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Canadian Medical Laboratory Technology (CSMLS)



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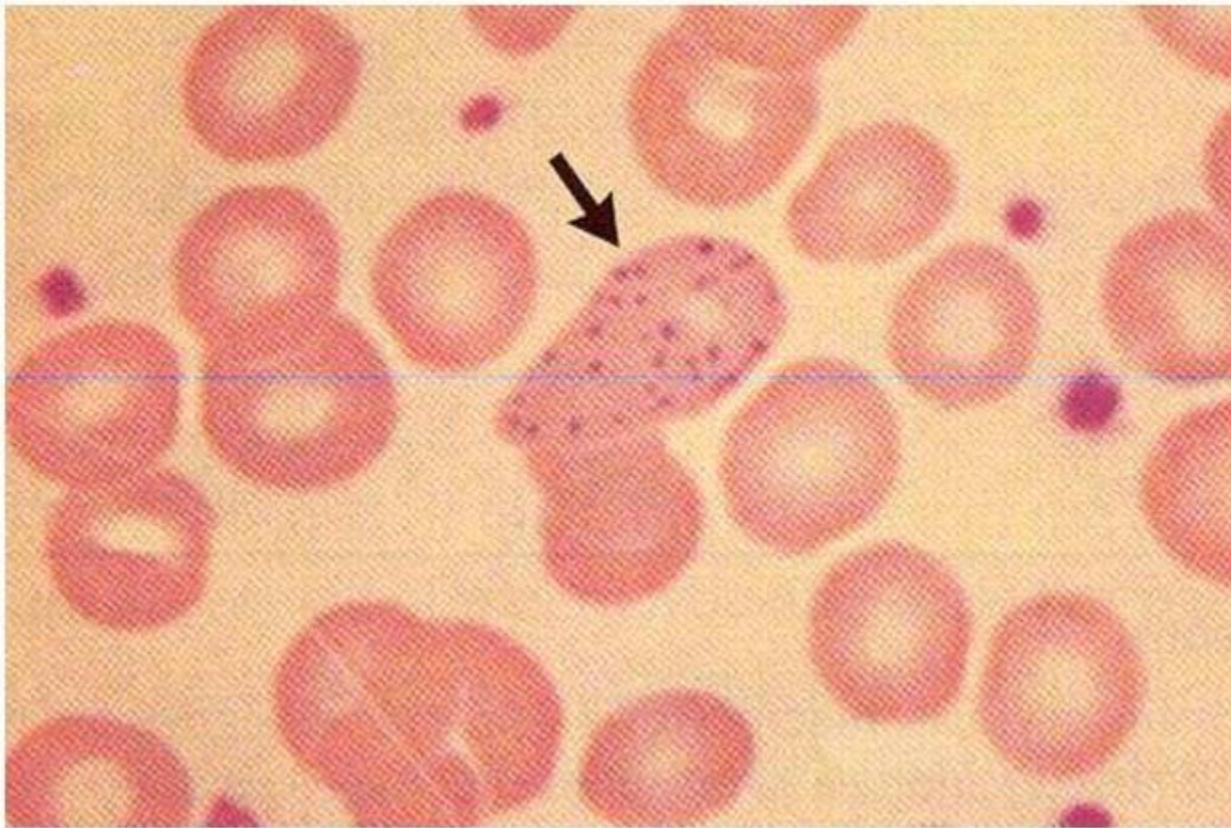
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## Question: 1

The cell designated by the arrow is which of the following erythrocyte inclusions?



- A. Howell-Jolly bodies
- B. Pappenheimer bodies
- C. Cabot rings
- D. Basophilic stippling

**Answer: D**

### Explanation:

Basophilic stippling refers to the appearance of small, darkly staining granules within red blood cells (erythrocytes) when viewed under a microscope. These granules are composed of precipitated ribonucleic acids (RNA) and are evenly distributed within the cell.

