Exam

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) What happens to the oxygen that we breathe?
   A) It is exhaled.
   B) It is incorporated into organic molecules during cellular metabolism.
   C) It is combined with hydrogen to form water.
   D) It acts as a coenzyme in the production of ATP.
   E) A and C

2) Which of these results in a REDUCED molecule?
   A) loss of H⁺
   B) loss of electrons
   C) gain of H⁺
   D) gain of electrons
   E) A and D

3) The addition of a phosphate group to a substrate is called __________. The enzyme that catalyzes this reaction is referred to as a __________.
   A) phosphorylation; kinase
   B) phosphorylation; phosphatase
   C) proteolysis; peptidase
   D) proteolysis; kinase
   E) None of the above represents the correct terminology.

4) An exergonic chemical reaction
   A) converts molecules into molecules that have less free energy.
   B) releases energy as the reaction progresses.
   C) requires the input of energy.
   D) A and B
   E) A, B, and C

5) Enzymes
   A) may be synthesized as inactive molecules.
   B) may require the binding of cofactors such as calcium.
   C) do not require coenzymes for metabolic reactions.
   D) A and B
   E) all of the above

6) In the metabolic reactions of cells, molecules such as vitamin C and biotin act as
   A) modulators.
   B) cofactors.
   C) coenzymes
   D) vitamins.
   E) B and C
7) When a chemical reaction is in equilibrium
   A) the reaction has stopped.
   B) there are equivalent amounts of reactants and products.
   C) the reaction is proceeding at its maximum rate.
   D) there is no net change in the amount of reactants or products.
   E) A and D

8) How would the lack of a required cofactor for an enzyme affect that enzyme's function?
   A) The enzyme would function more slowly.
   B) The enzyme's function would not be altered.
   C) The enzyme would function more quickly.
   D) The enzyme would not be able to function.
   E) none of the above

9) One kilocalorie (kcal) is the amount of energy needed to raise one _________ of water by 1 degree Celsius.
   A) cup
   B) gallon
   C) liter
   D) tablespoon
   E) milliliter

10) An enzyme that adds or subtracts water molecules is
    A) ligase.
    B) lipase.
    C) hydrolase.
    D) kinase.
    E) lyase.

11) An allosteric modulator binds to
    A) the active site.
    B) the product.
    C) the substrate.
    D) a region of the enzyme other than the active site.
    E) the surrounding tissue.

12) Enzymes are often useful as diagnostic tools. How?
    A) Damaged cells release enzymes into the blood so that plasma levels of the enzyme are noticeably elevated.
    B) The liver releases enzymes that accumulate in the urine.
    C) Enzymes destroy damaged cells so X-rays reveal smaller body organs.
    D) Enzymes destroy pathogenic bacteria so blood levels of bacteria decline.
    E) None of the above offers a rational explanation.
13) When an enzyme's activity is destroyed by heat or a change in pH, the enzyme is said to be  
   A) tertiary.  
   B) broken.  
   C) conjugated.  
   D) denatured.  
   E) toxic.  

14) During feedback inhibition, in order to slow or stop a cell from using a particular biochemical pathway, the end product of that pathway  
   A) turns into a sticky mucus.  
   B) accumulates inside the cell.  
   C) is removed from the cell more quickly.  
   D) becomes toxic to the cell.  

15) Before converting amino acids into intermediates for energy metabolism, they must first undergo  
   A) detoxification.  
   B) deamination.  
   C) denaturation.  
   D) depeptidization.  
   E) delousing.  

16) An enzyme reacts with only limited, selected substrates; this characteristic is referred to as the enzyme's  
   A) common bond.  
   B) product.  
   C) isozyme.  
   D) specificity.  
   E) active site.  

17) For each NADH molecule that moves through the electron transport system, what is the potential yield of ATP molecules?  
   A) 1  
   B) 2  
   C) 2.5  
   D) 3.5  
   E) 4  

18) Information stored in the nucleus is translated into  
   A) carbohydrates.  
   B) lipids.  
   C) phospholipids.  
   D) proteins.  
   E) none of the above  

19) The first law of thermodynamics states that  
   A) the total amount of energy in the universe is constant.  
   B) energy can be neither created nor destroyed.  
   C) natural processes move from order to disorder, or entropy.  
   D) what heats up must cool down.  
   E) A and B
20) Lactate dehydrogenase
   A) catalyzes the reaction lactate → pyruvate.
   B) uses NADH to produce NAD⁺.
   C) uses NAD⁺ to produce NADH.
   D) catalyzes the reaction pyruvate → lactate.
   E) All of the above statements are true.

