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Topic Break Down

Topic	No. of Questions
Topic 1, Writing	1
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QUESTION NO: 1

On a bad day, have you ever been irritable? Have you ever used a harsh tone or even been verbally disrespectful to your parents or teachers? Everyone has a short temper from time to time, but current statistics indicate that between 16% and 20% of a school population suffer from a psychological condition known as Oppositional Defiance Disorder, or ODD.

ODD symptoms include difficulty complying with adult requests, excessive arguments with adults, temper tantrums, difficulty accepting responsibility for actions, low frustration tolerance, and behaviors intended to annoy or upset adults. Parents of children with ODD can often feel as though their whole relationship is based on conflict after conflict.

Unfortunately, ODD can be caused by a number of factors. Some students affected by ODD suffer abuse, neglect, and severe or unpredictable discipline at home. Others have parents with mood disorders or have experienced family violence. Various types of therapy are helpful in treating ODD, and some drugs can treat particular symptoms. However, no single cure exists.

The best advice from professionals is directed toward parents. Therapists encourage parents to avoid situations that usually end in power struggles, to try not to feed into oppositional behavior by reacting emotionally, to praise positive behaviors, and to discourage negative behaviors with timeouts instead of harsh discipline.

As used in this passage, the phrase low frustration tolerance most nearly means:

A. The ability to cope with frustration

B. Patience

C. Low IQ

D. Difficulty dealing with frustration

ANSWER: D

Explanation:

“Difficulty dealing with frustration” is the best meaning of “low frustration tolerance.” Tolerance is the capacity to endure, manage, or cope with something unpleasant. Thus, when a person has a low tolerance for frustration, even relatively minor obstacles, delays, disappointments, or limits can become hard for that person to manage calmly. In the passage, the phrase appears among symptoms such as temper tantrums, frequent arguments, and trouble complying with adult requests. That context supports the meaning that the child becomes upset or reacts strongly when faced with frustrating situations rather than being able to cope with them. Clinical descriptions of oppositional defiant disorder likewise identify an angry or irritable mood and argumentative or defiant behavior as central features; difficulty regulating reactions to frustrating demands is consistent with these features. The phrase does not refer to intelligence or simply to an ability or trait in the abstract; it describes impaired coping when frustration occurs. See the American Psychiatric Association’s overview of oppositional defiant disorder and the Mayo Clinic’s description of ODD symptoms.

QUESTION NO: 2

Multiply 3 1/4 × 8/18.

A. 1/3

B. 3 1/9

C. 1/13

D. 1 4/9

ANSWER: D

Explanation:

The correct product is **1 4/9**. First, convert the mixed number 3 1/4 to an improper fraction: multiply the whole-number portion by the denominator and add the numerator, giving (3 × 4) + 1 = 13, so 3 1/4 = 13/4. The multiplication is therefore 13/4 × 8/18. Before multiplying, factors may be canceled to keep the arithmetic simple: 8 and 4 share a factor of 4, so 8/4 simplifies

to 2/1. This leaves 13 × 2/18, or 26/18. Reducing by 2 gives 13/9. Because 13/9 is an improper fraction, write it as a mixed number: 9 goes into 13 once, with a remainder of 4. Thus, 13/9 = 1 4/9. This method follows the standard procedure for multiplying fractions: convert mixed numbers to improper fractions, multiply or simplify factors, reduce the result, and convert to a mixed number when appropriate. See OpenStax Prealgebra: Multiply and Divide Fractions and Khan Academy: Multiplying Mixed Numbers.

QUESTION NO: 3

If the pI of a specific protein is 6, what is the charge on the protein when it is in a solution of pH 9?

A. −

B. 0

C. +

D. Cannot be determined.

ANSWER: A

Explanation:

The correct answer is **−**. A protein's isoelectric point (pI) is the pH at which its positive and negative charges balance, producing a net charge of zero. Here, the solution pH is 9, which is higher than the protein's pI of 6. At a pH above its pI, a protein has, on balance, lost protons from ionizable groups. This shifts the balance toward negatively charged groups, so the protein carries a net negative charge.

This relationship is fundamental to protein separation methods such as electrophoresis and ion-exchange chromatography. For example, in an electric field at a pH above its pI, the negatively charged protein will migrate toward the positive electrode. The direction of the net charge can be predicted by comparing only the pH and pI: below the pI, the net charge is positive; at the pI, it is zero; and above the pI, it is negative. Since 9 is above 6, the required conclusion is a negative net charge. See NCBI Bookshelf: Protein Structure and OpenStax Biology 2e: Proteins.

QUESTION NO: 4

Stefan's scores on his English essays were 75, 65, 80, 95, and 65. What is the average of his test scores?

A. 66

B. 71

C. 65

D. 76

ANSWER: D

Explanation:

The correct answer is 76. The arithmetic mean, commonly called the average, is calculated by adding all recorded scores and dividing that total by the number of scores. Stefan's five scores have a total of 380: 75 + 65 + 80 + 95 + 65 = 380. Because there are five essay scores, dividing 380 by 5 gives 76. Therefore, Stefan's average score is 76. This method gives each essay score equal weight, which is appropriate because the question provides no indication that any essay counts more heavily than another. The mean is a standard measure of central tendency used to summarize a set of numerical observations with one representative value. For additional guidance on calculating averages, see Encyclopaedia Britannica: Mean and Cuemath: Mean.

