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**QUESTION 1**

In which locations does this reaction occur?

Glyceraldehyde-3-phosphate (G3P)  $\longrightarrow$  Pyruvate

- A. cytoplasm
- B. nucleus
- C. mitochondria
- D. none of the above

Correct Answer: A

The oxidation of G3P into pyruvate occurs during the glycolysis stage of cellular respiration. Glycolysis occurs in the cytoplasm.

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**QUESTION 2**

Which compound forms when acetyl-CoA enters the TCA cycle?

- A. oxaloacetate
- B. acetic acid
- C. citrate
- D. FADH<sub>2</sub>

Correct Answer: C

Prior to the TCA cycle, glycolysis functions to breakdown glucose into pyruvate which is then decarboxylated and turned into acetyl-CoA. Acetyl-CoA combines with oxaloacetate to make citrate, which marks the start of the TCA cycle.

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**QUESTION 3**

Which law states that the volume of a gas is proportional to the number of moles of a gas at constant temperature and pressure?

- A. Dalton's law
- B. Avogadro's law
- C. Charles's law
- D. Henry's law

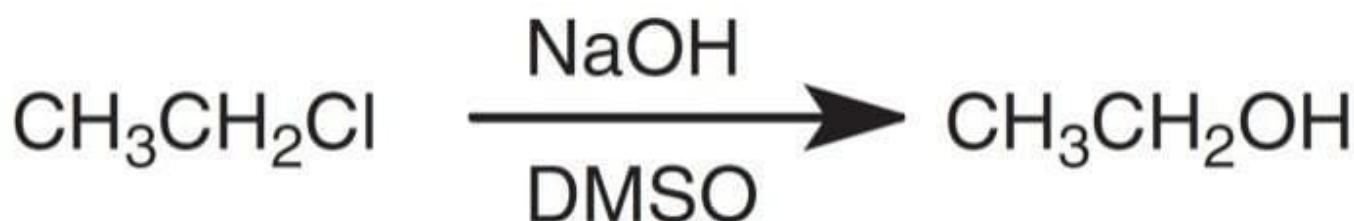
Correct Answer: B



Avogadro's law relates the volume of a gas to the amount of substance of gas present:  $V = nk$ , where  $V$  is the volume of the gas,  $n$  is the number of moles of the gas, and  $k$  is a constant equal to  $RT / P$  where  $R$  is the universal gas constant,  $T$  is temperature in Kelvins, and  $P$  is the pressure.

#### QUESTION 4

Given the following reaction conditions, which statement is most accurate?



- A. The reaction follows first-order kinetics and is a concerted reaction.
- B. The reaction follows first-order kinetics and involves formation of a carbocation.
- C. The reaction follows second-order kinetics and is concerted.
- D. The reaction follows second-order kinetics and involves formation of a carbocation.

Correct Answer: C

This substitution reaction shows chloride ( $\text{Cl}^-$ ) being replaced by hydroxide ( $\text{OH}^-$ ). Substitution reactions occur mainly via one of two mechanisms:  $\text{SN}_1$  (unimolecular kinetics and two steps with a carbocation intermediate) or  $\text{SN}_2$  (bimolecular kinetics and one step). In this situation, the mechanism isn't shown but can be inferred based on the reaction conditions. First, the reactant with the carbons (the substrate) has a strong leaving group; the  $\text{Cl}^-$  that detaches is relatively stable as an ion in solution by itself (think of how table salt,  $\text{NaCl}$ , is able to readily dissolve into  $\text{Na}^+$  and  $\text{Cl}^-$  in water). Second, the substrate has primary substitution, meaning the carbon attached to the leaving group is only attached to one other carbon, which in turn means that there is little steric hindrance but also that the carbon doesn't have many other carbons to stabilize it if it were to gain a charge. Third, the other reactant,  $\text{OH}^-$ , is a strong base and strong nucleophile, indicating that it can readily attack the substrate on its own. Finally, the solvent DMSO (dimethyl sulfoxide) is polar aprotic so can stabilize the leaving group without deactivating the nucleophile. All of these factors point toward an  $\text{SN}_2$  reaction. Since an  $\text{SN}_2$  reaction is always concerted, occurring in one step without forming discrete intermediates.