21) Coenzymes are
   A) derived from vitamins.
   B) organic molecules.
   C) organic cofactors.
   D) A and B only
   E) A, B, and C

22) __________ is the process where fatty acids are slowly disassembled into two-carbon units.
   A) Kreb’s cycle
   B) Oxidation phosphorylation
   C) Lipogenesis
   D) Beta oxidation
   E) Glycolysis

23) Phosphate groups may be transferred from one molecule to another during
   A) hydrolysis reaction.
   B) addition reaction.
   C) dehydration reaction.
   D) exchange reaction.
   E) B and D

24) The sense strand of DNA
   A) serves as a guide for mRNA synthesis.  B) is not a strand of DNA.
   C) is not involved in mRNA synthesis.  D) none of the above

25) The liver and skeletal muscles store glucose as _________ for a ready energy source.
   A) glycogen
   B) lipids
   C) urea
   D) glucose
   E) ketone bodies

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

26) The enzyme _________ and _________ ions are required for the synthesis of mRNA.  26) __________
Carbon dioxide and water readily combine to form carbonic acid. The change in pH as the acid dissociates can be demonstrated with an indicator dye that changes color at a particular pH. In your physiology lab, you perform this experiment in two beakers containing room-temperature water and indicator, labeled as A and B.

27) Your lab group forgot to dump the beakers at the end of the lab period. The next day you asked your professor to let you into lab to clean up. Did your beakers look the same? If not, explain in terms of reversible reactions and equilibrium disturbance.

28) What are the five ways that cells regulate flow of molecules through their metabolic pathways?

Carbon dioxide and water readily combine to form carbonic acid. The change in pH as the acid dissociates can be demonstrated with an indicator dye that changes color at a particular pH. In your physiology lab, you perform this experiment in two beakers containing room-temperature water and indicator, labeled as A and B.

29) CO₂ is bubbled into solutions A and B from a pressurized tank for 10 seconds. A stopwatch was used to measure how long it took for the solutions to change color. The data below were generated by the students.

<table>
<thead>
<tr>
<th>Group #</th>
<th>Time for reaction (seconds): Solution A</th>
<th>Time for reaction (seconds): Solution B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>62</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>58</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>57</td>
<td>0</td>
</tr>
</tbody>
</table>

Write the chemical equation for this reaction. Determine average values for each beaker. Explain how the reaction times differed. What may be present in beaker B that is absent from beaker A?

Match each term to its definition.

A. intermediate
B. anabolism
C. biochemical pathway
D. key intermediate
E. catabolism

30) reactions that result in the synthesis of large molecules

31) During the synthesis of proteins, amino acids are assembled in the proper sequence because the tRNA molecules that bring them to the ribosome have a(n) _________ that is complementary to a specific codon in the mRNA.

32) Compare and contrast potential energy with kinetic energy.

33) The rates of chemical reactions that occur in the human body are controlled by special molecules called _________.

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34) Lipids are broken down into ________, which feeds into glycolysis, and ________, which are metabolized to acetyl CoA.

35) A molecule of ________ consists of all the codons needed to produce a specific polypeptide chain at the ribosome.

36) ________ is the disappearance rate of reactants or the appearance rate of the products of a reaction.

Match each term to its definition.

A. intermediate  
B. anabolism  
C. biochemical pathway  
D. key intermediate  
E. catabolism

37) a molecule that participates at a branch point

In the reaction shown, identify the role of each of the participants.

CO₂ + H₂O $\overset{\text{CARBONIC ANHYDRASE}}{\longrightarrow}$ H₂CO₃

A. enzyme  
B. substrate(s)  
C. product(s)

38) H₂CO₃
For the following instructions, refer to the diagram below.

Left half of a DNA segment

39) Using the left half, construct a piece of m-RNA on a separate sheet of paper.

40) Place a dotted line around a triplet.

41) Explain how these statements differ, and identify which one(s) is/are correct. Explain what is wrong with each incorrect statement.
   A. A chemical reaction is at equilibrium when there is no further change in substrates.
   B. A chemical reaction is at equilibrium when the amounts of substrate and product no longer change.
   C. A chemical reaction stops when it reaches equilibrium.
   D. A chemical reaction is at equilibrium when the amount of substrate equals the amount of product.
For the following instructions, refer to the diagram below.

Left half of a DNA segment

42) How many amino acids would this strand of DNA specify? 42) __________

43) In the process of _________ a phosphate group is attached to a molecule. 43) __________

Classify each scenario below as to primarily which type of work is being done.

