2nd Class Power Engineering 2A2 Practice Exam (Sample)

Study Guide

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Questions

1. **What concentration range is typically maintained for neutralizing amines?**
   - **A. 7.0-8.0**
   - **B. 8.5-9.5**
   - **C. 9.5-10.5**
   - **D. 10.0-11.0**

2. **Which of the following is NOT a basic joint type in welding?**
   - **A. Butt**
   - **B. Tee**
   - **C. Circular**
   - **D. Lap**

3. **What does electrochemistry in the context of corrosion mainly involve?**
   - **A. A combination of corrosion and energy production**
   - **B. A process where electrons transfer between a metal and electrolyte**
   - **C. The study of gases reacting with metals**
   - **D. A method of physical strengthening of metals**

4. **What is the approximate dew point for sulphur gases in flue gas?**
   - **A. 100 Deg C**
   - **B. 150 Deg C**
   - **C. 200 Deg C**
   - **D. 250 Deg C**

5. **Which atomic structure is associated with high ductility and good thermal conductivity?**
   - **A. Body-centered cubic (BCC)**
   - **B. Face-centered cubic (FCC)**
   - **C. Close packed hexagonal (CPH)**
   - **D. Randomly oriented cubic (ROC)**

6. What is the approximate thickness of the magnetite layers in a boiler?
   - A. 0.005 to 0.010 mm
   - B. 0.01 to 0.025 mm
   - C. 0.03 to 0.050 mm
   - D. 0.1 to 0.2 mm

7. What design consideration is NOT mentioned as important for a plant's corrosion strategy?
   - A. External environment
   - B. Corrosion monitoring
   - C. Production capacity
   - D. Operating conditions

8. What term describes the increase in entropy due to friction and heat losses in a heat engine?
   - A. Heat exchange
   - B. Thermal efficiency
   - C. Exergy loss
   - D. Entropy production

9. In a vapour cycle heat engine, which is the most common working fluid?
   - A. Air
   - B. Steam
   - C. Refrigerant
   - D. Natural gas

10. What is one of the main advantages of the Vickers Hardness Test?
   - A. It uses a large indenter to minimize damage
   - B. It has a universal scale for all types of materials
   - C. It requires no load application
   - D. It can only be performed in laboratories

Answers

1. B
2. C
3. B
4. B
5. B
6. B
7. C
8. D
9. B
10. B

Explanations

1. What concentration range is typically maintained for neutralizing amines?

A. 7.0-8.0

B. 8.5-9.5

C. 9.5-10.5

D. 10.0-11.0

Neutralizing amines are typically used in steam generation systems to control pH levels and help prevent corrosion within the boiler and associated systems. The proper concentration range for these amines is generally maintained between 8.5 and 9.5. This pH range is effective because it helps ensure that the amines adequately neutralize any acidity present in the water, which can occur due to dissolved gases like carbon dioxide and oxygen. Maintaining a pH in this range is crucial as it optimizes the performance of the amines while preventing the formation of corrosion-causing conditions. If the pH is too low, it may not provide sufficient neutralization, leading to increased corrosion rates. Conversely, if the pH is too high, it can lead to other issues, such as the formation of scale. The concentration range of 8.5 to 9.5 strikes a balance that protects the integrity of the system while allowing for efficient operation, making it the correct choice for maintaining the effectiveness of neutralizing amines in water treatment systems.

2. Which of the following is NOT a basic joint type in welding?

A. Butt

B. Tee

C. Circular

D. Lap

The correct choice indicates that "Circular" is not a basic joint type in welding. In welding, the commonly recognized basic joint types are butt, tee, and lap joints.   A butt joint is formed when two pieces of material are aligned and joined at their edges. This is one of the most typical forms of joint used in structural applications due to its strength and straightforward fabrication. A tee joint occurs where two pieces meet, forming a T shape. It is commonly used when a new piece is attached perpendicularly to another piece, making it essential in various structural welding scenarios. A lap joint is created when two pieces of material are placed on top of each other and welded along the edges, providing a larger surface area for bonding and often used in joining sheets of metal. The "Circular" joint type does not exist as a recognized basic joint configuration in welding techniques. While circular welding can happen in certain specialized applications (like in pipe welding), it is not classified as a basic joint type like the others mentioned. Thus, identifying "Circular" as the choice that stands apart from recognized welding joint types is accurate.