The presence of basophilic stippling is significant because it can indicate various pathological conditions. It is most commonly associated with disorders that result in defective or disrupted erythropoiesis (the production of red blood cells). For instance, it is often seen in thalassemias and megaloblastic anemias.

Thalassemias are a group of inherited blood disorders characterized by abnormal hemoglobin production, while megaloblastic anemias are typically caused by deficiencies of vitamin B12 or folic acid, leading to the production of abnormally large red blood cells with delayed maturation.

Basophilic stippling is also a hallmark of lead poisoning. Lead disrupts several enzymatic processes essential for hemoglobin synthesis and red cell maturation, resulting in the accumulation of RNA remnants in the erythrocytes. Additionally, individuals with a history of alcoholism may exhibit basophilic stippling, possibly due to the toxic effects of alcohol on bone marrow and its interference with red blood cell production.

Moreover, any condition that leads to an increase in erythropoiesis, such as recovery from anemia or hypoxia, might also show basophilic stippling. This is because the red blood cell production process is accelerated, and the maturation of cells might be incomplete, leading to the retention of RNA in erythrocytes.

Identifying basophilic stippling is crucial for diagnosing and managing the underlying conditions causing these erythrocyte inclusions. Clinicians often use this finding in conjunction with other laboratory tests and clinical data to tailor appropriate treatment strategies for affected patients.

## Question: 2

In identifying a patient from whom phlebotomy personnel will collect a specimen, which of the following would be acceptable as unique patient identifier(s)?

- A. asking the person his or her name
- B. room number
- C. birth date
- D. Both A and C

## Answer: D

Explanation:

In medical settings, correctly identifying a patient before conducting any procedure, such as phlebotomy (the process of drawing blood), is critical. This ensures that the medical personnel are administering treatments or conducting procedures on the right individual, thereby preventing potential medical errors. The question at hand discusses acceptable unique identifiers that can be used for verifying a patient's identity.

Unique identifiers are specific pieces of information that can unequivocally identify a patient. In the context of the question, the options presented include: 1. Asking the person his or her name 2. Room number 3. Birth date 4. Both options A (name) and C (birth date)

Option B, which involves using the room number as a patient identifier, is generally not considered reliable. This is because room assignments can change, and often, multiple patients might share the same room, especially in hospital settings. Therefore, relying solely on a room number could lead to misidentification, which is a significant risk in healthcare.

On the other hand, a patient's name and birth date (Options A and C) are widely recognized as strong and reliable unique identifiers. These details are less likely to change over time and are specific to an individual. Asking for both the name and the birth date provides an additional layer of verification, making it highly unlikely to misidentify a patient. This dual-check system, where two forms of identification are used, aligns with best practices in patient safety protocols.

Therefore, the best answer to the question would be "Both A and C." This choice leverages both the patient's name and birth date as identifiers, ensuring a higher accuracy level in patient identification before the phlebotomy procedure. This method minimizes the risk of errors, such as collecting a specimen from the wrong patient or performing the wrong tests, which could lead to incorrect diagnosis or treatment.

In summary, it is critical for phlebotomy personnel to use reliable and unique patient identifiers to ensure patient safety and accuracy in medical procedures. The combination of a patient's name and birth date serves as a robust method for patient identification in clinical settings.

### Question: 3

A patient is at risk for fatal infection if her WBC is below which of the following?

- A.  $0.5 \times 10^9/L$
- B.  $5 \times 10^9/L$
- C.  $50 \times 10^9/L$
- D.  $15 \times 10^9/L$

**Answer: A**

Explanation:

\*White blood cells (WBCs) are crucial components of the immune system, responsible for fighting infections and defending the body against foreign invaders. A normal WBC count ranges from about  $4.0$  to  $11.0 \times 10^9/L$ . When the WBC count falls below this range, it can indicate a compromised immune system, making an individual more susceptible to infections. \*