QUESTION NO: 5

The distribution of electrons evenly in a molecule contributes to stability. This accounts for:

A. atomic mass

B. valence

C. resonance

D. electronegativity

ANSWER: C

Explanation:

Resonance is the correct answer because resonance delocalizes electrons over two or more atoms rather than confining them to one bond or one atom. When valid resonance contributors can be drawn, the actual molecule or ion is best represented as a resonance hybrid. Its electron density, bond order, and sometimes formal charge are distributed across the relevant atoms. This spreading of electron density lowers electrostatic repulsions and reduces localized charge, producing a lower-energy, more stable structure. For example, the two carbon–oxygen bonds in a carboxylate ion are equivalent because the negative charge and π-electron density are shared between both oxygen atoms; this delocalization stabilizes the ion. Resonance contributors are not separate forms that rapidly alternate. Instead, they are Lewis-structure models used to describe one real hybrid structure with delocalized electrons. The extent of stabilization depends on the quality and number of meaningful contributors, including those that preserve octets and minimize charge separation. This principle is central to predicting relative stability, acidity, and reactivity in general and organic chemistry. See the OpenStax discussion of resonance and the IUPAC Gold Book definition of resonance.

QUESTION NO: 6

Which of the following is NOT made by the pituitary gland?

A. ACTH

B. ADH

C. FSH

D. LH

ANSWER: B

Explanation:

ADH is the correct answer because it is synthesized by neurosecretory cells in the hypothalamus, principally in the supraoptic and paraventricular nuclei, rather than by pituitary tissue. ADH, also called vasopressin, is packaged into vesicles and transported down the axons of these hypothalamic neurons to the posterior pituitary. The posterior pituitary stores the hormone and releases it into the bloodstream in response to physiologic signals, especially increased plasma osmolality or decreased circulating blood volume. Its key roles are promoting water reabsorption in the renal collecting ducts and, at higher concentrations, contributing to vasoconstriction. Thus, the posterior pituitary is an important release site for ADH, but it does not manufacture the hormone. This distinction between hypothalamic synthesis and posterior-pituitary storage/release is essential when identifying the source of endocrine hormones. The anterior pituitary, in contrast, synthesizes and secretes tropic hormones such as ACTH, FSH, and LH. See OpenStax: The Pituitary Gland and Hypothalamus and NCBI Bookshelf: Hypothalamic-Pituitary System.

QUESTION NO: 7

When blood flow to human tissue is interrupted, the lack of sufficient blood supply is called ischemia. If ischemia is not restored quickly, the affected tissue may undergo a process called infarction, which involves a series of chemical changes that damage the tissue. The lack of blood supply results in lack of oxygen, and thus lactic acidosis. Mitochondrial dysfunction results. Microscopic examination and chemical analysis of ischemic cells reveal membrane degeneration, excessive calcium (Ca+) inside the cell, and free radical formation, accompanied by a reactive inflammation and free fatty acid formation. A

research experiment is designed to evaluate the response of infarcted tissue to intra-arterial administration of an antioxidant. Preliminary results demonstrate that follow-up evaluation of tissue exposed to intra-arterial antioxidant injection resulted, on average, in a smaller area of infarcted tissue after seven days when compared to controls without exposure to the antioxidant. It was noted that 70% of the patients who demonstrated smaller areas of infarction also had a notable decease in edema of the ischemic tissue lasting about 6 to 10 hours after injection.

Which of the following chemical moieties forms the backbone of DNA?

A. Nitrogenous bases

B. Glycerol

C. Amino groups

D. Pentose and phosphate

ANSWER: D

Explanation:

Pentose and phosphate forms the backbone of DNA. DNA consists of repeating nucleotide units, and each nucleotide contains a deoxyribose sugar, a phosphate group, and a nitrogen-containing base. Within each strand, adjacent nucleotides are covalently linked by phosphodiester bonds between the phosphate group and the deoxyribose sugars. This repeating sugar–phosphate arrangement creates the structural outer rails of the double helix and gives each DNA strand its directionality, conventionally described as 5′ to 3′. The bases attach to the sugars and project inward, where complementary base pairing connects the two antiparallel DNA strands. Thus, the pentose sugar in DNA is specifically deoxyribose, and phosphate groups bridge successive sugars to produce the stable, repeating backbone. This organization is fundamental to DNA replication and transcription because enzymes recognize the strand's sugar-phosphate structure and its 5′ and 3′ ends. The relevant ischemia and antioxidant-study information provides clinical context but does not change the biochemical structure being tested. See the National Human Genome Research Institute's overview of DNA and the NCBI Bookshelf discussion of DNA structure.

QUESTION NO: 8

In the process of Mitosis, if the number of chromosomes in the mother cell is designated as 2n, how many chromosomes will be present in each daughter cell?

A. 2n

B. n

C. 4n

D. 8n

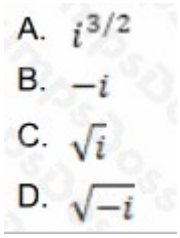
ANSWER: A

Explanation:

In mitosis, one parent cell divides to produce two genetically equivalent daughter cells. If the parent cell is diploid, meaning that it has two complete sets of chromosomes designated as 2n, each daughter cell receives one copy of every chromosome and therefore remains diploid, with 2n chromosomes. Before mitosis begins, DNA is replicated during the S phase of interphase, so each chromosome consists of two sister chromatids. This replication increases the amount of DNA temporarily but does not change the chromosome number: the replicated chromosome is still counted as one chromosome because it has one centromere. During mitosis, sister chromatids separate and are distributed equally to opposite poles. Cytokinesis then produces two cells, each containing the same chromosome complement as the original parent cell. Maintaining chromosome number is a defining function of mitosis and supports growth, tissue repair, and replacement of somatic cells. The National Human Genome Research Institute describes mitosis as producing two daughter cells with the same number and kind of chromosomes as the parent cell. See NHGRI: Mitosis and OpenStax Biology: The Cell Cycle.

