**Chemistry, Biochemistry, and Cell Physiology**

***Principles of Animal Physiology***

1)

The first living organism, the progenote, gave rise to many characteristics frequently found in modern life-forms, including

A)

no need for a nucleus.

B)

ability to survive in anaerobic conditions.

C)

using only twenty amino acids in proteins.

D)

using sulfur as an energy source.

Answer:

C

2)

Which of the following types of energy is strictly potential energy?

A)

mechanical energy

B)

radiant energy

C)

chemical energy

D)

electrical energy

Answer:

C

3)

Once the activation energy has been transferred to a molecule,

A)

it has reached the transition state.

B)

it will always return to the substrate conformation.

C)

it will always move on to the product conformation.

D)

both A and C

Answer:

A

4)

What is the correct relationship between chemical reactions and temperature?

A)

All chemical reactions are endothermic, and therefore require warmer temperatures.

B)

Warmer temperatures provide the activation energy required to start chemical reactions.

C)

Warmer temperatures allow more energy to be released during a chemical reaction.

D)

Chemical reactions are not dependent on temperature at all.

Answer:

B

5)

Which of the following types of bonds is not based on attraction of one molecule for the other, but instead is based on an uncharged molecule's inability to form a bond with water?

A)

van der Waals interactions

B)

hydrogen bonds

C)

ionic bonds

D)

hydrophobic bonds

Answer:

D

6)

The correct term(s) for the most abundant liquid in which other molecules are dissolved is/are

A)

solvent.

B)

solute.

C)

solution.

D)

both A and C

Answer:

A

7)

Diffusion of a solute through a solution is decreased by an

A)

increased concentration gradient.

B)

increased size of molecule.

C)

increased diffusion coefficient.

D)

increased diffusion area.

Answer:

B

8)

What is the osmolarity of a solution containing 3 M MgCl2 and 2 M glucose?

A)

5 OsM

B)

8 OsM

C)

11 OsM

D)

10 OsM

Answer:

C

9)

Two compartments are separated by a membrane that is permeable to water and urea. Compartment I contains 1 M NaCl. Compartment II contains 2 M urea. Which of the following is a correct statement of their relationship based on the initial conditions?

A)

Compartment I is isosmotic to Compartment II.

B)

Compartment I is hyposmotic to Compartment II.

C)

Compartment I is hypertonic to Compartment II.

D)

both A and C

Answer:

D

10)

pH is a measure of

A)

[H+].

B)

[OH-].

C)

ratio of [H+] to [OH-].

D)

ratio of [OH-] to [H+].

Answer:

A

11)

Which of the following statements is true for a strong base?

A)

It has a low p*K*.

B)

It has a high p*K*.

C)

It easily donates [H+].

D)

It dissociates slowly.

Answer:

B

12)

Some of the most common buffers in animal cells are effective because

A)

they have a p*K* value that is close to the normal pH of the cell.

B)

they can bind with H+ in a chemical reaction, forming a new product that can be eliminated from the body.

C)

they have very low p*K* values.

D)

both A and B

Answer:

D

13)

Metabolic pathways that include synthetic reactions are called

A)

anabolic

B)

catabolic

C)

amphibolic

D)

both A and C

Answer:

D

14)

Free energy (Δ*G*) represents the amount of energy

A)

available for use from a reaction.

B)

required to start the reaction.

C)

that could potentially be released from a reaction.

D)

that goes to randomness.

Answer:

A

15)

*K*m in the Michaelis-Menten equation represents

A)

the maximum amount of substrate that can be catalyzed by the enzyme.

B)

the amount of substrate required for the initial velocity to be half of the maximal velocity.

C)

the amount of substrate required to start an enzymatic reaction.

D)

a set constant used for all enzymatic reactions.

Answer:

B

16)

How can environmental conditions such as salt concentration, temperature, and pH *physically affect the enzyme* itself?

A)

Ions can bind to the active sites of enzymes, preventing the binding of substrate.

B)

Changes in temperature change the rate at which molecules interact with the enzyme.

C)

All these factors can disrupt the weak bonds that hold the enzyme in its active conformation.

D)

These factors affect only the substrate.

Answer:

C

17)

Which of the following types of regulation involves binding to the active site?

A)

competitive inhibition

B)

allosteric regulation

C)

covalent modification

D)

both B and C

Answer:

A

18)

Why is ATP an important molecule?

