of water, arrow 3
- E. a reaction that connects two subunits together with the removal of water, arrow 2



6. You are given four test tubes containing purified biological macromolecules. The test tubes are unlabeled except for a number between 1 and 4. You are told that one test tube contains a protein, one contains a lipid, one contains a carbohydrate, and one contains a nucleic acid. You then perform some tests on the macromolecules and collect the following information:

- 1. Test tubes #2 and #4 contain nitrogen, but the other tubes do not.
- 2. The contents of test tube #3 are not soluble in water, but the contents of the other test tubes are soluble in water.
- 3. The contents of test tube #1 can be broken down into subunits that are all exactly identical to each other.
- 4. The macromolecule in test tube #2 is found to have a globular shape.

What is the identity of the macromolecule present in Test tube 4?

- A. protein
- B. lipid
- C. nucleic acid
- D. carbohydrate

7. The pH of a solution is changed from 3.5 to 5.5. This _____

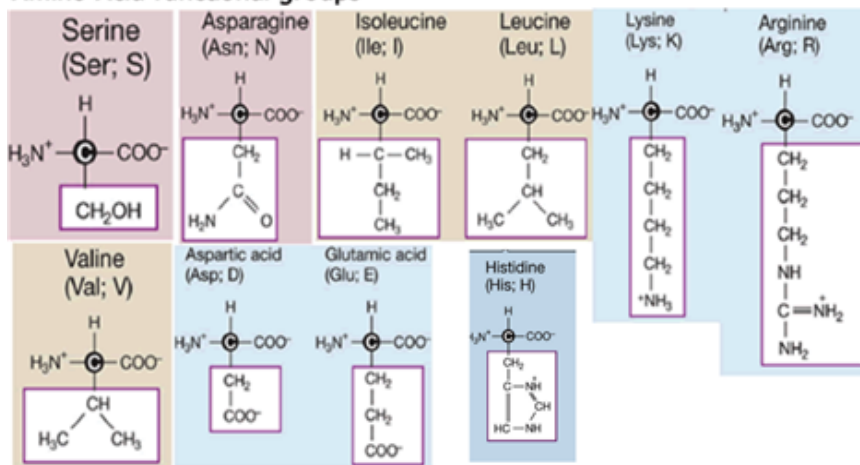
- A. increased the hydrogen ion concentration 2X.
- B. decreased the hydrogen ion concentration 2X.
- C. increased the hydrogen ion concentration 100X.
- D. decreased the hydrogen ion concentration 100X.
- E. None of the above.

8) The table below lists the pKa values of the R chains for five amino acids. If you examined these amino acids at pH 5.0, you would discover that the majority of the R chains in:

- A. Asp, Glu, Arg, Lys and His will be protonated
- B. Asp and Glu will be deprotonated, Arg; Lys and His will be protonated
- C. Asp, Glu, Arg, Lys and His will be deprotonated
- D. Asp and Glu will be protonated; Arg, Lys and His will be deprotonated
- E. More information about the relationship between pH and pKa must be provided in order to answer this question.

Amino Acid	pKa
Aspartate (Asp; D)	3.9
Glutamate (Glu; E)	4.3
Arginine (Arg; R)	12.0
Lysine (Lys; K)	10.5
Histidine (His; H)	6.08

Amino Acid functional groups



9) You are given the data from Experiment #1 shown below. Each test group included 10 poppies of the same species, germinated in the same type of soil in a greenhouse. Plants were grown under controlled temperature conditions. The experiment was repeated three times with equivalent results.

Experiment #1

Variable		Test Group 1	Test Group 2	Test Group 3
Water		5 ml	5 ml	10 ml
Sunlight		8h	16h	16h

Fertilizer		10 grams	20 grams	10 grams
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Results of Experiment:

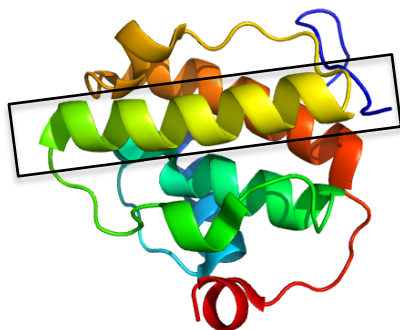
Average growth of poppies per day	0.5 cm	1 cm	1 cm
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Can Experiment #1 be used to test the statement “the amount of sunlight poppies are exposed to influences their growth rate”?

