

# Canadian CSMLS

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## Question: 1

Which of the following statements about bilirubinuria is correct?

- A. Bilirubinuria may result from insufficient nutrients.
- B. Bilirubinuria is an absence of bilirubin in the urine.
- C. Bilirubinuria refers to the absence of any bile pigment in the urine.
- D. Bilirubinuria is an excess of bile pigment in the urine.

**Answer: B**

Explanation:

The correct understanding of bilirubinuria is essential for diagnosing and managing various medical conditions. Bilirubinuria refers to the presence of bilirubin in the urine and is a sign that the liver is not processing bilirubin effectively or that there is an obstruction in the bile duct system. Bilirubin, a yellow pigment, is formed mainly from the breakdown of hemoglobin in red blood cells. Normally, bilirubin is processed by the liver, where it is conjugated (made water-soluble) and excreted into the bile, which is then stored in the gallbladder or passed into the intestines to aid in digestion.

When there is a dysfunction in the liver's ability to handle bilirubin, or if there is an obstruction preventing bile from being excreted as it should be, bilirubin may instead enter the bloodstream in higher concentrations and subsequently be filtered by the kidneys into the urine, leading to bilirubinuria. This condition is commonly associated with liver diseases such as hepatitis or cirrhosis, and conditions that lead to increased destruction of red blood cells (hemolysis), or blockages in the bile ducts (such as gallstones).

It is important to note that bilirubinuria is an indicator of excess bilirubin in the urine, not an absence of it. Some incorrect statements might suggest that bilirubinuria refers to a deficiency or absence of bilirubin in the urine, but this is not the case. The presence of bilirubin in the urine gives it a darker color, typically ranging from orange to dark brown.

Additionally, bilirubinuria is not caused by insufficient nutrients. While nutritional status can affect overall liver health, the presence of bilirubin in the urine is not directly triggered by nutritional deficiencies but rather by issues related to bilirubin processing or excretion as mentioned earlier.

In summary, the correct statement about bilirubinuria is that it refers to an excess of bile pigment in the urine and is a sign of potential underlying issues with liver function or bile ducts. This condition does not result from insufficient nutrients and does not mean there is an absence of bilirubin in the urine.

Instead, it indicates elevated levels of bilirubin, necessitating further medical evaluation to determine the underlying cause and appropriate treatment.

## Question: 2

Which of the following is the formal name for the class of helminths that includes roundworms?

- A. trematodes

- B. filarial parasites
- C. nematodes
- D. cestodes

**Answer: C**

Explanation:

The correct formal name for the class of helminths that includes roundworms is "nematodes."

Nematodes are one of several groups of parasites commonly referred to as helminths, which are worm-like organisms that can cause various diseases in humans and other animals. Unlike other helminth classes such as trematodes (flukes) and cestodes (tapeworms), nematodes are characterized by their elongated, cylindrical, and often smooth bodies that taper at both ends, which is why they are commonly known as roundworms.

Nematodes can be found in a variety of environments ranging from marine, freshwater, and terrestrial ecosystems to inside the bodies of host organisms. In human hosts, nematodes can cause a range of health issues, predominantly affecting the gastrointestinal tract and the skin. Common diseases caused by nematodes include ascariasis, hookworm infections, and trichuriasis, which typically manifest with symptoms such as diarrhea, abdominal pain, and weight loss. Some nematodes also affect the skin and subcutaneous tissues, leading to conditions such as cutaneous larva migrans.

The ability of nematodes to cause such diverse and impactful diseases lies in their complex life cycles, which often involve different developmental stages and sometimes multiple hosts. The resilience and adaptability of nematodes make them a significant concern in both medical and agricultural contexts, as they not only affect human health but also crop production and livestock health.

In summary, the class Nematoda encompasses the helminths known as roundworms, which are responsible for significant health issues worldwide, particularly in regions with inadequate sanitation and in close contact with environments where these worms can thrive. Understanding nematodes is crucial for developing effective prevention and treatment strategies for the diseases they cause.

### Question: 3

The type of blood collection tube that contains sodium citrate is which of the following?

- A. green stopper
- B. blue stopper
- C. red stopper
- D. lavender stopper

**Answer: B**

Explanation:

The correct answer to the question regarding the type of blood collection tube that contains sodium citrate is the tube with a blue stopper.

Blue stopper tubes are specifically designed for blood collection in tests that require plasma or whole blood for analysis. One of the primary uses of these tubes is in coagulation studies, such as Prothrombin Time (PT) and Partial Thromboplastin Time (PTT). These tests are essential for assessing the blood's

ability to clot properly, which is crucial in diagnosing conditions like hemophilia, thrombosis, and liver disease.