3. What does electrochemistry in the context of corrosion mainly involve?

A. A combination of corrosion and energy production

B. A process where electrons transfer between a metal and electrolyte

C. The study of gases reacting with metals

D. A method of physical strengthening of metals

Electrochemistry in the context of corrosion primarily involves the transfer of electrons between a metal and an electrolyte. This process is fundamental to understanding how corrosion occurs, as it entails the electrochemical reactions that take place at the interface of the metal and its surrounding environment. When a metal is exposed to an electrolyte—such as water containing dissolved salts—various electrochemical reactions can occur. At the anodic sites on the metal surface, oxidation takes place, releasing electrons. These electrons then travel through the metal to cathodic sites, where they participate in reduction reactions, often involving species from the electrolyte. This transfer of electrons creates a circuit that drives the corrosion process by promoting the deterioration of the metal. The other options do not accurately encapsulate the core processes of electrochemistry related to corrosion. A refers to energy production, which is more related to battery chemistry rather than corrosion mechanisms. C suggests a focus on gas reactions with metals, which is a narrower context not directly tied to electrochemical processes. D highlights a physical method of strengthening metals, which is unrelated to the chemical reactions and electron transfers that define corrosion in electrochemical terms.

4. What is the approximate dew point for sulphur gases in flue gas?

A. 100 Deg C

B. 150 Deg C

C. 200 Deg C

D. 250 Deg C

The dew point for sulfur gases in flue gas is approximately 150 degrees Celsius. This temperature is significant because it corresponds to the point at which sulfur compounds, including sulfur dioxide and sulfur trioxide, begin to condense from flue gases as the temperature decreases. Understanding the dew point is essential in the context of combustion processes and flue gas treatment, particularly in power generation and industrial applications. When the flue gas cools to the dew point, corrosion can start due to the condensation of these acidic sulfur compounds, which can damage equipment, such as boilers and heat exchangers. Therefore, maintaining flue gas temperatures above the dew point is crucial in preventing equipment damage and ensuring efficient operation. Selecting the correct value for the dew point is based on empirical data and operational experiences in different combustion settings. The options provided reflect a range of temperatures, where 150 degrees Celsius is utilized as the standard reference point for the dew point related to sulfur gases in typical flue gas compositions.

5. Which atomic structure is associated with high ductility and good thermal conductivity?

A. Body-centered cubic (BCC)

B. Face-centered cubic (FCC)

C. Close packed hexagonal (CPH)

D. Randomly oriented cubic (ROC)

Face-centered cubic (FCC) structures are associated with high ductility and good thermal conductivity due to their unique atomic arrangement. In an FCC lattice, atoms are positioned at each corner of a cube and at the center of each face, creating a closely packed structure. This arrangement allows for a higher number of slip systems, providing the material greater plasticity and ductility. As the atoms can move more freely due to this increased number of available slip planes, FCC metals are generally more malleable and ductile compared to other structures. Furthermore, the close packing in FCC structures allows for efficient conduction of heat. The atoms within FCC metals can vibrate and transfer energy more effectively, contributing to higher thermal conductivity. Common metals exhibiting FCC structures include aluminum, copper, and gold, which are known for both their ductility and excellent heat transfer capabilities. In contrast, other structures such as body-centered cubic (BCC) may exhibit less ductility and thermal conductivity due to their fewer slip systems and more complex atomic movement. Close-packed hexagonal (CPH) structures also have limited slip systems compared to FCC, which may restrict ductility. Randomly oriented cubic (ROC) is not a commonly recognized crystal structure in metals and does not represent the characteristics associated with

6. What is the approximate thickness of the magnetite layers in a boiler?

A. 0.005 to 0.010 mm

B. 0.01 to 0.025 mm

C. 0.03 to 0.050 mm

D. 0.1 to 0.2 mm

Magnetite, a common corrosion product that forms on the internal surfaces of boiler tubes, generally exhibits a thickness of around 0.01 to 0.025 mm. This measurement range reflects the typical conditions under which magnetite accumulates, which includes factors such as temperature, pressure, and water chemistry within the boiler system. The formation of magnetite is important as it can provide a protective layer that helps to minimize further corrosion of the underlying metal. A layer that is too thick may indicate issues such as excessive corrosion or poor water management, which can lead to problems with heat transfer and overall boiler efficiency. Understanding the typical thickness of magnetite allows engineers and operators to monitor boiler health and make informed decisions regarding maintenance and water treatment practices, ensuring safe and efficient operation of the boiler system.