- A. Yes, the poppies with 16h of sunlight grew more than the 8h group.
- B. Yes, the poppies growth increased with increased sunlight exposure, no other factors are important for plant growth.
- C. No, the poppies only grew 1cm a day, which is not enough to measure accurately.
- D. No, the test groups had varied fertilizer and water levels so no conclusions can be drawn from the experiment.

10) The protein structural element in the cartoon below that is highlighted by the box:

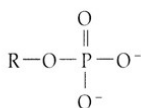
- A. secondary structure stabilized primarily by ionic bonds between R groups
- B. secondary structure stabilized primarily by hydrogen bonds between R groups
- C. secondary structure stabilized primarily by hydrogen bonds between backbone atoms
- D. tertiary structure stabilized primarily by ionic bonds between R groups
- E. tertiary structure stabilized primarily by hydrogen bonds between backbone atoms



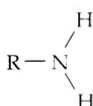
11) Which two functional groups interact to form a peptide bond?

- A. F and G
- B. A and F
- C. B and C
- D. B and E
- E. E and F

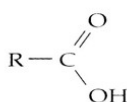
A.



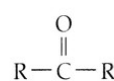
B.



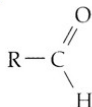
C.



D.



E.



F.

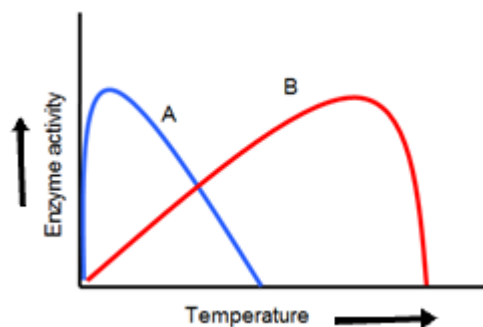


G.



12. The graph below shows the activity of two enzymes A and B in response to temperature. Assume all other conditions remain constant. A correct way to interpret this graph (without inferring additional information) is:

- A. Enzyme B has a larger range of activity than enzyme A.
- B. Enzyme A has a larger range of activity than enzyme B.
- C. Enzyme B is only made in large quantities when the temperature is high, and enzyme A is only made in large quantities when the temperature is low.
- D. Both A and C.
- E. Both B and C.

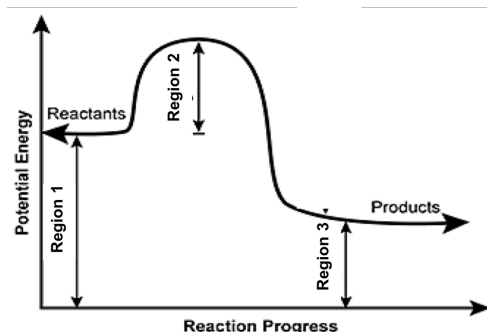


13. What determines whether a chemical reaction is spontaneous?

- A. If the reaction increases the disorder (entropy) of the substances involved.
- B. If the reaction decreases the enthalpy of the substances involved.
- C. Temperature is the main factor-- reactions are spontaneous at high temperature and non spontaneous at low temperatures.
- D. The combined effect of changes in enthalpy and entropy.

14. Based on the diagram to the right, which of the following regions of the curve would be affected by the addition of a catalyst to the reaction mixture?

- A. region 1
- B. region 2
- C. region 3
- D. regions 1 & 2
- E. regions 1, 2, & 3



15. Which of the following statements is true regarding catalysts and reaction coordinate diagrams?

- A. In the reaction coordinate diagram, the horizontal axis shows the progress of the reaction and is measured in units of time.
- B. You can determine whether a reaction is exothermic or endothermic using reaction coordinate diagrams.

- C. Although catalysts change the activation energy, they do not change the final equilibrium (ratio of products to reactants).
 D. Transition state intermediates have lower free energies than either the reactants or the products.
 E. Catalysts can cause a reaction to occur that cannot otherwise occur.

