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Question: 1

Which laboratory test would reflect blood glucose levels for a prolonged period of time before sampling?

- A. hemoglobin A1C
- B. glucose tolerance test
- C. random glucose test
- D. fasting glucose test

Answer: A

Explanation:

The correct answer to the question of which laboratory test reflects blood glucose levels over a prolonged period is the Hemoglobin A1C test. This test is also known as the HbA1c, glycated hemoglobin test, or glycohemoglobin.

Hemoglobin A1C is a specific component of the hemoglobin in your red blood cells that binds to glucose. As red blood cells live for approximately 120 days, the HbA1c test measures the average amount of glucose attached to hemoglobin over the past two to three months. This provides a more comprehensive view of a person's average blood sugar levels over time, unlike other glucose tests that only provide a snapshot of the glucose level at the time of the test.

The measurement of HbA1c is typically done through methods such as high-performance liquid chromatography (HPLC) or immunoassay. These methods are highly accurate and effective in identifying the percentage of glycated hemoglobin in the blood. The results of an HbA1c test are presented as a percentage. For instance, an HbA1c level of 6.5% or higher on two separate tests typically indicates diabetes.

In contrast to the HbA1c test, other tests like the fasting glucose test, random glucose test, and glucose tolerance test measure blood sugar levels at a specific point in time. The fasting glucose test requires fasting overnight and measures the glucose level in the blood at the time of the test. The random glucose test measures blood sugar without regard to when you last ate. The glucose tolerance test involves measuring blood sugar levels over several hours after consuming a high-glucose drink.

Due to its ability to provide a long-term overview of blood sugar levels, the HbA1c test is particularly useful for diagnosing and monitoring diabetes and prediabetes. It helps in assessing how well diabetes is being managed by providing an average blood glucose level. This is crucial for planning treatment strategies and adjustments in medications or lifestyle changes to better control blood sugar levels.

Question: 2

Which of the following autoimmune theories can be described as when suppressor T-lymphocytes control the antibodies produced by B-cells?

- A. sequestered antigen theory

- B. immunologic deficiency theory
- C. forbidden-clone theory
- D. clonal anergy

Answer: B

Explanation:

The correct theory that describes the scenario where suppressor T-lymphocytes control the antibodies produced by B-cells is the ****immunologic deficiency theory****.

To expand on this, the immunologic deficiency theory posits that autoimmune diseases may arise from a deficiency or functional impairment in the regulatory mechanisms of the immune system, particularly involving T-suppressor (or regulatory T) cells. These T-suppressor cells normally function to regulate or suppress other cells in the immune system to prevent excessive and inappropriate responses.

In a healthy immune system, T-suppressor cells closely monitor and control the activity of antibody-producing B-cells to ensure that they do not produce antibodies against the body's own tissues (self-antigens). They essentially help maintain self-tolerance by inhibiting harmful autoimmune reactions.

However, if there's a failure or deficiency in the suppressor T-cells, this critical control is lost.

When these suppressor T-cells are decreased in number or function, B-cells may become unchecked and begin to produce antibodies that mistakenly target and attack the body's own cells, leading to autoimmune disease. This can result in a variety of autoimmune disorders, depending on which tissues are targeted by these autoantibodies.

The immunologic deficiency theory highlights the importance of balance within the immune system and suggests that disturbances in this balance can lead to significant health issues. Research into this area continues to explore ways to enhance or restore the function of T-suppressor cells in order to treat and possibly prevent autoimmune diseases.

Question: 3

Which of the following is an acquired coagulation disorder?

- A. vitamin K deficiency
- B. Fletcher factor
- C. hemophilia C
- D. Hageman factor

Answer: A

Explanation:

Vitamin K deficiency is recognized as an acquired coagulation disorder, primarily because it can develop due to various external factors rather than being inherited genetically. Vitamin K is crucial for the synthesis of several proteins required for blood clotting, including factors II (prothrombin), VII, IX, and X. When the body lacks sufficient vitamin K, these clotting factors cannot be produced normally, leading to impaired blood clotting ability and an increased risk of bleeding.

This deficiency might arise from several conditions or situations. For example, it can be due to inadequate dietary intake, where the person does not consume enough vitamin K-rich foods such as green leafy vegetables and certain vegetable oils. It can also result from malabsorption disorders where

the body fails to absorb vitamin K from the intestine, as seen in diseases like celiac disease or cystic fibrosis, or due to the use of broad-spectrum antibiotics that kill the gut flora responsible for synthesizing vitamin K.