Sodium citrate, the anticoagulant found in blue stopper tubes, functions by binding to the calcium ions in the blood. Calcium is a vital component of the blood clotting process; by removing it, sodium citrate effectively delays the clotting process. This preservation of the blood's liquid state allows for accurate testing and analysis in the laboratory.

It is important to note that while blue stopper tubes are prevalent for coagulation tests, other color-coded tubes are used for different purposes in medical diagnostics. For example, red stopper tubes typically contain no additive or a clot activator for serum tests, lavender stopper tubes contain EDTA for hematology studies, and green stopper tubes contain heparin used in chemistry tests involving plasma. In summary, when collecting blood for coagulation studies or any test that requires whole blood or plasma and delayed coagulation, blue stopper tubes containing sodium citrate are the appropriate choice. Their specific use ensures that the blood remains unclotted and suitable for the intended laboratory analyses.

### Question: 4

The body component in which an analyte is to be measured is which of the following?

- A. medium
- B. template
- C. matrix
- D. pattern

**Answer: C**

Explanation:

The correct answer to the question is "matrix." The term "matrix" in a biomedical or clinical context refers to the body component or substance within which an analyte is measured. An analyte is a substance or chemical constituent that is analyzed or measured, typically using laboratory methods. The matrix provides the environment from which the analyte is tested and can influence the outcome and accuracy of the test results.

Examples of matrices include blood, urine, saliva, cerebrospinal fluid, and tissue samples. Each of these matrices can have different properties and compositions, which can affect how the analyte is measured and interpreted. For instance, blood can be further divided into different matrices such as plasma or serum, depending on whether the blood cells have been removed. Similarly, urine can be analyzed as a whole sample, or specific components can be isolated for more detailed study.

Choosing the appropriate matrix is crucial for accurate measurement of an analyte. Factors such as the concentration of the analyte in the matrix, the presence of interfering substances, and the matrix's own biological characteristics can impact the analytical results. For example, the presence of certain proteins in blood can affect the measurement of hormones or drugs, requiring specific adjustments or techniques to obtain accurate readings.

In summary, the matrix is a fundamental concept in the field of diagnostics and clinical biochemistry, serving as the medium in which various analytes are measured. Understanding the nature and properties of different matrices helps in selecting the right methods and tools for accurate and reliable measurement of substances of interest in medical and research settings.

## Question: 5

All of the following are true in regard to IgG antibodies except:

- A. They cannot cross the placenta.
- B. They are an immunoglobulin unit.
- C. They cannot visibly agglutinate RBCs.
- D. They can activate complement.

**Answer: A**

Explanation:

The statement "They cannot cross the placenta" is incorrect regarding IgG antibodies. IgG is the only class of immunoglobulins that can cross the placenta from the mother to the fetus. This transfer provides the newborn with passive immunity against pathogens by providing antibodies that the mother has already made, thus offering immediate protection to the infant for the first few months of life until the baby's own immune system can start producing its antibodies. This is a crucial mechanism as it provides the infant with a defense against infections in the early stages of life.

"They are an immunoglobulin unit" is a true statement. IgG antibodies are indeed a type of immunoglobulin, which is a term used to describe antibodies generally. Immunoglobulins are glycoprotein molecules produced by plasma cells (a type of white blood cell) and are an essential part of the immune response. IgG represents one of the most common and abundant forms of antibodies in the body, vital for fighting bacterial and viral infections.

"They cannot visibly agglutinate RBCs" is a true statement concerning IgG antibodies. Unlike IgM antibodies, which are large enough to bridge antigens on different cells and thus cause agglutination, IgG antibodies are generally too small to cause visible agglutination of red blood cells (RBCs). Agglutination refers to the clumping of particles and is a process commonly used in blood typing and in some diagnostic test methodologies. IgG can, however, opsonize pathogens, marking them for destruction by other cells of the immune system.

"They can activate complement" is another true statement about IgG antibodies. The complement system is a part of the immune system that enhances 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. IgG antibodies can initiate the classical pathway of the complement system, which ultimately leads to the destruction of the pathogen. This activation is an essential mechanism through which IgG contributes to the immune defense by facilitating the clearance and destruction of antigens. In summary, the assertion that IgG antibodies cannot cross the placenta is the only incorrect statement among the options provided. Understanding these aspects of IgG's function and characteristics is crucial in comprehending both the adaptive immune response and the integral role these antibodies play in maternal-fetal immunity and overall pathogen defense mechanisms.

## Question: 6

This photo depicts which of the following spirochetes?



- A. *Leptospira interrogans*
- B. *Treponema pallidum*
- C. *Borrelia recurrentis*
- D. *Borrelia burgdorferi*

**Answer: B**

Explanation:

To correctly identify the spirochete depicted in a photo, it's essential to understand the distinctive morphological characteristics of the major spirochetes, which include *Leptospira interrogans*, *Treponema pallidum*, *Borrelia recurrentis*, and *Borrelia burgdorferi*. Each has unique features that help differentiate them.