A)

It links major pathways that release energy with those that require energy.

B)

It is an energy source that is found in high concentrations in cells.

C)

It is an energy source that is always available in large quantities.

D)

all of the above

Answer:

A

19)

The \_\_\_\_\_\_\_\_\_\_ structure of proteins involves interactions of amino acids that are found on different subunits.

A)

primary

B)

secondary

C)

tertiary

D)

quaternary

Answer:

D

20)

Which of the following carbohydrates is a monosaccharide?

A)

sucrose

B)

lactose

C)

glucose

D)

maltose

Answer:

C

21)

Which of the following polysaccharides performs a structural role?

A)

amylose

B)

glycogen

C)

chitin

D)

amylopectin

Answer:

C

22)

\_\_\_\_\_\_\_\_\_\_ is the metabolic pathway that synthesizes glycogen.

A)

Gluconeogenesis

B)

Glycogenesis

C)

Glycogenolysis

D)

Glycolysis

Answer:

B

23)

Glycolysis is an important metabolic pathway for the production of ATP because

A)

it can proceed with or without oxygen.

B)

it can produce ATP quickly.

C)

it can be used to metabolize fats and carbohydrates equally well.

D)

both A and B

Answer:

D

24)

All of the following are lipids, EXCEPT

A)

steroids.

B)

glycogen.

C)

triglycerides.

D)

phospholipids.

Answer:

B

25)

Glycerol molecules connected to three fatty acids are termed

A)

monoacylglycerides.

B)

diacylglycerides.

C)

triglycerides.

D)

cholesterol.

Answer:

C

26)

Cells within the adipose tissue that store lipids are called

A)

adipocytes.

B)

fat bodies.

C)

hepatopancreas.

D)

blubber.

Answer:

A

27)

Lipids used as a major component of biological membranes include

A)

phospholipases.

B)

sphingolipids.

C)

free fatty acids.

D)

both A and B

Answer:

B

28)

\_\_\_\_\_\_\_\_\_\_ enters the TCA cycle and forms NADH and FADH2, which can then be used for ATP production.

A)

Acetyl CoA

B)

Glucose

C)

Pyruvate

D)

A fatty acid chain

Answer:

A

29)

Cells can regulate the rate of the TCA cycle using all the following ways, EXCEPT

A)

controlling the concentration of the substrate.

B)

controlling the concentration of the required enzyme.

C)

controlling the amount of energy the cell must expend for survival.

D)

controlling the catalytic activity of the required enzymes.

Answer:

C

30)

Electrons can enter the electron transport system via many paths. The first point of commonality in the ETS for all these paths is

A)

complex I.

B)

complex II.

C)

cytochrome c.

D)

ubiquinone.

Answer:

D

31)

Production of ATP by the mitochondrial ATP synthase is increased by

A)

high levels of ATP.

B)

high levels of ADP.

C)

low levels of physical activity.

D)

low proton motive force.

Answer:

B

32)

Which of the following is a benefit of using phosphocreatine to store energy (as compared to ATP)?

A)

Phosphocreatine can be used by almost any process requiring an input of energy.

B)

Phosphocreatine can diffuse more easily to areas needing energy.

C)

Phosphocreatine allows muscles to stop using ATP, conserving it for other uses.

D)

Phosphocreatine is produced during periods of high muscle activity.

Answer:

B

33)

What is the advantage of storing energy as glycogen rather than as lipids?

A)

It contains more energy per unit mass.

B)

It does not prevent physical functions of a cell.

C)

It can be mobilized very rapidly.

D)

both A and B

Answer:

C

34)

Using oxygen consumption or carbon dioxide production to measure the metabolic rate of an organism is called

A)

direct calorimetry.

B)

indirect calorimetry.

C)

doubly labeled water.

D)

gaseous exchange.

Answer:

B

35)

High concentrations of \_\_\_\_\_\_\_\_\_\_ indicate that a cell has plenty of energy.

A)

ADP

B)

AMP

C)

NAD+

D)

Acetyl CoA

Answer:

D

36)

When an ion crosses the membrane and binds to a protein to accomplish this feat, it is using

A)

passive diffusion.

B)

facilitated diffusion.

C)

active transport.