In contrast, the other mentioned disorders—Fletcher factor deficiency, hemophilia C, and Hageman factor deficiency—are inherited. The Fletcher factor, or prekallikrein, is a protein involved in the intrinsic pathway of the coagulation cascade and its deficiency leads to prolonged clotting times in certain tests, though it generally does not cause severe bleeding problems. Hemophilia C, caused by a deficiency in factor XI, and deficiencies involving the Hageman factor, or factor XII, are both genetic disorders impacting the coagulation pathway, typically passed down through families.

Thus, while Fletcher factor, hemophilia C, and Hageman factor deficiencies are rooted in genetic anomalies affecting the production or function of specific coagulation factors, vitamin K deficiency is distinctly acquired through dietary, gastrointestinal, or medication-induced causes. This difference categorizes vitamin K deficiency uniquely as an acquired disorder in coagulation contexts.

Question: 4

The public law that was enacted to provide all employees (clinical laboratory personnel included) with a safe work environment is which of the following?

- A. Toxic Substances Control Act
- B. Clinical Laboratory Standards Act
- C. HIPAA
- D. OSHA

Answer: D

Explanation:

The correct answer to the question regarding the public law enacted to ensure a safe work environment for all employees, including clinical laboratory personnel, is the Occupational Safety and Health Act (OSHA).

OSHA was established in 1970 with the primary goal of ensuring safe and healthful working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education, and assistance. The act covers most private sector employers and their workers, as well as some public sector employers and workers in the United States.

Under OSHA, employers are responsible for providing a safe and healthful workplace that does not have serious hazards and must follow all relevant OSHA safety and health standards. Employers must find and correct safety and health problems. OSHA further reinforces these requirements by providing essential education to employers and employees, such as guidelines on hazard recognition and safety standards compliance.

OSHA is also empowered to conduct workplace inspections and investigations to ascertain compliance with the law and to identify hazards that could lead to injury or illnesses. During these inspections, OSHA has the authority to issue monetary penalties for noncompliance, and in severe cases, can shut down operations until violations are corrected.

It's important to note that other options listed, such as the Toxic Substances Control Act, Clinical Laboratory Standards Act, and HIPAA (Health Insurance Portability and Accountability Act), serve different purposes. The Toxic Substances Control Act regulates the introduction of new or already existing chemicals. The Clinical Laboratory Standards Act (often confused with CLIA - Clinical Laboratory

Improvement Amendments) pertains to laboratory testing standards. HIPAA primarily deals with the protection of patient health information and not specifically workplace safety.

Thus, OSHA remains the critical and correct answer as it is specifically designed to ensure a safe and healthy working environment for all employees, including those in clinical laboratories.

Question: 5

Which of the following blood types is the H antigen with D-galactose attached?

- A. blood type
- B. A blood type
- C. B blood type
- D. all of the above

Answer: C

Explanation:

The correct answer to the question is the B blood type. This is because the B blood type specifically involves the H antigen with a D-galactose sugar molecule attached.

To understand why this is the case, it's important to delve into the basic biochemistry of blood group antigens. Blood types are determined by specific antigens present on the surface of red blood cells. These antigens are essentially different carbohydrates (sugars) attached to a lipid or protein molecule on the red blood cell's surface. The H antigen, which is the foundational antigen for the ABO blood group system, consists of a carbohydrate chain.

In individuals with the O blood type, the H antigen remains unmodified, meaning no additional sugar is added. This is why the O blood type is sometimes referred to as having no antigens, though more accurately, it has the unmodified H antigen.

For individuals with the A blood type, an enzyme specific to this type adds an N-acetylgalactosamine sugar to the H antigen. Contrastingly, in the B blood type, a different enzyme adds a D-galactose sugar to the H antigen. Thus, the specific sugar attached to the H antigen in the B blood type is D-galactose.

Understanding these biochemical distinctions is crucial for medical applications such as blood transfusions and organ transplants, where matching blood types between donor and recipient is necessary to prevent adverse immune reactions. It's also foundational knowledge in the study of genetics and heredity, as the enzymes that modify the H antigen are encoded by specific alleles at a single gene locus.

Question: 6

Which of the following is most likely to be a cause of hyperkalemia in neonates and infants?

- A. inappropriate ADH secretion
- B. alkalosis
- C. fluid deprivation/dehydration causing tissue leakage
- D. renal tubular acidosis secondary to bicarbonate loss

Answer: C

Explanation:

Hyperkalemia, which is characterized by an elevated level of potassium in the blood, can be a serious condition in neonates and infants, as their bodies are more vulnerable to shifts in electrolyte balances. Understanding the causes of hyperkalemia is crucial for effective management and treatment. Among the options provided, the most likely cause of hyperkalemia in neonates and infants is "fluid deprivation/dehydration causing tissue leakage."