Understanding *Treponema pallidum*, which causes venereal syphilis, is crucial. This bacterium is typically diagnosed using serological tests such as the Venereal Disease Research Laboratory (VDRL) test, the Rapid Plasma Reagin (RPR) test, and by direct visualization using dark-field microscopy. Morphologically, *Treponema pallidum* is known for its slender structure with tight, fine coils. This appearance helps distinguish it from other spirochetes.

*Leptospira interrogans*, another spirochete, is known for causing leptospirosis. It is visually different from *Treponema pallidum* as it typically features a distinctive hook or question mark shape at its ends. This hooked appearance is a key identifier in microscopic images or cultures.

*Borrelia* species include *Borrelia recurrentis*, which causes relapsing fever, and *Borrelia burgdorferi*, which is responsible for Lyme disease. These spirochetes are generally thicker compared to *Treponema* and have fewer and more irregular coils. Their larger size and distinctive coiling pattern can often be seen under a microscope, making them distinguishable from the more tightly coiled *Treponema*.

In the context of identifying the spirochete from a photograph, noting the specific physical characteristics such as the thickness of the bacterium, the tightness and regularity of the coils, and any unique shapes like hooks are crucial. A photo showing a slender, tightly coiled bacterium would suggest it is *Treponema pallidum*. In contrast, a photo displaying a thicker bacterium with fewer and irregular coils might indicate one of the *Borrelia* species. Similarly, a spirochete with hooked ends in the image likely points to *Leptospira interrogans*.

Therefore, when faced with a photo and options like the ones listed, the observer should look for these key morphological features. This approach will facilitate accurate identification of the spirochete, whether it be *Treponema pallidum*, *Leptospira interrogans*, or a *Borrelia* species, based on the visual cues described.

## Question: 7

Mature platelets are comprised of four major areas. Which of the following is NOT one of these areas?

- A. peripheral zone
- B. sol-gel zone

- C. membrane area
- D. organelle zone

**Answer: C**

Explanation:

Mature platelets, which are critical components in the blood clotting process, are structured into several distinct zones or areas that facilitate their function. These areas include the peripheral zone, sol-gel zone, organelle zone, and the membranous zone, which is often referred to as the submembrane area. Each zone has a specific role in the function and structural integrity of the platelet. **\*Peripheral Zone:\*** This outermost layer of the platelet plays a crucial role in interactions with other cells, particularly during the formation of a blood clot. It contains glycoproteins that are essential for platelet adhesion to the blood vessel wall and for the aggregation of platelets. **\*Sol-Gel Zone:\*** Located just beneath the peripheral zone, the sol-gel zone consists largely of microtubules and microfilaments. This area is responsible for maintaining the platelet's shape and enables the contraction movements necessary during the clotting process. **\*Organelle Zone:\*** This central part of the platelet houses various organelles such as mitochondria, lysosomes, and granules containing clotting factors and other molecules important for platelet function. This zone is essential for storing and releasing chemicals that promote clot formation and wound healing. **\*Membranous Zone (Submembrane Area):\*** Directly beneath the cell membrane, this zone links the surface structures with the internal components of the platelet. It plays a pivotal role in signal transduction and the mechanical stability of the platelet. The term "membrane area," if interpreted as a distinct major zone, does not align with the standard categorization of platelet structure. The correct term used is the "membranous zone" or "submembrane area," which refers to the part of the platelet just beneath the plasma membrane involved in linking the membrane to the platelet's internal structure. Thus, "membrane area" as a separate major zone is not accurate, and is the correct answer to the question about which of the options is NOT one of the four major areas of a mature platelet.

### Question: 8

Which of the following tumor markers is useful in identifying ovarian cancer in post menopausal women?

- A. CA 19-9
- B. CA 125
- C. carcinoembryonic antigen (CEA)
- D.  $\alpha$ -Fetoprotein (AFP)

**Answer: B**

Explanation:

Correct Answer: CA 125

CA 19-9 is a tumor marker primarily used to evaluate pancreatic cancer. It is not specific for ovarian cancer, although it may be elevated in some gastrointestinal cancers. Therefore, it is not typically the best marker for identifying ovarian cancer in postmenopausal women.

CA 125, on the other hand, is a protein that is elevated in the blood of many women with ovarian cancer. It is particularly useful in diagnosing ovarian cancer in postmenopausal women, where the occurrence of this type of cancer is higher. Studies have shown that CA 125 levels are elevated in about 80% of women with advanced ovarian cancers and in about 50% of those with early-stage ovarian cancer. CA 125 is also utilized to monitor treatment effectiveness and check for recurrence of the disease after treatment. However, it is important to note that elevated levels of CA 125 can also occur in benign conditions such as endometriosis, menstruation, pregnancy, and pelvic inflammatory disease, as well as in other types of cancers.