\*Leukopenia is the medical term used to describe a lower-than-normal WBC count, specifically when it is less than  $3.0 \times 10^9/L$ . Various factors can cause leukopenia, including chemotherapy, radiation therapy, exposure to toxic substances, and certain diseases that affect the blood and bone marrow, which is the primary site of blood cell production. \*

\*When the WBC count drops significantly lower, especially below  $0.5 \times 10^9/L$ , the condition becomes particularly dangerous. At such critically low levels, the body's ability to fight off infections is severely impaired, placing the patient at high risk for severe and potentially fatal infections. This critical threshold of less than  $0.5 \times 10^9/L$  is a clinical indicator of severe neutropenia, a type of leukopenia that specifically involves a decrease in neutrophils, which are a type of WBC particularly important for fighting bacterial infections. \*

\*Therefore, in the context of the original question, a WBC count of less than  $0.5 \times 10^9/L$  is the threshold below which a patient is considered at high risk for fatal infections. This level of leukopenia requires immediate medical attention and often necessitates interventions such as antibiotics or granulocyte colony-stimulating factor to boost WBC production and help protect the patient from severe infections.

### Question: 4

Which of the following statements about the complement system and coagulation is incorrect?

- A. The complement system is activated during coagulation and fibrinolysis.

- B. Complement activation is regulated by C3b inactivator, which also inhibits several coagulation factors.
- C. It contains more than 30 circulating blood proteins, primarily to mediate inflammatory response and immune and allergic reactions.
- D. Complement functions in lysing antibody-coated cells.

**Answer: B**

**Explanation:**

The complement system is a part of the immune system that enhances (complements) the ability of antibodies and phagocytic cells to clear microbes and damaged cells from an organism, promote inflammation, and attack the pathogen's cell membrane. It consists of a number of small proteins found in the blood, generally synthesized by the liver, and normally circulating as inactive precursors (zymogens). When stimulated by one of several triggers, proteases in the system cleave specific proteins to release cytokines and initiate an amplifying cascade of further cleavages. The end-product of this activation cascade is the generation of the membrane attack complex, which forms pores in the membranes of invading pathogens, leading to their death.

The complement system can be activated through three pathways: the classical pathway, the lectin pathway, and the alternative pathway. Each of these pathways involves the sequential activation of proteins that leads to the cleavage of C3 and C5, and eventually the formation of the membrane attack complex. The activation of the complement system is tightly regulated to prevent damage to host cells. One of the key regulators of the complement system is C1-inhibitor, which inhibits the enzyme C1, the first enzyme in the classical pathway of complement activation. C1-inhibitor also has a role in controlling the activation of several factors in the coagulation system, particularly factors involved in the intrinsic pathway of blood coagulation.

Coagulation, on the other hand, is the process by which blood forms clots to block and then repair blood vessel injury. There are two main pathways to initiate clotting: the intrinsic and the extrinsic pathways, both of which lead to the formation of a fibrin clot. The coagulation factors are also proteases (enzymes that digest other proteins), and they activate each other in a cascade that results in the rapid response necessary to achieve hemostasis.

The statement "Complement activation is regulated by C3b inactivator, which also inhibits several coagulation factors" is incorrect because it incorrectly assigns the role of inhibiting several coagulation factors and regulating complement activation to C3b inactivator. The primary role of the C3b inactivator, which is more correctly known as Factor I, is to cleave C3b and C4b, not to regulate the entire complement system nor to inhibit coagulation factors directly. Furthermore, it is C1-inhibitor, not C3b inactivator, that plays a significant role in regulating both the complement system (specifically the classical pathway) and having effects on the coagulation system.

Therefore, the correct understanding is that C1-inhibitor regulates the classical pathway of the complement system and affects several factors in the coagulation system, and Factor I (C3b inactivator) functions to inactivate C3b, thereby regulating the alternative pathway of complement activation and preventing excessive damage to host tissues. This nuanced understanding is important for accurate clinical assessment and treatment involving the immune and coagulation systems.