7. What design consideration is NOT mentioned as important for a plant’s corrosion strategy?

A. External environment

B. Corrosion monitoring

C. Production capacity

D. Operating conditions

In the context of a plant's corrosion strategy, the design consideration that is emphasized revolves around how external factors, operational parameters, and monitoring practices play critical roles in preventing and managing corrosion. The external environment can significantly influence corrosion rates due to factors such as humidity, temperature, and pollutants present in the air or surrounding water, establishing a need for considerations related to it. Corrosion monitoring is essential as it involves techniques and systems put in place to regularly assess the condition of materials and equipment, allowing for timely interventions before significant damage occurs. Operating conditions, including pressure, temperature, and the presence of corrosive agents, also heavily impact the integrity of materials and must be accounted for when designing systems to mitigate corrosion risks. In contrast, while production capacity is an important aspect of plant operations, it does not directly relate to the strategies aimed at addressing corrosion. Production capacity focuses primarily on the efficiency and output of the plant rather than the specific challenges posed by corrosion and the design considerations required to manage it effectively. Thus, in the context of a corrosion strategy, this element is not typically highlighted as critical compared to the others mentioned.

8. What term describes the increase in entropy due to friction and heat losses in a heat engine?

A. Heat exchange

B. Thermal efficiency

C. Exergy loss

D. Entropy production

The increase in entropy due to friction and heat losses in a heat engine is referred to as entropy production. This concept highlights the inherent inefficiencies that occur in real-world processes, particularly in thermodynamic systems like heat engines. When a heat engine operates, it converts heat energy into work, but this process is never 100% efficient due to factors such as friction and irreversibilities. As mechanical systems operate, friction generates heat, and energy is dissipated to the surroundings. This dissipation contributes to an increase in the overall entropy of the system and its environment. Entropy production specifically quantifies the amount of entropy generated as a result of irreversible processes. In the context of a heat engine, it underscores the limitations imposed by the Second Law of Thermodynamics, which states that the total entropy of an isolated system can never decrease over time. Therefore, understanding entropy production helps to evaluate the performance of heat engines and the efficiency losses attributable to these irreversible processes.

9. In a vapour cycle heat engine, which is the most common working fluid?

A. Air

<u>**B. Steam**</u>

C. Refrigerant

D. Natural gas

The most common working fluid in a vapor cycle heat engine is steam. This choice is based on the fundamental principles of thermodynamics and the traditional design of many heat engines, particularly in power generation. Steam is favored because it has a high latent heat of vaporization, which means it can absorb and release large amounts of energy during phase changes between liquid and vapor states. This property is crucial in maximizing the efficiency of the cycle, as it allows the engine to convert heat energy into work effectively. Additionally, many power plants use steam turbines, where steam is generated from boiling water in a boiler. The steam expands through the turbine, producing mechanical work that can be converted to electrical energy. The widespread use of steam in various thermal systems, from conventional power plants to industrial processes, highlights its role as the standard working fluid in vapor cycle heat engines. In contrast, the other options—such as air, refrigerants, and natural gas—are used in different types of cycles or applications. Air is typically utilized in gas turbine engines rather than vapor cycles, while refrigerants are used in refrigeration and air conditioning systems. Natural gas, on the other hand, is primarily a fuel source rather than a working fluid in a vapor cycle but may be part

10. What is one of the main advantages of the Vickers Hardness Test?

A. It uses a large indenter to minimize damage

<u>**B. It has a universal scale for all types of materials**</u>

C. It requires no load application

D. It can only be performed in laboratories

The main advantage of the Vickers Hardness Test is its ability to provide a universal scale for all types of materials. This is particularly beneficial because the Vickers method uses a diamond indenter to make an impression on the material being tested and measures the diagonal lengths of the resulting indentation. This technique is applicable to a wide variety of materials, including metals, plastics, ceramics, and even thin films. The Vickers scale allows for comparisons across different material types, making it a versatile choice in hardness testing. This universality is important in many engineering and manufacturing applications where materials with varying properties need to be assessed under consistent criteria. In contrast, other options suggest limitations or alternative practices that do not directly correlate with the key strengths of the Vickers Hardness Test. For instance, while the use of a large indenter could minimize damage, it does not apply specifically to the Vickers method, as it employs a smaller diamond indenter. The need for load application is fundamental to the test, and stating that it can only be performed in laboratories is misleading because many hardness tests can also be done on-site, depending on the context. The flexibility and broad applicability of the Vickers Hardness Test to various materials stands out as its key advantage.