

Medical Laboratory CAML

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Question: 1

Which of the following amoebae is the only pathogenic amoeba that causes several mild to serious disorders?

- A. acanthamoeba species
- B. entamoeba coli
- C. entamoeba histolytica
- D. naegleria fowleri

Answer:

Explanation:

The correct answer to the question about which amoeba is the only pathogenic amoeba that causes several mild to serious disorders is *Entamoeba histolytica*. This protozoan parasite is known primarily for causing amoebiasis, which includes amoebic dysentery and amoebic colitis. These conditions can range from mild abdominal discomfort and diarrhea to severe, life-threatening dysentery characterized by bloody stools.

While *Entamoeba histolytica* is indeed pathogenic and capable of causing significant health issues, it is important to distinguish it from other amoebae mentioned, which although pathogenic, have different pathologies and are not known for causing a range of disorders from mild to severe as is the case with *Entamoeba histolytica*. For instance, *Entamoeba coli*, commonly confused with *Entamoeba histolytica* due to the similarity in their names, is generally nonpathogenic and primarily exists as a commensal organism in the human intestine. However, in immunocompromised individuals, it might cause mild intestinal disturbances.

Acanthamoeba species, another type of amoeba mentioned, does not cause a range of gastrointestinal disorders like *Entamoeba histolytica*. Instead, it is notorious for causing severe conditions such as amoebic encephalitis and amoebic keratitis, primarily affecting the brain and eyes respectively, rather than the digestive system.

Lastly, *Naegleria fowleri*, often called the "brain-eating amoeba," causes primary amoebic meningoencephalitis (PAM), a very rapid and almost always fatal brain infection. This amoeba infects individuals when water containing the amoeba enters the body through the nose, typically during swimming in freshwater bodies. Unlike *Entamoeba histolytica*, *Naegleria fowleri* does not cause a spectrum of mild to serious disorders but rather a specific and acutely lethal condition.

In summary, while several amoebae can cause health issues in humans, *Entamoeba histolytica* is unique in its ability to cause a broad range of disorders from mild gastrointestinal disturbances to severe dysentery, making it the correct answer to the question regarding the only pathogenic amoeba that causes several mild to serious disorders.

Question: 2

Which of the following statements in regard to vitamin K is not correct?

- A. Vitamin K is produced by normal intestinal flora.
- B. Use of oral antibiotics can result in a vitamin K deficiency.
- C. A deficiency in vitamin K can result from vitamin K antagonists (coumarin).
- D. Breast-fed babies are less prone to vitamin K deficiency because breast milk is sterile.

Answer: D

Explanation:

The statement "Breast-fed babies are less prone to vitamin K deficiency because breast milk is sterile" is not correct. This assertion is flawed mainly because the sterility of breast milk does not confer any advantage in terms of vitamin K synthesis. Vitamin K is crucial for the synthesis of proteins involved in blood coagulation, and deficiency can lead to bleeding disorders, especially in newborns.

Vitamin K is not typically abundant in breast milk, and its low levels are compounded by the fact that the newborn's gut, which in adults helps in synthesizing additional vitamin K via bacterial fermentation, is initially sterile. Therefore, breastfeeding, though numerous in other health benefits, does not provide sufficient vitamin K to prevent deficiency unless supplemented, especially during the first days of life. Furthermore, the assertion that breast milk's sterility prevents bacterial colonization is misleading. While it is true that breast milk is generally very clean, it is not sterile and contains a variety of beneficial bacteria from the mother. These bacteria, however, do not contribute significantly to vitamin K synthesis. In contrast, the baby's intestine needs to be colonized with specific bacteria that can produce vitamin K, and this colonization is influenced by multiple factors, including the mode of delivery and the infant's diet.

It's also important to note that factors other than diet can affect vitamin K levels. For example, the use of oral antibiotics can disrupt the gut flora responsible for vitamin K production, leading to a deficiency. Additionally, certain medications like vitamin K antagonists, used primarily for treating or preventing blood clots, can also cause a deficiency in vitamin K.

Given these factors, it is clear why the statement about breast milk's sterility and its relation to lower risk of vitamin K deficiency in breast-fed babies is incorrect. Proper supplementation strategies during the early postnatal period are critical to prevent the complications arising from vitamin K deficiency.

Question: 3

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: 4

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: 5

When will rosette/clumps be formed in mothers?

- A. When Rh negative cells are present in the blood circulation of a Rh positive person.
- B. When Rh positive cells are present in the blood circulation of a Rh negative person.
- C. When Rh negative cells are present in the blood circulation of a Rh negative person.
- D. They do not form in mothers.