When there is fluid deprivation or dehydration, the body experiences a decrease in circulating blood volume. This condition prompts several physiological responses aimed at conserving fluid, but it also has secondary effects on cellular function. In the state of dehydration, decreased perfusion (blood flow) to tissues can lead to cellular damage and death. When cells are damaged, they release their intracellular contents, including potassium, into the extracellular fluid. Since potassium is predominantly an intracellular ion, any process that disrupts cell integrity can lead to an increase in serum potassium levels.

The increase in extracellular potassium (hyperkalemia) can have significant effects on the body, particularly on the heart, where it can alter normal electrical conduction, leading to arrhythmias, which can be life-threatening in severe cases. In neonates and infants, whose regulatory mechanisms are not as well-developed as in older children and adults, these changes can be particularly impactful.

The other options listed — inappropriate ADH secretion, alkalosis, and renal tubular acidosis secondary to bicarbonate loss — are typically associated with disturbances leading to hypokalemia (low potassium levels) rather than hyperkalemia. Inappropriate ADH secretion can lead to fluid overload, diluting serum potassium. Alkalosis generally causes potassium to shift from the extracellular fluid into cells, reducing serum potassium levels. Renal tubular acidosis, depending on the type, often involves a defect in acid handling that also leads to hypokalemia, primarily through renal losses or shifts of potassium into cells. Therefore, among the given choices, fluid deprivation/dehydration causing tissue leakage stands out as the most plausible cause of hyperkalemia in neonates and infants. It is essential for healthcare providers to quickly identify and manage such electrolyte imbalances to prevent complications and ensure the safety and well-being of the pediatric patients.

Question: 7

The oxygen-transporting protein contained within erythrocytes is called:

- A. T-cells
- B. hemoglobin
- C. bilirubin
- D. albumin

Answer: B

Explanation:

The correct answer to the question, "The oxygen-transporting protein contained within erythrocytes is called," is hemoglobin. Hemoglobin is a crucial protein found in red blood cells (erythrocytes) that is responsible for transporting oxygen from the lungs to the tissues of the body, and returning carbon dioxide from the tissues back to the lungs. This function is vital for maintaining the metabolic processes necessary for life.

The structure of hemoglobin is complex and includes four polypeptide chains, each containing a heme group. The heme groups are essential for the protein's function because they contain iron ions which can bind to oxygen molecules. The ability of hemoglobin to transport oxygen is due to the reversible binding of oxygen to these iron ions within the heme groups. When hemoglobin reaches oxygen-rich areas like the lungs, it binds to oxygen, forming oxyhemoglobin. When it reaches oxygen-poor areas like peripheral tissues, it releases the oxygen, becoming deoxyhemoglobin.

The color of erythrocytes is due to the presence of hemoglobin. When hemoglobin binds to oxygen, it changes its structure slightly, which affects its interaction with light, imparting a bright red color to oxygenated blood. Conversely, deoxygenated blood is darker due to the absence of bound oxygen.

Hemoglobin types can vary based on the amino acid sequences in their polypeptide chains. These variations can affect oxygen binding and are genetically determined. Some common variants of hemoglobin include hemoglobin A, the most prevalent form in adults, and hemoglobin F, found in fetuses and newborns, which has a higher affinity for oxygen than adult hemoglobin.

It's important to distinguish hemoglobin from other proteins mentioned, such as T-cells, bilirubin, and albumin. T-cells are a type of white blood cell involved in the immune response, not oxygen transport. Bilirubin is a breakdown product of hemoglobin metabolism, not a transport protein. Albumin, another type of protein found in the blood, primarily functions to regulate blood volume and pressure and to transport substances, but it does not carry oxygen.

In summary, hemoglobin is the key oxygen-transporting protein in erythrocytes, designed specifically for capturing, transporting, and releasing oxygen as needed throughout the body. Its structure and function are finely tuned to support cellular respiration, making it indispensable for aerobic life.

Question: 8

Which of the following is the smallest free-living organism, about the size of a large virus?

- A. rickettsiae
- B. mycoplasma
- C. chlamydia
- D. gardnerella vaginalis

Answer: B

Explanation:

Among the options given—rickettsiae, chlamydia, gardnerella vaginalis, and mycoplasma—the smallest free-living organism is Mycoplasma. Mycoplasma species are incredibly tiny, with some individual organisms being as small as 0.2 micrometers in diameter, which approaches the size range of larger viruses. This size similarity to large viruses highlights the unique nature of Mycoplasma as a cellular organism.