## **Question: 5**

Uric acid can typically be found in all of the following except?

- A. Heparinized plasma.

- B. CSF.
- C. Serum.
- D. Urine.

**Answer: B**

**Explanation:**

To address this, we need to understand what uric acid is, where it comes from, and in what bodily fluids it can typically be found.

Uric acid is a chemical created when the body breaks down substances called purines. Purines are nitrogen-containing compounds that are part of the nucleotides in DNA and RNA. They are found in high amounts in certain foods like organ meats, asparagus, and some seafoods, and are also produced naturally by the body.

When cells die and get recycled, the purines in their genetic material are broken down into uric acid.

Normally, uric acid is dissolved in the blood, processed by the kidneys, and then excreted from the body in urine. Abnormally high levels of uric acid can lead to medical conditions, most notably gout, which is a type of arthritis caused by uric acid crystals accumulating in the joints.

Uric acid can be measured in various bodily fluids to assess levels in the body. Common samples used for this purpose include serum (the fluid component of blood), urine, and heparinized plasma (a type of blood sample treated with heparin to prevent clotting). These fluids can directly reflect the concentration of uric acid being processed and excreted by the body.

Cerebrospinal fluid (CSF), however, is not a typical source of uric acid. CSF is a clear fluid found in the brain and spinal cord that helps to cushion these structures, clear waste, and provide a stable chemical environment. While CSF may contain trace amounts of uric acid, it does not contribute significantly to the body's overall production or processing of uric acid. CSF's primary roles are related to protecting and nourishing the brain and spinal cord rather than excreting metabolic waste products like uric acid.

Therefore, among the options given (heparinized plasma, CSF, serum, urine), CSF is the correct answer as it is not a significant source of uric acid in the body.

## **Question: 6**

Antimicrobial susceptibility testing is used to:

- A. Randomize antibiotic susceptibility patterns.
- B. Help determine antibiotic susceptibility patterns.
- C. Create false antibiotic susceptibility patterns.
- D. Eliminate antibiotic susceptibility patterns.

**Answer: B**

**Explanation:**

Antimicrobial susceptibility testing is a critical procedure used in clinical microbiology to determine the efficacy of various antimicrobial agents against specific pathogens. This testing is essential for guiding effective treatment strategies, ensuring that the most appropriate and effective antibiotics are selected to treat an infection. The primary purpose of this testing is to help determine antibiotic susceptibility patterns, which indicate how sensitive a particular bacterium or fungus is to potential treatments.

In the clinical setting, once a pathogen is isolated from a patient, it undergoes antimicrobial susceptibility testing. During this process, the isolated organism is exposed to different antibiotics in controlled conditions to observe their effects. The results help clinicians understand which antibiotics are likely to be effective in treating the infection, based on the sensitivity or resistance exhibited by the pathogen. This is crucial for avoiding the use of antibiotics that the pathogen is resistant to, which can lead to treatment failures and prolonged infections.

The methodology behind antimicrobial susceptibility testing can vary but generally includes techniques such as disk diffusion (Kirby-Bauer method), dilution methods, and automated systems. Each method aims to evaluate how different concentrations of antibiotics affect the growth of the bacterial or fungal isolate. The results are typically reported as sensitive, intermediate, or resistant, based on standardized interpretation criteria set by organizations like the Clinical and Laboratory Standards Institute (CLSI) or the European Committee on Antimicrobial Susceptibility Testing (EUCAST).

Moreover, antimicrobial susceptibility testing is not only pivotal in treating individual patients but also plays a significant role in tracking and managing antibiotic resistance on a broader scale. By monitoring susceptibility patterns over time, healthcare providers and researchers can detect trends in resistance, adapt antibiotic usage policies, and develop strategies to combat the emergence and spread of resistant strains.