16. In thermodynamic terms, the spontaneity of a reaction is determined by the balance of two state quantities. The first accounts for the internal energy of a system. The second quantity is known as:

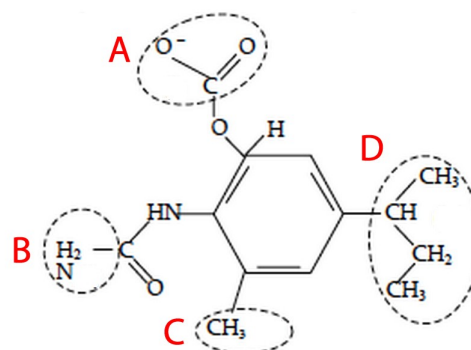
- A. enthalpy
 B. Gibbs energy
 C. entropy
 D. exothermic
 E. endergonic

17 & 18: The following two questions concern the interaction with a compound (antibiotic drug) with a protein (ribosome).

17) Shown to the right is the structure of a possible new antibiotic drug that binds to the *E. coli* ribosome.

The four functional groups important for the interaction of the drug with the ribosome and indicated by the dashed circle and are labeled A, B, C, D. The functional groups are drawn showing their state of protonation based on their pKa at physiological pH.

Listed in the table below are the types of interactions each circled region could possibly form with another molecule (ionic bonds, hydrogen bonds, or hydrophobic interactions).



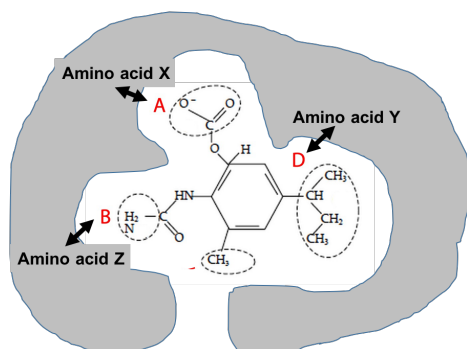
Which row (A, B, C, or D) has a mistake?

Answer choices	Functional Group	Can form ionic bonds	Can form <u>hydrogen bonds</u>	Can form <u>hydrophobic interaction</u>
A	A	Yes	Yes	No
B	B	Yes	Yes	No
C	C	No	No	Yes
D	D	No	No	Yes

18) (Cont. from previous question) A scientist is interested in understanding what amino acids in the active site of the ribosome are important for the binding of the antibiotic drug.

When the drug was tested on three different species of bacteria, it binds to the ribosome of *species 1 & 2*, but NOT *species 3*. The picture below shows the drug in the active site of the ribosome.

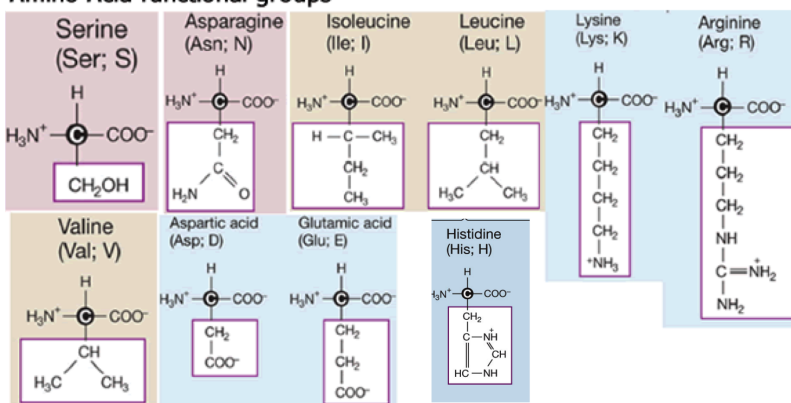
Based on the position of the drug in the active site, the functional groups have the potential to interact with specific amino acids. Based on the data below, which specific amino acid or amino acids prevent(s) the ribosome from **species 3** from binding the drug?



	amino acid X	amino acid Y	amino acid Z
Species 1	Lys	Asn	Leu
Species 2	Arg	Glu	Ile
Species 3	Glu	Ser	Val

- A. Glu interacting with A
 B. Ser interacting with D
 C. Val interacting with B
 D. Both A & B are correct.
 E. Both B & C are correct.