D)

either B or C

Answer:

D

37)

Ion channels that open or close based on changes in the membrane potential are called

A)

voltage-gated channels.

B)

ligand-gated channels.

C)

mechanogated channels.

D)

porins.

Answer:

A

38)

Which of the following statements is true concerning secondary active transporters?

A)

A symporter can bind only one particle.

B)

An exchanger/antiporter will always be electroneutral.

C)

Electrogenic carriers generate a charge difference across the membrane.

D)

The direction in which charged particles are transported across the membrane does not affect the electrical gradient.

Answer:

C

39)

The main reason the interior of the cell is negative at rest is because

A)

the membrane is more permeable to Na+ than any other ion.

B)

the membrane is more permeable to K+ than any other ion.

C)

the Na+/K+ pump is electrogenic.

D)

it contains a much higher concentration of Cl-.

Answer:

B

40)

The cytoskeleton is composed of a variety of fibers, including

A)

macrotubules.

B)

large filaments.

C)

microfilaments.

D)

all of the above

Answer:

C

41)

Vesicles that are produced by the ER-Golgi network may be released from the cell using the process of

A)

exocytosis.

B)

endocytosis.

C)

phagocytosis.

D)

both B and C

Answer:

A

42)

The extracellular matrix performs a variety of functions, including mediation of interactions between cells. \_\_\_\_\_\_\_\_\_\_ is a glycosaminoglycan (GAG), which provides protection and acts as a shock absorber.

A)

Collagen

B)

Chondroitin sulfate

C)

Hyaluronan

D)

Fibronectin

Answer:

C

43)

\_\_\_\_\_\_\_\_\_\_ are the sections of DNA used to encode RNA.

A)

Chromosomes

B)

Exons

C)

Introns

D)

Genomes

Answer:

B

44)

Which of the following statements correctly describes the relationship between DNA, RNA, and transcription factors?

A)

There is only one transcription factor for each region of DNA encoding RNA.

B)

Transcription factors must always bind close to the transcription start site.

C)

Phosphorylation is one way of regulating interactions between proteins required for transcription of DNA.

D)

Transcription factors carry out the process of transcription themselves.

Answer:

C

45)

Proteins may be degraded by proteosomes because

A)

they have become damaged.

B)

they are labeled with ubiquitin.

C)

they are proteins which are rapidly degraded as part of the cell's control of protein levels.

D)

all of the above

Answer:

D

46)

Variations in proteins can arise from a SINGLE gene using

A)

alternative splicing.

B)

different alleles.

C)

duplication of genetic material during crossover.

D)

mobile elements or jumping genes.

Answer:

A

47)

The term metazoan refers to single celled animals.

Answer:

FALSE

48)

Covalent bonds are strong because electrons are shared between two atoms.

Answer:

TRUE

49)

A semipermeable membrane allows all molecules to pass through it.

Answer:

FALSE

50)

Buffers have the ability to mitigate the changes in pH when an acid or base is added to the solution.

Answer:

TRUE

51)

Enzymatic reactions start when the product binds to the active site.

Answer:

FALSE

52)

Increasing the starting [S] in an enzymatic reaction will always cause an increased *V* (initial velocity) of the reaction.

Answer:

FALSE

53)

An enzyme found in multiple different animals will have a similar *K*m, despite different environmental conditions in each of the animals.

Answer:

TRUE

54)

Proteins in animals are created from chains of four different amino acids.

Answer:

FALSE

55)

Animals utilize the metabolic pathway of gluconeogenesis only when energy stores are very low.

Answer:

FALSE

56)

Many animals are capable of producing all the required fatty acids for catabolic pathways.

Answer:

TRUE

57)

All of a fatty acid is metabolized into acetyl CoA after a single trip through the β-oxidation pathway.

Answer:

FALSE

58)

Antioxidants are useful in preventing DNA damage because they counteract the heat produced during NADH and FADH2 oxidation.

Answer:

FALSE

59)

In a multicellular organism, the energy needs of the organism as a whole are given a higher priority than the energy needs of a single cell at any point in time.

Answer:

TRUE

60)

Increasing the amount of cholesterol in a membrane leads to a decrease in the fluidity of the membrane.

Answer:

FALSE

61)

Primary active transport requires that two particles bind to the protein so that the energy from one particle moving down its gradient can pull the other particle up its gradient.