QUESTION NO: 9

i3 –i3/2 =



A. Option A

B. Option B

C. Option C

D. −i/2

ANSWER: D

Explanation:

The expression simplifies to **−i/2**. Powers of the imaginary unit repeat in a cycle of four: *i*, −1, −*i*, 1, then back to *i*. Since i^3 is the third value in that cycle, $i^3 = -i$. Substitute that result into the expression: $-i - (-i)/2$. Subtracting a negative quantity is equivalent to adding its positive counterpart, so this becomes $-i + i/2$. Combining the like imaginary terms gives $-i/2$. Thus, **−i/2** is the correct simplified value represented by the corrected answer choice. This result remains in standard complex-number form because it has no real component and an imaginary coefficient of −1/2. For a review of powers of *i* and the repeating pattern used in this calculation, see OpenStax College Algebra: Complex Numbers and Wolfram MathWorld: Imaginary Unit.

QUESTION NO: 10

On a bad day, have you ever been irritable? Have you ever used a harsh tone or even been verbally disrespectful to your parents or teachers? Everyone has a short temper from time to time, but current statistics indicate that between 16% and 20% of a school population suffer from a psychological condition known as Oppositional Defiance Disorder, or ODD.

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Unfortunately, ODD can be caused by a number of factors. Some students affected by ODD suffer abuse, neglect, and severe or unpredictable discipline at home. Others have parents with mood disorders or have experienced family violence. Various types of therapy are helpful in treating ODD, and some drugs can treat particular symptoms. However, no single cure exists.

The best advice from professionals is directed toward parents. Therapists encourage parents to avoid situations that usually end in power struggles, to try not to feed into oppositional behavior by reacting emotionally, to praise positive behaviors, and to discourage negative behaviors with timeouts instead of harsh discipline.

Which of the following statements can be inferred from paragraph 4?

A. Parents of children with ODD are bad parents.

B. ODD is not a real psychological disorder.

C. Medication can worsen ODD.

D. Reacting emotionally to defiant behavior might worsen the behavior.

ANSWER: D

Explanation:

Reacting emotionally to defiant behavior might worsen the behavior. is supported by the advice in paragraph 4 that parents should avoid “feeding into” oppositional behavior through emotional reactions. To feed into a behavior means to respond in a way that gives the behavior more attention, intensity, or reinforcement. Thus, the passage supports the inference that an angry, highly emotional response may escalate a conflict or make a child more likely to continue the oppositional conduct.

The recommended parenting approach is deliberately calm and consistent: avoid predictable power struggles, recognize positive conduct, and use non-harsh consequences such as timeouts for negative conduct. This approach aims to reduce the cycle in which a child’s defiance prompts a strong parental reaction, which then creates more conflict. The inference does not require claiming that every emotional reaction will always make symptoms worse; rather, it follows from the professionals’ warning that emotional reactions can contribute to or reinforce the pattern of oppositional behavior.

This interpretation is consistent with clinical guidance emphasizing parent-management strategies, positive reinforcement, and consistent, non-harsh discipline for oppositional defiant disorder. See the American Academy of Child and Adolescent Psychiatry’s ODD guidance and the CDC overview of behavior and conduct problems in children.

QUESTION NO: 11

Auxin stimulates stem elongation and is involved in the process of phototropism. If plants bend toward a light source, in which region of the plant is auxin most likely to be found?

A. The shaded side of a stem

B. The top of a shoot

C. The bottom of a shoot

D. The sunny side of a stem

E. The top side of leaves

ANSWER: A

Explanation:

In a shoot exposed to one-sided light, auxin becomes unevenly distributed across the stem. The hormone accumulates at a higher concentration on **The shaded side of a stem**. In stems, auxin promotes cell elongation by stimulating processes that loosen the cell wall, allowing cells on that side to take up water and lengthen more than cells on the illuminated side. Because the shaded side grows faster and becomes longer, the stem curves toward the light source. This directional growth response is phototropism and helps the plant orient its leaves and shoot toward light, supporting photosynthesis. Auxin is produced primarily in young shoot tissues, including the shoot apex, but the question asks where it is most likely concentrated during bending toward light. The relevant location is therefore the shaded side of the elongating stem, where the unequal auxin concentration directly produces the differential growth responsible for the curvature. This mechanism is a classic example of how a plant hormone can convert an environmental cue—directional light—into a coordinated growth response. See NCBI Bookshelf: Auxin and phototropism and OpenStax Biology: Plant sensory responses.

QUESTION NO: 12

Which of the following groups of the periodic table contains alkali metals?