#### QUESTION 5

What are the critical points of  $y = 4x^2 + 3x$ ?

- A. 0
- B.  $-3/8$
- C. 0 and  $-3/8$
- D. 0 and  $3/8$

Correct Answer: B



A critical point of a function is a point where the derivative of the function is equal to 0 or is undefined. Evaluate the derivative with respect to  $x$ , set it equal to 0, and solve for  $x$ :

$$0 = 8x + 3 \Rightarrow x = -3/8$$

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### QUESTION 6

Lead is non-biodegradable, soft, malleable, as well as heat and corrosion resistant and is environmentally omnipresent. Its known properties make it an ideal metal for automobiles, paint, smelting, ceramics, and plastics. Not many years ago, it was also utilized in the toy industry. Unfortunately, lead is toxic to humans. Humans neither need lead nor derive benefits from it. Although lead toxicity has been a global concern since the industrial revolution in the late 1800s, civilization has been unable to prevent or control it satisfactorily. Overall incidence of lead poisoning among American children has fallen from 4.4% in the early 1990s to 1.4% in 2004. In 2002, around 10 out of every 100,000 of adults had lead toxicity. Venous blood lead levels (BLLs) of 10 mcg/dL and 25 mcg/dL were considered toxic in children and adults, respectively. But, since any level of lead can cause toxicity, the CDC announced a new, lower reference value for children in June 2012: 5 mcg/dL. Infants and children absorb a higher fraction of lead than adults do when exposed, increasing their vulnerability. Approximately 450,000 American children have BLLs >5 mcg/dL. Consequently, lead poisoning is still a problem. Lead exposure can start with prenatal maternal-fetal transmission. Outside the womb, children may inhale (or eat) lead dust, often present in street debris, soil, and most frequently, aged house paint. Lead-based paint was phased out in the 1970s, lowering, but not eliminating, risk of exposure. Old pipes sometimes leach lead into drinking water. Lead hazards are disproportionately found in low-income housing. Adults rarely develop lead poisoning, but risk is increased for industrial workers who use or manufacture lead-based products. Health care providers use many tests to identify lead poisoning. In addition to the BLL, a blood smear may show basophilic stippling ribosomal clusters. Increased urinary aminolaevulinic acid concentrations are also reliable indicators. Plain film radiographs can reveal visible lead lines in patients' long bones. Astute clinicians sometimes diagnose lead poisoning after seeing a blue line along patients' gums (Burton's line) that forms when lead reacts with sulfur ions released by oral bacteria. Lead affects every organ system and causes an unpredictable variety of symptoms. The nervous system is most sensitive (centrally in children, peripherally in adults), but lead affects hematopoietic, hepatic, and renal systems, producing serious disorders. Acute lead poisoning's classic symptoms include colic, encephalopathy, anemia, neuropathy, and Fanconi syndrome (abnormal glucose, phosphates, and amino acid excretion). Sometimes, classic signs and symptoms are absent, confusing the clinical picture.

What is NOT a test to detect lead poisoning?

- A. aminolaevulinic
- B. blood smear
- C. BLL
- D. radiographs

Correct Answer: A

This is not the name of a test or a method for detecting lead poisoning. It may be a word from the passage, but it does not answer the specific question posed. The other answer choices are all mentioned as tests for detecting lead poisoning.

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### QUESTION 7

Hemophilia is a sex-linked trait. From which parent(s) did an affected boy inherit the trait?

- A. Both the father and the mother



- B. Impossible to tell
- C. Only the mother
- D. The mother or the father but not both
- E. Only the father

Correct Answer: C

Sex-linked, or X-linked, traits can only be transmitted to males through the mother.

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### QUESTION 8

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.

Within the context of the passage as a whole, paragraph 2 serves what purpose?

- A. Give a general description of mycoplasma.
- B. Provide specific details of mycoplasma and how it relates to the common cold.
- C. Describe the progression of "walking pneumonia" in humans.
- D. Define the characteristics of mycoplasma pneumoniae.

Correct Answer: A

Passage 2 primarily describes the physical characteristics of mycoplasma, its requirements for survival, and the number of species known to man. All of these serve as a general description of the bacteria.