Mycoplasma's diminutive size contributes to its invisibility under standard light microscopy, often requiring more sophisticated imaging techniques such as electron microscopy for visualization. Unlike viruses, however, Mycoplasma is capable of self-replication without the need to infect a host cell. This capability distinguishes it as a free-living organism, albeit with a simpler structure and fewer cellular components compared to more complex bacterial species.

The genetic material of Mycoplasma includes both DNA and RNA, which are necessary for its functions such as replication, transcription, and translation. The presence of these nucleic acids ensures that

Mycoplasma can carry out essential life processes independently, although it often leads a parasitic or saprophytic existence, deriving nutrients from host organisms or other sources.

The minimalistic nature of Mycoplasma extends to its lack of a cell wall, which is an unusual trait among bacteria but common in Mycoplasma species. This absence of a cell wall contributes to their physical flexibility and resistance to antibiotics like penicillin, which typically target cell wall synthesis in bacteria. In conclusion, Mycoplasma, with its extremely small size and simple structure, stands out as the smallest free-living organism among the given choices. It embodies unique biological characteristics that allow it to survive and reproduce in a variety of environments, despite its microscopic size and simplified cellular architecture.

Question: 9

Humans can accidentally acquire an animal parasite. This is known as which of the following?

- A. filariasis
- B. zoonosis
- C. nematosis
- D. ectosis

Answer: B

Explanation:

The correct answer to the question "Humans can accidentally acquire an animal parasite. This is known as which of the following?" is zoonosis. Zoonosis refers to diseases that are naturally transmissible from vertebrate animals to humans. These diseases can be caused by a variety of pathogens including viruses, bacteria, fungi, and parasites. When it comes to parasites, humans can accidentally acquire them through direct contact with animals or by exposure to environments contaminated with animal feces or parasites themselves.

It is important to differentiate zoonosis from other types of diseases such as filariasis, nematosis, and ectosis, which are specific to certain types of parasitic infections and not necessarily transmitted from animals to humans. Filariasis, for example, refers to diseases caused by filarial worms, which are transmitted through insect bites rather than direct animal-to-human transmission. Nematosis pertains to infections by nematodes or roundworms, which may not necessarily originate from an animal host directly to humans. Ectosis is not a widely recognized medical term and may be confused with ectoparasitosis, which involves parasites such as ticks and fleas that live on the skin's surface but does not specifically denote a zoonotic transfer.

In summary, zoonosis captures the broad category of diseases that humans can acquire from animals, either directly or indirectly, including but not limited to parasitic infections. Understanding zoonosis is crucial for public health surveillance and preventive measures, especially in regions where close interactions between humans and animals are common, and where wildlife, livestock, and human populations intersect.

Question: 10

Agglutination reactions are graded. The 4+ RBC button is best described as which of the following?

- A. solid with a clear supernatant
- B. several large clumps, clear supernatant
- C. many medium-sized clumps, clear supernatant
- D. many medium and small-sized clumps, background has many free RBCs

Answer: A

Explanation:

Agglutination reactions in a clinical or laboratory setting are important for determining the presence and intensity of certain types of interactions between antigens and antibodies. These reactions are especially pivotal in fields such as hematology, blood transfusion, and immunology diagnostics. The grading of agglutination reactions helps in quantifying the extent of agglutination and thereby the strength of the antigen-antibody interaction.

The grading scale for agglutination typically ranges from 0 to 4+. A grade of 4+ represents the strongest agglutination reaction, characterized by the formation of a solid button of red blood cells (RBCs) with a clear supernatant. This clear supernatant indicates that almost all the RBCs have agglutinated, leaving very few, if any, free RBCs in the surrounding liquid. This grade implies a very strong interaction between antibodies and the antigens on the surface of RBCs, which results in the extensive clumping of the cells.

On the other hand, lower grades such as 3+, 2+, and 1+ indicate progressively lesser extents of agglutination. A 3+ might be represented by several large clumps of RBCs with a clear supernatant, a 2+ might show many medium-sized clumps, and a 1+ might display numerous small clumps, often with some free RBCs remaining in the background. A grade of 0 signifies no agglutination, with the RBCs uniformly suspended in the solution without any clumping.

Thus, when describing a 4+ RBC button, the correct characterization is "solid with a clear supernatant."

This denotes a high concentration of specific antibodies against the antigens on the RBCs, causing almost all the cells to agglutinate and form a compact mass, with the liquid part of the sample remaining clear due to the absence of free RBCs. This scenario is distinctly different from lower grades where the agglutination is less complete and free RBCs can still be observed.

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