A. Group I A

B. Group II A

C. Group VII A

D. Group VIII A

ANSWER: A

Explanation:

The correct answer is **Group I A**, which corresponds to modern **Group 1** numbering on the periodic table. Alkali metals are the metallic elements in the first column: lithium, sodium, potassium, rubidium, cesium, and francium. They have one valence electron, which they readily lose to form ions with a positive one charge. This characteristic electron configuration accounts for their strong chemical reactivity and their tendency to form ionic compounds, such as sodium chloride. Hydrogen is also positioned in Group 1 because it has one valence electron, although it is not classified as an alkali metal under ordinary conditions. The older American notation, “Group I A,” is commonly used in introductory chemistry materials and identifies the same family as IUPAC Group 1. The Royal Society of Chemistry’s periodic-table resource identifies these elements as the alkali metals and describes their shared group properties. For additional reference, see the Royal Society of Chemistry overview of alkali metals and the Encyclopaedia Britannica alkali metal reference.

QUESTION NO: 13

Coughs that linger after a cold or sinus problem cause constant disruption in the home, school, and workplace. Often, these dry, nonproductive coughs become increasingly troublesome although other symptoms – fever, congestion, and fatigue – resolved days or weeks ago. This stubborn cough persists for weeks, and plagues its victim and the victim’s family night and day. The diagnosis might be a common, but overlooked cause of lingering cough: atypical pneumonia caused by mycoplasma. Mycoplasma – pleomorphic bacteria that lack a cell wall – are the smallest and simplest self-replicating organisms known to humans. They probably evolved from gram-positive, walled eubacteria by degenerative evolution. Smaller than amoebas, these 0.1-micrometer organisms grow and reproduce slowly and require no oxygen or host cell. They also change shapes asymmetrically, appearing as long, thin filaments, tiny spheres, or branches. Scientists have identified more than 100 mycoplasma species. Fifteen species are known to live in humans, most as normal symbiotic flora. Mycoplasma pneumoniae, previously called “walking pneumonia,” is pathogenic in humans. Mycoplasma pneumoniae glides freely and uses its specialized filamentous tips to burrow between cilia within the respiratory epithelium, causing the respiratory epithelial cells to slough. It also produces hydrogen peroxide, which causes initial cell disruption in the respiratory tract and damages erythrocyte membranes. Researchers have determined that more than 40% of infants younger than 1 year old have had a mycoplasma infection. By age 5, approximately 65% of children have been infected. Nearly all adults have been infected at least once, often repeatedly. Mycoplasma pneumonia usually affects people younger than 40 years of age. The highest incidence is found in the 5- to 9-year age group. The risk of contracting mycoplasma pneumonia is greatest for people who live or work in crowded areas, such as daycare facilities, schools, homeless shelters, long-term care units, and military and prison environments. However, many people who develop mycoplasma infections have no identifiable risk factor. Most mycoplasma infections cause mild to moderate clinical symptoms, but the infection incubates over 3 weeks and can last weeks without treatment. This infection cannot be diagnosed based on symptoms alone; laboratory testing is essential. Infection can also cause ear infections, sinus infections, bronchitis, croup, severe sore throats, infectious asthma, and 1 type of the common cold. When mycoplasma infects children, about 25% of them develop nausea, vomiting, or diarrhea. In paragraph 2, “symbiotic” most nearly means

A. independent

B. cooperative

C. divided

D. shared

ANSWER: B

Explanation:

“cooperative” is correct because *symbiotic* describes a close association between different organisms, especially one in which they live together in a mutually beneficial or otherwise interdependent relationship. In the passage, most of the mycoplasma species living in humans are characterized as “normal symbiotic flora.” That description indicates that these organisms ordinarily coexist with the human host rather than functioning as disease-causing invaders. The immediately following contrast with *Mycoplasma pneumoniae*, which is specifically identified as pathogenic in humans, reinforces that “symbiotic flora” refers to organisms that normally live alongside the host in a compatible relationship. Thus, among the available word choices, “cooperative” most closely captures the idea of living together harmoniously or beneficially. This use follows the standard biological meaning of symbiosis: a close relationship involving organisms of different species. In microbiology and human-health contexts, normal flora can include microorganisms that inhabit body sites without causing

disease under usual conditions and may contribute to the broader microbial community. See the Merriam-Webster definition of “symbiotic” and the NCBI overview of normal microbial flora.

QUESTION NO: 14

Which of the following statements regarding energy production is true?

A. There is a net total of 4 ATP produced in glycolysis.

B. The GTP made in the TCA cycle does not become ATP.

C. Cytosolic NADH’s reducing equivalents must be transferred into mitochondria via shuttle systems because NADH cannot cross the inner mitochondrial membrane.

D. The net gain of ATP from each NADH is 2.

ANSWER: C

Explanation:

Cytosolic NADH’s reducing equivalents must be transferred into mitochondria via shuttle systems because NADH itself cannot cross the inner mitochondrial membrane. This is an important feature of aerobic energy metabolism in eukaryotic cells. Glycolysis occurs in the cytosol and generates NADH there, whereas the electron-transport machinery that uses those electrons to support oxidative phosphorylation is located in the inner mitochondrial membrane. The inner membrane is highly selective and is impermeable to NADH, so cells use shuttle pathways to carry the reducing power across indirectly.

The malate-aspartate shuttle transfers electrons in a way that can produce mitochondrial NADH, while the glycerol phosphate shuttle transfers them to a different mitochondrial electron carrier. Consequently, the amount of ATP ultimately associated with cytosolic NADH can depend on the shuttle used and the tissue involved. This transport issue helps explain why ATP-yield calculations should not treat cytosolic and mitochondrial NADH as automatically equivalent. For a detailed description of mitochondrial electron transport and oxidative phosphorylation, see NCBI Bookshelf: Oxidative Phosphorylation. The role of shuttle systems in transferring cytosolic reducing equivalents is also summarized by NCBI Bookshelf: Glycolysis.