In summary, antimicrobial susceptibility testing is integral to modern medical practice. It helps determine the most effective antibiotic treatment options, thus optimizing patient outcomes, reducing the risk of complications, and contributing to the overall management of antibiotic resistance. The accurate determination of antibiotic susceptibility patterns ensures that treatments are both effective against the pathogen and judicious in their use of antibiotics, helping to preserve the efficacy of these vital drugs for future use.

## Question: 7

Monosaccharides are classified in how many ways?

- A. 3.
- B. 4.
- C. 5.
- D. 6.

**Answer: A**

Explanation:

3. Monosaccharides, the simplest form of carbohydrates, are classified in three primary ways which help in understanding their structure and function in biological processes. The first classification is based on the number of carbon atoms present in the molecule. This ranges typically from three to seven carbons, and the monosaccharides are termed as trioses, tetroses, pentoses, hexoses, and heptoses, respectively, depending on the number of carbon atoms.
4. The second way monosaccharides are classified is by the location of the carbonyl group (C=O) within the molecule. If the carbonyl group is at the end of the carbon chain, the sugar is known as an aldose. If the carbonyl group is at any other position (typically the second carbon), it is known as a ketose. This placement significantly influences the chemical reactivity and the biological role of the sugar.
5. The third classification criterion is the chirality or the spatial arrangement of the atoms around one or more central carbon atoms. Each carbon atom that is attached to four different groups can exist in two

different configurations (enantiomers). This is crucial in biology as different enantiomers of the same sugar can have different properties and biological activities. Monosaccharides can thus exist in multiple stereoisomeric forms, adding to their diversity and functionality in living organisms.

## Question: 8

Which of these can cause a higher than normal level of chloride?

- A. Addison's disease.
- B. Bromide poisoning.
- C. Bartter syndrome.
- D. Dehydration.

## Answer: B

Explanation:

The human body maintains a delicate balance of electrolytes, such as chloride, to function correctly. Chloride, an essential electrolyte, helps to regulate fluid balance, maintain blood volume, and support proper nerve and muscle functions. Various health conditions can disrupt this balance, leading either to hyperchlremia (an abnormally high level of chloride) or hypochlremia (an abnormally low level of chloride).

Addison's disease is a condition characterized by the underproduction of hormones by the adrenal glands. These hormones include cortisol and aldosterone, which play crucial roles in managing the body's balance of sodium, potassium, and chloride. Typically, Addison's disease leads to lower levels of sodium and chloride in the blood because aldosterone deficiency prevents the kidneys from retaining enough sodium and, consequently, chloride.

However, the condition that can cause a higher than normal level of chloride is bromide poisoning. Bromide is a halide, similar to chloride, and the body handles it using many of the same mechanisms. When bromide is ingested or absorbed (commonly through environmental or occupational exposure), it competes with chloride for reabsorption in the kidneys. This competition can lead to an accumulation of chloride because the body attempts to retain chloride to compensate for the increased bromide levels. This mechanism can ultimately elevate the serum chloride concentrations, manifesting as hyperchlremia.

It's crucial to recognize the symptoms and causes of altered chloride levels, as they can indicate broader issues like dehydration, kidney dysfunction, or hormonal imbalances. Understanding these can help guide appropriate medical interventions and management strategies to restore electrolyte balance and ensure overall health stability.

## Question: 9

Humans acquire the infective oocyst of toxoplasma gondii in three ways. Which of the following is NOT one of these ways?

- A. tick bite
- B. cat feces contaminated food and water
- C. ingestion of undercooked meat containing viable tissue cysts

D. transmission from infected mother to newborn

**Answer: A**

Explanation:

Toxoplasma gondii is a parasitic protozoan that can cause the disease toxoplasmosis in humans and other warm-blooded animals. Humans can acquire this infection in several ways, but not all methods of transmission involve direct infection from ticks or other arthropods. Here is an expanded explanation of the ways humans can become infected with Toxoplasma gondii, highlighting the incorrect option among the given choices.

