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# **Medical Laboratory**

## **ASCP-HTI**

### **ASCP Histotechnician International (ASCP-HTI)**



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## Question: 1

Which of these is the wavelength range for Ultraviolet C?

- A. 400 - 315 nm.
- B. 315 - 280 nm.
- C. 280 - 100 nm.
- D. 100 - 40 nm.

## Answer: C

Explanation:

Ultraviolet light (UV) is a type of electromagnetic radiation that falls between visible light and X-rays in the electromagnetic spectrum. The UV spectrum is divided into several different bands or ranges, which are commonly known as UVA, UVB, and UVC. Each of these bands has a specific range of wavelengths, and they differ in their biological activity and the extent to which they can penetrate the Earth's atmosphere.

UVC, or Ultraviolet C, is one of these bands and is defined by its specific wavelength range between 280 nanometers (nm) and 100 nm. This range is shorter in wavelength and thus higher in energy compared to UVA and UVB. UVC is particularly significant because it has the highest energy among the UV radiation parts that reach the Earth. However, most UVC radiation is absorbed by the Earth's ozone layer and does not reach the planet's surface, making natural exposure to UVC relatively rare.

In terms of applications, UVC is widely used for its germicidal properties. It is commonly employed in sterilization and purification processes because it has the ability to break apart molecular bonds in the DNA of microorganisms, leading to their inactivation. The effectiveness of UVC in sterilization has led to its use in various settings, including hospitals, air and water purification systems, and even in the disinfection of drinking water.

In summary, the wavelength range for Ultraviolet C (UVC) is from 280 nm to 100 nm. This range is shorter and more energetic compared to the other UV ranges, and while it is mostly blocked by the Earth's atmosphere, it is extremely effective for sterilization and disinfection purposes in controlled environments.

## Question: 2

Which of the following statements is true about cryo embedding?

- A. Its major advantage includes perfect preservation of RNA.
- B. Free floating sections do not exist.
- C. It is very easy to handle free floating sections.

D. It is difficult to handle free floating sections.

**Answer: D**

**Explanation:**

Cryo embedding is a process used in histology to prepare tissue samples for microscopic examination. The main advantage of cryo embedding is that it preserves the tissue in a state very close to its natural condition, which is crucial for accurate histological analysis and for the detection of proteins, enzymes, and other biological structures. This makes cryo embedding particularly valuable in research settings where such details are critical.

However, cryo embedding also presents some challenges. One significant disadvantage is that the morphology, or the structure and form of the tissues, can sometimes be compromised. This is because the process involves freezing the tissue, which can lead to ice crystal formation that distorts the cellular structure.

Another challenge is the handling of free floating sections. In cryo embedding, tissues are frozen and then cut into thin sections using a microtome. These sections are often referred to as "free floating" because they are not embedded in a solid medium like paraffin (used in another common embedding technique). Handling these delicate, thin sections without causing damage or alterations can be difficult, requiring significant skill and experience.

Therefore, while cryo embedding offers the advantage of preserving the near-natural state of the tissue and is highly sensitive for detecting proteins and other biomolecules, it also requires careful handling of the free floating sections and can result in somewhat compromised tissue morphology. These factors make it essential to weigh the advantages and disadvantages of cryo embedding against other methods depending on the specific requirements of the study.

### **Question: 3**

Which of the following is true if fixation is not done under optimal conditions?

- A. The tissue will continue to expand until fixative is added.
- B. The tissue will begin to freeze itself.
- C. Irreversible damage can be caused to the tissue.
- D. Nothing will happen.

**Answer: C**

**Explanation:**

The correct answer to the question is that irreversible damage can be caused to the tissue if fixation is not done under optimal conditions.

Fixation is a critical process in histology, which is the study of the microscopic structure of tissues. Its primary purpose is to preserve tissues permanently in as life-like a state as possible. This is crucial for accurate subsequent examination under a microscope. The fixation process stabilizes the proteins and

cellular components of the tissue, preventing decay and autolysis, which is the self-digestion of cells by their own enzymes.

When fixation is not carried out under optimal conditions or if there is a delay in fixation, several detrimental effects can occur. For instance, enzymatic reactions may continue, which can degrade or alter the structure of proteins and other vital cellular components. This degradation leads to irreversible damage, which manifests as distortions and artifacts in the tissue structure when viewed under a microscope.