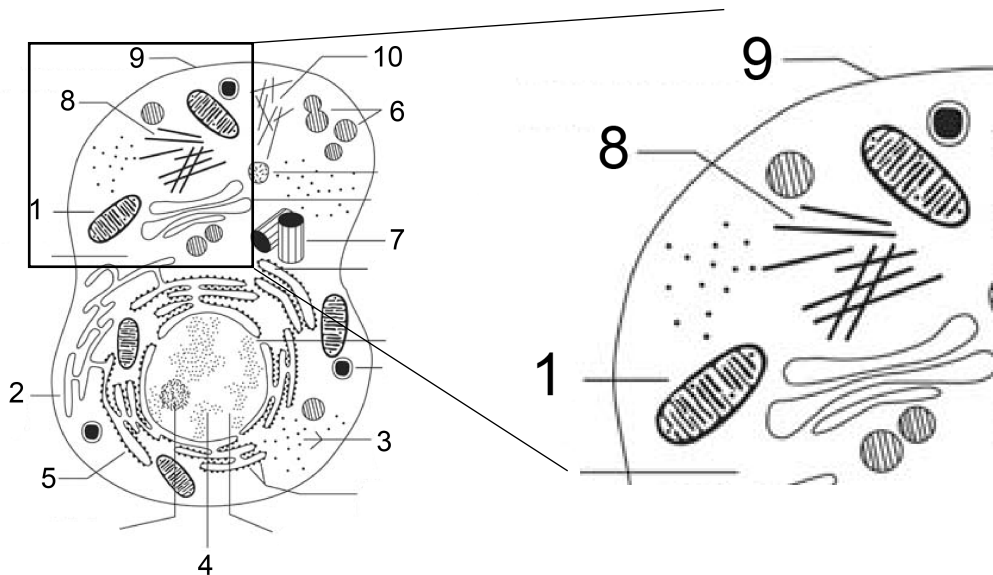
Amino Acid functional groups



19. The structure indicated by label 1 has the function of _____ and large amounts of this organelle would typically be found in cells that _____.

- A. transporting proteins produced by the ribosomes attached; secrete proteins outside of the cell
 B. transporting and modifying proteins that arrive from the RER; secrete proteins outside of the cell
 C. storing large amounts of water and micronutrients; live in a low nutrient environment
 D. producing lipids and steroid hormones; are associated with sexual reproduction.

E. converting fuel sources to more useable forms of cellular energy and CO₂; contract or move.



20. The evolution of cellular compartments - like everything else - came with immediate benefits but also immediate trade-offs (costs).

Each numbered row in the table below lists either a potential trade-off or benefit associated with the advent of compartmentalization.

Use the table to check whether the consequence is a trade-off or a benefit. In this scenario, trade-offs and benefits are meant to be evaluated immediately after their “invention” before solutions to any trade-offs evolve. Read your list in numerical order (e.g. C,C,C,B) and match that to the choices below.

	Consequence of compartmentalization	Trade-off (C)	Benefit (B)
1	there is an increase in the amount of lipid produced by cell		
2	compartments can have specialized functions		
3	targeting molecules to specific organelles must be facilitated		
4	compartmentalization reduces diffusion lengths for some reactions		

- A. C, C, C, B
- B. B, B, B, B
- C. C, B, C, B
- D. C, B, B, C
- E. B, B, C, B

Some example short answer questions from previous midterms:

For practice you can answer these questions and think of variations of these questions that could be asked.

1. Using the lipids below, draw at least 5 water molecules and indicate the possible bonds and structures formed. (Other biomolecules could be used besides lipids.)
2. Show a hydrolysis reaction that results in the formation of monosaccharides from the following disaccharide. (Hydrolysis reactions involving proteins or carbohydrates could be a variation.)
3. Create a peptide bond between the following three amino acids. (The creation of a glycosidic bond between the following three sugars would be a variation.)
4. Draw the following amino acids in their proper protonated or deprotonated state given the pH and pKa's listed below.
5. Label of the reaction coordinate diagram shown; then, use the diagram to answer the following questions about the reaction.