QUESTION NO: 15

Which of the following lipids in a cell membrane acts as a selective barrier for controlling the exit and entry of substances into and out of the cell?

A. Cholesterol

B. Glycolipids

C. Phospholipids

D. Lipoproteins

ANSWER: C

Explanation:

Phospholipids are correct because they form the fundamental bilayer structure of the cell membrane and create its selectively permeable barrier. Each phospholipid is amphipathic: it has a hydrophilic, phosphate-containing head that interacts with the aqueous fluid inside and outside the cell, and hydrophobic fatty-acid tails that orient inward, away from water. This arrangement produces a nonpolar interior within the membrane. Small nonpolar and lipid-soluble substances can diffuse relatively readily through this hydrophobic region, whereas ions and most large or polar water-soluble molecules cannot cross it freely. As a result, the phospholipid bilayer is the basic structure that controls passive entry and exit of substances. Cells can further regulate movement through membrane proteins, including channels, carriers, and pumps, but those proteins function within the barrier created by phospholipids. The membrane’s phospholipid composition also affects fluidity and permeability, allowing cells to maintain internal conditions that differ from their surroundings. For an overview of

membrane structure and selective permeability, see OpenStax Biology 2e: Components and Structure and NCBI Bookshelf: The Lipid Bilayer.

QUESTION NO: 16

What is the hybridization of the carbons in benzene?

A. s

B. sp

C. sp2

D. sp3

ANSWER: C

Explanation:

The correct answer is **sp2**. Every carbon atom in benzene forms three sigma bonds: one to each of its two neighboring carbon atoms in the ring and one to a hydrogen atom. Three regions of sigma-bonding electron density correspond to trigonal-planar geometry around each carbon, with bond angles close to 120°, and this arrangement uses sp2 hybrid orbitals.

Each carbon also retains one unhybridized p orbital perpendicular to the plane of the ring. These six p orbitals overlap continuously around the ring to produce the delocalized pi-electron system responsible for benzene's aromatic character. Thus, benzene is planar, and all six carbon atoms have equivalent sp2 hybridization rather than alternating carbon hybridizations. This bonding model accounts for the equal carbon–carbon bond lengths observed experimentally in benzene, which are intermediate between typical single- and double-bond lengths. The IUPAC Gold Book definition of hybridization describes the mixing of atomic orbitals used to form directed bonding orbitals, while LibreTexts' discussion of benzene structure explains its planar sp2 framework and delocalized pi system.

QUESTION NO: 17

A population of 1000 individuals has 110 births and 10 deaths in a year. Its growth rate (r) is equal to:

A. 0.01 per year

B. 0.11 per year

C. 0.1 per year

D. 0.09 per year

E. 0.009 per year

ANSWER: C

Explanation:

The correct answer is **0.1 per year**. For a population over a stated time interval, the per-capita growth rate attributable to births and deaths is calculated as the net population change divided by the population size: r = (births − deaths) / population size. There are 110 births and 10 deaths during the year, so the net increase is 100 individuals. Dividing 100 by the initial population of 1,000 gives 0.1. Because the observations cover one year, the appropriate unit is per year.

This value means that the population's net increase during that year is equivalent to 10% of the starting population. It is a decimal per-capita rate, not the raw number of individuals added. In basic population ecology, this birth–death calculation expresses the rate of change when migration is not included; if immigration or emigration were provided, those terms would also be incorporated into net change. The result is consistent with the standard population-change relationship, in which population size changes according to births minus deaths. See OpenStax Biology 2e: Population Demography and Encyclopaedia Britannica: Population Ecology.

QUESTION NO: 18

Ma'Tia drove 400 miles in 6 hours. She has an additional 180 miles to drive. If she drives at the same rate of speed, how long will it take her rounded to the nearest hour?

A. 3 hours

B. 4 hours

C. 1 hour

ANSWER: A

Explanation:

3 hours is correct because the trip is assumed to continue at a constant speed. Ma'Tia's speed for the first portion is 400 miles divided by 6 hours, or approximately 66.7 miles per hour. The time needed for the additional 180 miles is distance divided by speed: 180 ÷ 66.7, which is approximately 2.7 hours. Equivalently, a proportion can be used: 400 miles corresponds to 6 hours, so 180 miles corresponds to *x* hours. Solving 400x = 6 × 180 gives x = 2.7 hours. Since the question asks for the time rounded to the nearest whole hour, 2.7 rounds to 3 hours. This calculation concerns only the additional 180 miles, not the total time for all 580 miles. The relationship used is the standard rate formula, distance = rate × time; therefore, time is found by dividing distance by rate. See Khan Academy's overview of solving rate problems and Math is Fun's speed, distance, and time reference.