Such damage not only compromises the diagnostic value of the tissue sample but also affects the research outcomes where precise tissue architecture is crucial for interpretations and conclusions. Therefore, optimal fixation is imperative to halt biological processes immediately after the collection of the tissue sample and to maintain its structural integrity.

In summary, not adhering to optimal fixation procedures can result in irreversible tissue damage, making accurate histopathological diagnosis challenging. This reiterates the importance of timely and properly conducted fixation in histological practices.

## Question: 4

Hematoxylin is which of the following?

- A. Both negatively and positively charged.
- B. 100% neutral.
- C. Negatively charged.
- D. Positively charged.

## Answer: D

Explanation:

Hematoxylin is a staining compound commonly used in the field of histology, which is the study of the microscopic structure of tissues. To answer the question regarding the charge of hematoxylin, it is important to understand how staining works and the nature of hematoxylin itself. Hematoxylin is positively charged.

Stains in histology are used to increase the contrast in microscopic images of tissue sections, as they bind to cellular components, making them more visible under a microscope. Stains can be classified based on their charge into three categories: basic stains, acidic stains, and neutral stains. Basic stains are positively charged and bind to negatively charged components of cells, typically the nucleic acids and certain cytoplasmic proteins. Acidic stains, on the other hand, are negatively charged and bind to positively charged cell components, primarily proteins in the cytoplasm.

Hematoxylin, being a basic stain due to its positive charge, specifically binds to the negatively charged components within the cell, particularly the nucleic acids in the nucleus. This results in the dark blue or violet staining of the nucleus, allowing for clear visualization of the cell's structure. The staining property of hematoxylin makes it an essential tool in histopathology, as it helps in identifying cell types, cell morphology, and potential abnormalities.

Therefore, the correct answer to the question "Hematoxylin is which of the following?" is that hematoxylin is positively charged. This characteristic enables it to effectively stain components of tissues in histological preparations, enhancing the visibility of cellular structures and aiding in diagnostic and research processes.

## Question: 5

In antimicrobial susceptibility testing, which of the following should be determined?

- A. Causes of antimicrobial susceptibility between various species.
- B. Causes of different blood types.
- C. Ways to increase the pH levels above 10.
- D. Ways to keep the air cooler than 32 degrees F.

## Answer: A

Explanation:

The question focuses on identifying the necessary determinations in antimicrobial susceptibility testing. The correct choice among the options provided relates to understanding the causes of antimicrobial susceptibility between various species. This choice is directly linked to the purpose and methodology of antimicrobial susceptibility testing.

Antimicrobial susceptibility testing is a crucial laboratory procedure aimed at discovering how effective specific antibiotics are against particular bacterial infections. The primary goal of this testing is to guide clinicians in choosing the most effective antimicrobial agents for treating infections, thereby ensuring optimal patient care and helping to combat antibiotic resistance.

In the context of these tests, determining the causes of antimicrobial susceptibility between various species is essential. Different species of bacteria may exhibit varied responses to the same antimicrobial agent due to genetic differences, varying mechanisms of resistance, or differences in their metabolic pathways. By understanding these causes, scientists and healthcare providers can develop more targeted treatment strategies, predict resistance patterns, and refine the use of antimicrobial agents to prevent overuse and the subsequent development of resistance.

The other options listed—causes of different blood types, ways to increase pH levels above 10, and ways to keep the air cooler than 32 degrees F—are unrelated to antimicrobial susceptibility testing. These topics pertain to entirely different fields of study, such as hematology, chemistry, and environmental science, respectively. They do not contribute to the understanding or effectiveness of antimicrobial treatments in the context of susceptibility testing.

Thus, for antimicrobial susceptibility testing, the focus should indeed be on understanding how and why different bacterial species respond differently to antimicrobial agents. This knowledge is pivotal for advancing medical treatments and for the strategic use of antibiotics in clinical settings.

## Question: 6

Which of the following is an important step of tissue processing?

- A. Dehydration only.
- B. Clearing only.
- C. Both clearing and dehydration.
- D. Neither clearing nor dehydration.