Answer:

FALSE

62)

The equilibrium potential and the reversal potential for a cell are interchangeable terms, assuming only one ion is being considered.

Answer:

TRUE

63)

The primary function of mitochondria is to provide energy for the cell.

Answer:

TRUE

64)

Exoskeletons, bone, and shells of mollusks are examples of a special type of extracellular matrix.

Answer:

TRUE

65)

Gene recombination involves only "whole" genes. It can never occur with just a portion of a gene.

Answer:

FALSE

66)

The second law of \_\_\_\_\_\_\_\_\_\_ says that the universe is moving from a state of order to one of disorder.

Answer:

thermodynamics

67)

The energy of movement is termed \_\_\_\_\_\_\_\_\_\_ energy.

Answer:

kinetic

68)

The \_\_\_\_\_\_\_\_\_\_ is formed by water molecules that surround water-soluble molecules in a solution.

Answer:

hydration shell

69)

Molecules that can be positive or negative, depending on the pH of the solution, are called \_\_\_\_\_\_\_\_\_\_.

Answer:

zwitterions

70)

All metabolic pathways in a cell, tissue, or organism can be referred to as the \_\_\_\_\_\_\_\_\_\_.

Answer:

metabolism

71)

Reversible enzymatic reactions eventually reach the point of \_\_\_\_\_\_\_\_\_\_, where the reactions in the forward and reverse directions are occurring at the same rate.

Answer:

equilibrium

72)

Energy is stored temporarily in reducing equivalents such as \_\_\_\_\_\_\_\_\_\_, and then released later in oxidation reactions.

Answer:

NAD or NADP

73)

In order to ensure that some proteins are properly folded, the cells use \_\_\_\_\_\_\_\_\_\_, such as heat shock proteins.

Answer:

molecular chaperones

74)

The products of glycolysis are ATP, NADH, and \_\_\_\_\_\_\_\_\_\_.

Answer:

pyruvate

75)

Fatty acids with no double bonds are termed \_\_\_\_\_\_\_\_\_\_, and have a linear structure.

Answer:

saturated

76)

\_\_\_\_\_\_\_\_\_\_ is the process of forming acetoacetyl CoA from two acetyl CoA molecules.

Answer:

Ketogenesis

77)

Steroid hormones use \_\_\_\_\_\_\_\_\_\_ as a precursor molecule.

Answer:

cholesterol

78)

The ratio between oxygen consumption and carbon dioxide production is termed the \_\_\_\_\_\_\_\_\_\_.

Answer:

respiratory quotient

79)

The \_\_\_\_\_\_\_\_\_\_ describes how phospholipids, proteins, and other biological molecules come together to form a flexible cell membrane.

Answer:

fluid mosaic model

80)

An \_\_\_\_\_\_\_\_\_\_ protein is one that spans the entire membrane or is fixed in it.

Answer:

integral membrane

81)

When the potential of a cell membrane becomes less negative, or gains more positive charges, the term \_\_\_\_\_\_\_\_\_\_ is applied.

Answer:

depolarized

82)

Winding DNA around \_\_\_\_\_\_\_\_\_\_ serves two major purposes: protection and compression.

Answer:

histones

83)

RNA is degraded by enzymes called \_\_\_\_\_\_\_\_\_\_.

Answer:

RNases

84)

Your book refers to the process of diffusion and mentions that both chemical and electrical gradients may influence this process. Explain why Na+ would be influenced by both chemical and electrical gradients, but glucose would not.

Answer:

Diffusion allows molecules to form random distributions based on parameters such as charge and chemical concentration. A charged molecule such as Na+ will move into this distribution based on electrical and chemical relationships. Because glucose is not charged, it will not be influenced by other, charged, molecules.

85)

A water molecule is held together by polar covalent bonds. Because the electrons are not shared equally in this arrangement, water exhibits many unique characteristics that are beneficial for life (e.g. high surface tension). Discuss several of these characteristics and explain how they are beneficial to living organisms.

Answer:

High surface tension results from attractive forces between water molecules. Smaller organisms can travel across the surface of the water if they don't break these weak bonds. Water has a lower density when frozen, which means that it will float, insulating aqueous habitats. Its high boiling point/heat of vaporization means that animals can utilize it for cooling. Heat/energy from the animal is transferred to the water, which then evaporates. Water is also an excellent solvent for charged molecules such as Na+, K+, and Cl-. The concentration of these solutes can then be used by the organism to generate electrochemical gradients. They may also be used to alter the freezing point or osmotic pressure of an organism's internal environment.