Carcinoembryonic antigen (CEA) is another tumor marker that is more commonly associated with cancers of the gastrointestinal tract, particularly colorectal cancer. While it can be elevated in a variety of cancers, including some ovarian cancers, it is not as specific or sensitive as CA 125 for ovarian cancer, particularly in postmenopausal women.

$\alpha$ -Fetoprotein (AFP) is a tumor marker often used to diagnose and monitor treatment in cases of liver cancer, germ cell tumors, and other types of malignancies. Elevated AFP levels are not typically associated with ovarian cancer, making it less useful for this purpose compared to CA 125.

In conclusion, among the tumor markers listed, CA 125 is the most useful for identifying ovarian cancer in postmenopausal women. Its ability to be elevated in a significant percentage of ovarian cancer cases and its utility in monitoring treatment and recurrence make it a valuable tool in the management of ovarian cancer. However, it is essential to use CA 125 in conjunction with other diagnostic methods and clinical evaluations to ensure accurate diagnosis and effective treatment planning.

## Question: 9

The normal range of MCH (mean corpuscular hemoglobin) is which of the following?

- A. 26 – 34 pg
- B. 15 – 25 pg
- C. 20 – 25 pg
- D. 12 – 20 pg

**Answer: A**

Explanation:

The normal range of Mean Corpuscular Hemoglobin (MCH) is 26 – 34 picograms (pg). MCH is a calculated value derived from the measurement of hemoglobin and the count of red blood cells (RBCs) in a blood sample. It represents the average amount of hemoglobin present in a single red blood cell. Hemoglobin is a protein found in red blood cells that is responsible for transporting oxygen from the lungs to the rest of the body and returning carbon dioxide from the body's tissues back to the lungs. The MCH value is crucial because it helps in diagnosing different types of anemia. Anemia is a condition characterized by an insufficient number of red blood cells or a deficiency in their function, which often results from having too little hemoglobin.

When the MCH value is within the normal range (26 – 34 pg), it suggests that the hemoglobin content in each red blood cell is within the expected limits, implying average oxygen-carrying capacity and normal red blood cell function. If the MCH value is lower than 26 pg, it might indicate hypochromic anemia, where red blood cells do not have enough hemoglobin. Conversely, if the MCH value exceeds 34 pg, it may suggest macrocytic anemia, where the red blood cells are larger than normal, typically due to vitamin deficiencies such as B12 or folate deficiency.



It's important to note that MCH values should be interpreted in conjunction with other blood indices such as Mean Corpuscular Volume (MCV) and Mean Corpuscular Hemoglobin Concentration (MCHC) for an accurate diagnosis. By considering all these indices, healthcare providers can better determine the type of anemia or other underlying health issues and decide on the appropriate treatment or further diagnostic testing.

## Question: 10

If a blood donor has had a malarial infection, his or her blood donation must be deferred for how long?

- A. 72 hours
- B. 12 months
- C. permanently
- D. 3 years

**Answer: D**

Explanation:

When a person has been diagnosed with malaria, it is crucial to ensure that their blood is completely free from the malaria parasites before they can safely donate blood. Malaria is caused by Plasmodium parasites that are transmitted to people through the bites of infected female Anopheles mosquitoes. Once in the human body, these parasites multiply in the liver and then infect red blood cells, which can lead to severe health problems and, if untreated, can be fatal.

The reason for the deferral period of three years after treatment for malaria before a person can donate blood is to ensure the safety of the blood supply. This deferral period takes into account the lifecycle of the malaria parasites and the possibility of relapses, which can occur particularly with Plasmodium vivax and Plasmodium ovale infections. These species can remain dormant in the liver and cause relapses several months or even years after the initial infection.

During the three-year deferral period, the individual must also remain free of any symptoms of malaria, which includes fevers, chills, sweats, headaches, body aches, nausea, and vomiting. The absence of symptoms suggests that there are no active parasites in the blood that could be transmitted to a recipient through a blood transfusion.

Blood transfusions are a critical component of healthcare, and the safety of blood products is paramount. Malaria can be transmitted through blood transfusion, and thus, stringent guidelines are necessary to prevent this. The three-year deferral period helps to minimize the risk of transmitting malaria to recipients, who may be particularly vulnerable to infections.

In summary, the deferral period of three years for blood donors who have had malaria is based on the biology of the malaria parasites and the need to ensure that donated blood is safe for transfusion. This policy protects recipients of blood transfusions from the risk of contracting malaria, a disease that has significant health consequences.

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