Answer: B

Explanation:

The formation of rosette or clumps in mothers occurs in a specific immunological context involving the Rh blood group system. This system is crucial in transfusion medicine and maternal-fetal medicine due to its potential to cause hemolytic reactions when there is an incompatibility between the Rh status of the blood donor and recipient, or between a mother and her fetus.

In particular, rosette formation is observed when Rh-negative mothers are exposed to Rh-positive fetal red blood cells. This situation can arise during pregnancy or at childbirth. The human blood group system includes the Rh factor, where the presence of a specific antigen (D antigen) determines if the blood is Rh-positive. If this antigen is absent, the blood is Rh-negative.

During pregnancy and delivery, fetal red blood cells can sometimes enter the maternal circulation. If an Rh-negative mother carries an Rh-positive baby, she may be exposed to Rh-positive cells. Her immune system, not recognizing the Rh-positive cells, may produce antibodies against these cells, considering them as foreign. This immune response is the basis for the formation of rosettes or clumps—aggregates of cells formed when antibodies link Rh-positive cells together.

The Rosette test, a diagnostic procedure, is employed to detect these Rh-positive cells in the blood of Rh-negative mothers. This test is particularly useful postpartum, to determine if an Rh-negative mother has been sensitized to Rh-positive cells during the birth of an Rh-positive baby. The presence of rosette formation in this test indicates that the mother has indeed been exposed to Rh-positive cells and that her immune system has started to react by producing antibodies.

The clinical significance of detecting rosette formation lies in preventing Rh sensitization in subsequent pregnancies. If a sensitized Rh-negative mother becomes pregnant with another Rh-positive baby, her pre-formed antibodies can cross the placenta and destroy the baby's red blood cells, leading to hemolytic disease of the newborn. Thus, understanding and detecting rosette formation is crucial in managing Rh incompatibility and preventing its potentially severe consequences.

Question: 6

The threshold at which a value is statistically unlikely is which of the following?

- A. control chart
- B. random error
- C. constant threshold
- D. control limit

Answer: D

Explanation:

In the context of quality control, the term "control limit" refers to the statistically derived boundaries within which a process metric is expected to operate under normal conditions. These limits serve as critical markers to identify when a process is potentially going out of control, meaning the process is producing output that deviates from the established norm in a statistically significant way.

Control limits are calculated based on historical data and are used to set the upper and lower bounds for acceptable values. They are not arbitrary but are instead derived from the natural variability of the process being monitored. Typically, these limits are set at three standard deviations (commonly referred to as 3 sigma) from the process mean in both directions. This statistical threshold signifies that any data point falling outside of these limits is statistically unlikely, occurring due to an unusual event or condition rather than random variation.

It is important to distinguish control limits from specification limits. While control limits are concerned with the variability inherent to the process, specification limits are derived from customer requirements or industry standards and define what is acceptable for the end product. Control limits are internal to the process monitoring system and help in detecting process behavior, whereas specification limits relate to the final output's acceptability.

When a data point exceeds a control limit, it triggers an investigation to determine the cause and to correct the process if necessary. This is a proactive measure to prevent the production of nonconforming products and to ensure that the process continues to operate in a stable and predictable manner. Thus, control limits are essential tools in the practice of statistical process control (SPC), a methodology within quality control that uses statistical methods to monitor and control processes.

Question: 7

Tetrose has how many carbon atoms?

- A. 4.
- B. 5.
- C. 6.
- D. 7.

Answer: A

Explanation:

4. Tetrose, being a type of monosaccharide, falls under the broad category of carbohydrates, which are essential organic compounds prevalent in a variety of living organisms. Carbohydrates serve as a key source of energy and structural components within cells. Monosaccharides, the simplest form of carbohydrates, consist of single sugar molecules. The name "tetrose" derives from the Greek prefix "tetr-" meaning four, indicating that tetrose molecules contain four carbon atoms. This structural characteristic categorizes tetrose among other monosaccharides based on the number of carbon atoms present, making it distinct from trioses (three carbons), pentoses (five carbons), and hexoses (six carbons). Understanding the carbon count in these molecules is crucial as it affects their chemical properties and their role in biological processes.

Question: 8

Which of the following is considered a normal Hgb count for an adult female?

- A. 12-15 g/dL.
- B. 5-10 g/dL.
- C. 13-18 g/dL.
- D. 4-6 million/mm³ of blood.

Answer: A

Explanation:

The correct answer to the question regarding the normal hemoglobin (Hgb) count for an adult female is 12-15 grams per deciliter (g/dL). Hemoglobin is a crucial protein found in red blood cells, responsible for transporting oxygen from the lungs to various tissues throughout the body, and it also assists in carrying carbon dioxide back to the lungs for exhalation.