QUESTION NO: 19

For most Americans, the words "Alzheimer's disease" (AD) – often mispronounced purposefully or accidentally as "old timers' disease" – signify devastating memory loss and stigma. The information about AD – often learned solely through the media – may lead individuals to believe that AD is inevitable (it isn't), and possibly think that all AD patients receive poor care (there are many remarkably good AD units). Many individuals may envision a future burdened with more dementia patients and fewer societal resources to help support them (a real possibility). In general, pharmacists are well aware of what AD is and isn't. AD is complex and relentlessly progressive; it affects patients, loved ones, and caregivers adversely. Pharmacists can provide pertinent information about AD's myths, realities, and available symptomatic treatments. AD's harbinger is language difficulties, which include aphasia (language disturbance), apraxia (inability to carry out motor functions), and agnosia (failure to recognize or identify objects). Consequently, those with AD will often create new words for items. They may call a pencil a "list writer," or a key a "door turner." Clinicians stage AD as mild, moderate, or severe depending on the patient's cognitive and memory impairment, communication problems, personality changes, behavior, and loss of control of bodily functions. People often dismiss mild AD as normal cognitive decline or senility – in other words, "normal" aging. For this reason, most people don't seek treatment and are diagnosed in the late-mild to early-moderate stage. In the severe stage, difficulty swallowing elevates the risk of aspiration pneumonia, which often marks the beginning of the downward spiral that ultimately ends with death; AD has no cure. A handful of pharmacologic treatments – acetylcholinesterase inhibitors and N-methyl-D-aspartate antagonists – alter the decline trajectory. These treatments slow disease progression, enhance cognitive function, delay cognitive decline, and decrease disruptive behaviors. Not all patients respond to these medications, but experts generally believe that those who do will show mild to moderate improvements for 6 months to a year. Although the drugs' effects are short-lived, they improve patients' quality of life and briefly enable independence. Determining when medications stop providing a therapeutic benefit and should be discontinued is challenging. Clinicians use various methods to monitor decline, including mental status tools, patient self-report, and loved ones' observations. Most clinicians continue drug treatment if the patient seems to tolerate the medication well, can afford it, and if there seems to be a benefit. With disease progression, specific behavioral symptoms including depression, agitation, hallucinations, and sleep disturbances become concerns. Antianxiety drugs, antipsychotics, and antidepressants are sometimes used to alleviate symptoms, but effective behavioral strategies are much preferred.

In paragraph 2, "harbinger" most nearly means?

A. token

B. precursor

C. messenger

D. problem

ANSWER: B

Explanation:

"precursor" is correct because a harbinger is an early sign, signal, or forerunner of something that is to follow. In the passage, language difficulties are described as AD's harbinger: they appear as an important early indication of the disease and may precede or signal further cognitive, functional, and behavioral decline. The surrounding details reinforce this meaning by identifying communication-related impairments, including aphasia, apraxia, and agnosia, and illustrating how affected people may substitute descriptive invented phrases for the names of familiar objects. Thus, the word is used in its predictive sense: language disturbance serves as a warning sign or early manifestation that points to the onset or progression of Alzheimer's disease. This use aligns with standard dictionary definitions of *harbinger* as something that announces, indicates, or foreshadows a future development. See the Merriam-Webster definition of "harbinger" and the Cambridge Dictionary entry for "harbinger".

QUESTION NO: 20

The ____ is the ____ at which a protein has no net charge.

A. pH, pKa

B. pI, pKa

C. pH, pI

D. pI, pH

ANSWER: D

Explanation:

The **pI, pH** pairing correctly completes the statement: the isoelectric point (pI) is the pH at which a protein has zero net electrical charge. Proteins contain ionizable groups, including the amino and carboxyl termini and, depending on the amino-acid sequence, ionizable side chains. As pH changes, these groups gain or lose protons, changing the protein's overall charge. At the pI, the positive and negative charges balance so that the net charge is zero, even though charged groups may still be present on the molecule.

Knowing a protein's pI is important in biochemistry and pharmacy-related laboratory work. For example, a protein's charge relative to its pI helps predict its migration during electrophoresis and supports separation methods such as isoelectric focusing. A solution pH below the pI generally favors a net positive protein charge, whereas a pH above the pI generally favors a net negative charge. The pI is therefore a characteristic value expressed on the pH scale, rather than a different name for an individual group's acid-dissociation constant. See NCBI Bookshelf: Protein Structure and Encyclopaedia Britannica: isoelectric point.

QUESTION NO: 21

If $-10 \leq 3x + 4 < 20$, what would be the interval notation of the value of x?

A. $(-14/3, \infty)$

B. $(\infty, 16/3)$

C. $[-14/3, 16/3]$

D. $[-14/3, 16/3)$

ANSWER: D

Explanation:

The correct interval is **[−14/3, 16/3)**. To solve the compound inequality, apply the same operation to all three parts while preserving the inequality directions. First, subtract 4 throughout: $-10 - 4 \leq 3x + 4 - 4 < 20 - 4$, which gives $-14 \leq 3x < 16$. Then divide every part by 3. Because 3 is positive, division does not reverse either inequality sign, yielding $-14/3 \leq x < 16/3$. Interval notation uses a square bracket at −14/3 because the "less than or equal to" symbol includes that endpoint. It uses a parenthesis at 16/3 because the strict "less than" symbol excludes that endpoint. Thus, the solution set contains every real value of x from −14/3 inclusive up to 16/3 exclusive. For further guidance on solving compound inequalities and expressing solution sets in interval notation, see OpenStax Elementary Algebra: Solve Compound Inequalities and Khan Academy: Compound inequalities.

QUESTION NO: 22

The T-tubules transmit an action potential, causing the opening of ____ channels in the ____.