86)

Temperature and pH can have profound effects on the ionization states of molecules. Explain how they can cause these effects and why ionization is important physiologically.

Answer:

Molecules are frequently connected to each other via weaker or less stable bonds. The ionization state of molecules frequently is dependent upon weaker bonds. Generally, lower temperatures make bonds more stable, and higher temperatures destabilize the bonds by decreasing or increasing molecular movements. pH also changes bond strength by changing the concentration of hydrogen ions available to interact with molecules. Changes in ionization of proteins can change their folding, and therefore their function. Since proteins are integral to cell performance, disrupting their functionality will also disrupt normal processes in cells, causing possible harm to the organism.

87)

Proteins, carbohydrates, and lipids all perform vital functions for an organism. Discuss some of these vital functions and what could happen to an animal if one of these biological molecules were removed from their diet.

Answer:

Proteins play important roles in the structure of cells, as well as function. Receptors, transporters, and enzymes are just a few of the functional roles proteins play. Carbohydrates are important structurally and as an energy source. Carbohydrates can be used as a rapidly accessible form of energy, or they can be stored for later use. Lipids are critical for membrane formation, chemical signaling, and energy sources. Without lipids, isolation of the intracellular and extracellular components would be impossible.

88)

Release of energy from many biological molecules requires oxygen, and yet some species are able to survive in conditions having little or no oxygen (hypoxia or anoxia). What adaptations allow them to do this?

Answer:

The most obvious means is to decrease the energy requirements by slowing metabolic reactions in all or part of the tissues. This extends the supply of fuel that can be utilized without oxygen. Animals can also store more of their energy as glycogen, which can be metabolized by anaerobic glycolysis. Lastly, some animals have modified glycolytic pathways that produce end products other than lactate. These end products are less toxic, or can be removed easily from the body so they do not stop glycolysis.

89)

Organisms typically release more CO2 during periods of high activity. Based on your knowledge of the TCA cycle, explain how this occurs.

Answer:

If activity is increased, there is an increase in the need for ATP. In order to increase ATP production, there will be an increase in the rate of TCA cycle reactions. This leads to an increase in the amount of NADH and FADH2 produced, which will go through the electron transport system to provide energy for ATP production. Another by-product of the TCA cycle is CO2. Thus, when the rate of the TCA cycle increases, so does the rate of CO2 production.

90)

There are multiple ways that particles may cross a cellular membrane. Discuss the salient features of passive diffusion, facilitated diffusion, and active transport.

Answer:

Passive diffusion implies that no aid is given by a protein; therefore, only molecules that are lipid soluble can cross. Passive diffusion also does not require direct energy input, so substances can move only from areas of high to low concentration. Facilitated diffusion has the same energy parameters as simple diffusion, but utilizes a protein to enable charged molecules to cross the lipid membrane. Active transport requires that molecules or ions bind to the protein and that energy will be utilized. Because energy is consumed in this type of transport, it can be used to generate gradients (i.e., "uphill" transport).

91)

The Na+/K+ ATPase pump plays only a minor role in directly generating the resting membrane potential. (The electrogenic contributions are minimal.) However, the cell's membrane potential would not be possible without it. Explain how this can be true.

Answer:

Although the electrogenic properties of the Na+/K+ ATPase pump cannot account for the resting membrane potential, it does generate a large concentration gradient for both Na+ and K+. Because of this, when a K+ channel is open, K+ is able to move through the channel and down its gradient. The movement of the charge is a major contributor to the resting membrane potential.

92)

Proteins form enzymes, transporters, channels, and many other critically important components of cells. Thus, it is essential that cells be able to regulate the amount of each protein that is available for use. What mechanisms are available to the cell for this regulation of protein levels?

Answer:

Cells may increase or decrease the rate of transcription and translation. Transcription provides a "copy" of the instructions (mRNA) on how to produce a protein, and translation is the process that assembles the primary chain of amino acids from the directions on the mRNA. Cells can also remove existing proteins by enzymatic digestion. The protein is labeled by ubiquitin and then taken to a proteosome for destruction.