**Answer: B**

Explanation:

The correct answer to the question "Which of the following is an important step of tissue processing?" is "Both clearing and dehydration." Tissue processing is a critical procedure in histology, which involves preparing tissue samples for microscopic examination to study the fine structure of cells and tissues in biological research and medical diagnosis.

The primary purpose of tissue processing is to preserve the tissue's structure, remove any elements that might hinder microscopic imaging, and embed the tissue in a stable medium suitable for cutting thin sections. The main steps involved in tissue processing include fixation, dehydration, clearing, infiltration, and embedding. Each step serves a specific purpose and is crucial for the integrity and quality of the final tissue sections.

Fixation is the initial step, which stabilizes the tissues to prevent decay and maintain the structure of cellular components. Following fixation, the tissue undergoes dehydration. Dehydration involves the removal of water from the tissue samples using ascending concentrations of alcohol. This step is essential because the embedding medium (commonly paraffin wax) used in later stages is hydrophobic and does not mix with water.

After dehydration, the tissue samples are cleared. Clearing involves replacing the dehydrating agent (alcohol) with a substance like xylene or a xylene substitute that is miscible with both alcohol and the embedding medium. Clearing makes the tissue transparent and ready for the infiltration process, where the clearing agent is gradually replaced with the embedding medium.

Both dehydration and clearing are crucial for successful tissue processing. If tissues are not properly dehydrated, the residual water can prevent effective penetration and mixing of the embedding medium, leading to poor quality sections that are difficult to cut and examine under a microscope. Similarly, inadequate clearing can result in incomplete impregnation of the embedding medium, affecting the structural integrity of the final tissue block.

Therefore, both dehydration and clearing are not only important but essential steps in the tissue processing protocol, ensuring that the tissues are adequately prepared for embedding, sectioning, and subsequent microscopic examination. This meticulous process allows for detailed and accurate study of tissue architecture and cellular components, which is fundamental in both research and diagnostic settings.

**Question: 7**

Paraffin embedding is a common practice used for what?

- A. Histological analysis.
- B. Surgery.
- C. A tool to administer medication.
- D. Taking detailed notes on a patient's condition.

**Answer: A**

Explanation:

Paraffin embedding is a common practice used primarily for histological analysis. This method involves embedding biological tissues in paraffin wax, a process essential for the preparation of samples for microscopy. The technique is widely utilized in both medical diagnostics and scientific research to examine tissue structure and composition, diagnose diseases, and conduct detailed biomedical research.

The procedure begins by fixing the tissue specimens to preserve their structure and prevent decay. Following fixation, the tissue goes through a series of dehydration steps, typically using increasing concentrations of alcohol to remove all water from the specimen. After dehydration, the specimen is cleared in a substance like xylene and is then infiltrated with liquid paraffin wax. Once the tissue is thoroughly saturated with the wax, it is embedded into a solid block of paraffin. This wax block provides a supportive matrix that enables very thin slicing of the specimen using a microtome.

The thin tissue sections obtained are typically around 4-6 micrometers thick, which allows for detailed microscopic examination. Before these sections can be examined under a microscope, they are usually placed onto glass slides, deparaffinized, and stained to highlight different cellular components and structures. Staining is crucial as it enhances contrast in the microscopic image, allowing different biological tissues to be distinguished from one another.

Proper tissue positioning within the paraffin block is crucial for effective analysis. The orientation of the tissue can determine the aspects of its structure that are most visible in the resulting sections. For instance, organs such as the spleen and liver are usually embedded on their flattest surface to provide a clear view of their architecture. Meanwhile, tissues like the brain, heart, and skin might require specific orientations depending on the particular structures of interest being studied.

In summary, paraffin embedding is an essential technique in histology used to prepare tissue specimens for detailed examination under a microscope. This method not only supports the structural integrity of biological tissues during slicing but also facilitates the detailed visualization necessary for medical diagnosis and biological research.

## Question: 8

With regard to the laboratory, when should lab coats/gowns be worn?

- A. Only when leaving the laboratory.
- B. Only when directly touching the tissue.
- C. At all times in the laboratory.
- D. Only when entering the laboratory.