A. Na+, Sarcoplasm

B. Ca2+, Sarcoplasmic Reticulum

C. Na+, Sarcoplasmic Reticulum

D. Ca2+, Sarcoplasm

ANSWER: B

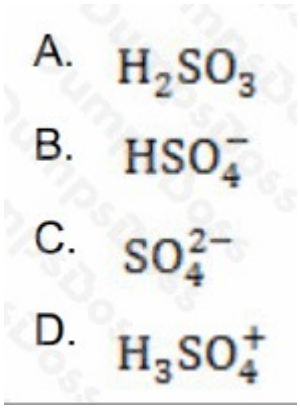
Explanation:

The correct completion is **"Ca2+, Sarcoplasmic Reticulum."** In skeletal muscle excitation-contraction coupling, an action potential travels along the sarcolemma and descends into the muscle fiber through transverse (T) tubules. Depolarization of the T-tubule membrane activates voltage-sensitive dihydropyridine receptors. These receptors are functionally coupled to ryanodine receptors, which are calcium-release channels located in the membrane of the sarcoplasmic reticulum. Their opening releases stored Ca2+ from the sarcoplasmic reticulum into the sarcoplasm surrounding the myofibrils.

The rise in cytosolic calcium is the key signal that initiates contraction: Ca2+ binds to troponin C on the thin filament, changing the position of tropomyosin and allowing actin-myosin cross-bridge cycling. Thus, T-tubule action potentials do not merely conduct an electrical signal; they link membrane depolarization to calcium release from the sarcoplasmic reticulum, allowing contraction to occur rapidly and nearly simultaneously throughout the fiber. This mechanism is described in the NCBI Bookshelf overview of skeletal muscle physiology and in OpenStax Anatomy and Physiology.

QUESTION NO: 23

What is the conjugate base of sulfuric acid?



A. Option A

B. HSO_4^-

C. Option C

D. Option D

ANSWER: B

Explanation:

The conjugate base of sulfuric acid is HSO_4^-, called the hydrogen sulfate ion (also commonly called bisulfate). Under the Brønsted–Lowry definition, an acid donates a proton, and its conjugate base is the species remaining after the loss of one proton. Sulfuric acid has the formula H_2SO_4. Removing one H^+ from this formula leaves HSO_4^-; the negative charge reflects that the proton departed without its bonding electron pair. The relevant first acid-ionization equation in water is $H_2SO_4 + H_2O \rightarrow H_3O^+ + HSO_4^-$. This directly identifies hydrogen sulfate as the conjugate base paired with sulfuric acid in that proton-transfer reaction. Although hydrogen sulfate can itself donate another proton in a subsequent equilibrium, that does not change its role as the conjugate base formed from the first deprotonation of sulfuric acid. The conjugate-base relationship always differs by exactly one proton. See the IUPAC definition of a conjugate acid–base pair and LibreTexts' discussion of Brønsted–Lowry acids and bases.

QUESTION NO: 24

What is the predominant source of progesterone after ovulation?

A. the oocyte

B. the ovary

C. the corpus callosum

D. the corpus luteum

ANSWER: D

Explanation:

The corpus luteum is the predominant source of progesterone after ovulation. Following release of the oocyte, the ruptured ovarian follicle transforms into the corpus luteum under the influence of luteinizing hormone. This temporary endocrine structure produces substantial progesterone during the luteal phase of the menstrual cycle. Progesterone acts on the endometrium to promote its secretory maturation, making the uterine lining receptive to implantation and helping support an early pregnancy. If fertilization and implantation do not occur, the corpus luteum regresses, progesterone concentrations fall, and menstrual shedding follows. If pregnancy occurs, embryonic human chorionic gonadotropin initially maintains the corpus luteum so progesterone production continues until placental hormone production becomes sufficient. Thus, although the corpus luteum is located within the ovary, it is the specific postovulatory ovarian structure responsible for the major rise in progesterone. This relationship between ovulation, corpus luteum formation, and luteal progesterone secretion is a core feature of normal menstrual-cycle physiology. See the NCBI Bookshelf overview of the menstrual cycle and Merck Manual discussion of female reproductive physiology.

QUESTION NO: 25

Which of the following carbohydrate polymers serves as an energy storage molecule in plants?

A. Chitin

B. Cellulose

C. Starch

D. Glycogen

E. Phospholipids

ANSWER: C

Explanation:

Starch is the carbohydrate polymer that serves as the principal energy-storage molecule in plants. Plants synthesize starch from glucose produced during photosynthesis, then store it in plastids, including chloroplasts and amyloplasts. Starch provides a compact reserve of glucose that can be broken down when cellular energy or carbon is needed, such as during the night, seed germination, or early growth before a seedling can photosynthesize sufficiently.

Structurally, starch consists of the glucose polymers amylose and amylopectin. Amylose is primarily composed of glucose units joined by alpha-1,4 glycosidic bonds, while amylopectin also contains alpha-1,6 branch points. These alpha-linked structures permit plants to access stored glucose through enzymatic breakdown. This storage role is essential to plant metabolism because it allows carbohydrates generated when light is available to support metabolism and growth when photosynthesis is limited. For additional background, see OpenStax Biology: Carbohydrates and NCBI Bookshelf: Starch and Sucrose Metabolism.

QUESTION NO: 26

Which of the following most recently evolved to its present state?