A. chemical work
B. transport work
C. mechanical work

44) enlarging one’s muscles through body-building exercises 44) __________

45) Based on the facts about chemical equilibria in animal systems, indicate for each summary reaction below if it is reversible or irreversible (don’t worry about balancing the reactions). Explain the lack of reversibility. In what kind of system would the reaction(s) you selected as irreversible be reversible? Explain.
A. C₆H₁₂O₆ → CO₂ + H₂O
B. ADP + P_i → ATP
C. H₂O + CO₂ → H₂CO₃

ESSAY. Write your answer in the space provided or on a separate sheet of paper.

46) Define substrate and product. Are these definitions relative or absolute, and why?
47) What is alternative splicing and why is it necessary?

48) What is chemiostatic theory? What is its role in metabolism?

49) Define the law of mass reaction.

50) High protein (low carbohydrate) diets have become popular in recent years. Based on what you’ve learned about metabolism and the body’s energy needs, explain what might be some of the disadvantages of this type of diet.
1) E
2) E
3) A
4) D
5) D
6) E
7) D
8) D
9) C
10) C
11) D
12) A
13) D
14) B
15) B
16) D
17) C
18) D
19) E
20) E
21) E
22) D
23) E
24) A
25) A
26) RNA polymerase, magnesium or manganese
27) While the beaker solutions were yellow when you left the day before, they were red again the next day. The carbon dioxide evaporated over night, driving the reaction back in the reverse direction, because the amount of substrate changed. This caused the pH to increase again, above the level required to maintain the yellow color.
28) 1. by controlling the enzyme concentration
2. by producing allosteric and covalent modulators
3. by using two different enzymes to catalyze reversible reaction
4. by isolating enzymes within intracellular organelles
5. by maintaining an optimum ratio of ATP to ADP
29) \( \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \rightarrow \text{H}^+ + \text{HCO}_3^- \)
   Average time for beaker A to change is 59 seconds, and for beaker B is 0 seconds, that is, the reaction occurred faster than the student could measure. An enzyme such as carbonic anhydrase was present in beaker B.
30) B
31) anticodon
32) Potential energy is the energy an object has stored in its position while kinetic energy is energy associated with a moving object / movement.
33) enzymes
34) glycerol, fatty acids
35) mRNA
36) Reaction rate
37) D
38) C
39) Strand should have mirror-image 5-P backbone, with a base projecting off of each S, to the left, in this order: C, U, A, A, U, G, C, A, C.
40) Dotted line should encompass a sequence of three nucleotides, with bases GAT, TAC, or GTG.
41) Only B is correct as written. A could be corrected by clarifying that it is concentration or amount of substrates that ceases to change; individual molecules can form or break at any given time, but the overall amount will not change because synthesis will be balanced by degradation. C is incorrect because the reactions continue as long as conditions such as presence of catalysts, favorable temperature, and presence of substrates are maintained. As a given enzyme can both synthesize and degrade, both processes will continue as equilibrium. D is incorrect because at equilibrium there is no net change in amounts, but it is not necessary for concentrations of substrates and products to be the same as each other.
42) three
43) phosphorylation
44) A
45) Only A is irreversible in animal systems. The products are rapidly removed from the system as soon as they are formed, so they are not recombined. This reaction is reversible in plants, which form and store glucose for food, but also need to use some of the glucose to make ATP.
46) Substrates are chemicals that bind to the enzyme and become altered (bonds formed and/or broken), producing a product. A product is the result of enzyme action on substrates. These terms are relative because chemical reactions are reversible. Example: if two monomers bind to the enzyme and form a dimer, the monomers are the substrates and the dimer is the product. If instead the dimer binds to the enzyme and splits to form two monomers, the monomers are the products and the dimer is the substrate.

47) Alternative splicing occurs when enzymes clip segments out of the middle or off the ends of an mRNA strand and then splice the remaining piece back together. It is necessary because mRNA contains segments with exons (encode proteins) and introns (noncoding region). The introns of the mRNA are removed before it leaves the nucleus.

48) Chemiostatic theory is a model, and its role is to explain the movement of electrons through the electron transport system, an important component of metabolism.

49) When a reaction is at equilibrium, the ratio of the substrate to the products is always the same.

50) Low carbohydrate diets shift the body to a fasting mode because glucose is needed for the brain, central nervous systems, and red blood cells. After glycogen stores have been depleted, the body will convert protein and fats into glucose and ketone bodies to provide the energy needed. The disadvantages of this shift are excess ketone bodies can seriously disrupt the body’s pH balance (lead to ketosis) and loss of protein from body tissue (this occurs even when abundant protein from food is provided).