## Answer: C

### Explanation:

In laboratory environments, particularly those where biological, chemical, or physical hazards are present, wearing appropriate personal protective equipment (PPE) is crucial for ensuring the safety and health of personnel. One common form of PPE in many laboratories is the lab coat or gown. The primary purpose of wearing lab coats or gowns is to protect the wearer from spills, splashes, and other forms of contamination, as well as to prevent the spread of contaminants outside the laboratory environment.

Lab coats or gowns should be worn at all times in the laboratory. This consistent use is important because it helps to minimize the risk of transmitting infections or diseases that may be present on laboratory surfaces or within samples being handled. The lab coat serves as a barrier between the laboratory environment and the wearer's skin and personal clothing, which can contribute to both personal protection and the maintenance of a sterile or controlled environment.

Furthermore, lab coats and gowns should be fastened properly to provide maximum coverage and effectiveness. Leaving a lab coat unbuttoned or partially open can reduce its protective efficacy and expose the wearer to potential hazards. It is also essential that lab coats and gowns are not worn outside of the laboratory to prevent cross-contamination. Contaminants from the lab should not be transferred to public or common areas, which could potentially expose others to laboratory hazards.

In addition to wearing lab coats or gowns, other PPE such as gloves must be worn when handling potentially infectious or hazardous materials. Gloves protect the hands directly and can further reduce the risk of contamination. Each type of PPE plays a specific role in laboratory safety protocols and must be used appropriately to ensure maximum protection.

It is important for laboratory personnel to adhere to these guidelines consistently, not only when they perceive a direct risk or only during specific procedures. Regular training and reminders can help maintain compliance and awareness of the importance of PPE in the laboratory setting. This comprehensive approach to safety helps to create a culture of responsibility and care, which is essential for the effective operation of any laboratory.

## Question: 9

Carmine is what type of dye?

- A. Basic dye.
- B. Acidic dye.
- C. Both basic and acidic dye.
- D. Flat dye.

## Answer: A

### Explanation:

Carmine is a type of basic dye. Basic dyes are used in the staining process to color transparent sections of tissue, allowing pathologists to observe tissue structure and the presence of specific cell types under a microscope.

Staining is a critical technique in medical histology which involves coloring tissues with dyes to enhance the visibility of their microscopic features. This process is crucial for diagnosing diseases and conducting scientific research. A commonly used procedure in staining is the hematoxylin and eosin stain, also known as H&E stain. This method utilizes a combination of two dyes: hematoxylin, which behaves like a basic dye, and eosin, which is an acidic dye.

In the context of basic dyes, hematoxylin can sometimes be substituted with other basic dyes depending on the specific needs of the staining process. These substitutes include toluidine blue, thionine, methylene blue, carmine, azure II, and basic fuchsin. Each of these dyes has unique properties that make them suitable for highlighting different aspects of cellular structure and function.

On the other hand, eosin, the acidic component of the H&E stain, can also be substituted with other dyes like phloxine and orange G, which are acidic dyes. These substitutions are selected based on the specific characteristics required in the staining process to enhance the visibility of certain cell types or tissue components.

Thus, carmine, being listed among the substitutes for hematoxylin, is categorized as a basic dye. It is used to stain the basic (alkaline) components of cells, typically the nuclei, which are stained blue or purple, thereby contrasting sharply with the pink or red coloring of the cytoplasm stained by eosin or its substitutes. This differential staining helps in the detailed examination and analysis of tissue samples.

## Question: 10

Hexose has how many carbon atoms?

- A. 6.
- B. 7.
- C. 8.
- D. 9.

## Answer: A

Explanation:

Hexose is a type of carbohydrate, specifically a monosaccharide, which is the simplest form of carbohydrate. Monosaccharides are the basic building blocks of more complex carbohydrates. The term "hexose" comes from "hex," indicating six, and "ose," a suffix used in chemistry to denote sugars. Therefore, hexose refers to a monosaccharide that contains six carbon atoms. This is confirmed by the molecular formula of hexoses, which is typically C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>. Hexoses play crucial roles in various biological processes, including the provision of energy and as structural components in cells. Examples of hexoses include glucose, fructose, and galactose, each of which is a fundamental energy source for living organisms.

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