**\*\*Ingestion of Undercooked Meat Containing Viable Tissue Cysts\*\*:** One of the primary ways humans can become infected with Toxoplasma gondii is through the ingestion of undercooked or raw meat from animals that have been infected with the parasite. Animals such as pigs, sheep, and deer can harbor tissue cysts of *T. gondii* in their muscles. When meat from these animals is consumed without proper cooking, the cysts can infect humans. Cooking meat to safe temperatures or freezing it can help kill the cysts, thus preventing infection.

**\*\*Cat Feces Contaminated Food and Water\*\*:** Cats are the definitive hosts of Toxoplasma gondii, where the parasite can complete its reproductive cycle. Infected cats shed oocysts (the egg-like form of the parasite) in their feces, which can contaminate soil, water, or surfaces. Humans can become infected by ingesting these oocysts, which can occur by accidentally consuming contaminated food, water, or by handling cat litter without proper hygiene. This route of transmission underscores the importance of hand washing and careful handling of cat litter.

**\*\*Transmission from Infected Mother to Newborn (Congenital Transmission)\*\*:** Toxoplasma gondii can also be transmitted from an infected mother to her fetus during pregnancy. This type of transmission can occur if a woman becomes infected just before or during her pregnancy. The parasite can cross the placenta and infect the unborn child, potentially leading to serious health issues such as blindness, mental disabilities, or even stillbirth. Preventive measures include testing and monitoring during pregnancy and avoiding known sources of infection.

**\*\*Tick Bite\*\*:** The option suggesting that tick bites are a method of acquiring the infective oocyst of Toxoplasma gondii is incorrect. Toxoplasma gondii is not transmitted by ticks or any other insects. The lifecycle of *T. gondii* primarily involves cats as definitive hosts and various warm-blooded animals (including humans) as intermediate hosts. It does not include insects in its transmission cycle. Therefore, tick bites are not a recognized route of transmission for Toxoplasma gondii. Understanding the correct pathways of transmission for Toxoplasma gondii is crucial for both preventing and managing the infection effectively.

## Question: 10

Molarity can best be defined as which of the following?

- A. the amount of solute per 1 kg of solvent
- B. the number of moles per 1 L of solution
- C. the number of gram equivalent weights per 1 L of solution
- D. the number of units that can combine with or replace 1 mole of hydrogen ions for acids

**Answer: B**

**Explanation:**

Molarity is a term used in chemistry to describe the concentration of a solution. It is defined as the number of moles of solute (the substance being dissolved) per liter of solution. This measurement is expressed in moles per liter (mol/L), and it helps chemists understand the concentration of substances in a solution for various chemical reactions and solutions preparation.

The mole is a standard unit in chemistry that represents a specific number of molecules, atoms, or other particles. Specifically, one mole is equivalent to  $6.022 \times 10^{23}$  particles, known as Avogadro's number. By measuring the number of moles in a liter of solution, molarity provides a clear and quantifiable way of describing how concentrated a solution is.

It is critical to distinguish molarity from other measures of concentration such as molality, normality, and valence. Molality, for instance, measures the moles of solute per kilogram of solvent, rather than per liter of solution. This can be particularly useful when dealing with solutions where temperature changes might affect the volume, as mass (and thus molality) does not change with temperature.

Normality, another concentration unit, measures the number of gram equivalents of a solute per liter of solution. It is often used in acid-base chemistry and redox reactions where the equivalent concept takes into account the ions participating in the reaction.

Lastly, valence refers to the combining power of an element, particularly how many hydrogen ions (in acids), hydroxyl ions (in bases), or electrons (in redox reactions) one unit of the substance can replace or combine with. This concept is essential in understanding chemical bonding and reactions but is distinct from the concept of molarity.

In summary, the correct definition of molarity is the number of moles of solute per liter of solution. It is a fundamental concept in chemistry that aids in the precise formulation and understanding of solutions, crucial for both laboratory work and theoretical studies.

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