A. pons

B. cerebrum

C. cerebellum

D. medulla oblongata

ANSWER: B

Explanation:

The cerebrum is the best answer because it represents the most recently expanded and elaborated major brain region among the structures listed, particularly in mammals and most dramatically in primates. The cerebral hemispheres include the cerebral cortex, which supports higher-order functions such as conscious perception, language, planning, abstract reasoning, voluntary motor control, and complex learning. During vertebrate evolution, forebrain structures underwent substantial diversification; in mammals, cortical expansion and increased connectivity enabled increasingly sophisticated sensory integration and cognition. Although all brain structures have evolutionary histories and continue to change across lineages, introductory biology comparisons commonly distinguish the relatively ancient brainstem functions from the later enlargement and specialization of the cerebrum. The cerebrum's extensive development is therefore associated with the most evolutionarily recent level of complex neural processing represented by these choices. For an overview of the cerebrum and its functions, see NCBI Bookshelf: The Cerebral Cortex. Comparative evidence for the expansion of mammalian cortical areas is also summarized by Nature Reviews Neuroscience.

QUESTION NO: 27

In photosynthesis, high-energy electrons in Photosystem II are transferred along an electron transport chain and eventually end up in high-energy molecules used in the Calvin Cycle. Which molecule provides electrons to replace those lost by Photosystem II after light stimulation?

A. CO_2

B. $FADH_2$

C. NADPH

D. ATP

E. H_2O

ANSWER: E

Explanation:

H2O is correct because Photosystem II replaces its light-excited electrons by extracting electrons from water in a process called photolysis, or water splitting. At the oxygen-evolving complex associated with Photosystem II, water is oxidized to yield electrons, hydrogen ions, and molecular oxygen. The released electrons are transferred to the Photosystem II reaction center, restoring the electrons that chlorophyll molecules lost after absorbing light energy. This continual replacement is essential: without a source of replacement electrons, linear electron flow through the photosynthetic electron transport chain could not continue. The electrons ultimately contribute to the reduction of NADP+ to NADPH, while the hydrogen-ion gradient generated across the thylakoid membrane helps power ATP synthesis. NADPH and ATP are then used as energy and reducing-power inputs for carbon fixation reactions in the Calvin cycle. Oxygen released from water splitting is the oxygen gas produced during oxygenic photosynthesis. See OpenStax Biology 2e: Light-Dependent Reactions and NCBI Bookshelf: Photosynthesis.

QUESTION NO: 28

If a multivitamin supplement costs $n for 100 pills, how many pills can be bought for $10?

A. 10n

B. 1000n

C. 10/n

D. 1000/n

ANSWER: D

Explanation:

The correct answer is **1000/n**. If 100 pills cost $n, the number of pills obtained per dollar is found by dividing the quantity of pills by the cost: 100 ÷ n, or 100/n pills per dollar. A $10 purchase provides ten times that amount, so the number of pills is 10 × (100/n) = 1000/n.

This result can also be obtained with a proportion. Let p represent the number of pills purchasable for $10. Since the cost per pill remains constant, set up 100 pills/$n = p pills/$10. Cross-multiplying gives np = 1000, and dividing by n gives p = 1000/n. The expression appropriately varies with the price: as n increases, the number of pills that $10 can buy decreases; as n decreases, $10 buys more pills. This assumes n is a positive dollar cost, as is required for a meaningful price. For review of solving proportions and representing rate relationships algebraically, see Khan Academy: Introduction to rates and OpenStax: Solve proportions and their applications.

QUESTION NO: 29

The rhythm of the heart is set by the:

A. AV node

B. SA node

C. purkinje fibers

D. Heart valves

ANSWER: B

Explanation:

The **SA node** sets the normal rhythm of the heart because it is the heart's primary pacemaker. Located in the upper wall of the right atrium near the opening of the superior vena cava, the sinoatrial node contains specialized autorhythmic cells that

spontaneously depolarize. These cells generate electrical impulses at the fastest intrinsic rate within the cardiac conduction system, typically establishing a resting sinus rhythm of about 60–100 beats per minute in adults. Each impulse spreads through the atrial myocardium, producing atrial contraction, and then travels through the normal conduction pathway to coordinate ventricular activation. Because the SA node normally fires before other potential pacemaker tissues, it suppresses their slower intrinsic rhythms and determines the overall heart rate and rhythm. This normal rhythm is therefore called *sinus rhythm*. The heart can continue to beat without direct nervous stimulation because of this intrinsic automaticity, although autonomic nerves modify the SA node's firing rate to adjust cardiac output to the body's needs. The American Heart Association describes the SA node as the heart's natural pacemaker, and OpenStax details its role in initiating cardiac electrical activity. See American Heart Association: The Heart's Electrical System and OpenStax: Cardiac Muscle and Electrical Activity.

QUESTION NO: 30

Jim has 10 apples and he gives 7 to Bill. Now Bill has 3 times as many apples as Jim had. How many apples did Bill have to begin with?

A. 20

B. 17

C. 23

D. 2

ANSWER: C

Explanation:

The correct answer is **23**. The wording "Jim had" refers to Jim's stated original amount of 10 apples. After Jim gives 7 apples to Bill, Bill's current total is described as three times Jim's original amount. Thus, Bill's total after receiving the apples is 3 × 10 = 30 apples. Because 7 of those 30 apples came from Jim during the exchange, subtract those transferred apples to determine how many Bill possessed before Jim gave him any: 30 − 7 = 23.

This can also be represented with an equation. Let b be Bill's starting number of apples. Receiving 7 apples changes Bill's quantity to $b + 7$. The condition in the question gives $b + 7 = 3(10)$. Solving yields $b + 7 = 30$ and therefore $b = 23$. This uses inverse operations: subtraction reverses the addition of the 7 apples. For additional guidance on forming and solving one-variable equations, see Khan Academy's linear-equations resources and OpenStax's strategy for solving linear equations.