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**QUESTION 9**

Virus should be classified as:

- A. Akaryotic
- B. Eukaryotic
- C. Prokaryotic
- D. Nokaryotic

Correct Answer: A

Each cell has two main components - Cytoplasm and the nucleus. Usually there is a nucleus in the cell. Organisms without any cytoplasmic organizations and devoid of definite nuclear material are grouped as Akaryota. (e.g. Virus) Organisms having a primitive type of nucleus in cell, are classified Prokaryota. (e.g. Bacteria and Blue green algae.) Organisms having a cell with a well-developed nucleus are grouped as Eukaryota. (e.g. Fungi-yeast, mushroom).

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**QUESTION 10**

If a recipe calls for 3 parts sugar and 2 parts milk, and a total of 45 oz is made, how much milk is there?

- A. 18 oz
- B. 9 oz
- C. 27 oz
- D. 18 parts

Correct Answer: A

The ratio of sugar to milk is  $3x : 2x$ . Combining these and setting the amount equal to the given total:

$5x = 45$  ?gt;  $x = 9$  Plugging this back in to find the total amount of milk:  $2 \cdot 9 = 18$  oz

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**QUESTION 11**

An element whose atomic number is 16 would have how many unpaired electrons?

- A. 0
- B. 1
- C. 2
- D. 4

Correct Answer: C



The atomic number indicates the number of protons (and electrons). Writing the electron configuration:  $1s^2 2s^2 2p^6 3s^2 3p^4$  ( $2 + 2 + 6 + 2 + 4 = 16$ ). The 3p orbital will contain 1 filled orbital, and 2 half-filled orbitals, which indicates 2 unpaired electrons.

## QUESTION 12

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.

The tone of the passage could best be described as?

- A. erudite
- B. gloomy
- C. intimate
- D. didactic

Correct Answer: D

Throughout the passage, the author attempts to eliminate misconceptions and myths about Alzheimer's disease while elucidating factual details about it. The author covers the public's views of the disease as well as its progression and the difficulties faced by those impacted by the disease. The passage as a whole is very instructive.

## QUESTION 13

George can run 25 miles in the same amount of time that his brother, Alan, can run 15 miles. If George runs 3 miles per hour faster than Alan, how fast does Alan run?



- A. 10
- B. 4.5
- C. 15
- D. 7.6

Correct Answer: B

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#### QUESTION 14

Which algebraic expression best represents the following statement: the number of books Brian read over the summer (B) is 2 less than 3 times the number of books his brother Adam read over the summer (A)?

- A.  $B = 3A - 2$
- B.  $B = 3A + 2$
- C.  $A = 3B - 2$
- D.  $A = 3B + 2$

Correct Answer: A

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#### QUESTION 15

##### PLASTICS

Plastics have long been considered one of the great conveniences of the modern era, but evidence is mounting to indicate that these conveniences have come at an incredible cost. The chief benefit of plastics is their durability, but this benefit turns out to be the same reason plastic has become a significant problem: It takes 200 to 400 years to decompose. All of this plastic has accumulated into a catastrophic mess and has also caused disease in humans.

Between Hawaii and Japan, a giant mass of plastic twice the size of Texas slowly swirls with the currents of the Pacific Ocean. This area has come to be known as the Great Pacific Garbage Patch, and its effects on the ecology of the ocean are unimaginable. According to United Nations researchers, a hundred thousand sea mammals and a million seabirds die each year. They are found with cigarette lighters, syringes, and other plastics that they mistake for food in their stomachs.

Evidence also indicates that the plastic receptacles that people store their food in poses health risks. For instance, phthalates have been shown to have detrimental effects on the reproductive system, yet they are found in many plastic products including baby bottles and water bottles. They have also been linked to various forms of cancer. Additionally, a chemical called bisphenol A that is found in many plastics can mimic the effects of the hormone estrogen, which can also affect the reproductive system.

Which of the following best describes the author's purpose in writing this passage?

- A. To persuade readers to accept the author's point of view.
- B. To explain the benefits of plastic.





C. To explain the risks of plastic bottles.

D. To inform the reader of the effects of phthalates in plastics.

Correct Answer: A

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