Hemoglobin levels are commonly measured through a Complete Blood Count (CBC) test, which is a standard blood test often conducted during physical exams or to diagnose various health conditions. The hemoglobin levels are an integral part of this test because they can indicate the oxygen-carrying capacity of the blood, which is vital for maintaining bodily functions.

In adults, normal hemoglobin levels vary by sex and possibly by age. For adult males, a typical hemoglobin range is from 13 to 18 g/dL. For adult females, the normal range is slightly lower, from 12 to 15 g/dL. This difference is primarily due to physiological variations between sexes, including factors such as hormonal differences and the impact of menstruation in females.

It's important to maintain hemoglobin within the normal range. Levels below the normal range could indicate conditions such as anemia, which can lead to fatigue and other health problems because the

body's tissues are receiving less oxygen than they require. Conversely, excessively high hemoglobin levels might suggest dehydration or other medical conditions, such as polycythemia vera, which can lead to increased blood viscosity and complications such as clotting.

Therefore, knowing the normal range of hemoglobin for specific groups, like adult females, helps in early detection and management of potential health issues. Regular monitoring, especially in people with known risks or underlying conditions, is crucial for maintaining optimal health.

Question: 9

The most routinely used method of preservation of urine specimens is which of the following?

- A. chemical preservatives
- B. refrigeration at 2 to 8 degrees C
- C. refrigeration at 2 to 8 degrees F
- D. none of the above

Answer: B

Explanation:

The most routinely used method for preserving urine specimens is refrigeration at temperatures between 2 to 8 degrees Celsius. This temperature range is ideal because it slows down the metabolic processes of any bacteria that might be present in the urine, thereby preventing the alteration of the urine's chemical composition. Alterations could potentially affect the results of urine tests, leading to inaccurate diagnoses.

Refrigeration helps in preserving the physical and chemical integrity of the urine sample. It inhibits the growth of microorganisms and prevents the breakdown of substances like urobilinogen and bilirubin, which are commonly tested in urine analyses. It also slows down the conversion of nitrites to nitrates, which is an important factor in urine tests for infections.

When refrigeration is not available, especially during long-distance transportation of urine specimens, chemical preservatives may be added. These preservatives can include formaldehyde, boric acid, or sodium fluoride, among others. They serve to prevent bacterial growth and preserve the sample's original state, but they can also interfere with certain chemical tests and are generally considered a less preferred option compared to refrigeration.

In conclusion, while chemical preservatives are an alternative, refrigeration at 2 to 8 degrees Celsius remains the most preferred and routinely used method for the preservation of urine specimens due to its effectiveness in maintaining the sample's integrity without introducing potential complications in subsequent laboratory analyses.

Question: 10

Blood donors are carefully screened. If a potential donor has taken aspirin or aspirin-containing drugs he or she will be deferred for how long?

- A. 12 months
- B. 1 month
- C. 72 hours

D. No need to defer

Answer: D

Explanation:

Blood donors are subject to a screening process to ensure the safety and quality of the blood supply. This screening includes questions about recent medication intake, as some medications can affect the usability of the donated blood, particularly for platelet donations. Aspirin is one such medication that can influence blood donation but in specific ways.

Aspirin, known for its blood-thinning properties, can cause a prolonged bleeding time, which is generally harmless to the donor but can impact the quality of platelets in the blood. Platelets are critical components used in clotting and wound healing. Therefore, if a donor has taken aspirin or any aspirin-containing medication, they must wait for a specific period before they can donate platelets.

The deferral period for platelet donations after taking aspirin is not uniform across all regions. Generally, the required waiting period is 48 hours after the last dose of aspirin before a donor can donate platelets. However, in New York State, the waiting period is extended to 72 hours. This waiting period ensures that the effects of aspirin have worn off and the platelets function normally.

It is important to note that this deferral only applies to platelet donations by apheresis and not to whole blood donations. For donating whole blood, there is no need to defer after taking aspirin. This differentiation is crucial because while platelets are directly affected by aspirin, the other components of whole blood are not significantly impacted in a way that would contraindicate donation immediately after aspirin intake.

In summary, while there is no need to defer whole blood donations after taking aspirin, potential donors must wait for 2 days (or 3 days in New York State) after consuming aspirin or aspirin-containing drugs before they can donate platelets by apheresis. This protocol helps maintain the safety and effectiveness of the blood products, particularly platelets, which are vital for patients needing clotting assistance.

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